ABUNDANCE AND DISTRIBUTION OF MARINE MAMMALS IN NORTHERN BRISTOL BAY AND SOUTHERN KUSKOKWIM BAY

-- A Status Report of the 1996 Marine Mammal Monitoring Effort at Togiak National Wildlife Refuge

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December 1996

KEY WORDS:

Bristol Bay	haulout
Cape Newenham	mortality
Cape Peirce	northern sea lion
harbor seal	Pacific walrus
Kuskokwim Bay	southwest Alaska

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SUMMARY

Togiak National Wildlife Refuge's (TNWR) 1996 marine mammal program focused on monitoring the abundance and distribution of walruses, seals and sea lions in northern Bristol Bay and southern Kuskokwim Bay. For the first time since 1993, funding permitted regular monitoring of Cape Newenham walrus and sea lion haulouts from early June to mid-August. Ground counts of walruses at Cape Peirce, Cape Newenham and Round Island produced peak numbers of 3,105 on 6 October, 1,280 on 13 July, and 6,331 on 25 July, respectively. The peak count at Cape Peirce in 1996 occurred later than usual and was lower than the peaks of the last three years. The greatest number counted on any one day during 1996 in northern Bristol Bay-southern Kuskokwim Bay was 6,691 on 15 July. Other high total counts of the area occurred on 25 July with 6,614 walruses, and on 23 July with 6,388 walruses, counted at all three haulouts.

For the third consecutive year, walruses hauled out atop cliffs overlooking Maggy and Parlier beaches. At least 50 fell to their deaths in 1996 in late August.

Nanvak Bay near Cape Peirce continues to be the largest seal haulout in northern Bristol Bay. A peak count of 581 seals was recorded there on 21 August. This year's peak is similar to the peaks of the past several years, and much lower than the peak count of 3,100 in 1975. This decline parallels harbor seal population trends observed in other parts of Alaska; the causes of the decline are unknown and must be further investigated. Harbor seal pups were observed in Nanvak Bay; a high count of 6 pups was recorded on 1 July.

Staff at Cape Peirce assisted U. S. Geological Survey - Biological Resources Division (USGS-BRD) personnel in tagging walruses with radio and satellite-linked transmitters from 20 July-8 August. A biological technician from USGS-BRD remained at Cape Peirce to monitor tagged walruses until camp was closed on 1 November.

INTRODUCTION

Togiak National Wildlife Refuge's rocky coast and sand beaches support a diverse and abundant marine mammal population. The Cape Peirce-Cape Newenham area and the Walrus Islands State Game Sanctuary (Fig. 1) are two areas particularly rich in marine mammals, providing haulout areas for walruses (*Odobenus rosmarus divergens*), harbor seals (*Phoca vitulina*), spotted seals (*P. largha*), and northern sea lions (*Eumetopias jubatus*).

Cape Peirce and Round Island are the two largest regularly used terrestrial haulouts for Pacific walruses in the United States. Other terrestrial haulouts in southwest Alaska include Cape Newenham and Cape Seniavin, though it appears these are not used as frequently or by as many walruses as Cape Peirce and Round Island. The female and young walruses that winter in and near Bristol and Kuskokwim Bays migrate north in the spring, however some of the males remain behind and haul out at Cape Peirce and Round Island (Fay 1982), and other terrestrial haulouts in the area. Cape Peirce was historically used as a haulout but was abandoned sometime during the first half of this century (Taylor, pers. comm.). Walruses began reusing the haulout in 1981 (Annual Narrative, TNWR 1981) and have returned every summer since.

In 1987 and 1988 the number of walruses hauling out at Cape Peirce and Round Island declined (Alaska Dept. of Fish and Game [ADFG] and TNWR unpub. data). During this time the yellow-fin sole fishery began in northern Bristol Bay, with fishing activities concentrated in the Round Island area. Concern that the decline in the number of walruses hauling out might be related to the initiation of the yellow-fin sole fishery resulted in the North Pacific Fisheries Management Council's (NPFMC) decision to restrict the activities of the yellow-fin sole fishery. In August of 1991 the NPFMC voted to continue indefinitely the 12-mile closure around Cape Peirce and Round Island, with a 3-mile transit zone around Right Hand Point. The U.S. Fish and Wildlife Service (USFWS) has verbal agreements with the NPFMC, National Marine Fisheries Service (NMFS), and ADFG to continue monitoring walruses at Cape Peirce to assess the effects of the fishery.

Harbor and some spotted seals haul out along the TNWR coast, with highest concentrations at Nanvak Bay and Hagemeister Island. Nanvak Bay is the northernmost pupping area and the largest haulout for harbor seals in northern Bristol Bay (Frost et al. 1982). The number of seals hauling out in Nanvak Bay has declined since the mid 1970s (TNWR unpub. data, Jemison 1991). Population trends examined in the Gulf of Alaska indicate a similar population decline. Limited data from Prince William Sound and southeastern Bering Sea suggest harbor seal numbers have declined since the mid 1970s (Pitcher 1990).

Cape Newenham and Round Island support the two largest sea lion haulouts in northern Bristol Bay. Sea lion populations have been monitored by ADFG staff at Round Island since the late 1970s. Monitoring of the sea lions at Cape Newenham by USFWS staff, with funding from NMFS, began in 1990 and continued through 1993. In 1991 concentrated efforts determined that Cape Newenham is a haulout, and that pupping is rare. From the late 1950s to the mid 1980s, sea lion numbers have declined in Alaska (Hoover 1988). In 1990 the northern sea lion was listed as a threatened species and in 1995 NMFS proposed listing the population west of Cape Suckling as endangered, making this a critical time to monitor sea lion haulout sites and rookeries. Sea lions were censused at Cape Newenham twice from the ground and once from the air in 1996. Sea lions were not monitored in 1994-1995, due to funding constraints, though opportunistic aerial surveys were conducted.

During 1996, TNWR, Marine Mammals Management (MMM), and ADFG have worked jointly to determine abundance and distribution of walruses in northern Bristol Bay. A continued cooperative effort will help ensure responsible management of this species.

OBJECTIVES

1. Determine number of walruses, number and average length of haulout peaks, and long-term population trends at Cape Peirce and Cape Newenham.

2. Determine walrus behavioral response to aircraft, boats and increased visitor use at Cape Peirce and Cape Newenham.

3. Monitor walruses hauled out on Maggy Beach for their tendency to travel up to cliffs. Intervene and take preventative measures, when possible. Document activities, injuries and mortalities resulting from this behavior.

4. Determine changes in the number, location and state of decay of walrus carcasses at Cape Peirce and Cape Newenham.

5. Collect teeth from walrus carcasses for aging by MMM, and tissue samples for MMM and University of Alaska at Fairbanks (UAF) frozen tissue collection.

6. Estimate number and ages of walruses 10 years of age and under at the South Firebaugh haulout throughout the season.

7. Determine number, number of pups, peak numbers during pupping and molting periods, and long-term population trends of harbor and spotted seals hauling out in Nanvak Bay.

8. Collect tissue samples and skulls from seals harvested by native hunters and beached seal carcasses for the harbor seal biosampling program (ADFG-Subsistence Division).

9. Determine numbers of sea lions hauled out at Cape Newenham as opportunity permits.

10. Provide support for other organizations conducting marine mammal research in Bristol Bay, particularly the USGS-BRD walrus tagging effort.

STUDY AREA

The study area covers approximately 43 km of coastline in southwest Alaska, from Rugged Point east of Cape Peirce in northern Bristol Bay to Air Force Cove on the north side of Cape Newenham (Fig. 2). It also includes Round Island in the Walrus Islands State Game Sanctuary (ADFG). The Cape Peirce-Cape Newenham area is located approximately 193 km west-southwest of Dillingham within the TNWR. Steep, jagged cliffs above rock and sand beaches characterize the coastline in this area. Nanvak Bay is located approximately 3 km north of Cape Peirce Point (Fig. 2).

METHODS

WALRUSES

Haulout

Cape Peirce: Beaches where marine mammals haul out at Cape Peirce were checked daily 3 May - 30 October from ground observation points and the following information was recorded: date, time, weather (wind direction and speed, cloud cover, visibility, precipitation, barometric pressure, temperature), tide, beach conditions, number of animals hauled out, number of animals in the water, and unusual scars or features on walruses. Additionally, the number of animals in age classes 0, 1, 2, 3, 4-5, 6-9, and 10 years, estimated based on Fay and Kelly (1989) and on body size, were counted at South Firebaugh Cove.

Animals were individually counted or their numbers estimated using binoculars and a tally meter from the same observation points each day to minimize inconsistencies. Each smaller haulout (<500 animals) was counted at least 2 times and the counts averaged. If the 2 counts were not within 5% of each other the animals were counted again and the 2 closest counts were averaged. For larger haulouts (>500), at least 4 counts or estimates were made, the high and low counts/estimates discarded, and the rest averaged. Observers estimated large haulouts by either; 1) counting the number of animals in a highly visible group, and then counting the number of groups judged to be of that size in the haulout, or by 2) dividing the haulout into rectangles, counting the number of animals in several rows and columns within each rectangle, and multiplying the average row and column values, with peripheral groups counted individually. Larger haulouts during October were photographed with a Pentax zoom-90-WR, using Kodachrome 64 color slide film. Numbers of walruses in the slides were counted and compared to ground counts. Slides taken of Maggy Beach haulouts were unusable for comparison to ground counts, due to the lack of good photographic vantage points, and the movement of walruses off the beach during counts.

One aerial estimate of numbers of walruses hauled out at Cape Peirce took place during a survey after camp closed, on 22 November, in a Cessna-185 on wheels at an altitude of 1400'.

For data analysis of haulout numbers, a peak in 1996 was defined as the highest count for the 3 previous days and the 3 following days, based on Hills (1992). This differs slightly from the 1995 report, where the peaks were defined by numbers falling below a certain chosen threshold on either side of a high count for more than one day. Peaks were not overtly defined in reports previous to 1995, but identification of peaks intuitively followed Hills' definition. A "lowest count" in 1996 was defined as the lowest count between peaks, as in previous years.

Radio contact was attempted with personnel on Round Island twice each week to compare walrus activity at the 2 haulouts.

Cape Newenham: Walruses were censused daily from the cliffs above the haulouts from 1 June-11 August by TNWR staff stationed at Cape Newenham. Haulouts were counted in a manner similar to that used at Cape Peirce.

Round Island: The walrus haulout on Round Island was monitored by ADFG and MMM staff from 5 May-10 August and from 28 September- 31 October.

Behavioral Response to Human Activities-Opportunistic Observations

In the past at Cape Peirce, walruses have moved off the beach when boats or planes traveled near hauled-out animals (O'Neil and Haggblom 1987, Sheffield 1988, Jemison 1989, 1991 and 1992). Walrus response to boats and planes was observed opportunistically throughout the summer at Cape Peirce and Cape Newenham. Incidences of marine mammal disturbances were reported to TNWR headquarters, where appropriate follow-up actions were taken. Because the Cape Peirce field camp was opened early this summer, staff were able to monitor boat and plane traffic, and walrus numbers and behavior during the herring fishery season (early May).

In order to determine the degree of a response, walrus behavior was divided into three category levels, based on Salter (1979). The number of walruses responding at each level was recorded.

Level 1: Walruses raise heads or move bodies, seen as a wave or ripple within a group of walruses ("Head Raise").

Level 3: Walruses orient and/or move toward water, usually stopping on the beach or at the water line ("Orientation").

Level 5: Walruses move directly into water, usually do not mill, and do not haul again for at least several hours ("Dispersal").

The number of walruses responding at a particular level is multiplied by the value of that level. The sum of the products of these numbers determines the index category and associated degree of response (Hessing and Sheffield 1989).

INDEX	DEGREE OF RESPONSE
0-100	low
101-1,000	moderate
1,000+	high

For example: an aircraft flies over a haulout of 200 animals. Fifty animals raise their heads (level 1), while 25 orient (level 3). The degree of response [(50 x 1) + (25 x 3) = 125] would be classified as moderate.

Behavioral Study

Staff on Round Island designed a study in 1993 for long-term monitoring of human impacts on walrus behavior. Sampling protocols were revised in 1995 (Kruse 1995). Data were collected at Round Island in 1993 and 1995-1996, and cooperatively by TNWR staff at Cape Peirce during the same years. Study design and methodology are described in detail by Kruse and Koenen (1993).

Each behavioral watch consisted of 10 consecutive 2-minute intervals and included collection of environmental data. Hauled-out walruses were observed at South Firebaugh and Odobenus Cove beaches. Three levels of behaviors described above (head raise, orientation, and dispersal) were identified. Each occurrence of target behavior displayed by the focal animal during a 2-minute interval was recorded.

Telemetry Monitoring

U.S. Geological Survey - Biological Resources Division (USGS/BRD) (formerly National Biological Service) personnel monitored walrus haulouts twice daily from 10 August-31 October to determine the condition of tusk-mounted transmitters and the sightabilty of instrumented and marked walruses relative to group size. Additionally, a VHF scanning system with a linked data collection computer was stationed at two of the haulouts to record 24-hour presence/absence of VHF-instrumented animal. Results from these monitoring activities will be reported in detail by USGS/BRD (DeGroot and Jay, pers. comm.).

Carcasses

Mapping of carcasses for the entire northern Bristol Bay coast via aerial surveys was not done this season due to funding constraints. Cape Peirce was the focus of carcass surveys this year. Opportunistic counts were made at other locations.

The location and condition of carcasses at Cape Peirce were recorded when they first appeared or if they were moved by tides and storms. Length measurements were taken and lower jaw teeth for aging were collected from carcasses and sent to MMM. Tissue samples were collected for the UAF frozen tissue collection when possible. Samples of whiskers were sent to A. Hirons, a UAF graduate student, who is studying the trophic dynamics of pinnipeds and fisheries in Alaskan waters using stable isotope ratios (Hirons, pers. comm.).

Tusks were removed by staff to prevent disturbances to walruses on haulouts by pilots and boaters in search of ivory. After registration and tagging in Dillingham, most of the tusks were transferred to the Alaska Department of Fish and Game in Dillingham. This ivory was sold at auction to Native Alaskan residents at the Alaska Federation of Natives convention in Anchorage, or will be sold at the Beaver Round-Up Festival in Dillingham. The money from the sale of ivory goes into an account managed by the Eskimo Walrus Commission (EWC), and can only be used for walrus research (non-salary) approved by the EWC (Aderman, pers. comm.). Additionally, 16 tusks were donated to school carving programs in Ekwok, Koliganek, New Stuyahok, Togiak, and Twin Hills.

SEALS

Haulout/Nanvak Bay

Seals hauled out on the mid-bay bars in Nanvak Bay were primarily censused from observation points ("Lauri's Lookout" and "North Spit Dune") established in 1990 on North Spit. Crossing Nanvak channel to North Spit was done in either a *Klepper* kayak or a rigid inflatable *Naiad* with a 25HP outboard motor. A secondary observation point ("Watch Point Dune") 0.5 km east of Lee's Landing was used when bad weather (usually high winds) made channel crossing risky or when seals were present on North Spit. Occasionally, counts were made from the bluff behind the cabin, cliffs, dunes near Lee's Landing, or the mudflats northwest of Watch Point Dune, if the haulout configuration or timing made counts difficult from Watch Point Dune. Counts were made at or close to the lowest tide of the day (usually in the late afternoon or evening), primarily with a 600mm spotting scope, or occasionally with 8 x 42 binoculars. Data recorded were: date, time, weather, tide, number of seals hauled out, number in the water, number of pups, and wounded or scarred seals.

Aerial Surveys

Six refuge aerial surveys included opportunistic sightings of harbor seal haulouts in various locations in northern Bristol Bay and southern Kuskokwim Bays this summer. All flights were flown in a Cessna-185 on wheelskis, floats or wheels, depending on the season, except for a flight on 31 July, flown in a DeHavilland Beaver on floats. Surveys of the entire coastline were not scheduled for this summer by NMFS.

Northern Bristol Bay and Southern Kuskokwim Bay Haulouts

Staff made weekly opportunistic ground counts at Cape Newenham from 1 June-1 September in the course of other work. Only certain areas (seabird plots, walrus haulouts, and areas en route between camp and these observation points) were surveyed, not all possible seal haulouts. No other ground surveys of seals were conducted on refuge land.

Behavioral Response to Human Activities-Opportunistic Observations

Though no method has been standardized for assessing the degree of anthropogenic disturbances to seals at Cape

Peirce, disturbances have been monitored for several years in Nanvak Bay. In 1996, as in previous years, documentation has been descriptive, and quantified approximate numbers of seals leaving their haulout in response to boats, planes, and other human activity. Disturbances were reported to TNWR headquarters.

Carcasses

Tissue samples from beached seal carcasses and seals harvested by native hunters were collected for the ADFG-Subsistence Division's harbor seal biosampling program. Whiskers were collected for A. Hirons, a graduate student at UAF, who is studying the trophic dynamics of pinnipeds and fisheries in Alaskan waters using stable isotope ratios (Hirons, pers. comm.).

NORTHERN SEA LIONS

Numbers of northern sea lions hauled out at the tip of Cape Newenham were estimated during two ground counts, though staff may not have observed the entire area that was counted in previous years of ground surveys (1991-1993). One opportunistic aerial survey was conducted this summer by refuge personnel. Ground counts of sea lions were conducted weekly at Round Island by MMM and ADFG staff. Opportunistic observations were recorded at other sites.

RESULTS

WALRUSES

Numbers/Haulout Patterns

Cape Peirce: Walrus haulouts were censused daily at Cape Peirce from 3 May - 30 October (Appendix 1). Walruses were first observed hauled out on 19 April during an aerial survey, with 9 walruses hauled out on Odobenus Cove and 5 on South Firebaugh. A subsequent aerial survey on 30 April found no walruses hauled out. On 22 November, 700-800 walruses were observed on South Firebaugh and 300 on North Firebaugh during an aerial survey after camp closed.

Low numbers of walruses were observed hauled out when ground censusing began on 3 May, but were gone from haulouts 5 May - 9 May, during the peak of the herring season.

Twenty-two peaks in the number of walruses hauled out occurred this season, though total numbers were under 150 during the first four peaks (Fig. 3). Length of haulout periods (the number of days from one low count to the next) ranged from 5 to 15 days, and averaged 7.75 days.

The peak walrus count occurred on 6 October with a count of 3105. Another peak haulout may have occurred late on the night of October 29, with an estimated 2,000-3,000 on Maggy Beach plus 900 counted earlier that day at the other haulouts, but stormy weather drove walruses from the beaches before an actual count could be conducted in daylight. Numbers of walruses in 8 photographs (slides) taken of larger haulouts on North and South Firebaugh and Odobenus Cove were counted and compared to ground counts. Slide counts were typically lower, ranging from 68%-105%, and averaging 90.7 %, of the ground counts. This discrepancy may be partly due to missing some walruses on haulout edges, under cliffs, or behind rocks or other animals while photographing the haulouts.

Scans for walruses estimated to be ≤10 years old were conducted 119 days at South Firebaugh between 3 May-14 October (Fig. 4 and Appendix 2). The percent of the total haulout consisting of younger walruses ranged from zero to 16.7, and averaged 1.96. The highest percentages occurred early in the season, when very few walruses were hauled out, and may be misrepresentative, due to small sample size.

Round Island: Walruses hauled out on Round Island were censused from 6 May - 14 August and from 24 September - 31 October (Appendix 1). The peak count was 6331 on 25 July (ADFG unpub. data, 1996). Other high counts took place on 27 May, 15 June, and 15 July with 4901, 5086, and 5038 walruses counted, respectively. The highest count during the autumn field season was 537 on September 29.

Cape Newenham: Walruses were censused daily at Cape Newenham from 1 June-11 August, and occasionally from 16 Aug- 24 Aug (Appendix 4). The peak count occurred on July 13 with 1280 walruses hauling out. Another count, nearly as high, of 1255, took place on July 20. (Fig. 5)

Cape Seniavin: MMM surveyed Cape Seniavin on 2 July. A photo count of the number of walruses on the haulout was 450-500 (Dewhurst, pers. comm.). A local pilot reported the high count at Cape Seniavin from 5-13 July was 8, and that he saw approximately 2,500 walruses hauled out on 25 October. He also commented that numbers have generally been higher in spring and autumn, and lower during the summer at Cape Seniavin over the past decade (Gillis, pers. comm.).

Peak Total Haulout Counts

The high total count for northern Bristol Bay-southern Kuskokwim Bay was 6691 on 15 July, consisting of ground counts at Cape Peirce of 1096, Cape Newenham of 557 and Round Island of 5038.

Disturbances

Cape Peirce: Twenty-eight anthropogenic disturbances (occurring on 28 days) to walruses were observed at Cape Peirce in 1996; 10 were caused by aircraft (far less than last year), eight by biologists taking preventative measures to keep walruses from ascending to cliffs (i.e. herding), five by hunters, three by researchers tagging walruses, and two by boats (skiffs which came in close to cliffs) (Appendix 3).

Twenty-five percent of disturbances provoked a high degree of response from walruses, 46% provoked a moderate degree, and 29% provoked a low degree.

Cape Newenham: Five disturbance to walruses were observed (Appendix 3), but more may have occurred, because disturbances at Cape Newenham are not as easily observed as at Cape Peirce, as walrus haulouts are a minimum of 4 km away from the field camp (Fig. 2). Of the five disturbances, 60% were moderate-level and 40% were low-level. Four were caused by aircraft, and one by hunters in a skiff.

Behavioral Observations

Cape Peirce:

Early in the afternoon on 21 August, 15 walruses separated from a larger group that was up in the high dunes, and went over cliffs approximately 2 meters tall, onto dirt and sand on Maggy Beach. Two walruses died as a result. Sixty live walruses remaining in the high dune area were herded down to safety by staff.

Late in the evening on 26 August, three walruses which had hauled out in the high dune area were herded down. Staff found over 200 animals hauled out atop high cliffs the next morning. They herded 158 back down to Maggy Beach, but a group of 70 walruses stayed on the cliff edge all day and could not be herded without risk of the animals falling. Throughout the day, many of these fell or slid off the cliffs overlooking Parlier and Maggy beaches. Walruses falling onto Parlier Beach died upon impact, as they dropped approximately 30-38 meters. Animals falling onto Maggy Beach did not drop as far (6-23 m), and some survived long enough to return to the water, where they may have later died from internal injuries. By nightfall (about 23:00), 14 carcasses lay on Maggy Beach, at least 25 on Parlier Beach, and 22 live animals remained on the cliff edge.

The following morning only two walruses remained on the cliff edge over Parlier Beach. One of these was dead, with blood streaming from his mouth. This walrus had been observed alive the day before with a small amount of blood dripping from his mouth. Staff conjectured it may have died from heat exhaustion - no injuries were found upon inspection. The other walrus went off the cliff and died at 08:35.

A total of 48 known cliff mortalities from August 27-28 was ultimately counted, with 19 on Maggy Beach and 29 on Parlier. Including the walrus that died atop the cliff and the two that fell on 21 August, total known cliff-related mortalities came to 51. There were probably more, judging from the condition of still-living animals that fell and entered the water, and the inability of staff to view all of Parlier Beach. One animal was seen on 31 August - 1 September on South Firebaugh, with badly scraped sides and bloody back, who could not move very well.

Staff in Dillingham notified representatives of the local outlying villages of Goodnews Bay, Manokotak, Togiak, Twin Hills and the Bristol Bay Native Association of Dillingham on 27 August. Because of the possibility of causing remaining walruses on the cliff edge to fall, concern was stressed that the situation at that time was unsafe for humans and walruses, should anyone attempt to salvage parts of the carcasses (Aderman, pers. comm.).

When no live walruses were hauled out nearby, staff at Cape Peirce removed ivory, took body length measurements, and collected lower jaw teeth and whiskers from accessible carcasses. Heart, liver, and muscle tissue samples were not collected due to time constraints and lack of sampling protocol and equipment.

Hunters from Togiak recovered ivory from 27 carcasses on 31 August. None of the meat was salvageable by then. A second group of people from Togiak visited Cape Peirce on 8-9 September and removed oosiks from many of the carcasses.

Walruses began displaying a tendency to ascend up into the high dune area adjacent to the cliffs and Maggy Beach (Fig. 6) on 11 August, with the second substantial haulout (>150 animals) of the season on this beach. This marked the start of the period when walruses began using Maggy Beach regularly in large numbers. Yet, large numbers weren't hauled out on Maggy Beach every time the walruses ascended to the high dune area. Walruses went up into the high dunes six times between 11 August and 5 October. Staff herded them down each time, if they judged the herd to be hauled out in such a way as to preclude injury or mass stampeding. On 27 August, staff could not herd all walruses down, as many were on the edges of cliffs. Low to high level disturbances to the herd occurred as a result of herding (Appendix 3).

After 5 October, staff rigged up tall posts, from which they strung parachute cord and large plastic tarps. As in the past, rustling plastic was observed to deter walrus movement, and kept walruses out of the high dune area until camp was closed on 1 November. Walruses hauled out within 8 m of this construction, which did not seem to scare them off the beach. Several repairs and adjustments were necessary, and high winds took their toll on the posts, which became bent or snapped, and on the tarps which became frayed and ragged.

Two fresh dead walruses were observed on Maggy Beach after camp closed during an aerial survey on 22 November. The carcasses lay far from the base of the cliffs, and it is unlikely they fell.

Cape Newenham:

On 3 August, walruses had climbed up the hill adjacent to Bird Rock Cove and Camp Stream (Fig. 2). Two were seen near the edge of the cliffs approximately 15m above the beach when staff arrived to census walruses. About 30 minutes later, the two walruses headed toward the cliff edge, and then turned and went back down the slope the way they had ascended. A plane was heard overhead (above 3,000' altitude) prior to their descent, but it did not provoke a response from other walruses hauled out. Nine additional walruses had been hauled out atop the cliff recently, apparent from trampled vegetation leading to this group at the bottom of the hill and about 52 m in from the shore, far from the main haulout. Bird Rock Cove beach was crowded, and walruses were climbing over one another in search for room to haul out.

Subsistence Harvests

Hunters shot two walruses on Maggy Beach on 31 August, taking the animals quickly and causing a moderate level of disturbance to walruses hauled out. They took flippers, blubber, a large amount of meat and the tusks.

A second harvest by another group of hunters occurred on September 23, after they attempted for two days to take a walrus. On the first day of their arrival, some young people in the hunting party were seen throwing rocks at the herd on Maggy Beach; the entire herd, except an old, emaciated animal left the beach. This animal was found dead later in the day, with its ivory removed. The hunters then drove their skiff into South Firebaugh cove to investigate hunting possibilities; all animals left the beach. On the following day, the hunters tried to herd a walrus from Maggy Beach to their boat in Nanvak Bay , a distance of about 0.5-0.8 km. After taking more than three hours to move the animal 100m and causing a moderate level disturbance to the walruses hauled out, they gave up. On the third day, the hunters killed a walrus on Maggy Beach after firing 20 shots to its head. Only the chest meat, flippers and tusks were harvested. TNWR staff notified village council representatives in the hunters' village, who spoke to the hunters about the incident.

Behavioral Study

In conjunction with MMM, a revised developmental study of walrus behavior was continued at Round Island and Cape Peirce. Twelve behavioral scans lasting about 30 minutes each were conducted at Cape Peirce from 12 June-13 July. Cape Peirce data was forwarded to MMM for analysis.

Carcasses

Cape Peirce was the focus of carcass surveys this year. Regular observations were made at Cape Newenham and opportunistic counts were made at other locations.

As of 16 May, 123 carcasses were counted during a ground survey at Cape Peirce that covered the south shore of Nanvak Bay and Maggy Beach (Fig. 2). All of these were at least several months old, and some were a few years old. Many of these probably fell from the cliffs in 1994 and 1995.

Throughout the season, carcasses were counted and tracked at Cape Peirce (Table 1). On 26 May, the first fresh carcass, with tusks intact, appeared in the surf at South Firebaugh cove. A gillnetter boat had been observed near shore the day before. No more carcases appeared until mid-July. From 21 July-30 October, 19 new carcasses had appeared in the Cape Peirce area, excluding those from cliff-falling mortalities. At least 50 additional mortalities resulted from walruses falling from cliffs on 21 and 27-28 August. Three carcasses were hunting mortalities, and two were from NBS tagging operations. Two additional fresh carcasses were observed on Maggy Beach after camp closed during an aerial survey on November 22. The number of new walrus carcasses observed on the beaches of Cape Peirce from 3 May-22 November totaled 72.

Biological samples were removed from all accessible carcasses, including lower jaw teeth for MMM, skin tissue samples for UAF frozen tissue archives, and whisker samples for A. Hirons of UAF.

Two carcasses, both fresh, were seen by staff at Cape Newenham between 1 June-24 August this year. The first carcass appeared on 13 July in the water near Wally Cove. The second, with both tusks broken off, appeared on 16 July at East Bird Rock Cove.

Other Observations

A female with her calf, estimated to be less than one-year-old (no tusks were visible, even when the calf was lying on its back with its mouth pointed upward), were observed on 11 days from 10 September-10 October. They were seen for 3-5 successive days each time, 10-12 and 22-24 September and 6-10 October. The cow and calf were hauled out on South Firebaugh during all observations, except once on North Firebaugh. When the two were first sighted on 10

September, the calf was bellowing as nearby adult males jabbed at it and its mother attempted to protect it. On most subsequent sightings, both animals were restful and quiet. During the high-level disturbance on South Firebaugh on 8 October, when 150 walruses stampeded into the water in response to a skiff traveling near shore, the cow and calf were hauled out on the shore-edge of the herd, about midway from either end of the haulout. Many bulls attempted to push and climb over the calf in their rush to the water, but the cow was very protective, hovering over the calf, and fending off tusk-strikes and trampling by bulls. Mother and calf managed to stay on the beach, and were seen later that day and the following two days. The calf was observed nursing only once, on 9 October.

Among the usual array of walrus wounds such as cuts, bloody facial punctures, and patches of torn-off flesh, some were especially noteworthy. Throughout the field season, staff observed a walrus blind in his left eye once, walruses with one prolapsed eye six times (at least three of these were separate individuals), one walrus with a prolapsed rectum seen for a three-day period, walruses with large swellings or tumors three times, and walruses with large (>10" long) flesh wounds nine times.

Additionally, a walrus with an injured penis was observed twice in mid-August, and once in early October (it is unknown whether this was the same animal). Both times the animal walked so as not to drag his penis on the ground, and the penis apparently could not be retracted. During the October sighting, the penis was very swollen, with wrinkled and peeling skin, and bleeding profusely from the tip. The walrus was emaciated and appeared to be suffering in general.

SEALS

Nanvak Bay

Haulout patterns: During aerial surveys over Nanvak Bay before camp opened, five seals were observed on 19 April, and 150 seals were seen hauled out on Mid-Bay Bar on 30 April. Seals hauling out in Nanvak Bay were censused daily from the ground 3 May - 1 November (Appendix 5). Seals hauled out only on Mid-Bay and Far bars until 1 August, when they also began using the tip of North Spit (Fig. 2). However, one seal was seen hauled out on North Spit tip on 18 July, and one hauled out on the west side of North Spit on 19 July. Seals regularly hauled out on North Spit in August and a few times in early September, coinciding with their molting season. Mid-Bay and Far bars were used to a lesser extent during this period. After camp closed, 20 seals were seen hauled out on Mid-Bay Bar (at high tide) on 22 November during an aerial survey. Though Nanvak Bay had become partially frozen by the end of October, it was ice-free during this last survey.

Numbers: The number of seals in Nanvak Bay decreased after mid-May through mid-July, then increased, peaking in mid-August and remaining high until early September (Fig. 7). In northern Bristol Bay, molting probably peaks in late August and early September (Johnson 1976); peak seal numbers typically occur during the height of the molt. The peak haulout count for the molting period, as well as the high count for the year, occurred on 21 August with a total of 581 seals in Nanvak Bay. Both harbor and spotted seals haul out in Nanvak Bay, however the percentage of each was not determined.

Pupping: The first pup of the season was seen on 23 May, with lanugo covering the posterior half of its body. The high pup count of 6 occurred 1 July (Fig. 8). The peak haulout during the pupping period (June-early July) was 273 on 2 June.

Northern Bristol Bay and Southern Kuskokwim Bay Haulout Locations

During weekly opportunistic ground counts at Cape Newenham, between one and 17 seals were seen hauled out on rocks below Radar West, one to five seals were observed in the water or hauled out in Bird Rock Cove, and one was occasionally seen in the water in Wally Cove (Fig. 2). The higher numbers occurred in August-early September, concurrent with molting. Mother-pup pairs were seen three times, on 17 and 21 June and 13 July, hauled out on rocks beneath Radar West.

In addition to the Nanvak Bay haulout sites, seals haul out in others areas near Cape Peirce. In 1996, four seals were hauled out on *PECO* rocks with 10 in the water nearby on 13 May, when waterfowl hunters were running their skiff in Nanvak Bay. Two were seen hauled out on the rocks of Parlier Beach on 22 May and one on 8 July. Eight seals on 3 June and 13 seals on 11 October were seen hauled out on the rocks just east of Rugged Point. A few seals were also observed in the ocean at the mouth of Puffin Creek on 11 October. Both Rugged Point and Puffin Creek are surveyed infrequently (Fig. 2).

Opportunistic sightings of harbor seal haulouts in various locations in northern Bristol Bay and southern Kuskokwim Bay took place during refuge flights or surveys for other projects. Observations included; on 19 April, one seal near Estus Point; on 31 May, eight seals (one in the water) were hauled out on the coast midway between Estus Point and Tongue Point; on 12 June, no seals were seen at Chagvan Bay, but five skiffs were anchored in the mouth of the bay; on 31 July, 21 seals were hauled out on the rocks at N. Hagemeister.

Disturbances

Nanvak Bay: Though no method has been standardized for assessing the degree of anthropogenic disturbances to seals at Cape Peirce, disturbances have been monitored for several years in Nanvak Bay. In 1996, 24 anthropogenic disturbances were documented. Eleven of these were caused by planes, nine by boats in Nanvak Bay, and three by seal hunters in boats. One disturbance by ravens was also documented. All disturbances drove most or all seals from their haulout. Seals seemed especially skittish this summer, becoming scared occasionally even by staff paddling a kayak on their usual course to the tip of North Spit to census seals.

One disturbance from a plane and boat together on 2 August may have driven seals from their haulout on North Spit for a few days, though they continued to haul out on Mid-Bay Bar. While hunters had their boats anchored in Nanvak Bay from 21-23 September, seal numbers were very low. Seals left Mid-Bay Bar during a seal hunt on 8 October, and did not haul out the following day.

Subsistence Harvests

Three known attempts to harvest seals in Nanvak Bay occurred between early May and early November. On 31 August, hunters shot at least 7 rounds from boats, but it was unknown if any seals were retrieved. Hunters on 21 September fired more than 30 shots into the water at the mouth of the bay, and did not retrieve any seals. Hunters harvested two seals on 8 October after firing several rounds into the water near Mid-Bay Bar; **FNWR staff took samples, with the cooperation of the hunters for ADFG- Subsistence Division's harbor seal biosampling project.**

Carcasses

A very fresh newborn seal pup was found dead on Mid-Bay Bar on 26 June and was sampled. Another seal pup, dead less than one week, was discovered on 7 July at the north end of North Spit, but the carcass was not sampled. On 21 September, an adult seal carcass washed up on Maggy Beach sandbar, in an advanced state decay with its skull missing; no samples were taken.

NORTHERN SEA LIONS

Cape Newenham

Four hundred sea lions were estimated hauled out at the tip of Cape Newenham during an aerial survey on 12 June. During ground counts, staff counted 221 sea lions on 23 July, and 106 sea lions on 6 August. From various observation points, staff opportunistically sighted one to six sea lions 42 times, swimming or hauled out between 1 June and 24 August. Sea lions were feeding five of these times; twice on crustaceans in June, once on fish (possibly salmon) on 6 July, and twice on unknown prey items.

Cape Peirce

Individual or small groups (2-6 individuals) of sea lions were seen 25 times between 5 May - 31 October in the water below the west and south cliffs of Cape Peirce. The predominance of sightings occurred in May. Sea lions were observed feeding on herring 12 May, and on unidentified prey 13 and 16 May.

Round Island

The peak of weekly sea lion ground counts during the summer field season was 364 on 10 May. Numbers declined steadily and dramatically by mid-June, ranging from 18 - 85 throughout the rest of the summer. During October, 300 sea lions were counted on 16 October and 330 on 28 October (ADFG unpub. data 1996).

Other Observations/Carcasses

Staff discovered a dead sea lion at Wally Cove on 1 June, which had been dead at least three weeks. A sick sea lion was observed at Wally Cove on 6-8 and 12 June. It exhibited little movement, with its eyes closed, and a green discharge and foul smell emanating from its mouth. It appeared near death on 12 June, and was not seen again.

A large adult male sea lion hauled out on Wally Cove on 19 June, when no walruses were present. On 2 July, two sea lions swam within 23m of walruses in the water, and continued on.

DISCUSSION

WALRUSES

Limitations of Data

Inconsistencies exist in the walrus data collected at Cape Peirce from 1981 through 1986. The first walrus activity documented at Cape Peirce during this century occurred in late November 1981 when approximately 2,500 walruses were observed on Maggy Beach (Annual Narrative, TNWR 1981). Several aerial surveys were flown in 1982 and 1983 but daily ground counts were not begun until 1984 when a field camp was staffed from June to September. From 1984 through 1986 inconsistent counts resulted from untrained volunteers rotating through the field camp to census the walruses. For example, a photo was enlarged of a peak haulout in 1986. The ground estimate proved to be 35% to 49% higher than the estimate from the photo (11,800 ground estimate vs. 7,100-7,500 photo estimate). As a result, the 1984-1986 peak estimates are probably biased.

Ground counts averaged 9.3% higher than eight photo counts done in 1996. More comparisons between ground and photographic counts should be made in order to better evaluate such discrepencies.

New personnel censused marine mammals at Capes Peirce and Newenham this summer. Personnel at Cape Peirce changed in late September, and again in mid-October. These changed may have resulted in variable counts, though new personnel were trained by experienced counters to foster consistency.

The primary purpose of the Cape Peirce field camp from 1984 through 1986 was to maintain a presence to deter wasteful taking of walruses (Hotchkiss, pers. comm.). Walrus counts have become more consistent since 1987 as personnel at Cape Peirce remained the entire season, had overlap with previous personnel to obtain training, and focused on standardizing counts.

Round Island walrus numbers are also difficult to analyze. Changes in personnel on the island and the inability to census the entire island daily result in inconsistent or incomplete haulout data (Hills, pers. comm.).

With these limitations in mind, the haulout numbers from Cape Peirce and Round Island have been used to estimate numbers, general patterns in haulout behavior, and population trends in northern Bristol Bay over time. Census data for 1984 at Cape Peirce was collected sporadically, and is not used in this report.

Numbers/Haulout Patterns

Cape Peirce: The peak walrus count at Cape Peirce was 3105 on 6 October, the lowest peak since 1992 (Fig. 9). The recorded peak would have been much lower if Cape Peirce had been censused only through September, which it has been for most years except 1986 and 1988 (censused through mid-October) and 1995-1996 (censused through late October). The 1996 peak is the latest recorded field season peak of any year. Walrus numbers were low all summer compared to past years, and did not increase until late September. Numbers did not exceed 2,000 until 5 October in 1996. During the last five years (1991-1995), numbers reached 2,000 at least by late July.

Walrus numbers generally declined from 1986-1990, and have been rising but variable in the past five years (Fig.9). Beginning with 1989, a pattern appears of alternating higher and lower peak counts from year to year. Both the higher and lower peaks increased from 1989-1995. However, the peak in 1996 was lower than the last low peak in 1994.

Prior to the steady decline begun in 1986, the number of walruses using the Cape Peirce haulout had been increasing from 1981 through 1985, when a high count of 12,500 walruses was recorded. The 1995 peak was the highest count since 1985. In contrast, the peak of 1996 represents a dramatic drop from the 1995 peak of about 69%.

Twenty-one peaks and 21 lowest counts in the number of walruses hauled out occurred during the census period at Cape Peirce in 1996 (Fig. 3). Peaks were defined differently this year than in 1995 and more precisely than in previous years (see *Methods*). Peaks defined by this revised definition result in an additional one in 1995 and no additional ones in 1994 than what were previously reported. It appears there were proportionately more peaks in 1996 than in the past. These strong fluctuations in numbers of walruses onshore may be synchronous with resting and feeding cycles, based on telemetry studies at Round Island (Taggart 1987). Such fluctuations may also be related to severity of storms and to anthropogenic disturbances.

During storms with strong onshore winds and heavy surf, hauling grounds are usually abandoned (Nikulin 1947 *in* O'Neil and Haggblom 1987). Preliminary analyses comparing wind speed to declines and increases in walrus numbers in 1993-1995 (Wilson & Jemison 1994, Wilson 1995, Moran & Wilson 1996) seem to suggest some relationships.

More detailed analysis of wind effect should be undertaken. Other environmental factors affecting numbers of walruses on haulouts, such as barometric pressure, tidal range, and wind direction, have been identified (Hills 1992) and need further investigation.

As in most other low-count years (1989-1991 and 1994), walrus numbers in 1996 followed the general pattern of low numbers in June, increasing to a peak late in the summer season, typically late August-September. This year's peak was even later, partially due to the later date on which monitoring ended.

Seasonal peaks at Cape Peirce consistently occur later in the year (July-September) than do peaks at Round Island (May-early July) (Fig. 10). This may be due in part to males migrating north in the fall to join females at the edge of the ice pack (Fay 1982). This year, both Round Island's and Cape Peirce's peaks occurred later than usual, on 25 July and 6 October, respectively.

Walruses began using Maggy Beach (Figs. 2 and 6) in 1996 later in the season (on 14 July, but not consistently until early August) than in the previous three years. Use of Maggy Beach has begun later each consecutive year for the past four years; 1996 (14 July), 1995 (8 July), 1994 (mid-June), and 1993 (30 May). Walruses were present on Maggy Beach 34% of the 181 days censused from 3 May-30 October. Adjusting the number of days censused in 1996 to match previous years' census periods results in a usage rate of 36% in 1996 compared to years censused late May

through September (most years) and 38 % compared to years censused mid-May through October (1995). This compares to Maggy Beach usage rates of 65% of days censused in 1995, and 60% of days censused in 1994. This lower use of Maggy Beach in 1996 is probably directly related to lower walrus numbers overall.

Maggy Beach is a large, sandy exposed beach where typically the most walruses haul out. In 1989-1990, 1992 and 1996, when overall walrus numbers were lowest at Cape Peirce, use of Maggy Beach was low. Walruses primarily hauled out on South Firebaugh Beach and in Odobenus Cove, the smaller, more protected beaches below the cliffs. From field observations, it seems when these smaller beaches "fill up," walruses begin hauling out on Maggy Beach. South Firebaugh Beach is normally occupied throughout the season, as it was in 1996. Odobenus Cove is usually abandoned by late July every year, as it was in 1996. Walruses, however, returned to Odobenus Cove in large numbers (50-650) beginning 28 September until camp closed in late October in 1996; in 1995 they returned to Odobenus Cove in mid-October. In previous years, when camp closed in late September, walruses were not observed returning to this haulout once they abandoned it.

Between 3 May-14 October, the percent of the total haulout on South Firebaugh Beach consisting of walruses ≤10 years old ranged from 0-16.7%, and averaged 1.96% (Appendix 2 and Fig. 4). The highest percentages occurred early in the season, when very few walruses were hauled out, and may be misrepresentative, due to small sample size. Aside from these early high percentages, the percent of young walruses remained fairly uniform from mid-June through mid-October. This contrasts sharply to the pattern seen in 1995, when an apparent trend of younger walruses making up a larger proportion of the haulout later in the season occurred. The average percent of the herd consisting of walruses ≤ 10 years was 5.3% in 1995, a marked increase over other years when aging was done (1991-1994 and 1996).

Ages of walruses were estimated differently this year, and by a different observer (L. Burke) for the majority of the field season (June-late September). She classified animals in age classes 0, 1, 2, 3, 4-5, 6-9, and 10 years, following Fay and Kelly (1989). In past years, ages were broken into classes of 1, 2-3, 4-5, 6-7, 8-9 and 10 years. This change doesn't affect the use of the data in past reports since animals ≤10 years old have been grouped together in analysis.

Burke was trained by an observer who had aged walruses at Cape Peirce (J. Moran), but not many young animals were hauled out during the training period. Without substantial training in the method used in the past at Cape Peirce (which included both tusk and facial dimensions as well as body size and pelage morphology), Burke may have inadvertently relied more on Fay and Kelly's (1989) figure of "*Anterior and lateral views of average facial characters of walruses*" of different age classes. In judging the age of a walrus, the dimensions of tusk length vs. muzzle width should be the only criteria used (Kelly, pers. comm.) It is necessary to observe the animal face-on.

Still, past data may not be completely invalid. The observer who has primarily estimated ages of walruses from 1991-1995 (C. Wilson) did some preliminary comparisons between her former methods and revised methods, based more closely on Fay and Kelly (1989), during late September-October, 1996. She found her estimates of age classes remained nearly or often exactly the same using both methods, though this was not a rigorous scientific study. Also, since the same observer estimated ages of walruses from 1991-1995, data should be consistent. This data may be useful in estimating adolescent recruitment into the adult population or in assisting in determining the status of the walrus population (Fay and Kelly 1989). More research is needed to determine the usefulness of this data and to design a more scientific study of walrus aging at Cape Peirce, including methods of unbiased sampling and observer training.

Cape Newenham: This is the first year since 1992 that funding has allowed daily monitoring of walrus haulouts at Cape Newenham throughout the summer season. Numbers were low (below 200) from early June until mid-July, when they increased suddenly to peak on 13 July at 1,280 animals (Fig. 5). Another high count (1,255) took place on July 20. Afterwards, numbers gradually declined until camp was closed in late August.

The beaches at Cape Newenham appear to have been used sporadically by walruses during the last ten years, though monitoring has not been consistent. In the four years of more regular censusing (1991-1993 and 1996), peaks ranged from 870 to 5,444 (Fig. 11). Between 1988 and 1990, few walruses were seen at Cape Newenham (Jemison 1992).

From 1978 to 1984, when observations were very irregular, numbers ranging from a few individuals to several thousand animals were reported hauled out during the spring and fall months (Jemison 1992, TNWR Annual Narrative 1986).

Total Haulout Count

The greatest number of walruses known to have hauled out on any one day in northern Bristol Bay-southern Kuskokwim Bay was the combined ground count at Cape Peirce (1,096), Cape Newenham (557) and Round Island (5,038) on 15 July of 6,691 (Fig. 12). Another high count, nearly equaling this peak, occurred on 25 July with 6,614 counted at all three haulouts and coincided with Round Island's peak of the year of 6,331. This does not represent a complete census of Bristol Bay haulouts, as Cape Seniavin was not regularly monitored this season. A local pilot reported seeing no more than eight walruses at Cape Seniavin during the week of 5-13 July (Gillis, pers. comm.).

This peak count for the area is much lower than the peak of 10,471 in 1995, but comparable to area peaks for the three years previous, which ranged from 5,968-7,530 (Fig. 13).

Keeping in mind the inconsistencies and gaps in data collection (see *Limitations of Data*), the peak cumulative counts for northern Bristol Bay-southern Kuskokwim Bay haulouts are graphed in Figure 13 and appear in Table 2, based on data compiled and corrected by Hills and Jemison (USFWS unpub. report, 1991) and on USFWS and ADFG unpublished data (1991-1996). These represent the highest total counts for each year at all monitored haulouts (Cape Peirce, Round Island and Cape Newenham). In some years, the highest bays-wide count was the peak at one haulout, either because data from other haulouts was not collected at that time, or because more walruses hauled out at one time at that haulout than they did at all haulouts combined on any other date. Additionally, counts at haulouts may not have been complete. This graph and table are not a comprehensive study of the data, and caution must be given in drawing any conclusions from them. These numbers only represent counts, not population estimates. It appears this year's total for northern Bristol Bay-southern Kuskokwim Bay is one of the three lowest in all years of censusing. The timing of the bays-wide peaks ranges from mid-June to late September, with the majority occurring in July.

During 1991-1993, it appeared that walruses were less likely to congregate at any one haulout area than in previous years. In 1994-1996, walruses appeared to congregate primarily at Round Island up until late June-late July, and primarily at Cape Peirce beginning mid-July-early September, with more similar numbers at both haulouts in the interim. It is probable that some of the same animals use all three northern Bristol Bay haulouts, and possibly Cape Seniavin, intermittently. Movement of walruses between Cape Peirce and Round Island has been confirmed through telemetry studies (Hills 1987 & 1990, Taggart 1987). Surveys of all four haulouts are essential to better determine the extent of the walrus population in Bristol Bay and southern Kuskokwim Bay.

Yellow-Fin Sole Fishery and Factory Trawling

A comparison of annual haulout peaks from 1985-1996 at both Cape Peirce and Round Island show fluctuations in the number of walruses hauling out from year to year (Fig. 11). A potential cause of these fluctuations is the presence of the yellow-fin sole fishery in northern Bristol Bay. During 1987 and 1988, when the yellow-fin sole fishery was highly active within three miles of Round Island, haulout numbers were low at Round Island and high at Cape Peirce. In 1989 and 1990 when there was no yellow-fin sole fishery in northern Bristol Bay, peak numbers at Round Island were higher than peak numbers at Cape Peirce. Few walruses were seen at Cape Newenham these years (Miller, pers. comm.). During 1991-1996, when the fishery was restricted, haulout numbers were variable at Cape Peirce and Round Island. In 1991, haulout peaks at Cape Peirce and Round Island were similar, and hundreds of walruses began hauling out at Cape Newenham (Jemison 1992). In 1992, the number of walruses at Cape Peirce was low; however, Cape Newenham had the highest peak of all three haulout areas. Cape Newenham was infrequently surveyed from 1993-1995.

In 1989 the NPFMC voted to close waters within 12 miles of Cape Peirce and Round Island to the yellow-fin sole fishery. In August 1991 the NPFMC voted to continue the 12-mile closure indefinitely and to allow a three-mile transit zone around Right Hand Point. Further investigation is needed to evaluate the possible effects of the yellow-

fin sole fishery on the distribution and number of walruses hauling out in northern Bristol Bay. Feeding areas, migration routes, and/or travel corridors may be affected by the yellow-fin sole fleet. Cape Peirce and Cape Newenham may be used as alternate haulout sites.

Compliance with the regulations has been good in the past four years. From 1993-1996 no yellow-fin sole vessels were cited for violating the 12-mile restricted zone around Round Island (Graham, pers. comm.). In 1992 there was little activity by yellow-fin sole vessels inside the 12-mile zone (Hessing and Van Daele 1992). This contrasts with 1991 when nine boats linked to the yellow-fin sole fishery were cited by the Coast Guard for violating the 12-mile closure (Dubois, pers. comm.).

In 1996, NPFMC voted to close all waters (with a seasonal exception in one area) east of 162° W and north of 58° N to factory trawling to protect juvenile red king crab habitat. An area bounded by 159 to 160° W and 58 to 58° 43' N (between Round Island and Cape Constantine, and south), but excluding the 12-mile restricted zone around Round Island and the state's 3-mile restricted zone off all shores, will remain open from 1 April - 15 June. Also, all boats must have observers on board and achieve 100% accountability for all bycatch (Samuelsen, pers. comm.). The area closed to factory trawling includes waters south and east of Cape Newenham to a point midway between Egegik and Pilot Point. This closure may help protect prey of walruses using Capes Newenham and Peirce and Round Island, as well as reduce potential disturbances.

Disturbances

Cape Peirce: Twenty-eight anthropogenic disturbances (occurring on 28 days) to walruses were documented in 1996 (Appendix 3), comparable to the 26 and 24 recorded in 1995 and 1994, respectively. Twenty-five percent of disturbances provoked a high degree of response from walruses, 46% provoked a moderate degree, and 29% provoked a low degree. Of the 28 disturbances which occurred, 17 were associated with some degree of decline in walrus numbers lasting longer than a day.

Ten (35.7%) of the disturbances were caused by aircraft (three associated with the herring fishery), eight (28.6%) by biologists taking preventative measures to keep walruses from ascending to cliffs (i.e. herding), five (17.9%) by hunters, three (10.7%) by researchers tagging walruses, and two (7.1%) by boats.

Besides the 10 documented flights (14 total aircraft) that disturbed walruses, there were 754 other aircraft sighted or heard in the vicinity. Of these, 648 were associated with the herring fishery between 2-17 May. Most of these planes were observed flying below 1500' altitude, and many below 500'. Low numbers of walruses were observed hauled out when ground censusing began on 3 May, and were gone from haulouts 5 - 9 May, during the peak of the herring season. It is possible that the heavy aircraft and boat traffic in the vicinity during this time prevented walruses from hauling out.

The other 106 aircraft caused no apparent disturbances. More aircraft were documented in 1996 than in previous years, yet caused fewer disturbances. This may be partly due to a longer field season, less days walruses were hauled out on Maggy Beach (where walruses are most vulnerable to disturbance and disturbances are easily observed), and more careful documentation of all air traffic by observers. Also, many of these flights were coordinated with staff to avoid disturbances or occurred when no walruses were hauled out on beaches within hearing range (based on human observation). Public use and refuge aircraft have been increasingly using Sangor Lake since 1994 through 1996 as a landing and take-off site, in order to avoid disturbances to marine mammals hauled out. Sangor Lake lies approximately 3 km away from the nearest walrus haulout and 2 km from the seal haulout in Nanvak Bay (Fig. 2).

Two boat-induced disturbances were observed in 1996, both which resulted from skiffs traveling close to shore. An additional disturbance, involving four herring spotter planes and two fishing boats occurred on 10 May. In 1996, of 247 boats seen between 3 May-31 October, 74 were sighted within 0.8 km (0.5 miles) of the coast, 71 were seen more than 0.8 km offshore, and 102 others were seen, but their distances from shore were not documented. Of this total, 84.7%, or 209 boats, were in the Cape Peirce vicinity from 3-17 May, involved in the herring fishery. Also during this period, as many as 8 large (>45 m) fishing boats were moored at one time in South Firebaugh Cove, the primary

walrus haulout. There was much boat traffic in and out of this and Odobenus coves for several days, which may have been instrumental in keeping walruses from hauling out. Few to no walruses were observed during this time.

In 1995, when camp was opened after the herring fishery ended, 34 boats were seen during the entire field season. An earlier aerial survey on 11 May found 25 large (>45 m) fishing boats anchored in South Firebaugh cove. No walruses were observed hauled out.

Cape Newenham: Five anthropogenic disturbances to walruses were observed between 1 June - 24 August. Disturbances at Cape Newenham are not as easily observed as at Cape Peirce, as walrus haulouts are a minimum of 4 km away from the field camp (Fig. 2 and Appendix 2). Four of the disturbances, were caused by aircraft, three of which were large (DC-3 and C-130) and flying above 2500'. Air traffic arrives and departs at least weekly at an airstrip located near walrus haulout beaches on the Cape Newenham long-range radar site. The effects of this traffic on the walrus haulouts are undetermined, and should be investigated.

The other disturbance was caused by hunters in a skiff, who came close to shore, but decided not to hunt. Another disturbance occurred on 19 July at Bird Rock Cove, when 20 walruses went into the water and 107 raised their heads, out of 127 hauled out. The cause of the disturbance was unidentified, but was suspected to be three ravens who landed on a bluff overlooking the haulout.

Behavioral Observations

Cape Peirce: For the third consecutive year, walruses ascended to the cliff tops at Cape Peirce, and many fell to their deaths or severe injury. Much speculation has occurred as to the causes of this behavior, and there has been a recent profusion of media attention over it, some of it misguided. No one cause has been identified. More than a behavioral phenomenon, this activity seems to be a response to naturally occurring landscape changes. Erosion from wind and walrus activity has diminished high, grass-covered sand dunes to a lower incline over which walruses can easily climb and continue on to higher dunes and a tundra slope that leads to the cliff edges (Fig. 6).

Since walruses returned to Cape Peirce in 1981 they have gradually destabilized dunes by destroying beach grasses, allowing the high winds typical of this region to blow away sand. By 1994, walrus haulout activity had caused enough erosion to allow walruses to haul out near the top of the dunes adjacent to the tundra leading to the cliffs. Eventually the walruses went over the lowest dune during a storm in 1994 to the higher tundra, trampling down vegetation, and flattening out this dune. Erosion continued through 1996, making the cliff tops even more accessible to the walruses.

Additionally, currents and wind affect sand deposition offshore of Maggy Beach. In the last few years, an east-west channel has formed close in and parallel to the base of the north-facing cliffs of Maggy Beach. Walruses swim up this channel to the beach, arriving onshore close to the cliff wall. They tend to stay close to the natural line of the cliff base in their haulout pattern, following it east as they push further up the slope of Maggy Beach to the eroded dune area, and sometimes eventually to the cliff edges.

It seems likely storms with high winds (>50 mph) were instrumental in originally prompting walruses to travel up to cliffs at Cape Peirce in 1994 and 1995. The offshore direction of these severe storms and the sea state may have presented the walruses with unusual conditions that caused them to react by trying to find cover from the winds in the leeward (i.e., the cliffs) side of the haulout behind the dunes. However, unlike the previous two incidents, the weather on August 21 and 26-27, 1996 was mild and clear with very light (5-15 mph) winds.

In all three years when walruses were atop the cliffs, staff closely monitored the animals during all daylight hours. Walruses wandered along the cliff edge and some attempted to return to the beach by going off cliffs over Parlier Beach or grassy slopes ending abruptly in tall drop-offs over Maggy Beach. They seemed unable to discern their height (6-38m) above the beaches, and often willingly began steep descents, ending in uncontrollable sliding and rolling, and fatal falls. Others often followed, as walruses typically do when hauled out in cohesive herds. Some walruses were crowded out and inadvertently pushed off cliffs as their closely packed herd mates moved closer to the cliff edge. Slippery, wet grass and unstable cliff edges may have been contributing factors in these mortalities. Some

animals survived long enough to reach the water, but probably died from severe internal injuries after swimming away. One walrus, who had been hauled out with a group atop the cliffs on 27 August, 1996, died there. No injuries were found on the animal upon inspection, and the cause of death was not determined. Staff suspected the walrus may have died from overheating after ascending the long slope, as the weather was quite warm and calm.

Staff have herded walruses out of the dangerous areas, if conditions allowed little chance of harm to the animals, or of disturbance to walruses hauled out below. Staff have also actively discouraged walruses from hauling out in the eroded dune area which leads to the cliffs by stringing large plastic tarps along the upper reaches of the haulout. The rustle of plastic materials such as rain gear has been observed to frighten walruses at Cape Peirce. The tarps effectively deterred walruses from ascending to the high dunes until camp was closed on 1 November, though they were deteriorating rapidly with exposure to the wind. Walruses hauled out near these, but did not cross them. These interferences may have altered natural haulout configurations, but did not seem, in general, to drive walruses from the haulout.

Under the Marine Mammal Protection Act (Section 109[h][1][a]), USFWS employees have the authority to intentionally interfere with or herd walruses to prevent further mortality (Garlich-Miller, pers. comm.). These methods may be controversial, though, as some biologists believe such natural occurrences should be allowed to unfold without human interference. Representatives of neighboring Native villages have suggested building a barrier to prevent walruses from reaching the cliff edges, though it may be difficult to design a barrier able to withstand the forces of wind and sand. Togiak NWR staff will be consulting with USFWS staff and other biologists to determine a course of action in the event this phenomena recurs, which seems likely.

Cape Newenham: Walruses climbed up a tundra-covered hill adjacent to Bird Rock Cove, one of the major hauling grounds for walruses at Cape Newenham, in early August (Fig. 2). Two were seen near the edge of the cliffs where one side of the hill ended, approximately 15m above the beach. There was evidence of another small group having been near the cliff edge, too. None of these animals went over the cliff, but descended back down the tundra slope. USFWS staff working at Cape Newenham in 1992-1993 have also on occasion seen walruses on this hill, but have not seen walruses go off the adjacent cliff (Jemison, pers. comm.).

The biological technician stationed at Cape Newenham this year observed behavior in walruses hauling out which he interpreted as guarding behavior. He spent many hours observing small groups (<60 individuals) of walruses. On over 12 occasions, he observed at least one individual sitting stationary near shore in the water, facing toward the haulout, alert and vigilant of its surroundings. When other walruses approached the haulout from the water, this vigilant walrus would go ashore, and one of the walruses in the approaching group would take over the sitting position. A vigilant walrus, or "guard" could spend hours offshore before another took over. This behavior was not observed in larger haulout groups at Cape Newenham; though sometimes more than one individual was seen sitting in the water near large haulouts, no walrus came to take over another's position in the water. There were some periods when haulouts were small when the behavior was not observed, though this usually occurred during very windy weather or rough water. During a week spent at Cape Peirce, Ahrens witnessed this behavior once on South Firebaugh when there were 55 animals hauled out, but at no other times, when numbers ranged from 300-800 (Ahrens, pers. comm.).

Carcasses

When camp was first opened in early May, 123 carcasses were counted at Cape Peirce, all of which were several months to a few years old. This is a much higher number present on Cape Peirce beaches than in past years, and can most probably be attributed to those walruses that fell from cliffs in 1994-1995.

On 26 May, the first fresh carcass appeared in the surf at South Firebaugh cove. No more carcasses appeared until mid-July. From 21 July-30 October, when camp closed, 19 new carcasses appeared in the Cape Peirce area, excluding those from cliff-falling mortalities (Table 1). At least 50 additional mortalities resulted from walruses falling from cliffs on 21 and 27-28 August. Two additional fresh carcasses were observed on Maggy Beach after

camp closed during an aerial survey on November 22. The number of new walrus carcasses observed on the beaches of Cape Peirce from 3 May-22 November totaled 72.

Disregarding the cliff-fallen walruses, number of carcasses in 1996 were equivalent to the number in 1994 and far fewer than in 1995. This is probably directly related to the much lower numbers of live walruses present in 1996 and 1994. In general, most new carcasses appear later in the season at Cape Peirce, as walrus numbers increase and more animals use Maggy Beach.

In 1996, as in other years, the majority (46%) of the naturally deposited new carcasses (i.e. not related to cliff-falling, hunting or tagging operations) at Cape Peirce was found on Maggy Beach, a northwest-facing, sand/gravel beach where most of the walruses hauled out this summer.

In 1995-1996 scavengers played a much larger role in the decomposition of carcasses than in past years. Brown bears (*Ursus arctos*) began feeding on carcasses nightly in late August, reducing the majority of carcasses east of Maggy Beach to bone by late September. During September, well-worn bear trails from the Puffin Creek drainage to Maggy Beach became evident. Bears ate many of the carcasses on Maggy Beach by late October. In addition to consuming the carcasses, bears opened up the tough carcass hides, allowing access by other scavengers such as red foxes (*Vulpes vulpes*), ravens (*Corvus corax)* and gulls (*Larus* sp.). The increased number of carcasses from cliff-falling walruses, and increased scavenging may influence the number of carcasses observed in the spring, as well as scavenger productivity. Consequently, changes in the productivity of these scavengers, who also hunt, may affect the productivity of their prey, such as seabirds, marmots and ground squirrels.

The fewer number (2) of carcasses documented at Cape Newenham than at Cape Peirce may be a result of several factors, including lower numbers of walruses using the haulouts and a shorter field season during which observations were made. Currents, tides, and winds play a significant role in the movement of carcasses in the water and in the location of their deposition. Perhaps carcasses are more likely to wash up on Cape Peirce beaches than on Cape Newenham beaches.

During high tides and storms, carcasses can be deposited higher on sand/gravel beaches than on rocky beaches and are likely to remain there longer. Walrus carcasses observed from 1990-1996 were found predominantly on sand/gravel beaches.

SEALS

Limitations of Data

In 1975 seals in Nanvak Bay were studied intensively (Johnson 1976). From 1976 to 1983 occasional aerial surveys were flown over Nanvak Bay, but not until 1984 were ground counts resumed. In order to accurately census the mid-bay bars and identify pups it is necessary to cross Nanvak channel and view the haulout from a high point on North Spit. From 1984 -1988 the seal population was censused only from the Cape Peirce side and not daily. In 1989 counts were made daily, but not until 1990 were the seals observed from both the North Spit and Cape Peirce observation points.

Numbers/Haulout Patterns

Censusing began almost a month earlier in 1996 than in recent years, and numbers of seals were higher in May than in June and July (Fig. 7). Otherwise, 1996 follows the haulout pattern for all other years; numbers are low from early June to mid-July during pupping, rise steadily to peak in August-mid-September during molting, and then begin to decline. In 1996 the peak count for the season was 581 on 21 August, slightly higher than the peaks of 1994-1995 (Fig. 14). The peak haulout during the pupping period (June-early July)was 273 on 2 June, higher than the peak in 1995 of 244, and lower than the peak of 338 in 1994. Yet, the maximum number of pups in 1996 was 6, much lower than the peaks in 1993-1995. Seal haulouts were monitored one month later (through the end of October) in 1995-

1996 than they have been in all past years of censusing. Numbers continued a steady decline after the molting peak through October.

Though the peak seal counts from 1993-1996 were higher than the peaks of the previous three years of reliable observations, the peak pup counts have been lower. During the years 1990-1992 peak pup counts were 19, 21, and 24, respectively. A peak of 15 pups was counted yearly from 1993-1995. The number of pups observed in 1996 (Fig. 8) is a decline of 60% from the previous three years. The apparent decline in pupping may be partly due to the availability of less time to observe seals, as other projects took precedence over seal observations, and a change in observers over the years. Still, careful and consistent observations did take place in 1996, many from the North Spit observation point, and it seems likely that observers saw most of the pup production this year.

Observations of seal pups during 1993-1996 suggest that most or all newborn pups in Nanvak Bay during June-July are harbor seals rather than spotted seals. Based on the taxonomy of Nowat (1991), harbor seal pups are usually born with adult-like pelages and are able to swim immediately; all new pups but one observed in Nanvak Bay in 1996 fit this description. Spotted seal pups, by contrast, have long white lanugo that is molted after about one month, and are unable to swim at birth. One pup, seen on 23 May, was covered in lanugo on the posterior half of its body.

All pups were observed on Mid-Bay and Far bars, where seals consistently hauled out until early August, when they began using the tip of North Spit. North Spit was occupied 28 times from 1 August - 16 September, coinciding with their molt (Appendix 5). This compares to 27 times it was used as a haulout in 1995.

If the peak seal count for each year of reliable censusing (1989-1996) is an accurate reflection of that year's population trend, seal numbers have slightly increased at Nanvak Bay since 1989. If all years of censusing are considered, peak numbers have doubled since the lows near 200 in 1987-88, but are still not as high as the peaks of 1984 and 1986. (Fig. 14).

In 1975 an estimated 3,100 seals were present in Nanvak Bay in late August (Johnson 1976). During the period 1975-1983, the number of seals in Nanvak Bay averaged 2,630 (Loughlin 1992), based on the Johnsons' data and aerial surveys. No counts over 700 animals have been recorded since. A peak of 36 pups was counted in 1975 in contrast to the peak pup production observed in 1996 of 6. Fewer seals consistently hauled out during 1996 (Fig. 7) and in 1995 (Moran and Wilson 1996), especially during June and July than in 1994 (Wilson 1995). In general, seals were more skittish and apt to leave their haulouts in 1996 and 1995 than in past summers.

The decline in the number of seals in Nanvak Bay since the early 1980s parallels population trends observed in many parts of Alaska. A variety of factors may play a role in the decline, such as changes in distribution, disease or pollution, subsistence harvest, entanglement in nets or other debris, incidental and direct take by fishers, and changes in prey abundance and availability (Lowry 1990). A long-term oceanic warming trend may be influencing marine mammal populations and their prey base (Ono *in* Peterson and Johnson 1995).

Anthropogenic disturbances may affect numbers, too. Throughout the season, boat and plane traffic caused seals to leave their haulouts at least 24 times. Three of these disturbances occurred during Native hunts. Only during one hunt were seals seen taken. Ravens were observed scaring seals off their haulout once, compared to the numerous raven disturbances in 1995.

Bering Sea harbor seals have been classified as one of three separate harbor seal stocks in Alaska, based on geographical separation, population response data, and clinal variation in body size and color phase (Hill et. al. 1996). Bering Sea harbor seal numbers are thought to be continuing to decline, especially on the north side of the Alaska Peninsula, with an average decline of about 3.5% annually (Withrow, pers. comm.).

The Nanvak Bay seal haulout is unique because it is the northernmost pupping area for harbor seals in Bristol Bay, as well as a region where the ranges of harbor and spotted seals overlap. Coupled with the population decline, this makes the Nanvak haulout both interesting and important.

SEA LIONS

Cape Newenham and Round Island are the major sea lion haulouts in northern Bristol Bay (Jemison 1991). Regular monitoring of the sea lion haulout at Cape Newenham was funded in 1991 and 1992; data was collected opportunistically in 1993-1996. Based on the few and sporadic observations at Cape Newenham since 1993, it is difficult to detect a trend in numbers of sea lions using this haulout. The highest number observed in 1996 was 400 on 12 June; in 1995, it was 640 on 25 May; in 1994, it was 300 on 6 July; and in 1993, it was 800-900 on 12 May. Numbers in the past have been observed to typically drop off after May at both Cape Newenham and Round Island.

The peak of weekly sea lion ground counts during the summer field season at Round Island was 364 in mid-May, compared to 467 in 1995, 542 in 1994, and 369 in 1993. During October 1996, the peak sea lion count was 330, compared to 600 counted on 11 September in 1995. The field camp was not reopened until later in September, 1996 than in 1995.

The northern sea lion was listed as a threatened species in 1990; numbers have declined throughout their range in Alaska from the late 1950s to the mid 1980s (Hoover 1988). In 1995 NMFS proposed listing the population west of Cape Suckling (the Western U.S. stock) as endangered. This population has experienced a decline of 37.4% from 1989-1994 (Hill et. al. 1996). This is a critical time to monitor major sea lion haulout sites, such as Cape Newenham and Round Island.

RECOMMENDATIONS

1. Develop a comprehensive inter-/intra-agency inventory plan to monitor marine mammals in northern Bristol Bay.

2. Continue monitoring walrus haulouts at Cape Peirce, coordinating methods and timing with ADFG. Begin regular monitoring of the Cape Newenham haulout. During peak haulouts at Cape Peirce, Round Island, and Cape Newenham, conduct aerial surveys of the Cape Seniavin haulout.

3. In cooperation with NMFS/ADFG, continue monitoring seals at Nanvak Bay. Determine their movement patterns in Bristol Bay with marked individuals. Attempt to more closely monitor numbers and behavioral differences of harbor and spotted seals. Continue to accurately identify pups of each species. Coordinate with NMFS/ADFG to continue scat collection to detect changes in prey species.

4. In cooperation with NMFS, monitor the sea lion population at Cape Newenham. Establish observation points at Cape Newenham and install permanent markers, and stakes for safety ropes. Train personnel in sex and age composition of sea lions.

5. Develop a study plan together with MMM and ADFG to analyze the effects of disturbance from aircraft and boat traffic on walruses hauled out at Cape Peirce. This should include comparisons between normal and disturbed behavior. Continue efforts to minimize boat and aircraft disturbance related to commercial fishing, public use and refuge activities.

6. Propose closing the waters off Cape Peirce and Cape Newenham to herring fishing to prevent disturbance to marine mammals and seabirds.

7. Document severity of walrus disturbances in terms of percent of haulout disturbed, rather than pure numbers alone.

8. In cooperation with NMFS/ADFG, develop a standardized method for documenting and assessing disturbances to seals hauled out in Nanvak Bay.

9. Design and outline a method of collecting data on the estimation of walruses ≤ 10 years old at Cape Peirce, including an unbiased sampling method and observer training. Determine how data collected can be used to help monitor the status of walrus populations.

10. Count walruses in photographs taken of Cape Peirce haulouts from 1995 and previous years, and compare to ground counts.

11. Continue cooperation with National Biological Survey (USGS-BRD) to develop and implement a method to tag and follow individual walruses, in order to better assess length of stays at and movement of animals between northern Bristol Bay haulouts.

12. Observe walrus activity at the Maggy Beach haulout over 24-hour periods, either directly or through videotaping, to detect diurnal patterns in movement on and off the beach.

13. Compile and analyze sea lion data from Round Island to determine if number of sea lions hauling out has declined.

14. Continue to define peaks in walrus haulouts as defined in the *Methods* section of this report.

ACKNOWLEDGMENTS

Thanks to everyone involved in monitoring marine mammals this year in northern Bristol Bay-southern Kuskokwim Bay. Thanks to A. Aderman, our brave and fearless project leader; to M. Hinkes, biologist-pilot extraordinaire; and A. Archibeque, unequaled refuge manager, (TNWR), for all your support and assistance. Thank-you most especially to L. Burke (TNWR) at Cape Peirce and J. Ahrens (TNWR) at Cape Newenham for censusing pinnipeds for many months, through wind and storm; to T. Burke, L. Haggblom, K. Nolan, and J. Peirce, (TNWR), and B. Anderson (USFWS-Realty Division) for helping out with marine mammal observation at the capes. Thanks also to Cape Newenham long-range radar site employees D. Bishop, D. Forrester, and Linda for additional observations of walruses. Extra added thanks to J. Moran (TNWR) and J. DeGroot (USGS-BRD) for braving ice, blizzards and the little people in collecting marine mammal data during October at Cape Peirce. Thank-you USGS-BRD crew, G. Garner, C. Jay, B. Ballachey, J. DeGroot, T. Olson, D. Mulcahy and P. Tuomi, for the cooperative walrus-tagging research project. Thank-you L. Jemison, B. Kelly, and G. Sheffield (UAF) for your guidance and sharing of knowledge and resources. Thanks to K. Koenen (ADFG), S. Rice (MMM), and M. McClaran (volunteer, ADFG) for keeping track of walruses and sea lions at Round Island. Additional thanks to S. Rice for the walrus sampling protocol. Thank-you L. Van Daele(ADFG) for your cooperation and Round Island data resources. Thanks to V. Vanek (ADFG-Subsistence, Kodiak) for the harbor seal biosampling kit and enthusiastic interest, to S. Lewis, UAF Alaska Frozen Tissue Collection for sampling supplies and protocol, and S. Kruse (MMM) for the post-mortem techniques manual. Finally, thank-you, J. Moran for all the help with figures, tables and appendices, and for your mapping expertise.

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Miller, M. Alascom Technician, Anchorage, AK. In communication with L. Jemison, Togiak N.W.R., Dillingham, AK.

Samuelsen, R. Bristol Bay Native Association, Natural Resources Division, Dillingham, AK.

Taylor, K. Alaska Dept. of Fish and Game, Fairbanks, AK. In communication with L. Jemison, Togiak N.W.R., Dillingham, AK.

Withrow, D. National Marine Fisheries Service, National Marine Mammal Laboratory, Seattle, WA.

Table 1. Walrus mortalities at Cape Peirce, southwest Alaska, May - October 1996.

Date	Beach	Number	Cause of Mortality
05/26	SB	1	unknown - skiff observed in area on 05/25
07/21	NS	1	sick - first observed 07/14, still alive 07/19
08/13	MB	1	unknown - no wounds
08/14	MB	1	USGS-BRD capture related
08/15	PB	1	unknown - washed up, decayed
08/21	MB	2	falling
08/23	MB	1	USGS-BRD capture related
08/27	MB	14	falling
08/27	PB	25	falling
08/28	PB	4	falling
08/28	MB	5	falling
08/28	CT	1	unknown - died on tundra possibly from heat exhaustion
08/31	MB	2	hunting
09/21	MB	1	sick, possibly shot on 09/21
09/22	PB	1	unknown - washed up, decayed
09/23	MB	1	hunting
10/05	SFB	1	unknown - fresh
10/06	MB	1	unknown - fresh
10/07	NB	1	unknown - fresh
10/18	MB	2	unknown - 1 washed up, 1 sick for several days
10/26	NB	1	unknown - fresh
10/26	OC	1	unknown - fresh
10/30	MB	1	unknown - fresh, high on beach
11/22	MB	2	unknown - fresh (seen during aerial survey)

SB=South Firebaugh Beach, NS=North Spit, MB= Maggy Beach, PB=Parlier Beach, CT=Clifftop, NB=North Firebaugh Beach, OC=Odobenus Cove; USGS-BRD=U.S. Geological Survey-Biological Resources Division.

Table 2. Annual peak walrus counts in northern Bristol Bay and southern Kuskokwim Bay, southwest Alaska, 1978-1996 (all haulouts were not censused every year).

Date	Total Count	Haulouts Censused
7-1-78	15,000	Round Island
6-27-80	11,603	Round Island
6-18-81	7,387	Round Island
8-11-84	9,450	Round Island
7-27-85	12,548	Cape Peirce
6-10-86	12,378	Round Island
7-27-87	8,551	Cape Peirce, Round Island
7-5-88	8,952	Cape Peirce, Round Island
7-22-89	8,664	Cape Peirce, Round Island
7-16-90	7,347	Cape Peirce, Round Island
8-21-91	4,829	Cape Peirce, Round Island
8-24-92	7,328	Cape Peirce, Cape Newenham, Round Island
8-22-93	7,530	Cape Peirce
6-4-94	5,968	Cape Peirce, Round Island
9-24-95	10,471	Cape Peirce, Round Island
7-15-96	6,691	Cape Peirce, Cape Newenham, Round Island

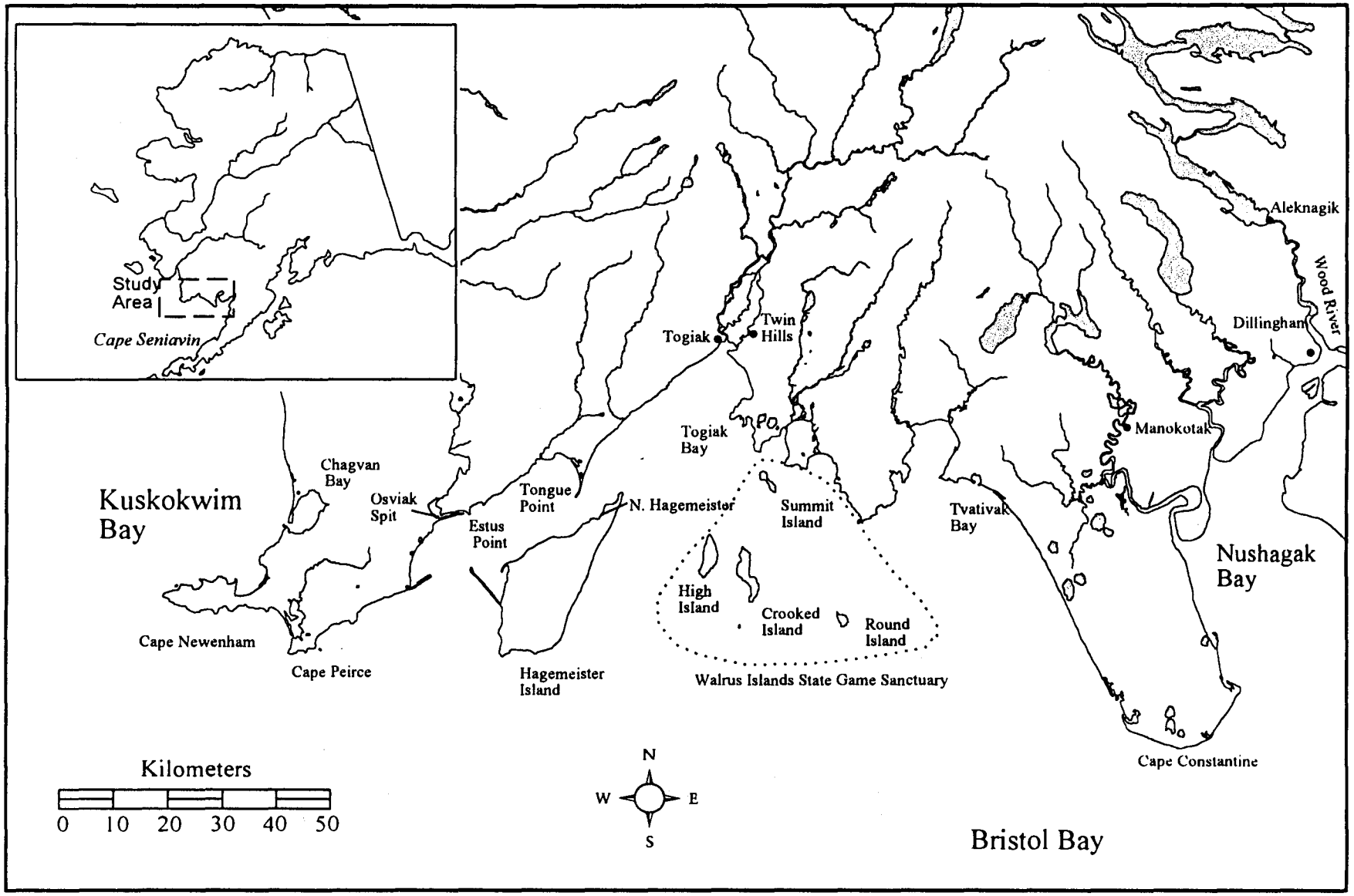

Figure 1. Location of the marine mammal study area, southwest Alaska 1996.

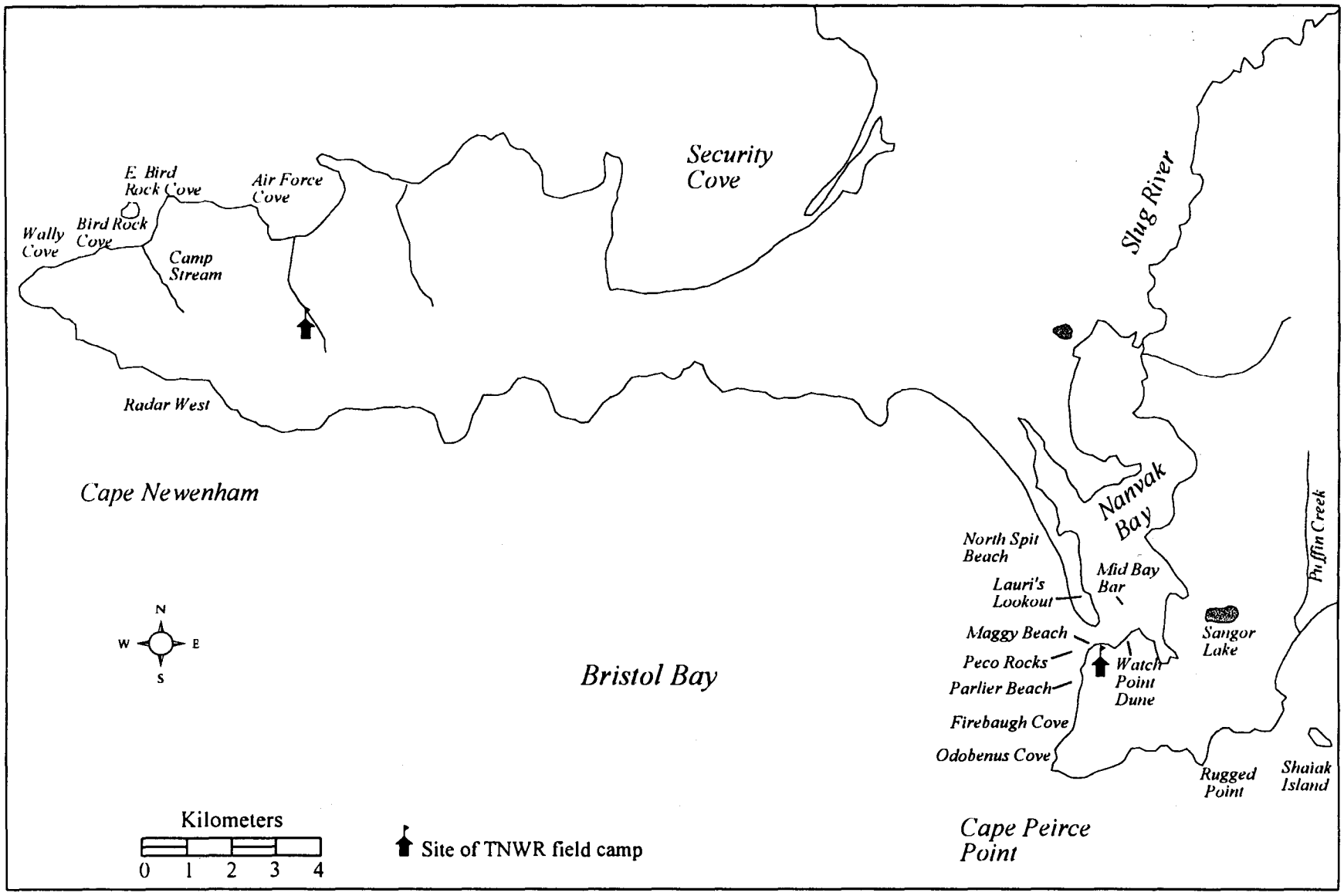

Figure 2. Cape Peirce and Cape Newenham, Togiak National Wildlife Refuge, southwest Alaska.

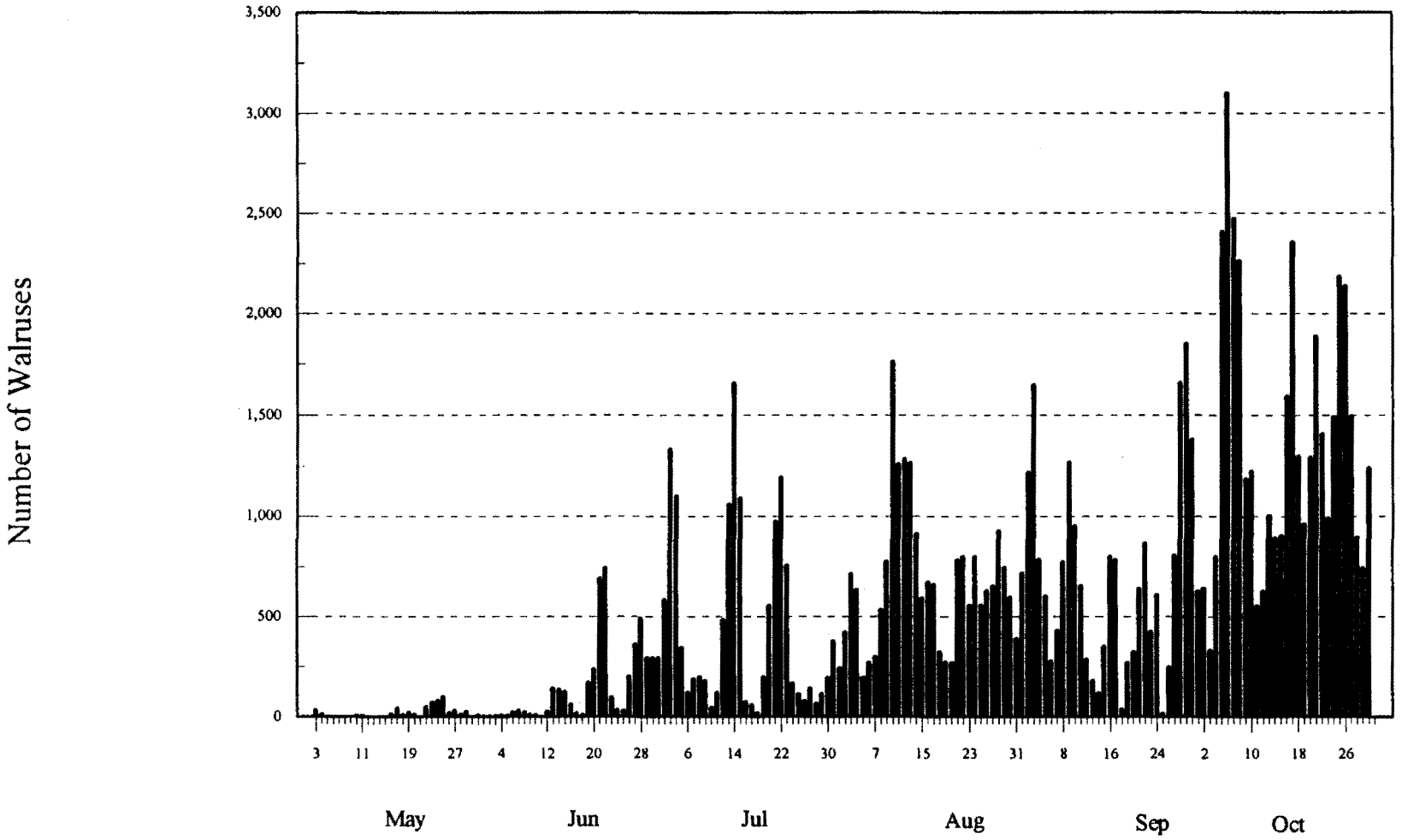

Figure 3. Number of walruses hauled out at Cape Peirce, southwest Alaska, 3 May - 30 Oct, 1996.

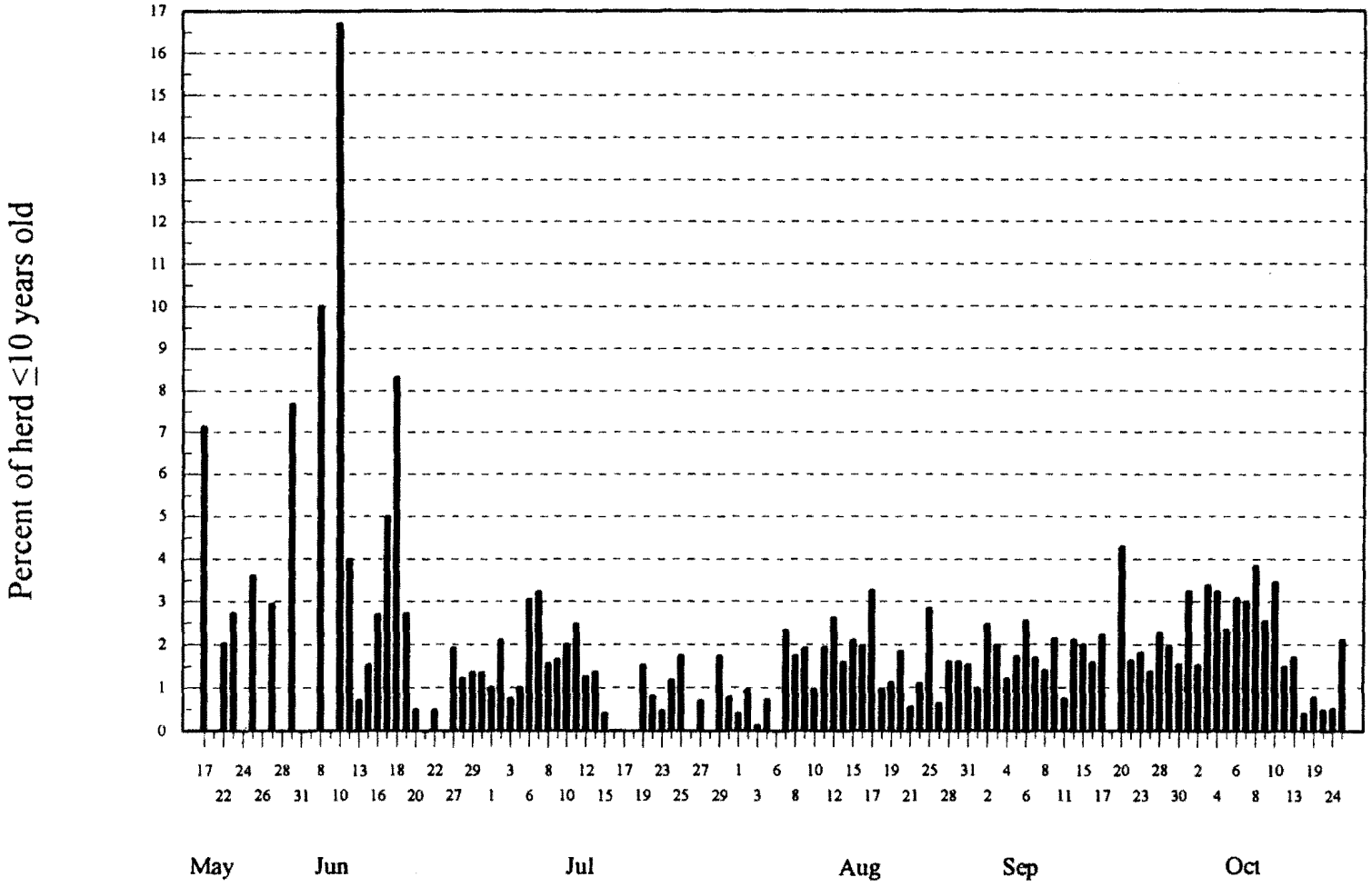

Figure 4. Percent of walrus herd ≤ 10 years old hauled out on South Firebaugh Beach at Cape Peirce, southwest Alaska, May - Oct, 1996.

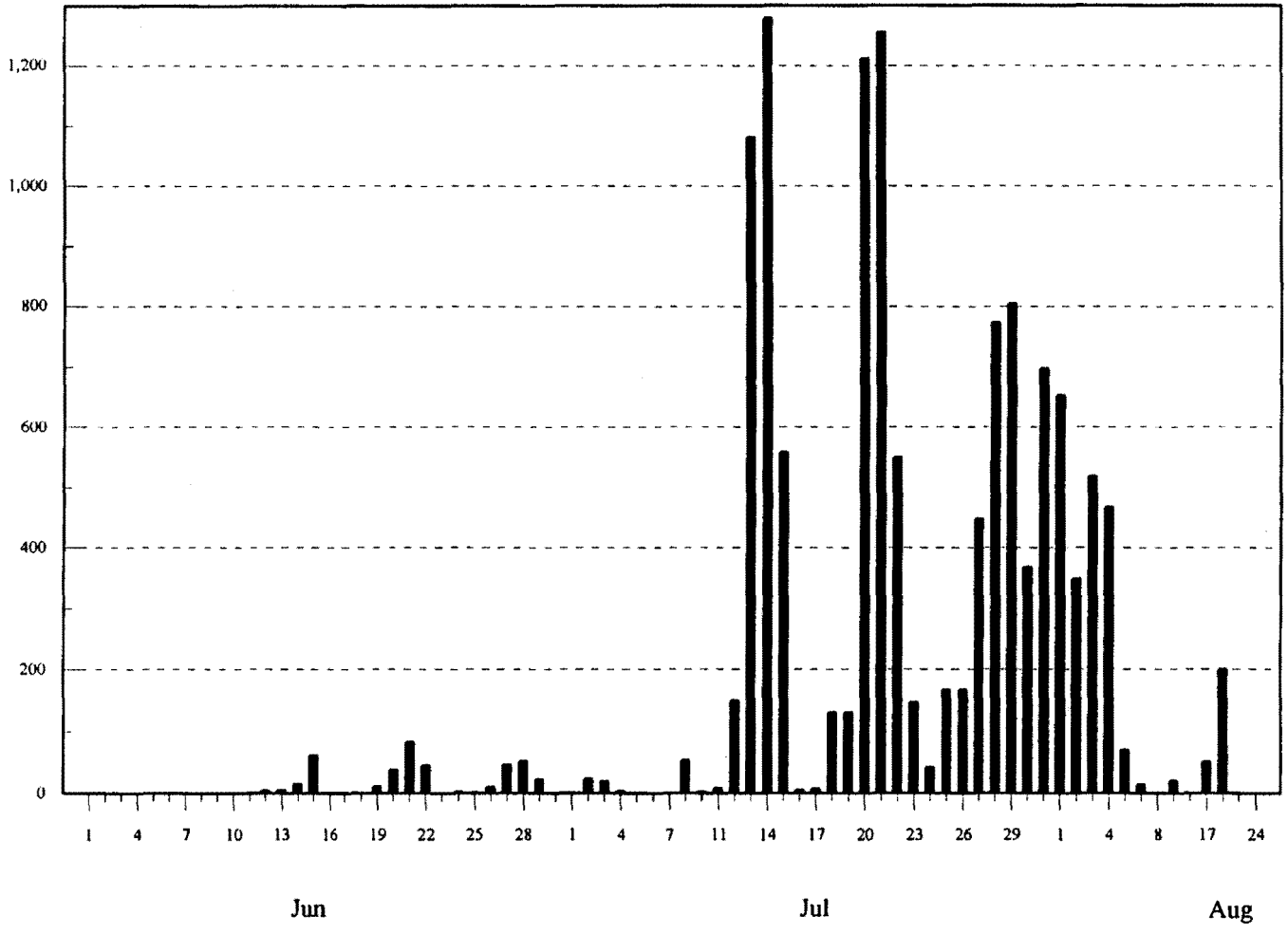

Figure 5. Number of walruses hauled out at Cape Newenham, southwest Alaska, 1 Jun - 11 Aug and 17 & 22-24 Aug, 1996.

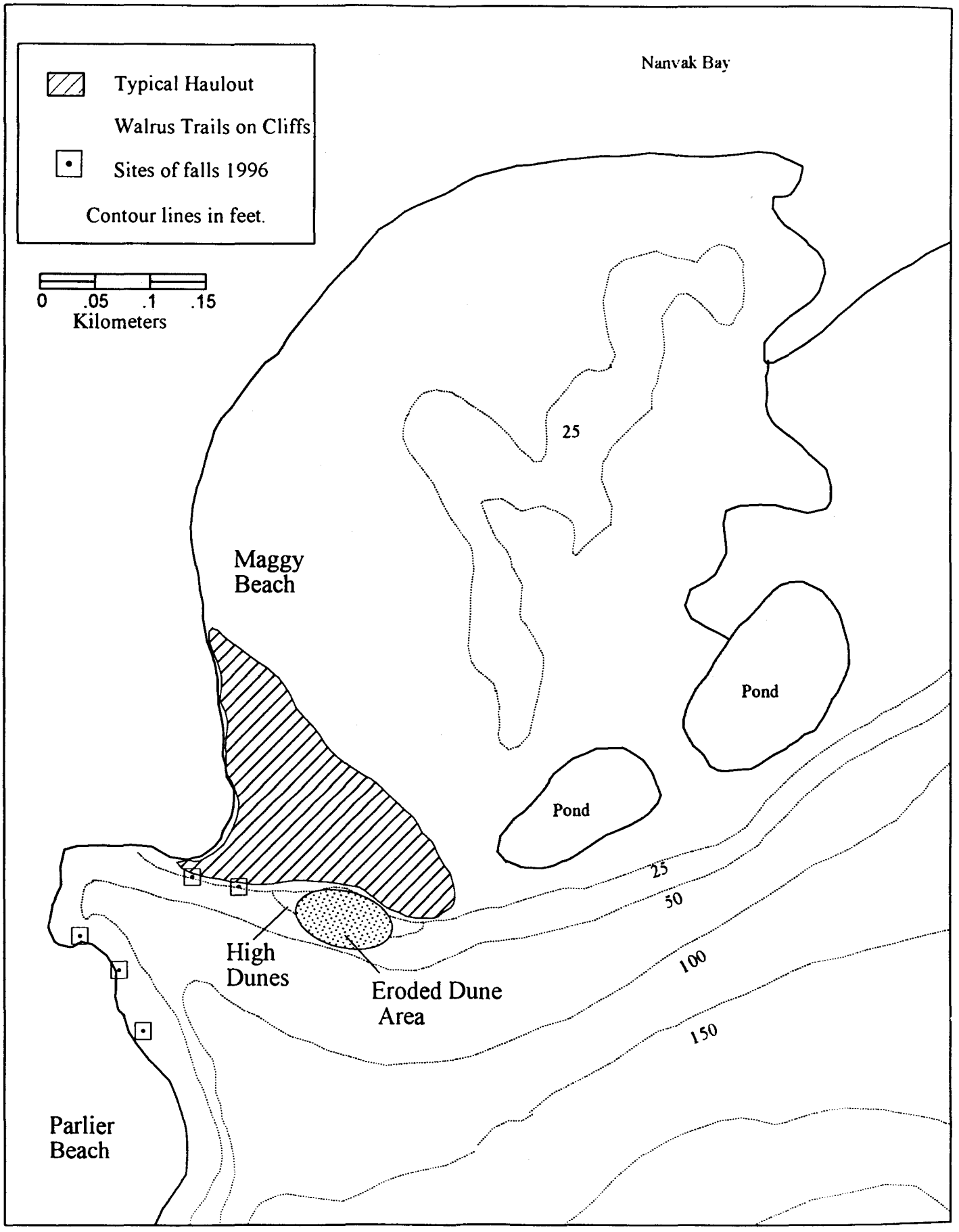

Figure 6. Sites of walrus haulouts atop cliffs and locations of resultant walrus mortalities, Maggy Beach, 21 and 27-28 Aug 1996.

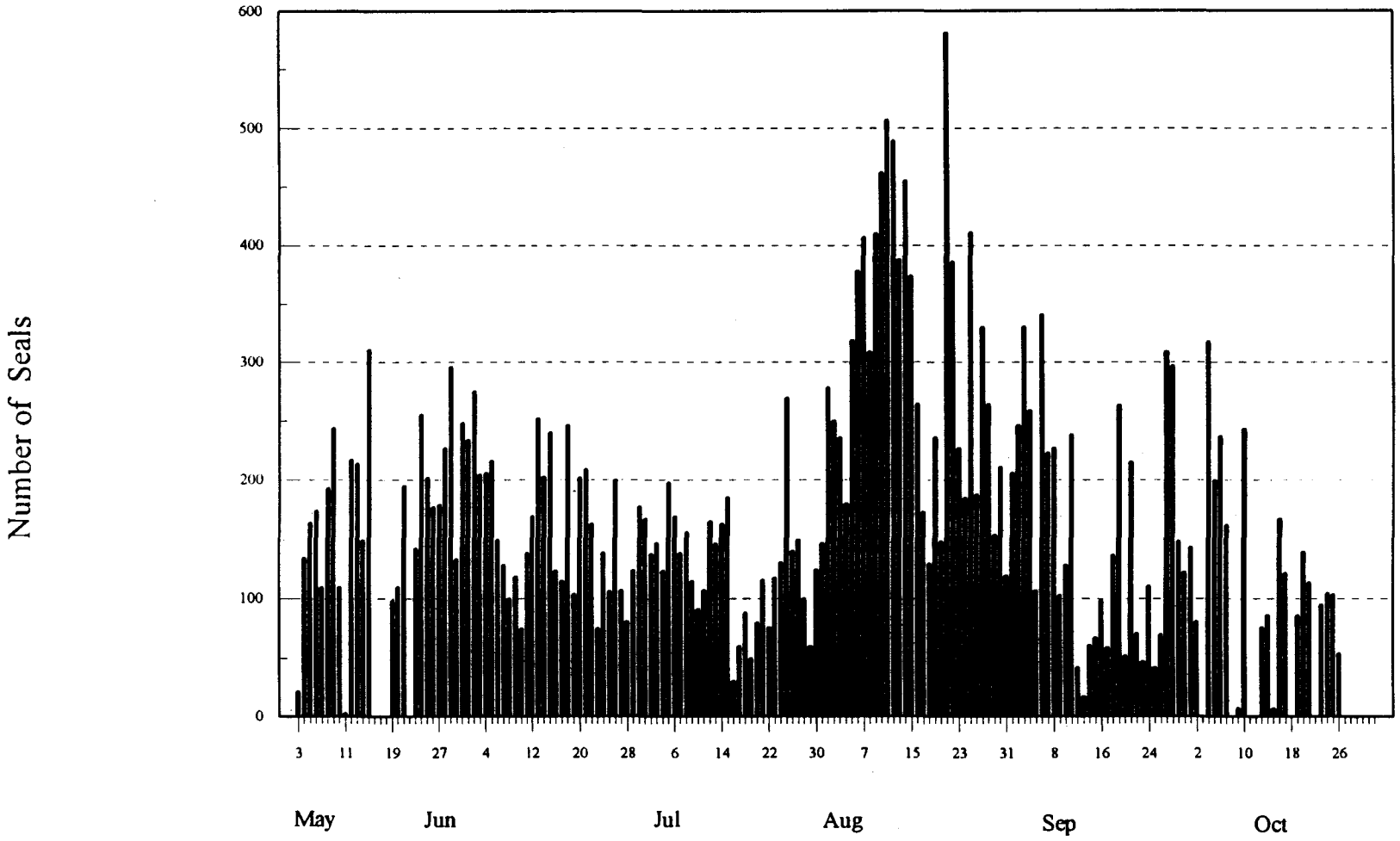

Figure 7. Number of seals hauled out at Nanvak Bay, southwest Alaska, 3 May - 1 Nov, 1996

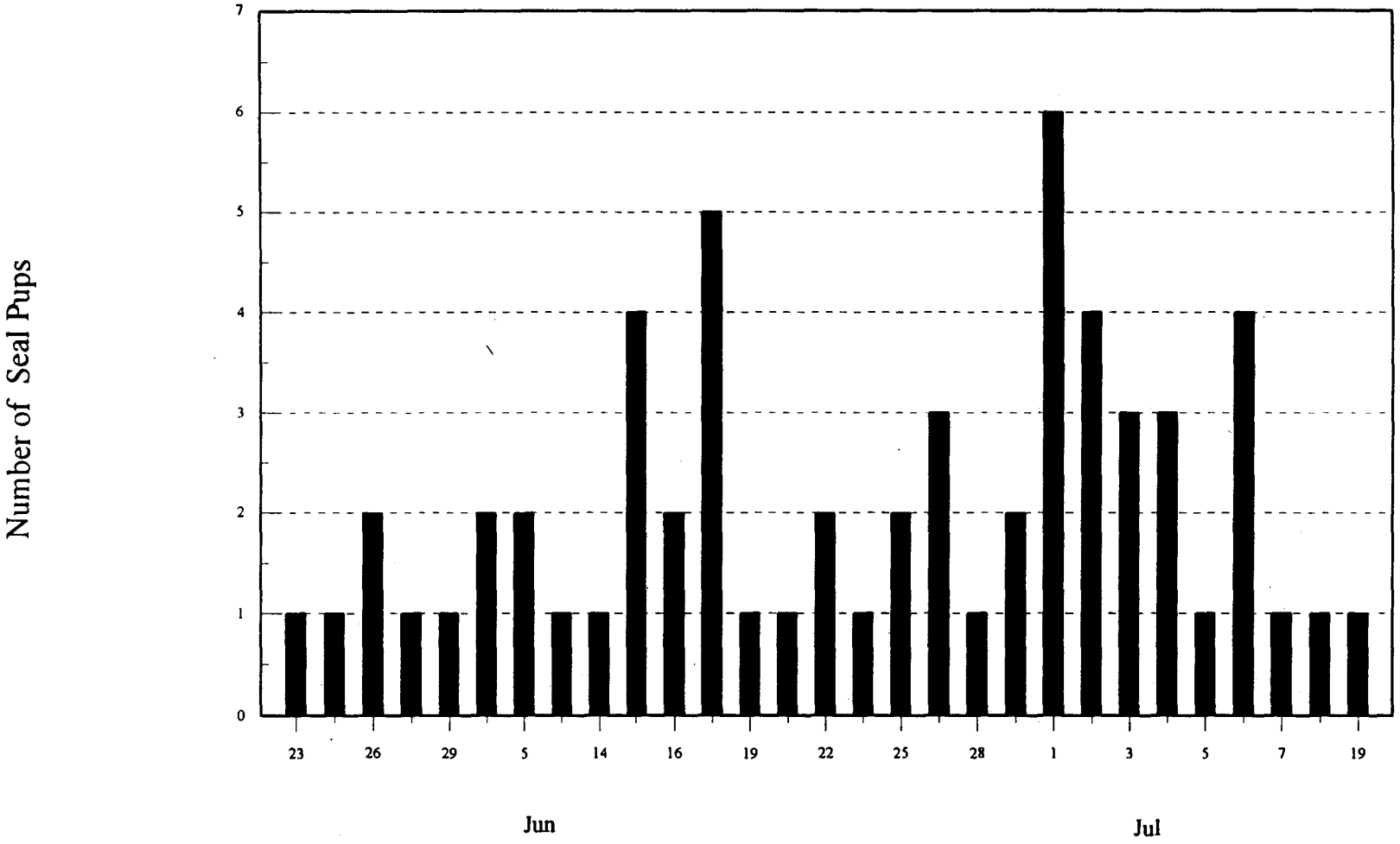

Figure 8. Number of seal pups in Nanvak Bay, southwest Alaska, Jun-Jul, 1996.

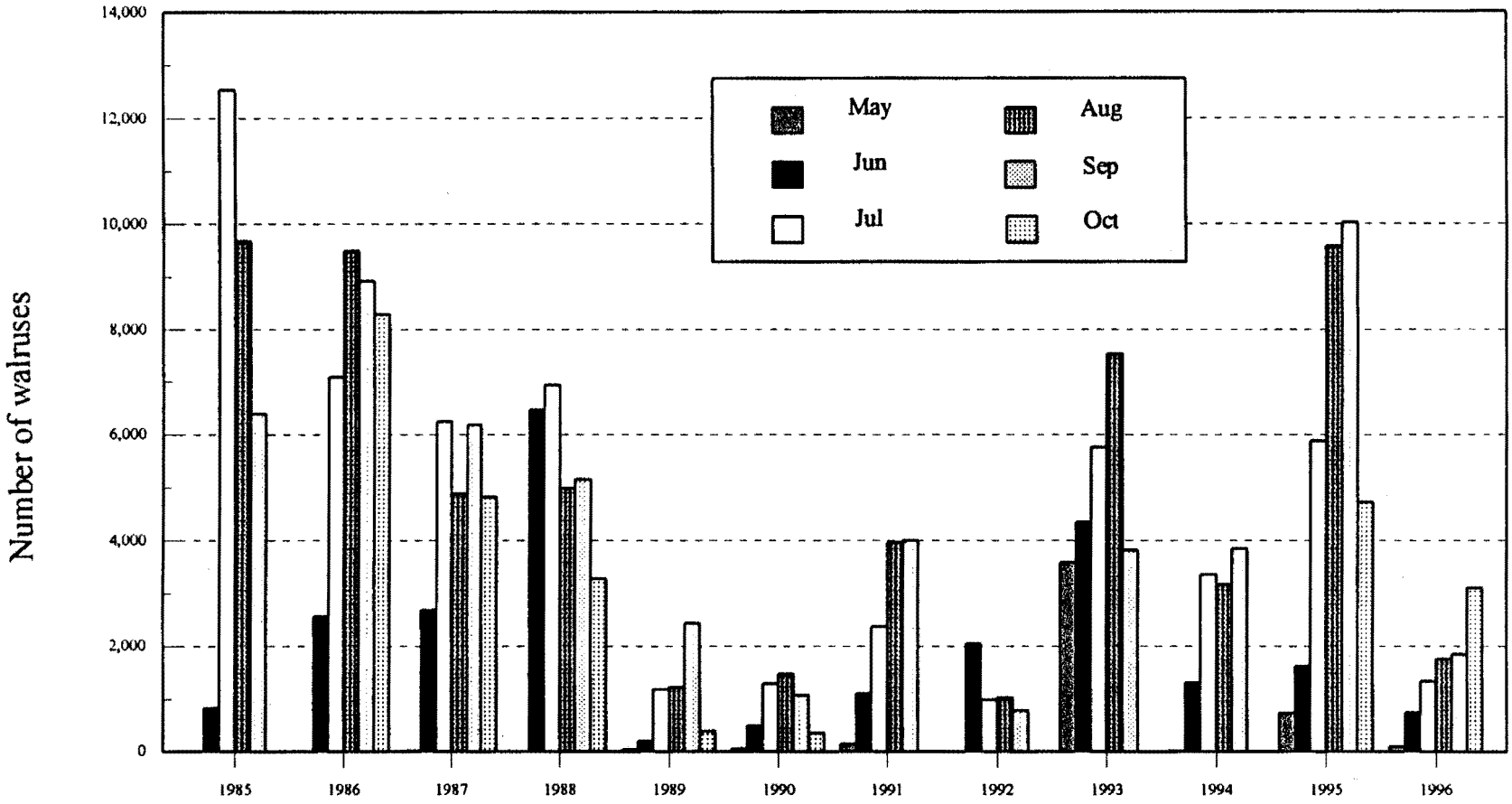

Figure 9. Monthly walrus haulout peaks at Cape Peirce, southwest Alaska, 1985-1996.

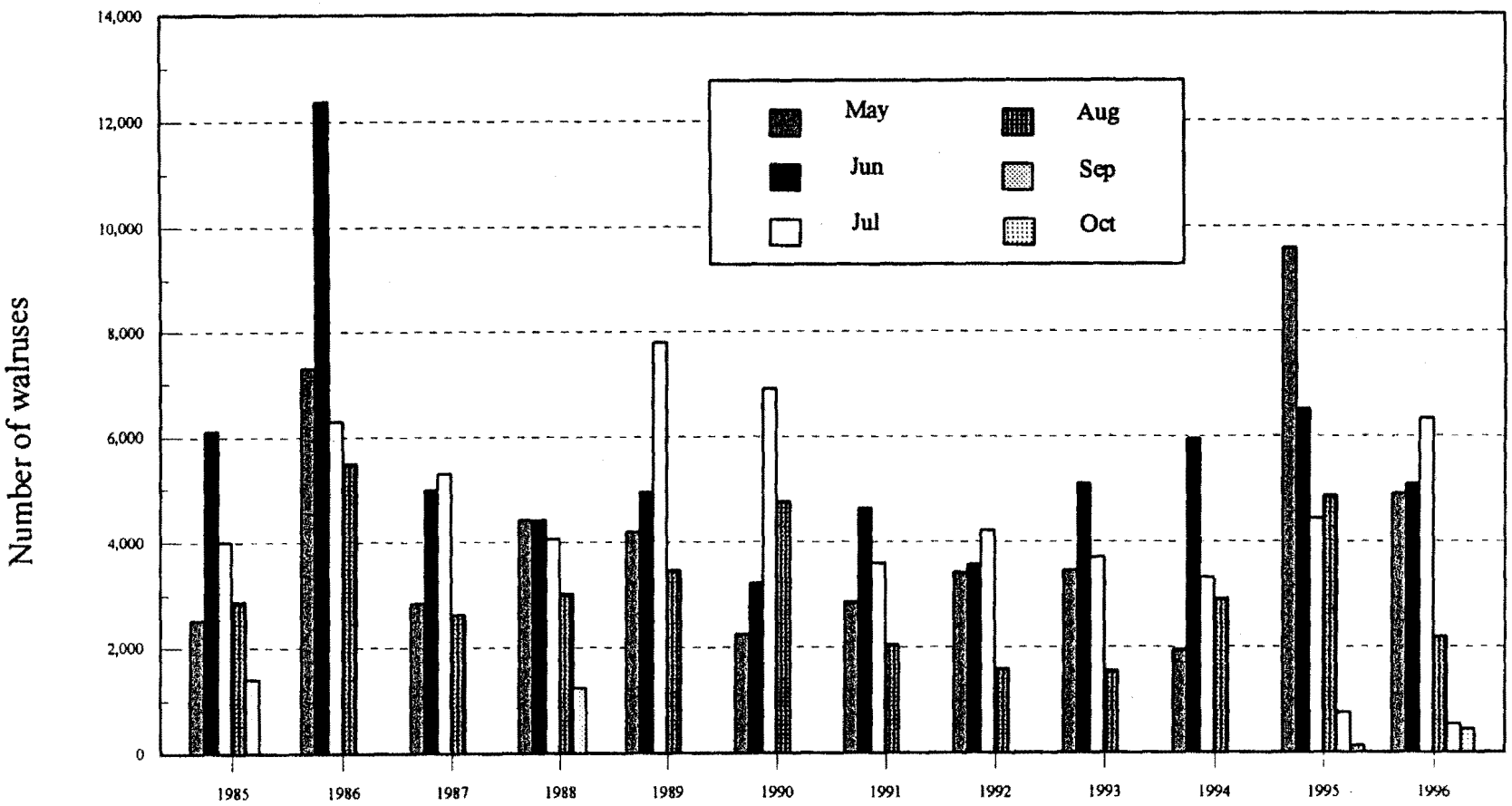

Figure 10. Monthly walrus haulout peaks at Round Island, southwest Alaska, 1985-1996.

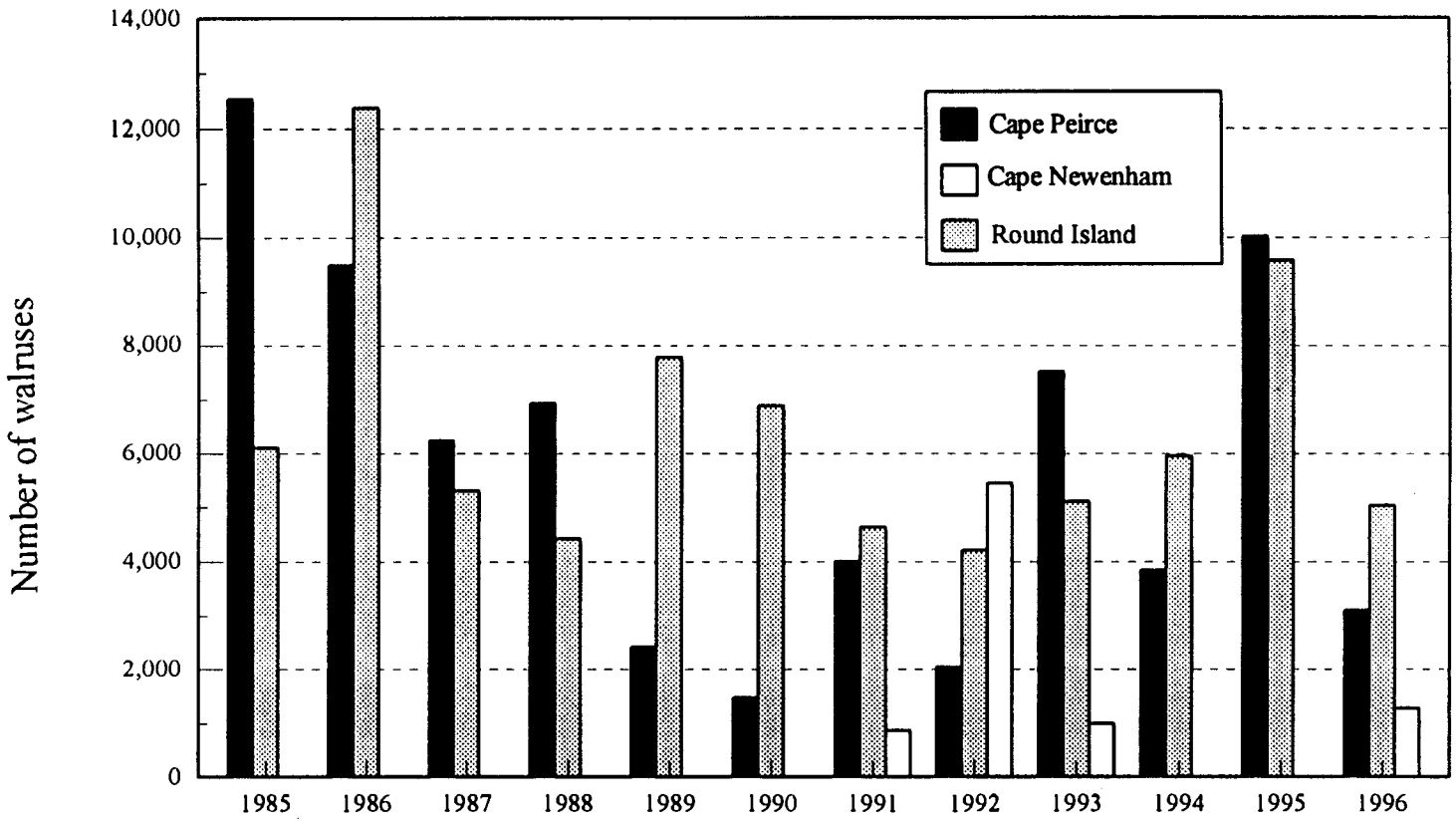

Figure 11. Comparison of walrus haulout peaks at Cape Peirce, Cape Newenham, and Round Island, southwest Alaska, 1985-1996 (Cape Newenham surveyed 1991-1993 and 1996).

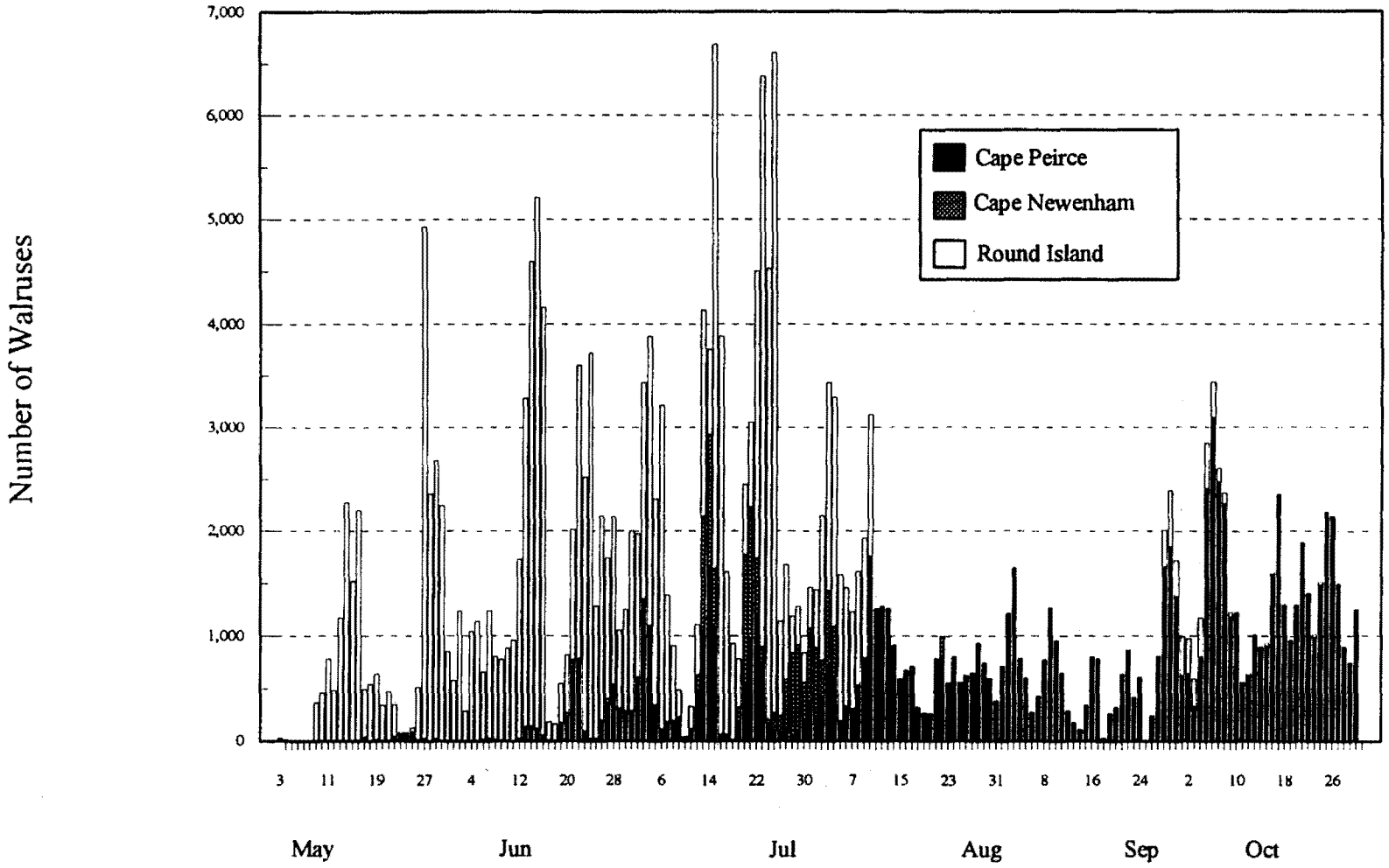

Figure 12. Total walrus haulout counts from Cape Peirce, Cape Newenham and Round Island, southwest Alaska, 1996. (Cape Newenham not censused after 25 Aug. Round Island not censused from 11 Aug.-27 Sep.)

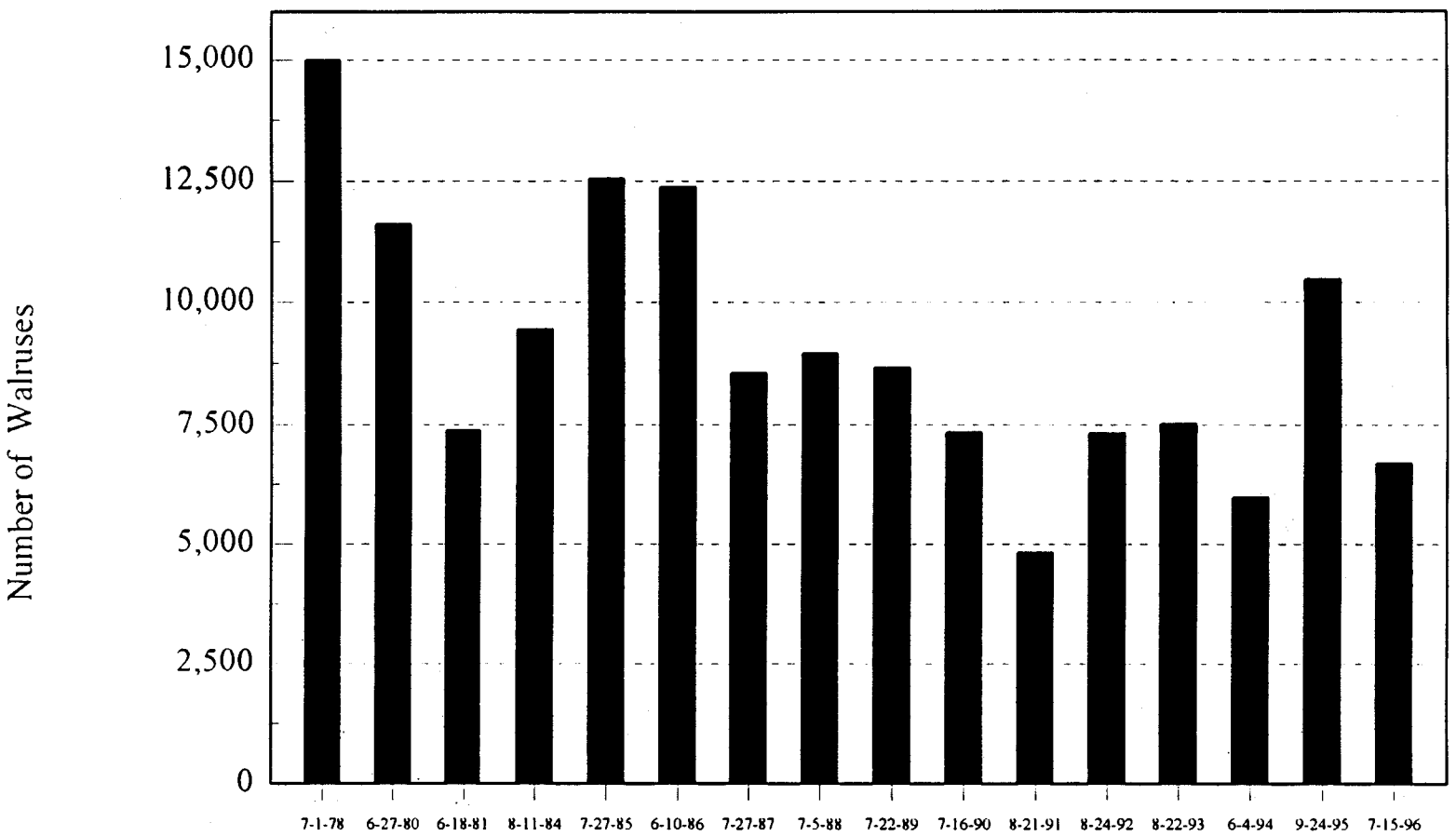

Figure 13. Annual peak walrus counts in northern Bristol Bay and southern Kuskokwim Bay, southwest Alaska, 1978-1996 (all haulouts were not censused every year).

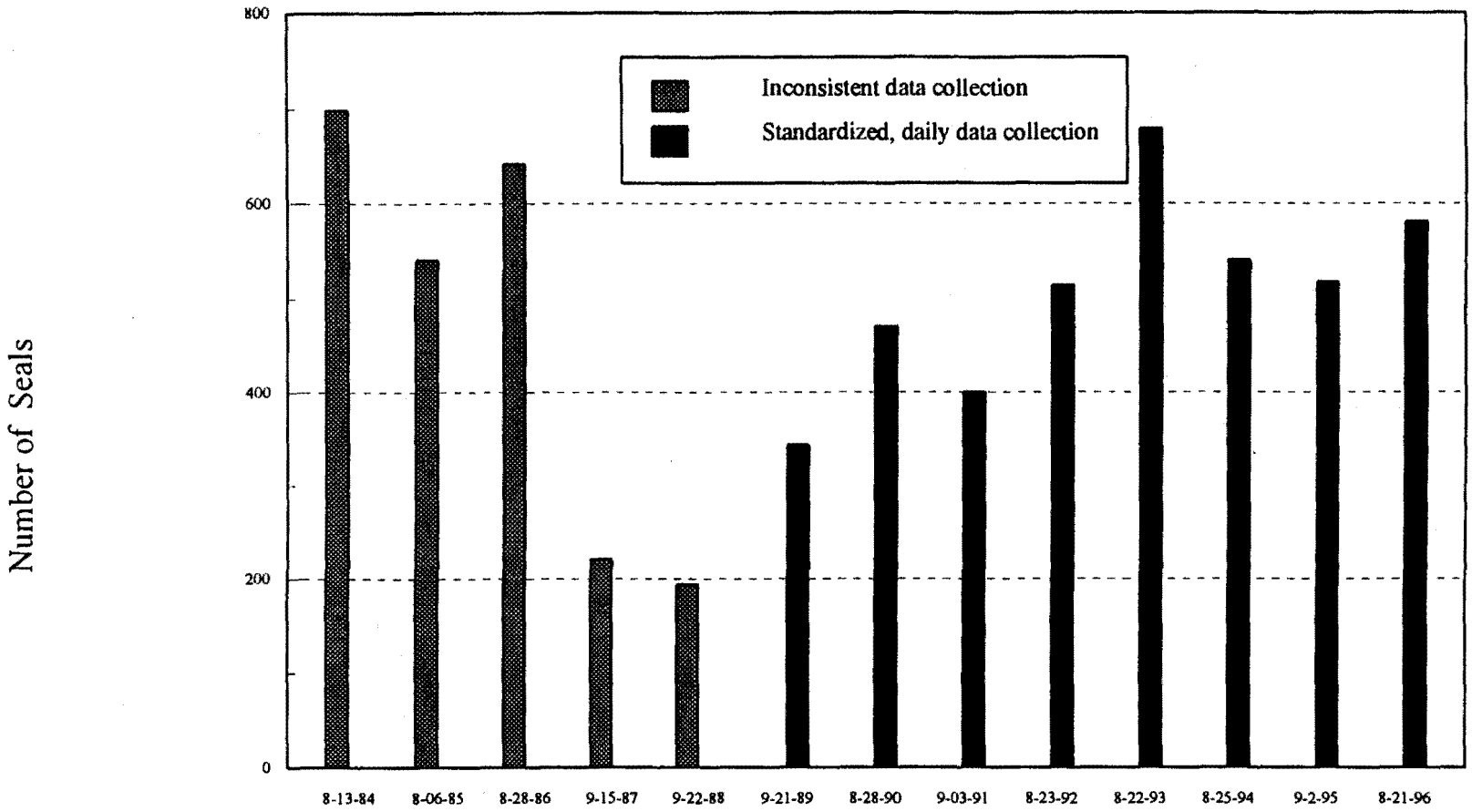

Figure 14. Annual seal haulout peaks at Nanvak Bay, southwest Alaska, 1984-1996 (counts before 1989 may be unreliable).

APPENDIX 1. Walrus haulout census data, Cape Peirce, Round Island and Cape Newenham, southwest Alaska, May-Oct, 1996.

							C.P. DATA									R.I.	DATA		
MO	DA	BC	CLD CVR	WND SPD	WND DIR	PC	BAROM	MA	MI	TD	TIME	LOC'N	CP WTR	CP LND	CP TOT	R.I. Count LOC'N	RI TOT	CN TOT	CP+CN + RI TOT
5	3	2	2	10	6	1	1025	50	-	1	13:45	SB,OC	4	32	36				36
5	4	2	2	5	3	0	1023	45	34	3	10:45	SB,OC	17	0	17				17
5	5	2	2	15	4	0	1023	44	38	4	9:35	SB,OC	2	1	3	E. Main	0		3
5	6	2	2	15	3	0	1021	44	37	4	10:30	SB,OC	0	0	0	E. Main	0		0
5	7	1	2	5	7	0	1027	47	34	2	10:00	SB,OC	0	0	0	E. Main	0		0
5	8	0	0	10	7	0	1029	46	26	3	11:10	SB,OC	1	0	1	E. Main	0		1
5	9	2	0	15	6	0	1024	51	34	4	11:00	SB,OC	1	0	1	E. Main	368		369
5	10	2	0	5	7	0	1025	56	34	2	13:30	SB,OC	6	3	9	E. Main	452		461
5	11	1	0	20	1	0	1025	62	38	2	12:50	SB,OC	1	7	8	E. Main	778		786
5	12	1	0	10	4	0	1011	60	40	3	13:50	OC	1	1	2	E. Main	484		486
5	13	0	0	5	7	0	1007	54	38	2	11:50	OC	1	0	1	E. Main	1172		1173
5	14	1	0	10	1	0	1005	62	38	3	12:00	OC	0	2	2	E. Main	2270		2272
5	15	0	0	5	4	0	995	68	42	1	13:00	SB,OC	4	0	4	E. Main	1518		1522
5	16	2	0	40	6	0	993	60	37	2	11:30	SB,OC	1	16	17	E. Main	2185		2202
5	17	1	0	5	6	0	998	57	42	1	17:10	SB,OC	2	42	44	E. Main	449		493
5	18	2	0	50	8	0	1005	42	36	3	14:00	SB,OC	6	5	11	E. Main	531		542
5	19	2	1	20	8	0	1009	44	34	4	12:20	SB,OC	8	15	23	E. Main	618		641
5	20	2	1	25	7	0	1002	39	38	4	13:45	SB,OC	13	0	13	E. Main	333		346
5	21	2	1	25	7	1	999	49	29	1	17:15	SB,OC	4	0	4	E. Main	469		473
5	22	0	2	15	2	0	1001	48	32	3	17:40	SB,OC	7	45	52	E. Main	300		352
5	23	2	1	30	2	1	993	42	39	1	21:00	SB,OC	1	74	75	E. Main	18		93
5	24	0	2	15	2	0	991	46	40	1	19:10	SB,OC	0	82	82	E. Main	5		87
5	25	1	2	20	6	1	998	52	42	2	12:40	SB,OC	17	83	100	E. Main	30		130
5	26	1	2	20	6	0	1007	48	41	1	11:30	SB	5	17	22	E. Main	492		514
5	27	1	2	20	4	1	1012	46	40	1	10:25	SB	0	34	34	E. Main	4901		4935
5	28	1	2	15	3	0	1008	46	43	1	19:00	MB,SB	4	11	15	E. Main	2346		2361
5	29	1	2	20	3	0	1009	50	42	2	13:20	SB,OC	2	25	27	E. Main	2649		2676
5	30	0	0	5	5	0	1010	62	40	1	19:15	MB,SB,OC	0	0	0	E. Main	2248		2248
5	31	1	0	10	8	0	1014	62	36	3	13:15	SB	3	6	9	E. Main	843		852
6	1	2	0	20	8	0	1019	64	36	1	14:20	OC	0	4	4	E. Main	578		582
6	2	1	0	5	1	0	1020	67	42	3	14:55	OC	0	2	2	E. Main	1236		1238
6	3	2	1	20	1	0	1016	56	46	1	13:10	SB,OC	0	5	5	E. Main	289		294
6	4	2	0	10	8	0	1016	62	45	1	15:10	SB,OC	5	3	8	E. Main	1038		1046
6	5	2	0	15	8	0	1014		47	1	15:00	SB	8	0	8	E. Main	1135		1143
6	6	2	2	25	8	0	1011	56		1	17:20	SB,OC	6	18	24	E. Main	640		664
6	7	1	2	20	7	1	1001	48	42	1	18:40	SB,OC	5	29	34	E. Main	1211		1245
6	8	2	2	20	7	0	997	52	39	1	16:45	SB,OC	1	22	23	E. Main	786		809
6	9	2	0	30	6	0	1001	45	40	1	17:35	SB	0	15	15	E. Main	765		780
6	10	3	1	40	7	1	1004	42	36	1	18:45	SB	0	12	12	E. Main	874		886
6	11	2	1	25	8	0	1006	44	32	1	11:30	SB,OC	4	0	4	E. Main	954		958
6	12	1	0	15	8	0	1005	51	34	3	14:50	SB,OC	1	28	29	E. Main	1699	4	1732
6	13	1	0	10	8	0	1010	56	45	1	17:05	SB,OC	3	141	144	E. Main	3142	5	3291
6	14	1	0	10	8	0	1012	58	39	1	17:05	SB,OC	2	134	136	E. Main	4450	15	4601
6	15	1	0	10	8	0	1009	64	42	1	21:10	SB	3	122	125	E. Main	5086	6	5217
6	16	0	0	15	3	0	1004	52	44	1	18:00	SB	1	63	64	E. Main	4105	0	4169
6	17	1	2	35	3	1	1004	52	46	1	18:00	SB	2	18	20	E. Main	171	0	191
6	18	1	2	5	6	1	1005	55	45	1	18:05	SB	8	4	12	E. Main	159	0	171
6	19	0	2	5	6	0	1003	48	41	1	19:45	SB,OC	2	170	172	E. Main	368	11	551
6	20	0	2	15	6	1	1005	50	46	1	17:15	SB,OC	13	225	238	E. Main	548	37	823
6	21	1	2	5	4	0	1009	52	45	1	19:30	SB,OC	7	688	695	E. Main	1241	82	2018
6	22	0	0	2	7	0	1009	63	38	1	19:15	SB,OC	20	726	746	Tot. Isl.	2813	44	3603
6	23	2	2	40	3	1	999	48	46	1	18:30	SB,OC	3	96	99	E. Main	2419	2	2520
6	24	2	2	20	3	0	991	54	46	1	16:00	PB,SB,OC	8	28	36	E. Main	3688	0	3724
6	25	2	2	20	3	1	993	47	45	1	18:45	SB,OC	1	32	33	E. Main	1255	1	1289
6	26	2	2	10	8	0	984	52	44	1	18:05	SB	9	194	203	E. Main	1944	10	2157
6	27	2	0	5	8	0	989	63	46	3	16:45	SB	2	363	365	E. Main	1338	45	1748
6	28	2	1	20	7	0	998	60	47	1	15:00	SB	1	491	492	E. Main	1593	51	2136
6	29	2	1	35	7	0	1002	54	68	1	17:10	MB,SB	0	296	296	E. Main	744	22	1062
6	30	2	1	20	7	0	1009	56	44	3	15:30	SB,OC	8	288	296	E. Main	962	2	1260
7	1	1	2	10	7	0	1014	56	46	3	14:15	SB	0	296	296	E. Main	1705	0	2001
7	2	1	1	5	7	0	1008	59	45	3	14:10	SB	17	571	588	E. Main	1365	23	1976
7	3	0	0	5	3	0	999	65	46	1	18:30	PB,NB,SB,OC	81	1256	1337	E. Main	2081	19	3437
7	4	0	0	5	2	0	996	65	45	1	19:35	NB,SB,OC	28	1077	1105	E. Main	2775	3	3883
7	5	0	1	5	2	0	1001	60	45	1	16:45	NB,SB,OC	26	322	348	E. Main	1965	0	2313
7	6	1	1	5	7	0	1006	71	52	3	16:50	SB,OC	8	116	124	Tot. Isl.	3097	0	3221
7	7	0	0	0	9	0	1003	63	48	3	20:00	SB,OC	2	187	189	E. Main	1201	0	1390
7	8	0	0	10	3	0	994	58	49	1	17:35	SB,OC	8	192	200	E. Main	705	N/C	905
7	9	1	1	15	3	1	992	58	49	1	16:35	SB	4	177	181	E. Main	261	51	493
7	10	1	2	20	3	1	991	54	48	1	17:15	SB	6	44	50	E. Main	1	2	53
7	11	1	2	20	5	1	999	55	47	1	17:25	SB	0	121	121	E. Main	205	8	334
7	12	1	2	15	5	1	1001	51	47	1	17:35	SB	11	477	488	E. Main	473	150	1111
7	13	2	2	10	6	0	1005	49	45	1	17:50	SB,OC	12	1052	1064	E. Main	1989	1082	4135
7	14	1	2	5	6	0	1014	58	44	1	18:45	MB,SB,OC	3	1656	1659	E. Main	820	1280	3759

APPENDIX 1. (continued) Walrus haulout census data, Cape Peirce, Round Islandand Cape Newenham, southwest Alaska, May-Oct, 1996.

MO	DA	BC	CLD CVR	WND SPD	WND DIR	PC	BAROM	MA	MI	TD	TIME	LOC'N	CP WTR	CP LND	CP TOT	R.I. R.I. Count LOC'N	DATA RI TOT	CN TOT	CP+CN + RI TOT
7	15	1	0	5	5	0	1014	60	48	3	14:00	MB,SB,OC	84	1012	1096	Tot. Isl.	5038	557	6691
7	16	1	2	15	5	1	1011	56	48	1	13:00	MB,SB,OC	11	66	77	E. Main	3805	3	3885
7	17	2	2	10	5	1	1014	58	46	1	14:45	MB,SB,OC	7	54	61	E. Main	1541	7	1609
7	18	3	2	15	6	0	1001	56	46	1	13:30	MB,SB	9	12	21	E. Main	905	2	928
7	19	2	2	15	7	1	1001	60	47	1	15:55	SB,OC	2	198	200	E. Main	453	131	784
7	20	1	2	10	8	1	1008	58	58	1	19:40	MB,NB,SB,OC	13	545	558	Tot. Isl.	674	1222	2454
7	21	1	2	5	8	0	1011	68	46	3	16:45	MB,NB,SB,OC	28	952	980	E. Main	825	1255	3060
7	22	1	0	5	4	0	1013	65	44	1	20:00	MB,NB,SB,	8	1191	1199	Tot. Isl.	2757	551	4507
7	23	1	1	5	7	0	1011	61	46	1	10:05	MB,NB,SB,OC	1	760	761	E. Main	5480	147	6388
7	24	1	2	5	7	0	1008	67	53	1	19:30	SB	1	169	170	E. Main	4324	41	4535
7	25	1	2	10	4	0	1008	62	50	1	12:50	SB	2	114	116	E. Main	6331	167	6614
7	26	2	2	10	6	1	1004	57	50	1	16:00	SB	4	79	83	E. Main	897	167	1147
7	27	1	2	10	4	1	1004	54	50	1	15:30	SB	2	141	143	E. Main	1088	447	1678
7	28	1	2	20	4	1	997	53	51	1	13:45	SB	2	66	68	E. Main	351	774	1193
7	29	3	2	25	7	0	998	54	48	1	15:00	SB	2	114	116	E. Main	364	803	1283
7	30	1	2	20	7	0	1006	54	47	1	17:30	SB	3	193	196	E. Main	278	368	842
7	31	1	2	30	7	1	994	58	47	1	18:20	SB	2	379	381	E. Main	385	698	1464
8	1	2	2	25	7	0	1004	58	48	1	20:30	SB	0	245	245	E. Main	548	654	1447
8	2	2	2	15	7	0	1008	51	48	1	20:00	SB	5	420	425	E. Main	1379	349	2153
8	3	1	2	15	7	0	1013	56	46	1	18:30	SB	4	713	717	E. Main	2000	721	3438
8	4	2	2	50	7	0	1010	55	45	1	17:30	MB,SB,OC	2	635	637	E. Main	2192	467	3296
8	5	1	2	15	7	0	1017	52	45	1	11:00	SB,OC	0	198	198	E. Main	1384		1582
8	6	1	1	15	8	0	1014	54	46	1	12:00	SB	1	269	270	E. Main	1125	69	1464
8	7	1	0	15	8	0	1014	53	46	1	13:20	SB	2	299	301	E. Main	919	14	1234
8	8	2	2	20	8	0	1008	57	47	1	17:05	MB,SB,OC	13	523	536	E. Main	1077		1613
8	9	2	2	20	8	0	997	54	47	1	17:30	MB,SB	42	739	781	E. Main	1134	20	1935
8	10	2	1	25	8	0	994	54	47	1	19:45	MB,SB	21	1744	1765	E. Main	1369		3134
8	11	2	1	10	8	0	995	56	48	1	21:00	MB,SB	19	1247	1266			0	1266
8	12	1	0	5	8	0	997	60	48	1	20:15	MB,SB	22	1268	1290				1290
8	13	1	2	10	8	0	1011	54	50	1	22:20	MB,SB,OC	15	1255	1270				1270
8	14	1	2	10	5	0	1012	57	47	1	22:40	MB,NB,SB	58	858	916				916
8	15	1	2	5	6	0	1012	55	47	1	20:30	MB,SB	8	588	596				596
8	16	1	2	5	6	0	1012	58	48	1	19:30	MB,SB	8	669	677				677
8	17	0	0	10	4	0	1006	57	49	1	16:40	MB,NB,SB	0	666	666			50	716
8	18	1	2	20	4	1	995	54	41	2	20:15	MB,SB	14	313	327				327
8	19	1	2	20	4	1	992	58	48	1	18:25	SB	5	268	273				273
8	20	1	0	5	3	0	990	60	49	1	17:00	SB	1	270	271				271
8	21	1	0	15	7	0	992	62	49	1	19:25	MB,SB	71	718	789				789
8	22	1	1	35	8	0	994	54	50	1	18:00	MB,SB,OC	19	785	804			200	1004
8	23	1	2	10	8	0	997	61	40	1	22:20	MB,SB	11	550	561			0	561
8	24	1	2	5	8	0	1004	67	43	1	19:10	MB,SB,OC	35	770	805			0	805
8	25	2	2	25	8	0	995	56	48	1	18:50	MB,SB	4	558	562				562
8	26	1	1	5	8	0	1000	52	47	1	20:45	MB,SB	8	623	631				631
8	27	0	1	5	8	0	1001	60	39	1	18:00	MB,SB	9	648	657				657
8	28	1	2	10	6	0	995	59	45	1	19:00	MB,SB	15	918	933				933
8	29	3	2	30	6	1	994	51	48	2	20:40	MB,SB	36	715	751				751
8	30	1	2	20	6	0	989	54	47	1	19:00	MB,SB	19	581	600				600
8	31	1	1	5	7	0	1004	58	47	1	16:55	SB	3	389	392				392
9	1	1	0	5	6	0	1010	62	46	1	15:00	MB,SB	14	705	719				719
9	2	1	2	10	6	0	1010	58	51	1	14:30	MB,NB,SB,OC	45	1178	1223				1223
9	3	1	2	10	8	0	1010	58	50	1	18:00	MB,PB,NB,SB	30	1621	1651				1651
9	4	0	2	25	2	1	995	54	49	1	17:40	MB,NB,SB	17	774	791				791
9	5	0	2	25	6	1	984	55	47	1	20:25	MB,NB,SB	15	591	606				606
9	6	1	1	10	3	0	991	57	45	1	13:45	MB,SB	4	274	278				278
9	7	1	2	10	6	1	991	57	48	1	16:00	MB,SB	17	417	434				434
9	8	0	2	1	9	0	994	58	45	3	15:00	MB,NB,SB	14	765	779				779
9	9	1	0	20	1	0	998	54	46	1	21:45	MB,NB,SB	3	1271	1274				1274
9	10	1	0	15	1	0	998	52	39	1	15:30	MB,NB,SB	8	950	958				958
9	11	1	0	20	1	0	991	52	35	1	21:10	MB,NB,SB	3	654	657				657
9	12	2	1	40	1	0	993	43	34	3	15:50	MB,NB,SB	1	287	288				288
9	13	2	2	30	1	0	996	46	35	1	15:30	SB	0	182	182				182
9	14	1	1	10	8	0	1001	47	35	1	13:00	SB	1	121	122				122
9	15	1	1	5	8	0	998	62	36	1	15:45	SB	4	349	353				353
9	16	0	2	5	1	0	992	50	33	1	16:15	MB,NB,SB	33	772	805				805
9	17	1	2	30	7	0	989	47	38	1	19:15	MB,NB,SB	22	766	788				788
9	18	2	2	40	7	1	984	42	38	1	16:10	SB	5	35	40				40
9	19	1	1	3	1	1	1009	46	33	1	20:30	NB,SB	17	254	271				271
9	20	2	2	15	6	1	1009	50	36	1	12:00	MB,SB	3	323	326				326
9	21	1	2	5	1	1	1006	46	36	1	10:20	MB,SB	20	623	643				643
9	22	1	1	15	8	0	999	46	33	1	9:20	MB,SB	19	851	870				870
9	23	2	1	5	6	0	998	38	36	1	10:50	MB,SB	8	419	427				427
9	24	0	1	5	8	0	992	37	27	1	11:25	MB,SB,NB	2	608	610				610
9	25	2	2	45	6	1	983	45	27	1	14:30	MB,SB	0	20	20				20
9	26	3	1	20	6	1	1004	46	35	1	15:00	SB	N/A	250	250				250
9	27	2	1	10	8	0	1011	48	36	2	16:11	SB,OC	24	786	810				810
9	28	2	1	15	8	1	1021	40	36	2	15:20	SB,NB,OC	24	1638	1662	E. Main	352		2014
9	29	2	2	15	8	1	1023	53	40	3	09:53	MB,SB,NB,OC	23	1830	1853	E. Main	537		2390

APPENDIX 1. (continued) Walrus haulout census data, Cape Peirce, Round Island and Cape Newenham, southwest Alaska, May-Oct, 1996.

MO	DA	BC	CLD CVR	WND SPD	WND DIR	PC	BAROM	MA	MI	TD	TIME	LOC'N	CP WTR	CP LND	CP TOT	R.I. R.I. Count LOC'N	DATA RI TOT	CN TOT	CP+CN + RI TOT
9	30	3	1	35	8	1	1015	44	40	1	12:38	MB,SB,NB,OC	12	1371	1383	E. Main	340		1723
10	1	3	1	30	8	0	1012	40	36	3	11:31	SB,NB,OC	0	628	628	E. Main	370		998
10	2	3	1	30	8	0	1006	42	30	1	14:11	SB,NB,OC	0	647	647	E. Main	331		978
10	3	3	0	40	1	0	997	40	29	1	14:38	SB,OC	4	329	333	E. Main	263		596
10	4	1	0	5	8	0	996	45	27	3	16:21	SB,OC	15	788	803	Tot. Isl.	375		1178
10	5	1	0	5	3	0	997	49	28	3	11:33	MB,SB,NB,OC	155	2257	2412	Main Bch.	435		2847
10	6	3	1	30	8	0	998	37	31	2	14:40	MB,P,SB,NB,OC	15	3090	3105	Main Bch.	340		3445
10	7	1	2	5	1	0	997	46	31	3	10:32	MB,SB,NB,OC	17	2458	2475	E. Main	130		2605
10	8	2	1	15	8	1	999	38	31	3	10:19	MB,SB,NB,OC	50	2217	2267	E. Main	107		2374
10	9	1	0	7	8	0	1003	33	23	1	14:00	MB,SB,NB,OC	22	1168	1190	E. Main	41		1231
10	10	1	1	5	1	0	996	42	24	1	14:46	SB,NB,OC	24	1205	1229	E. Main	2		1231
10	11	1	1	8	8	0	999	35	23	2	16:46	SB,NB,OC	6	551	557	E. Main	12		569
10	12	1	1	5	4	0	997	37	17	3	11:04	SB,NB,OC	11	617	628	E. Main	22		650
10	13	2	1	17	8	1	995	34	17	1	14:02	SB,OC	9	999	1008	E. Main	5		1013
10	14	2	2	3	1	1	1004	37	20	3	10:39	SB,OC	11	888	899	E. Main	0		899
10	15	2	2	16	7	1	1008	42	20	3	10:29	SB,NB,OC	62	847	909	E. Main	30		939
10	16	1	1	12	8	0	1008	33	28	2	15:50	MB,SB,OC	11	1585	1596	E. Main	19		1615
10	17	2	0	5	3	0	1020	36	27	1	14:45	MB,SB,NB,OC	55	2303	2358	Tot. Isl.	4		2362
10	18	0	2	50	3	1	990	32	26	1	13:00	MB,SB,NB	N/A	1302	1302	E. Main	0		1302
10	19	2	2	20	3	1	993	36	26	1	14:50	MB,SB,NB,OC	7	959	966	E. Main	0		966
10	20	1	2	15	3	0	990	36	32	1	15:40	MB,SB,NB,OC	14	1284	1298	E. Main	0		1298
10	21	1	2	15	2	0	990	39	32	1	10:59	SB,NB,OC	N/C	1892	1892	E. Main	0		1892
10	22	0	2	40	2	1	976	40	32	2	14:00	P,SB,NB,OC	20	1390	1410	E. Main	0		1410
10	23	1	1	10	2	0	984	38	34	2	14:55	P,SB,NB,OC,	18	976	994	Tot. Isl.	26		1020
10	24	3	1	10	1	0	996	28	28	3	10:00	SB,NB,OC	50	1444	1494	Tot. Isl.	25		1519
10	25	1	1	10	2	0	999	28	20	3	15:45	SB,NB,OC	88	2100	2188	E. Main	2		2190
10	26	1	0	5	2	0	999	30	20	3	12:30	SB,NB,OC	14	2127	2141	E. Main	2		2143
10	27	2	0	20	6	0	1014	22	22	3	11:30	SB,NB	N/C	1500	1500	E. Main	0		1500
10	28	3	0	20	6	0	1010	40	40	3	16:30	MB,SB,NB,OC	N/C	900	900	E. Main	0		900
10	29	3	3	6	1	1	1005	40	38	2	17:00	MB	N/C	750	750	E. Main	No count - fog		750
10	30	3	2	65	8	0	1003	42	32	1	10:30	MB,SB,NB,OC	N/C	1245	1245	E. Main	12		1257
10	31	3	2	70	8	0	998	28	20	-	-	-	No count due to weather			E. Main	0		0

BC = Beach Conditions: calm=0, moderate waves=1, rough=2, very rough=3
CLD CVR = Cloud Cover: clear=0, broken=1, overcast=2
WND SPD = Wind Speed in mph
WND DIR = Wind Direction: 1=N, 2=NE, 3=E, 4=SE, 5=S, 6=SW, 7=W, 8=NW, 9=Variable
PC = Precipitation: yes=1, no=0
MA = Maximum Temperature (degrees Fahrenheit)
MI = Minimum Temperature (degrees Fahrenheit)
TD = Tide: high=4, low=1, rising=2, falling=3
TIME = Time count began
LOC'N = Location of haulout (beach); CPPT = SE beach adjacent to CP Point, MB = Maggy Beach, NB = North Firebaugh, P31 = seabird plot 31, P = Parlier Beach, OC=Odobenus Cove, SB=South Firebough, aerial = aerial survey
CP WTR = Number of walruses in water at Cape Peirce observation points
CP LND = Number of walruses hauled out at Cape Peirce observation points
CP TOT = Total number of walruses (in water + hauled out) at Cape Peirce observation points
RI Count LOC'N = Location of count; E. Main = East Main Beach; Tot Isl = Total Island
RI TOT = Total number of walruses (in water + hauled out) at Round Island observation points
CP TOT+ RI TOT+CN TOT = CP Total + RI Total number of walruses
N/A=data not available

Appendix 2. Age composition of walruses hauled-out on South Firebaugh Beach, Cape Peirce, southwest Alaska, May-Oct, 1996

Month	Day	Total	0-10	Percent
5	17	42	3	7.14%
5	20	7	0	0.00%
5	22	49	1	2.04%
5	23	73	2	2.74%
5	24	82	0	0.00%
5	25	83	3	3.61%
5	26	22	0	0.00%
5	27	34	1	2.94%
5	28	11	0	0.00%
5	29	26	2	7.69%
5	31	9	0	0.00%
6	6	4	0	0.00%
6	8	10	1	10.0%
6	9	15	0	0.00%
6	10	12	2	16.7%
6	12	25	1	4.0%
6	13	139	1	0.72%
6	14	130	2	1.54%
6	16	64	3	4.69%
6	17	20	1	5.00%
6	18	12	1	8.33%
6	19	147	4	2.72%
6	20	201	1	0.50%
6	21	588	0	0.00%
6	22	623	3	0.48%
6	26	203	0	0.00%
6	27	363	7	1.93%
6	28	492	6	1.22%
6	29	295	4	1.36%
6	30	295	4	1.36%
7	1	296	3	1.01%
7	2	571	12	2.10%
7	3	658	5	0.76%
7	5	198	2	1.01%
7	6	98	3	3.06%
7	7	185	6	3.24%
7	8	192	3	1.56%
7	9	181	3	1.66%
7	10	50	1	2.00%
7	11	121	3	2.48%
7	12	477	6	1.26%
7	13	805	11	1.37%
7	15	232	1	0.43%
7	16	66	0	0.00%
7	17	54	0	0.00%
7	18	12	0	0.00%
7	19	198	3	1.52%
7	21	737	6	0.81%
7	23	421	2	0.48%
7	24	169	2	1.18%
7	25	114	2	1.75%
7	26	79	0	0.00%
7	27	141	1	0.71%
7	28	66	0	0.00%
7	29	114	2	1.75%
7	31	379	3	0.79%
8	1	245	1	0.41%
8	2	420	4	0.95%
8	3	713	1	0.14%
8	4	549	4	0.73%
8	6	269	0	0.00%
8	7	299	7	2.34%
8	8	515	9	1.75%
8	9	623	12	1.93%
8	10	728	7	0.96%
8	11	463	9	1.94%
8	12	534	14	2.62%
8	14	563	9	1.60%
8	15	381	8	2.10%
8	16	556	11	1.98%
8	17	489	16	3.27%
8	18	312	3	0.96%
8	19	268	3	1.12%
8	20	270	5	1.85%
8	21	712	4	0.56%
8	22	544	6	1.10%
8	25	423	12	2.84%
8	27	626	4	0.64%
8	28	558	9	1.61%
8	29	248	4	1.61%
8	31	389	6	1.54%
9	1	704	7	0.99%
9	2	644	16	2.48%
9	3	603	12	1.99%
9	4	494	6	1.21%
9	5	347	6	1.73%
9	6	273	7	2.56%
9	7	415	7	1.69%
9	8	571	8	1.40%
9	10	653	14	2.14%
9	11	526	4	0.76%
9	12	237	5	2.11%
9	15	349	7	2.01%
9	16	633	10	1.58%
9	17	360	8	2.22%
9	18	35	0	0.00%
9	20	304	13	4.28%
9	22	367	6	1.63%
9	23	276	5	1.81%
9	24	584	8	1.37%
9	28	1060	24	2.26%
9	29	918	18	1.96%
9	30	713	11	1.54%
10	1	463	15	3.24%
10	2	524	8	1.53%
10	3	265	9	3.4
10	4	618	20	3.24%
10	5	892	21	2.35%
10	6	714	22	3.08%
10	7	631	19	3.01
10	8	623	24	3.85%
10	9	509	13	2.55%
10	10	519	18	3.47%
10	12	271	4	1.48%
10	13	589	10	1.70%
10	14	491	2	0.41%

Total = total number of walruses hauled out; 0-10 = number of walruses <10 years old; Percent = % of haulout < 10 years old;
NOTE: No walruses < 10 years old present at Cape Peirce 3-16 May

APPENDIX 3. Walrus response to aircraft, boats, and human disturbance at Cape Peirce and Cape Newenham, southwest Alaska, 1996.

Date (time)	Vehicle (or other)	Loc'n	Alt (feet)	Lateral distance (km)	No. of wal h/o	No. wal responding at each level	Degree of response
3 May (15:12)	Super Cub	OC	1000	0	34	L1:4	L
5 May (9:50)	2 Super Cubs & 2 small Cessnas & 1 seiner & 1 tender	OC	800-1500 -	0 0.3	1	L5:1	L
10 May (15:12)	R22 Helicopter	SB	50-100	0.1-0.3	3	L3:3	L
29 May (N/A)	Skiff	SB	-	0	25	L5:25	M
8 Jun (17:20)	Single-engine plane (unidentified)	SB	N/A	N/A	10	L1:7	L
20 Jun (17:17)	Jet	SB	3000+	N/A	189	L1:170,L3:29	M
4 Jul (13:10)	Single-engine small plane (unidentified)	SB,NB,OC	250-400	0	1105	@least L1:1105	H
1 Aug (14:45)	6 Biologists tagging walruses	MB	-	0	78	L5:78	M
11 Aug (8:00)	2 Biologists herding walruses from dunes	MB	-	0	1350	L3:50, L5:300	H
14 Aug (14:05)	Prop plane (Beaver?)	MB	200-300	0.3	300	L1:300	M
15 Aug (17:33)	Grumman Goose & DeHavilland Beaver	MB	150	0.1	200	L1:200	L
16 Aug (14:00)	Biologists tagging walruses	MB	-	0	300	L5:100	M
18 Aug (16:25)	Biologists tagging walruses	MB	-	0	230	L5:228	H
21 Aug (14:30)	2 Biologists herding walruses from dunes	MB	-	0	68	L5:62	M
24 Aug (14:43)	Jet	MB	5000+	0	50	L1:50	L
26 Aug (22:00)	2 Biologists herding walruses from dunes	MB	-	0	253	L3:3	L
27 Aug (10:30)	2 Biologists herding walruses from dunes	MB	-	0	158	L5:158	M
31 Aug (10:00)	Hunters	MB	-	0	61	L5:61	M
3 Sep (8:35)	2 Biologists herding walruses from dunes	MB	-	0	975	L3:75	M
10 Sep (8:30)	2 Biologists herding walruses from dunes	MB	-	0	529	L3:29	L
21 Sep (15:45)	Hunters on foot - no hunting	MB	-	0	52	L5:51	M
21 Sep (18:00)	Hunters in skiff (no hunting)	SB	-	N/A	480	L5:480	H
22 Sep (12:30)	Hunters on foot (no hunting)	MB	-	0	125	L3:1, L5:75	M
23 Sep (11:10)	Hunters in skiff & on foot (hunted)	MB	-	0	143	L5:143	M
5 Oct (8:30)	2 Biologists herding walruses from dunes	MB	-	0	625-675	L5:518-568	H
6 Oct (20:00)	2 Biologists adjusting tarp construction on dunes	MB	-	0	700-800	L3:50	M
8 Oct (12:11)	Skiff	SB,NB,OC,MB	-	0.3	2247	L1:300, L3:410+, L5:515+	H
17 Oct (14:57)	Medium-size Cessna	MB	100-200	<0.3	300	L5:250	H
CAPE NEWENHAM DATA							
15 Jun (14:50)	DC6	BRC	3000+	N/A	6	L5:6	L
21 Jun (16:50)	Hunters in skiff (no hunting)	Wlly	-	0.01	82	L5:82	M
29 Jun (12:20)	Single-engine small plane (unidentified)	BRC	2000+	0	20	L5:20	L
9 Jul (13:10)	C-130	Wlly	3000+	0	50	L1:1, L5:47	M
6 Aug (16:40)	C130 (unseen, but heard)	BRC	2500+	0	68	L5:68	M

Loc'n = Location of haulout; OC=Odobenus Cove; SB=South Firebaugh; MB=Maggy Beach; NB=North Firebaugh, BRC=Bird Rock Cove; Wlly=Wally Cove

Alt = Altitude of aircraft (in feet, to correspond with aircraft altimeters)

Lateral distance (estim) = Estimated lateral distance from vehicle or other stimulus to haulout; for aircraft, 0 = directly over haulout

No. of wal h/o = Number of walruses hauled out on the beach

No. of wal responding at each level = Number of walruses responding at Levels 1 (heads raised), 3 (orienting), 5 (leaving the beach); see METHODS for details

Degree of response = high, moderate or low ; see METHODS for details

Appendix. 4 Walrus haulout census data, Cape Newenham, southwest Alaska, Jun-Aug, 1996.

MO	DA	BC	CLD CVR	WND SPD	WND DIR	PC	MA	MI	TD	Time	LOC'N	WTR	LND	TOT
6	12	3	1	22	8	0	42	30	2	1450	Wlly	4	0	4
6	13	1	1	10	7	0	50	32	2	1630	Wlly, BRC	2	3	5
6	14	1	1	7	1	0	48	32	2	1457	Wlly, BRC	6	9	15
6	15	1	0	9	4	0	60	37	2	1440	Wlly	0	6	6
6	16											0	0	0
6	17											0	0	0
6	18											0	0	0
6	19	0	2	9	4	1	48	40	4	1300	Wlly, BRC	11	0	11
6	20	0	2	8	4	1	44	42	4	1230	Wlly	0	37	37
6	21	0	2	12	4	0	47	41	3	1335	Wlly	3	79	82
6	22	0	1	2	8	0	60	37	3	1302	Wlly	0	44	44
6	23	1	2	38	4	1	51	39	3	1345	Wlly	1	1	2
6	24											0	0	0
6	25	1	2	16	4	1	45	41	3	1301	Wlly	1	0	1
6	26	1	2	10	8	1	48	41	3	1220	Wlly	8	2	10
6	27	1	1	4	4	0	50	42	3	1230	BRC	1	44	45
6	28	2	2	6	8	0	48	43	3	1232	Wlly, BRC	5	46	51
6	29	2	2	7	8	0	45	43	3	1139	BRC	4	18	22
6	30	2	2	9	8	0	48	40	3	1155	BRC	2	0	2
7	1											0	0	0
7	2	0	1	4	8	0	52	41	3	1306	Wlly, E. BRC	18	5	23
7	3	0	0	1	2	0	62	40	3	1527	Wlly, BRC	19	0	19
7	4	0	1	6	1	0	62	45	3	1110	Wlly, BRC	0	3	3
7	5											0	0	0
7	6											0	0	0
7	7											0	0	0
7	8													N/C
7	9	0	1	11	3	0	58	48	3	1300	Wlly, E. BRC	3	48	51
7	10	1	2	20	3	1	48	45	3	1254	Wlly, E. BRC	1	1	2
7	11	0	2	8	3	1	48	44	3	1235	Wlly, E. BRC	7	1	8
7	12	0	2	5	4	1	49	45	3	1150	Wlly, BRC, E. BRC	34	116	150
7	13	0	1	5	6	0	50	46	4	1038	Wlly, BRC, E. BRC	26	1056	1082
7	14	0	1	5	6	0	50	44	3	1130	Wlly, BRC, E. BRC	28	1252	1280
7	15	0	1	7	4	0	65	44	3	1539	Wlly, BRC, E. BRC	61	496	557
7	16	0	2	16	5	1	52	48	3	1457	BRC, E. BRC	3	0	3
7	17	2	2	5	6	0	50	45	4	1140	Wlly, E. BRC	7	0	7
7	18	1	2	5	6	1	49	45	3	1245	E. BRC	2	0	2
7	19	1	2	5	8	0	49	44	3	1240	BRC, E. BRC	15	116	131
7	20	2	2	6	1	0	52	46	4	1219	Wlly, BRC, E. BRC	78	1144	1222
7	21	1	2	0	8	0	55	43	3	1115	Wlly, BRC, E. BRC	58	1197	1255
7	22	1	1	11	5	0	51	43	3	1425	Wlly, BRC, E. BRC	44	507	551
7	23	1	1	7	5	0	57	45	3	1340	Wlly, BRC, E. BRC	15	132	147
7	24	1	1	1	8	1	63	51	3	1226	Wlly, BRC	7	34	41
7	25	1	2	10	6	0	54	48	4	1224	BRC	0	167	167
7	26	1	2	10	5	1	54	48	3	1248	BRC, E. BRC	9	158	167
7	27	1	2	9	5	1	53	50	3	1252	BRC, E. BRC	19	428	447
7	28	0	2	9	4	1	50	48	3	1256	BRC, E. BRC	20	754	774
7	29	1	2	5	5	0	50	41	3	1220	Wlly, BRC, E. BRC	5	798	803
7	30	2	2	7	7	0	53	42	4	1135	BRC, E. BRC	6	362	368
7	31	1	2	22	4	1	50	38	4	1217	BRC, E. BRC	24	674	698
8	1	2	2	14	6	1	54	41	4	1200	BRC, E. BRC	28	626	654
8	2	3	2	8	5	0	57	45	4	1202	BRC, E. BRC	33	316	349
8	3	1	2	8	7	0	46	43	4	1208	BRC, E. BRC	31	690	721
8	4	1	2	26	4	1	44	43	3	1205	BRC, E. BRC	31	436	467
8	5													N/C
8	6	1	1	13	8	0	51	44	3	1640	BRC	1	68	69
8	7	1	1	9	1	0	51	44	3	1145	BRC, E. BRC	6	8	14
8	8													N/C
8	9	1	2	5	5	1	50	46	3	1136	BRC	1	19	20
8	10													N/C
8	11											0	0	0
8	12													N/C
8	13													N/C
8	14													N/C
8	15													N/C
8	16													N/C
8	17	0	1	12	4	1	56	48	N/A	16:00	BRC, E. BRC	N/A	50 est.	50
8	22	2	1	34	8	0	58	46	N/A	20:00	BRC, E. BRC	N/A	200 est.	200
8	23	2	1	15	1	0	62	40	4	13:20	Wlly, BRC, E. BRC	0	0	0
8	24	0	1	0	N/A	0	70	40	3	15:00	Wlly, BRC, E. BRC	N/A	0	0

MO = Month, DA = Day
BC = Beach Conditions: calm=0, moderate waves=1, rough=2, very rough=3
CLD CVR = Cloud Cover: clear=0, broken=1, overcast=2
WND SPD = Wind Speed in mph
WND DIR = Wind Direction: 1=N, 2=NE, 3=E, 4=SE, 5=S, 6=SW, 7=W, 8=NW, 9=Variable
PC = Precipitation: yes=1, no=0
MA = Maximum Temperature (degrees Fahrenheit)
MI = Minimum Temperature (degrees Fahrenheit)
TD = Tide: high=4, low=1, rising=2, falling=3
TIME = Time count began
LOC'N = Location of haulout (beach). Wlly = Wally Cove, BRC = Bird Rock Cove, E. BRC = East Bird Rock Cove
WTR = Number of walruses in water seen from observation points
LND = Number of walruses hauled out on beaches
TOT = Total number of walruses (in water + hauled out)
Bristol Bay Total (CN + CP + RI) = Total (for days when walruses were present at Cape Newenham) of Cape Newenham, Cape Peirce, and Round Island counts

APPENDIX 5. Seal haulout census data, Nanvak Bay, southwest Alaska, May-Oct 1996.

MO	DA	CNT LOC'N	CLD CVR	WND SPD	WND DIR	PC	BAROM	MA	MI	TD	TIME	LOC'N	NO. WTR	NO. LND	NO. PUP	TOT
5	3	WPD	2	10	5	0	1025	50	-	1	19:05	MBB	21	0		21
5	4	WPD	2	10	4	0	1023	45	34	1	17:00	MBB	2	133		135
5	5	WPD	2	10	4	0	1022	44	38	1	16:15	MBB	0	164		164
5	6	WPD	2	5	4	1	1021	44	37	1	17:55	MBB	2	172		174
5	7	WPD	2	10	7	0	1027	47	34	3	17:15	MBB,ICE	19	91		110
5	8	WPD	0	10	7	0	1029	46	26	1	18:50	MBB,FB	2	191		193
5	9	LALO	0	5	4	0	1024	51	34	3	19:10	MBB,FB	5	239		244
5	10	LALO	0	5	7	0	1025	56	34	1	20:35	MBB	16	94		110
5	11	LL	0	25	1	0	1025	62	38	1	21:15	N/A	3	0		3
5	12	LALO	0	0	7	0	1011	60	40	1	19:15	MBB	8	214		217
5	13	WT	0	10	7	0	1007	59	38	1	09:15	MBB	10	204		214
5	14	LALO	0	10	7	0	1005	62	35	3	20:40	MBB	15	135		150
5	15	LALO	0	5	6	0	995	68	42	1	13:15	MBB	2	309		311
5	16	CB	0	40	8	0	993	60	37	1	14:00	MBB	N/A	150 est.		150 est.
5	17	LL	0	5	7	0	998	57	42	3	14:13	MBB	N/A	200 est.		200 est.
5	18	CB	0	55	8	0	1005	42	36	2	16:55	MBB	N/A	265 est.		265 est.
5	19	LALO	2	20	7	0	1009	44	34	3	17:45	MBB,FB	19	79		98
5	20	WT	2	50	8	1	1008	39	38	4	18:00	MBB	0	110		110
5	21	CB	1	20	1	0	1003	49	29	4	19:55	MBB,FB	0	195		195
5	22	CB	2	50	2	1	1002	48	32	3	17:00	MBB	N/A	200 est.		200 est.
5	23	CB	2	35	2	1	993	42	39	3	17:00	MBB	0	143	1	143
5	24	LALO	1	25	3	0	989	46	40	3	19:15	MBB,FB	2	253	1	255
5	25	LALO	2	10	6	1	998	52	42	3	19:52	MBB,FB	0	202		202
5	26	LALO	2	5	6	0	1007	48	41	2	20:13	MBB,FB	3	174	2	177
5	27	LALO	2	15	4	1	1011	46	40	2	20:30	MBB,FB	4	175		179
5	28	LALO	2	20	4	0	1008	46	43	1	20:05	MBB,FB	1	226	1	227
5	29	LALO	2	20	3	0	1009	50	42	3	11:20	MBB,FB	1	295	1	296
5	30	LALO	0	5	3	0	1010	62	40	1	19:15	MBB,FB	117	17		134
5	31	LALO	0	20	8	0	1014	62	36	2	15:15	MBB, FB	3	245		248
6	1	CB	0	20	8	0	1019	64	36	3	15:36	MBB, FB	0	234		234
6	2	LALO	0	5	1	0	1020	67	42	1	17:33	MBB,FB	2	273	2	275
6	3	LL	1	25	8	0	1016	56	46	1	17:00	MBB	0	205		205
6	4	CB	0	25	1	0	1016	62	45	1	19:40	MBB	0	206		206
6	5	LALO	0	20	8	0	1014	N/A	47	2	18:00	MBB	1	215	2	216
6	6	CB	2	25	8	0	1011	56	N/A	1	18:25	MBB	0	150		150
6	7	LALO	2	15	7	0	1001	48	42	1	20:22	MBB	13	116		129
6	8	CB	2	20	7	1	997	52	39	1	19:00	MBB	0	100		100
6	9	CB	1	25	8	0	1001	45	40	1	20:51	MBB,FB	0	119		119
6	10	CB	1	40	8	1	1004	42	36	1	19:09	MBB	0	75		75
6	11	LL	1	25	8	0	1007	44	32	2	17:50	MBB	2	139		139
6	12	CB	0	20	8	0	1005	51	34	2	19:32	MBB,FB	9	160		169
6	13	LALO	0	10	8	0	1010	56	45	1	13:18	MBB	4	248	1	252
6	14	LALO	0	5	8	0	1012	58	39	3	14:48	MBB,FB	3	200	1	203
6	15	Boat	1	10	8	0	1009	64	42	1	20:00	MBB, FB	N/A	240	4	240
6	16	CB	0	20	3	0	1004	52	44	1	20:37	MBB,FB	6	118	2	124
6	17	CB	2	35	3	1	1004	53	46	1	18:30	MBB	0	115		115
6	18	LALO	2	5	6	1	1005	55	45	1	18:10	MBB,FB	3	243	5	246
6	19	CB	2	5	6	0	1003	48	41	1	21:40	MBB,FB	4	100	1	104
6	20	LALO	2	10	4	1	1005	50	46	3	19:30	MBB,FB	4	198		202
6	21	LALO	2	10	4	0	1009	52	45	3	17:50	MBB,FB	1	208	1	209
6	22	LALO	0	5	6	0	1010	63	38	3	17:46	MBB,FB	0	163	2	163
6	23	CB	2	40	3	1	999	48	46	3	19:20	MBB	3	75		75
6	24	CB	2	20	3	1	990	54	46	3	21:15	MBB	4	135	1	139
6	25	CB	2	5	3	1	993	47	45	3	19:57	MBB,FB	7	99	2	106
6	26	LALO	1	10	8	0	984	52	44	3	20:20	MBB	6	194	3	200
6	27	LL	0	5	8	0	989	63	46	3	15:40	MBB,FB	0	107		107
6	28	CB	1	20	7	0	998	60	47	3	14:00	MBB	2	79	1	81
6	29	CB	1	35	7	0	1002	54	48	1	19:00	MBB,FB	6	118		124
6	30	LALO	1	15	7	0	1009	56	44	1	17:42	MBB,FB	5	172	2	177
7	1	LALO	2	15	7	0	1014	56	46	1	17:52	MBB,FB	2	165	6	167
7	2	CB	1	0	7	0	1008	59	45	3	18:00	MBB,FB	3	135	4	138
7	3	LALO	0	5	3	0	999	65	46	3	18:40	MBB,FB	1	146	3	147
7	4	LALO	0	5	5	0	995	65	45	1	20:45	MBB,FB	3	121	3	124
7	5	LALO	2	5	1	1	1001	60	45	1	19:32	MBB,FB	1	197	1	198
7	6	LALO	1	5	7	0	1006	71	52	1	20:20	MBB,FB	1	168	4	169
7	7	LALO	0	2	6	0	999	63	48	1	20:05	MBB,FB	11	128	1	139
7	8	LALO	0	10	3	0	994	58	49	3	20:05	MBB,IB,FB	8	148		156
7	9	CB	2	15	2	1	991	58	49	3	19:30	MBB,FB	0	115		115
7	10	CB	2	15	3	1	991	54	48	3	21:47	MBB,FB	0	91		91
7	11	CB	2	10	4	1	999	55	47	3	20:00	MBB	2	105		107

APPENDIX 5. Seal haulout census data, Nanvak Bay, southwest Alaska, May-Oct 1996.

MO	DA	CNT LOC'N	CLD CVR	WND SPD	WND DIR	PC	BAROM	MA	MI	TD	TIME	LOC'N	NO. WTR	NO. LND	NO. PUP	TOT
7	9	CB	2	15	2	1	991	58	49	3	19:30	MBB,FB	0	115		115
7	10	CB	2	15	3	1	991	54	48	3	21:47	MBB,FB	0	91		91
7	11	CB	2	10	4	1	999	55	47	3	20:00	MBB	2	105		107
7	12	MF	2	10	5	1	1001	51	47	3	15:58	MBB	1	164	1	165
7	13	MF	2	5	6	0	1009	49	45	1	21:11	MBB	0	147		147
7	14	LALO	2	5	4	0	1014	58	44	1	16:35	MBB,fB	2	161		163
7	15	LALO	1	10	5	0	1014	60	48	3	18:30	MBB,IB,FB	4	181		185
7	16	MF	2	5	5	0	1011	56	48	1	21:40	FB	0	30		30
7	17	MF	2	10	5	1	1014	58	46	1	20:30	MBB,FB	7	53		60
7	18	LL	2	10	6	1	1001	56	46	3	19:45	MBB	0	88		88
7	19	LALO	2	15	7	1	1001	60	47	3	21:35	MBB,IB,FB	5	45	1	50
7	20	LL	2	10	8	1	1008	58	58	3	19:50	MBB,FB	N/A	80		80
7	21	LALO	2	3	6	0	1011	68	46	1	20:20	MBB,IB,FB	0	116		116
7	22	LL	0	5	4	0	1013	65	44	1	19:45	MBB,FB	1	75		76
7	23	LL	1	5	7	0	1011	61	46	2	09:45	MBB	3	115		118
7	24	LALO	2	5	7	0	1008	67	53	1	20:30	MBB,FB	4	127		131
7	25	LALO	2	2	7	0	1008	62	50	1	19:00	MBB	5	264		269
7	26	LALO	2	5	6	1	1004	57	50	3	18:35	MBB	0	141		141
7	27	CB	2	10	4	1	1004	54	50	3	17:30	MBB	0	150		150
7	28	LALO	2	15	6	0	997	53	51	3	19:30	MBB	15	85		100
7	29	CB	2	25	7	0	998	54	48	3	16:00	MBB	0	60		60
7	30	LL	2	20	7	0	1006	54	47	3	15:32	MBB	4	121		125
7	31	MF	2	20	7	1	994	58	47	3	19:15	MBB	7	140		147
8	1	LL	2	20	7	0	1004	58	48	3	18:45	NS,MBB,FB	6	272		278
8	2	CB	2	15	7	0	1008	51	48	2	19:00	MBB	0	250		250
8	3	LL	2	10	7	0	1013	56	46	1	18:50	MBB	0	236		236
8	4	LL	2	50	7	0	1010	55	45	3	16:30	MBB	0	180		180
8	5	LL	2	20	7	0	1017	52	45	3	15:10	NS	3	316		319
8	6	LL	1	20	8	0	1014	54	46	3	15:15	NS	2	376		378
8	7	LL	2	20	8	0	1014	53	46	3	16:40	NS	1	406		407
8	8	LL	2	10	6	0	1008	57	47	3	13:10	NS	13	296		309
8	9	LL	2	10	8	0	997	54	47	3	19:40	NS	3	407		410
8	10	LL	1	25	8	0	995	54	47	1	20:45	NS	3	459		462
8	11	LL	1	10	8	0	995	56	48	1	20:10	NS,MBB	4	503		507
8	12	LL	1	10	8	0	997	60	48	3	18:35	NS,MBB	6	483		489
8	13	LL	2	10	8	0	1011	54	50	3	16:45	NS.MBB	2	386		388
8	14	LL	2	5	5	0	1012	57	47	3	20:20	NS,MBB,IB	2	453		455
8	15	LL	2	5	6	0	1012	55	47	3	20:40	NS	20	354		374
8	16	LL	2	5	6	0	1009	58	48	1	20:50	NS,MBB	4	260		264
8	17	LL	0	3	3	0	1006	57	49	1	21:00	NS,MBB	35	138		173
8	18	LL	2	20	4	1	995	54	41	2	19:30	MBB	12	118		130
8	19	LL	2	10	4	0	992	58	48	2	12:38	NS	2	234		236
8	20	LL	2	5	7	0	991	60	49	1	19:15	MBB	2	147		149
8	21	LL	0	15	7	0	992	62	49	1	19:35	NS	1	580		581
8	22	LL	1	35	8	0	994	54	50	1	20:30	NS,MBB	5	381		386
8	23	LL	2	10	8	0	997	61	40	1	22:30	NS,MBB	1	226		227
8	24	LL	2	5	8	0	1004	67	43	3	17:00	NS,MBB	4	181		185
8	25	LL	2	25	8	0	995	56	48	1	21:15	NS	1	410		411
8	26	LL	1	5	8	0	1000	52	47	3	11:30	NS	4	184		188
8	27	LL	0	2	8	0	1001	60	39	1	19:20	NS,MBB	10	320		330
8	28	LL	2	2	6	0	995	59	45	3	16:00	NS,MBB	4	260		264
8	29	LL	2	30	6	1	989	51	48	2	17:00	NS	4	150		154
8	30	LL	2	25	6	0	989	54	47	2	22:00	NS	0	211		211
8	31	LL	1	15	6	0	1004	58	47	2	20:20	NS	100	20		120
9	1	LL	0	5	6	0	1010	62	46	1	17:00	MBB	11	195		206
9	2	LL	2	10	6	0	1010	58	51	1	19:15	MBB	6	240		246
9	3	LL	2	15	2	0	1010	58	50	2	20:15	MBB	0	331		331
9	4	LL	2	25	2	1	995	54	49	1	18:20	MBB	0	259		259
9	5	LL	2	25	6	1	987	55	47	1	19:00	MBB	7	100		107
9	6	LL	1	10	3	0	989	57	45	1	20:30	MBB	6	335		341
9	7	LL	2	5	3	0	991	57	48	1	20:25	MBB	1	222		223
9	8	LL	2	2	9	1	994	58	45	2	17:00	MBB	0	227		227
9	9	LL	0	20	1	0	998	54	46	3	19:30	MBB	3	100		103
9	10	LL	0	15	1	0	998	52	39	1	21:00	MBB	4	125		129
9	11	LL	0	20	1	0	993	52	35	1	21:00	NS,MBB	12	226		238
9	12	LL	1	40	1	0	993	43	34	1	17:00	MBB	6	36		42
9	13	LL	2	30	1	0	996	46	35	1	15:30	none h/o	17	0		17
9	14	LL	1	10	8	0	1001	47	35	1	13:00	MBB	0	61		61
9	15	LL	1	5	8	0	998	62	36	1	17:30	MBB	3	64		67
9	16	LL	2	5	1	0	992	50	33	1	17:30	NS	13	85		98

APPENDIX 5. Seal haulout census data, Nanvak Bay, southwest Alaska, May-Oct 1996.

MO	DA	CNT LOC'N	CLD CVR	WND SPD	WND DIR	PC	BAROM	MA	MI	TD	TIME	LOC'N	NO. WTR	NO. LND	NO. PUP	TOT
9	17	LL	2	30	7	0	989	47	38	1	17:00	MBB	4	55		59
9	18	LL	2	40	7	1	984	42	38	2	16:00	MBB	7	130		137
9	19	LALO	1	3	1	1	1009	46	33	1	10:45	MBB	7	256		263
9	20	LL	2	15	6	1	1009	50	36	1	15:45	MBB	27	25		52
9	21	LL	1	5	1	0	1006	46	36	1	09:00	MBB	25	190		215
9	22	LL	1	15	8	0	999	46	33	1	08:45	MBB	14	57		71
9	23	LL	1	5	6	0	998	38	36	1	19:00	MBB	10	37		47
9	24	LL	1	5	8	0	992	37	27	1	13:00	MBB	0	111		111
9	25	LL	2	40	6	1	983	45	27	1	14:00	MBB	9	33		42
9	26	Aerial	1	20	8	1	1004	46	35	3	12:30	MBB	N/A	70 est.		70
9	27	LALO	1	9	8	1	1011	48	36	3	12:16	MBB	1	308		309
9	28	LALO	1	14	8	1	1021	40	36	3	13:05	MBB	5	292		297
9	29	LALO	1	15	8	0	1023	53	40	1	14:43	MBB	18	131		149
9	30	WPD	1	27	8	0	1015	44	40	3	11:43	MBB	N/A	123		123
10	1	LALO	0	35	1	0	1012	40	36	1	14:05	MBB	10	134		144
10	2	WPD	0	35	8	0	1006	42	30	1	15:00	MBB	6	75		81
10	3		1	15	8	1	997	40	29		0					N/C
10	4	LALO	1	3	8	0	996	45	27	3	13:09	MBB	14	304		318
10	5	LALO	0	0	9	0	997	49	28	3	13:40	MBB	20	180		200
10	6	WPD	1	22	8	0	998	37	31	1	13:14	MBB	11	226		237
10	7	LALO	2	5	1	0	997	46	31	3	12:21	MBB	0	162		162
10	8	WT	1	15	8	1	999	38	31	3	10:15	MBB	N/A	200 est		200 est
10	9	LL	0	7	8	0	1003	33	23	all	all day	N/A	7	0		7
10	10	LALO	1	0	N/A	0	996	42	24	1	12:13	MBB	8	235		243
10	11	LL	1	8	8	0	999	35	23	3	11:30	MBB	N/A	200 est.		200 est.
10	12	WPD	1	5	2	0	997	34	17	3	12:59	MBB	N/A	200 est.		200 est.
10	13	LALO	1	12	1	0	995	34	17	3	12:07	12	64			76
10	14	LL	1	3	1	1	1004	37	20	1	13:45	MBB	N/A	86		86
10	15	LL	2	17	7	1	1008	42	20	all	all day	N/A	7	0		7
10	16	WPD	1	15	8	0	1008	33	28	1	14:35	MBB	5	162		167
10	17	WT	0	5	3	0	1020	36	27	2	17:58	MBB	4	118		122
10	18	N/A	2	40	2	1	990	32	26	all	all day	N/C		blizzard - no visibility - no count		N/C
10	19	WT	2	20	3	1	993	36	26	1	17:30	MBB	3	83		86
10	20	WT	2	15	3	0	990	36	32	1	17:30	MBB	N/A	140		140
10	21	WT	1	20	2	0	990	39	32	1	18:30	MBB	4	110		114
10	22	LL	2	30	2	1	976	40	32	2	14:00-18:30	N/A	0	0		0
10	23	WPD	1	20	3	0	984	38	34	3	11:30	MBB	0	95		95
10	24	WT	2	10	1	0	996	28	28	2	12:30	MBB	0	105		105
10	25	WT	2	15	2	0	999	28	20	1	13:10	MBB	6	98		104
10	26	WT	0	15	1	0	999	30	20	2	16:00	MBB	2	52		54
10	27	LL	2	5	2	0	1014	22	22	4	12:00	MBB	N/A	50 est.		50 est.
10	28	N/A	1	20	6	0	1010	40	40	4	N/A	N/A	N/A	No count due weather		N/C
10	29	N/A	2	3	5	0	1005	40	38	N/A	N/A	N/A	N/A	No count due to poor visibility		N/C
10	30	N/A	2	65	8	0	1003	42	32	1	N/A	N/A	N/A	No count due to high winds		N/C
10	31	LL	1	50	8	0	998	28	22	1	all day	N/A	0	0	Bay frozen	0
11	1	LL	0	5	7	0	N/A	N/A	N/A	1	N/A	N/A	0	0	Bay frozen	0

WND DIR = Wind Direction: 1=N, 2=NE, 3=E, 4=SE, 5=S, 6=SW, 7=W, 8=NW, 9=Variable
PC = Precipitation: yes=1, no=0
MA = Maximum Temperature (degrees Fahrenheit)
MI = Minimum Temperature (degrees Fahrenheit)
TD = Tide: high=4, low=1, rising=2, falling=3
TIME = Time of count
LOC'N = Location of haulout; MBB=Mid-bay bars, FB=Far bars,IB = bar between MBB and FB NS=North Spit tip
NO.WTR=Number of seals in water
NO.LND.= Number of seal hauled out
NO. PUP = Number of pups
TOT = Total number of seals hauled out and in water
CNT LOC'N = Location of observation point; Aerial =aerial survey, CB=Cabin Bluff, cliffs=estimate from cliff trail, LALO= Lauri's Lookout (aka Big Dune), LL= Lee's Landing, WPD=Watch Point Dune, WT=Walrus Tower, MF= Mud flats north of seal tower.
N/A=data not available

APPENDIX 6. Other marine mammal sightings, northern Bristol Bay and Kuskokwim Bay, southwest Alaska, May-Oct, 1996.

Bristol Bay

Cetaceans

Grey whales (*Eschrichtius robustus*) were sighted by TNWR staff 262 times during May, 18 times during June, and twice in early July, traveling north along the coast of Cape Peirce. At least six of the sightings were females with calves.

A large, clean, baleen whale skull, measuring 348cm in length and 221cm in width, was found on North Spit at Cape Peirce, on 26 July. The skull was almost completely buried. TNWR staff unearthed it, took photos, and are in the process of identifying it.

Carcasses

The carcass of an adult male beluga whale (*Delphinapteras leucas*) was found 8 July on the shore of Squaw Creek in Dillingham. Measurements and skin tissue samples were taken and forwarded to NMFS.

Kuskokwim Bay

Cetaceans

Grey whales were seen from Cape Newenham by TNWR staff 14 times during the first half of June; eight of these sightings were females with calves.