MARINE MAMMAL SCIENCE, 24(4): 845–863 (October 2008)

DOI: 10.1111/j.1748-7692.2008.00225.x

Harbor seal population decline in the Aleutian Archipelago

ROBERT J. SMALL
Alaska Department of Fish and Game,
Division of Wildlife Conservation,
1255 West 8th Street, Juneau, Alaska 99811, U.S.A.
E-mail: bob.small@alaska.gov

PETER L. BOVENG
National Marine Mammal Laboratory,
NOAA/Alaska Fisheries Science Center,
7600 Sand Point Way NE, Seattle, Washington 98115, U.S.A.

G. VERNON BYRD
U.S. Fish and Wildlife Service,
Alaska Maritime National Wildlife Refuge,
95 Sterling Hwy, Homer, Alaska 99603, U.S.A.

DAVID E. WITHROW
National Marine Mammal Laboratory,
NOAA/Alaska Fisheries Science Center,
7600 Sand Point Way NE, Seattle, Washington 98115, U.S.A.

ABSTRACT

Populations of Steller sea lions, northern fur seals, and northern sea otters declined substantially during recent decades in the Bering Sea and Aleutian Islands region, yet the population status of harbor seals has not been assessed adequately. We determined that counts obtained during skiff-based surveys conducted in 1977–1982 represent the earliest estimate of harbor seal abundance throughout the Aleutian Islands. By comparing counts from 106 islands surveyed in 1977–1982 (8,601 seals) with counts from the same islands during a 1999 aerial survey (2,859 seals), we observed a 67% decline over the ~20-yr period. Regionally, the largest decline of 86% was in the western Aleutians ($n = 7$ islands), followed by 66% in the central Aleutians ($n = 64$ islands), and 45% in the eastern Aleutians ($n = 35$ islands). Harbor seal counts decreased at the majority of islands in each region, the number of islands with >100 seals decreased ~70%, and the number of islands with no seals counted increased ~80%, indicating that harbor seal abundance throughout the Aleutian Islands was substantially lower in the late 1990s than in the 1970s and 1980s.

Key words: population decline, harbor seal, *Phoca vitulina*, Aleutian Islands, Gulf of Alaska stock.

The population declines of Steller sea lions (*Eumetopias jubatus*), northern fur seals (*Callorhinus ursinus*), and northern sea otters (*Enhydra lutris kenyoni*) in the Bering Sea and Aleutian Islands region during recent decades have prompted substantial efforts to identify the causes of those declines, conserve and manage the species, and interpret marine ecosystem dynamics (Estes *et al.* 1998, NRC 2003, Springer *et al.* 2003, Trites and Donnelly 2003, DeMaster *et al.* 2006, Wade *et al.* 2007). Less information has been available to determine whether harbor seals (*Phoca vitulina)* have also declined in the Aleutian Islands region, yet robust estimates of multi-year population trends indicate declines in several relatively small regions in the Gulf of Alaska and Southeast Alaska (Frost *et al.* 1999, Small *et al.* 2003, Mathews and Pendleton 2006).

Harbor seals were considered common and relatively abundant throughout the Aleutian Archipelago during the 1960s and early 1970s (Pitcher 1985), yet a reliable estimate of abundance is not available for that period or earlier. Harbor seals in the Aleutians have been surveyed on numerous occasions during the past 70 yr: 1930s (Murie 1959), 1956–1957 (Mathisen and Lopp 1963), 1960–1965 (Kenyon 1960, 1962, Kenyon and Rice 1961, Kenyon and King 1965), 1975–1977 (Everitt and Braham 1980), 1979 (Fiscus *et al.* 1981), 1986 (Brueggeman *et al.* 1988), and 1992 and 2000 (Doroff *et al.* 2003). However, harbor seals were typically not the species for which these surveys were conducted, thus survey effort and protocols varied substantially, and available counts were often incomplete for individual islands as well as larger geographic regions.

Directed surveys for this species in the Aleutians were not conducted until the 1990s, when an aerial survey program was initiated with the objective of enumerating seals throughout their extensive geographic range, from Southeast Alaska north through the Gulf of Alaska, west across the Aleutian Islands, and in Bristol Bay (southeast Bering Sea; Boveng *et al.* 2003). The first of these surveys in the Aleutians, during 1994, was hampered by weather and was incomplete in its coverage, especially of the western Aleutians. In 1999 a nearly complete survey of the Aleutians was conducted. Following the aerial surveys conducted in the 1990s, we searched for historic data that might be used to evaluate changes in harbor seal abundance in the Aleutians during the same period in which Steller sea lions, northern fur seals, and northern sea otters declined.

The U.S. Fish and Wildlife Service (USFWS) made an extensive effort to census and map all wildlife populations within the Aleutian Islands Unit of the Alaska Maritime National Wildlife Refuge over a 6-yr period, during the summers of 1977–1982. The primary marine mammal census effort comprised coastline surveys for harbor seals, sea otters, and Steller sea lions; northern fur seals and several species of cetacean were also observed and counted. The intention was to survey the entire shoreline of all islands, though this was not always possible. The number of harbor seals observed, including pups, was recorded for each island. We assembled the count data from these skiff-based surveys and determined that they were sufficiently complete to represent the earliest estimate of harbor seal abundance for the Aleutian Archipelago. In this paper our primary objective was to compare that earliest estimate to counts from the aerial survey in 1999 to calculate the first estimates of change in population abundance of harbor seals across the Aleutian Archipelago.

METHODS

Counts of harbor seals were obtained from the reports for each of the USFWS skiff-based surveys conducted during 1977–1982 to census and map birds and mammals

in the Aleutian Islands (Day *et al.* 1978, 1979, Early *et al.* 1980, 1981, Nysewander *et al.* 1982, Bailey and Trapp 1983, Dragoo and Deines 1983). The survey methods in those reports indicated that harbor seals were counted, along with other marine mammals and birds, from a 4-m inflatable boat operated at the outer edge of the kelp forest around the coastline of each island. Island coastlines were subdivided into survey segments for data recording based on prominent physical features. The distance from shore typically varied from ~25 m to ~200 m, and occasionally more, depending on the extent of the dense kelp. Using binoculars to scan the near-shore marine waters and shorelines, usually two observers who were not operating the boat recorded all birds and marine mammals seen between the boat and the shoreline; thus, harbor seal counts included seals hauled out and in the water. Most surveys were conducted when winds were <46 km/h (25 knots) and when fog or rain did not substantially obscure visibility. Surveys were conducted irrespective of tide stage and the annual seal molting period. The duration of the period in which seals were surveyed during the six summers of 1977–1982 ranged from about 2.5 wk in 1978 to about 12 wk in 1980, with a large majority (~70%) of the survey effort from mid-May to mid-July (Appendix 1). Additional information on the methods used in the seal surveys is in the original survey reports, cited above.

The fixed-wing aircraft surveys conducted in 1999 by the National Marine Fisheries Service to enumerate harbor seals in the U.S. Aleutian Islands (Unimak Pass to Attu Island) provided a second count of seals. The dates for the 10-d survey, 6–15 August, were chosen to coincide with the period during the annual molt when the greatest proportion of the harbor seal population is hauled out (Pitcher and Calkins 1979, Calambokidis *et al.* 1987, Jemison and Kelly 2001, Daniel *et al.* 2003). The survey was flown within 2 h on either side of low tide, weather and available daylight permitting, to coincide with the peak in the numbers of seals hauled out relative to the tide cycle. Most surveys were flown at an altitude between 100 and 300 m (wind permitting) and at a speed of about 167 km/h (90 knots). Small groups of seals (generally <10) were counted as the plane passed by, whereas larger groups were circled and photographed for later counting. At least four counts on separate days were planned for each major haul-out site over the 10-d survey period, and the maximum count for each site was used in our analysis.

Recognizing the 1977–1982 skiff-based survey and the 1999 aerial survey used different protocols to obtain counts of harbor seals, we reviewed all counts available from both periods to determine the most comparable counts from which to estimate the change in seal abundance. Based on written comments within the reports of the skiff-based surveys in the western and central Aleutian Islands, portions of some islands were not surveyed for seals due to poor weather or extensive kelp. Details on the survey effort were not included for every island, and thus we could not always determine the extent of coastline coverage for harbor seal observations. Nevertheless, we determined there was adequate coverage to use all the counts from the western and central Aleutians except from four islands (Sagigik Island, Atka Island, Elf Island, and Gramp Rock), recognizing the incomplete count for some islands could result in the skiff-based counts being biased low. The survey report of the eastern Aleutians (Nysewander *et al.* 1982) included more complete information on whether each island count was complete or incomplete, including whether a count was not conducted even though seals were present. Based on comments within the 1982 report and verbal discussions with the senior author of the report, we determined a relatively large proportion of the coastline was not surveyed for several islands in the eastern Aleutians, and thus counts for the following seven islands were not included in our analysis: Samalga, Umnak, Unalaska, Unalga, Akun, Tigalda, and

Ugamak. We used the counts for all the remaining islands in the eastern Aleutians, even though a relatively small proportion of the coastline was not surveyed for some islands. Omission of the seven islands in our analysis resulted in an inflated relative percentage of the seal population in the central and western regions, yet any trend in regional percentages should not have been affected.

The skiff-based surveys of the central Aleutians did not include the large island of Amchitka. A helicopter survey of Amchitka was conducted in the early 1970s under contract with the Atomic Energy Commission, and although sea otters were the primary focus of the survey, harbor seals were also counted. We could not locate the report in which the survey results were published. However, the biologist who counted otters during the survey reflected that the count of harbor seals was 3,000–4,000.[1] Abegglen (1977) references a population estimate of 900 to 1,000 seals for Amchitka Island in 1971, based on a personal communication with C. Hardy of the USFWS. We confirmed that a count of harbor seals was obtained during a circumnavigation survey for marine mammals of Amchitka Island by helicopter and the count was provided to the USFWS.[2] For our analysis we chose the conservative approach of using the minimum count of 900 harbor seals for Amchitka Island as cited in Abegglen (1977), and it represents the count obtained nearest in time to the skiff-based surveys.

The counts obtained during the 1977–1982 skiff-based surveys were reported for individual islands whereas the 1999 aerial survey counts were reported for individual haul-out sites on those islands. Thus, for each island that a skiff-based count was available, we summed the aerial counts for all the haul-out sites on that island and for those haul-out sites with more than one count we used the maximum count. We then calculated the difference in the counts of harbor seals, by island, between 1977–1982 and 1999. We did not make any adjustments to the counts for covariates known to influence the proportion of the population hauled out (Frost *et al.* 1999, Boveng *et al.* 2003, Simpkins *et al.* 2003, Small *et al.* 2003). Thus, our difference in counts between the two time periods represents a change in relative rather than actual abundance, and is subject to any bias resulting from the two survey methods.

To examine the change in harbor seal numbers on a regional basis within the Aleutian Archipelago we defined three regions: western, central, and eastern (Fig. 1). The western Aleutians included the islands from Attu east to Buldir; the central Aleutians, Kiska to Uliaga; and the eastern Aleutians, Breadloaf to Ugamak. Samalga Pass, which separates the central and eastern island groups, represents a primary ecological boundary in the marine waters of the Aleutian Archipelago (Hunt and Stabeno 2005), with islands to the east on the continental shelf and oceanic islands to the west. Additional ecological boundaries may exist (Hunt and Stabeno 2005), including the large pass between the Near and Rat islands, the boundary we chose between the western and central regions. We included Buldir Island in the western region based on zoogeographical data that indicate it is near the eastern edge of the distribution for some Asian plants (Byrd 1984) and the migration of Asiatic birds (Gibson and Byrd 2007). The boundaries we selected for our three regions have also been used in the published literature of Steller sea lions, and the Gazetteer of Aleutian Islands (Gibson and Byrd 2007) that we used as our reference for island names and location (*i.e.*, longitude and latitude).

[1] Personal communication from James A. Estes, U.S. Geological Survey, Long Marine Lab, 100 Shaffer Road, Santa Cruz, CA 95060, February 2007.

[2] Personal communication from Clayton M. Hardy, General Delivery, Island Falls, Maine 04047, October 2006.

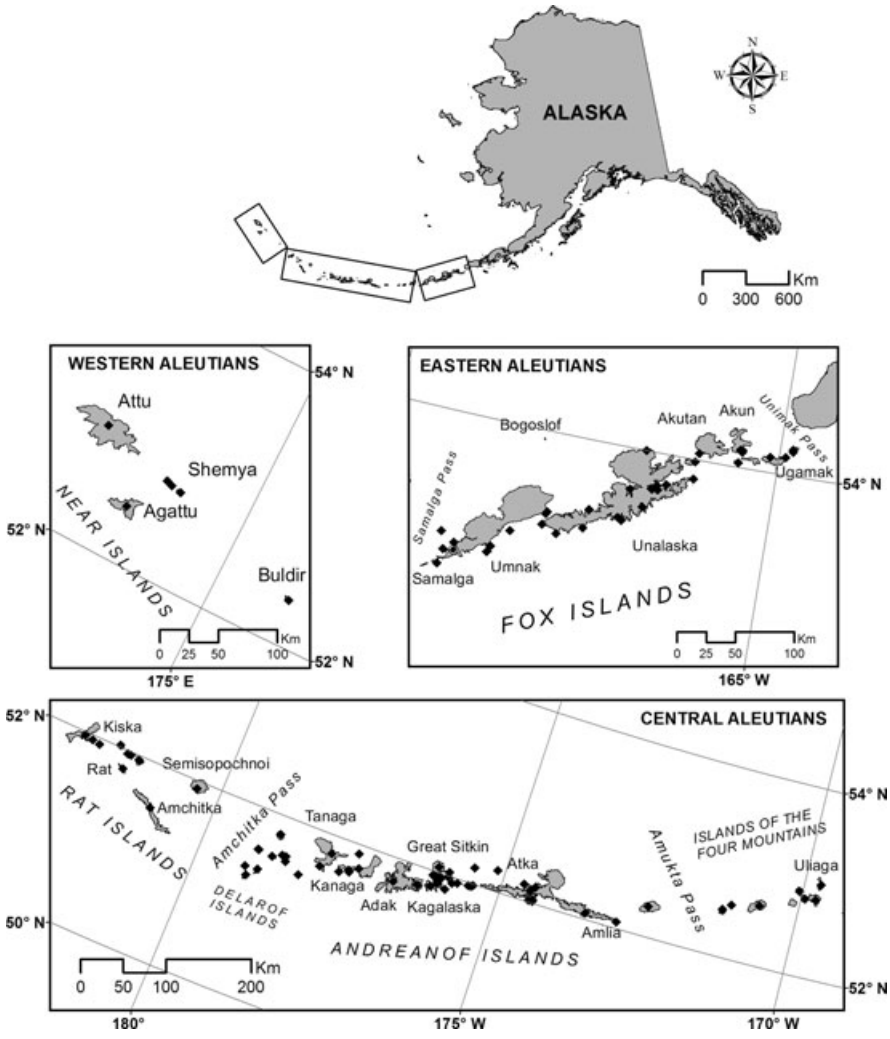

Figure 1. The main islands within the western, central, and eastern regions of the Aleutian Islands, Alaska, from which counts of harbor seals were obtained during skiff-based surveys in 1977–1982 and an aerial survey in 1999 to estimate a change in population abundance. The black diamonds denote the location of the islands where counts were obtained (see Appendix 1).

RESULTS

The count of harbor seals at 106 islands from Attu Island east to Unimak Pass was 8,601 when surveyed by skiff during 1977–1982 and 2,859 when surveyed by aircraft during 1999 (Appendix 1, Fig. 1), indicating a 67% decline across the U.S. Aleutian Archipelago during the period of approximately 20 yr. Furthermore, the number of seals counted declined in all three regions (Table 1), with the largest decline of 86% in the western Aleutians ($n = 7$ islands), followed by a 66% decline in the central Aleutians ($n = 64$ islands), and a 45% decline in the eastern Aleutians

Table 1. Summary statistics of harbor seal counts by island within regions of the Aleutian Islands, Alaska, based on skiff-based surveys conducted during 1977–1982 and aerial surveys conducted in 1999.

Region (# islands)	Median	Maximum	Mean	Total (% by region)	% decrease	% of islands with decreased[a] counts	% of islands with increased[a] counts
Western Aleutians (7)							
1977–1982	205	913	267.9	1,875 (22%)			
					86%	100%	0%
1999	21	120	37.0	259 (9%)			
Central Aleutians (64)							
1977–1982	16	900	79.8	5,107 (59%)			
					66%	61%	28%
1999	8	212	26.8	1,716 (60%)			
Eastern Aleutians (35)							
1977–1982	18	245	46.3	1,619 (19%)			
					45%	61%	31%
1999	11	230	25.3	884 (31%)			
Combined (106)							
1977–1982	18	913	69.6	8,601			
					67%	63%	29%
1999	10	230	25.4	2,859			

[a]Does not include islands with no change in counts between periods: $n = 7$ for central Aleutians and $n = 3$ for eastern Aleutians.

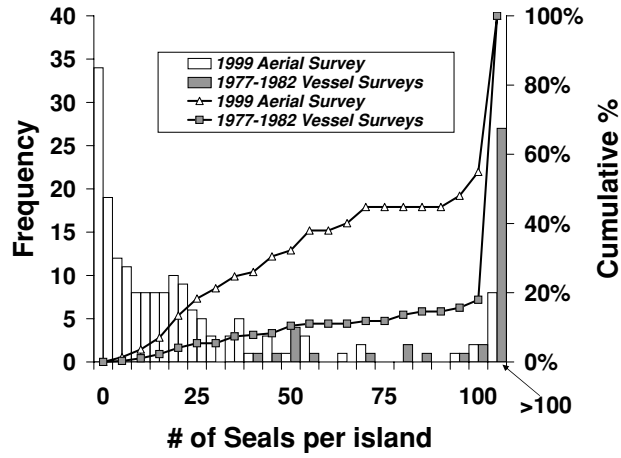

Figure 2. The frequency distribution of the number of harbor seals per island and the cumulative percentage of the population surveyed in the Aleutian Islands, Alaska, during both the 1977–1982 skiff-based surveys and the 1999 aerial survey.

($n = 35$ islands). The proportions of the total population distributed among regions changed accordingly, decreasing from 22% to 9% in the western region, increasing from 19% to 31% in the eastern region, and remaining constant at ~60% in the central region (Table 1). The median, maximum, and mean counts were greater during 1977–1982 than 1999 for each region and overall. The count of seals decreased at the majority of islands in each region (Table 1), and counts decreased at 68 of 106 islands across all regions. The number of islands with no harbor seals counted increased from 19 to 34 between the two survey periods (Fig. 2). Seals hauled out in relatively large numbers (*i.e.*, >100) at 27 islands during 1977–1982, composing ~80% of the total seal count, whereas only eight islands had counts >100 seals in 1999, composing ~45% of the count.

Discussion

The counts of harbor seals obtained through the skiff-based surveys conducted during 1977–1982 represent the earliest estimate of harbor seal abundance throughout their extensive range in the Aleutian Islands. Of the counts of harbor seals obtained subsequently, those from the 1999 aerial survey are the most comparable, with respect to geographic coverage, for estimating the first change in population abundance for this region, a 67% decrease. The decline was widespread in the Aleutians, as the number of seals counted decreased on nearly two-thirds of 106 islands, and the number of islands with large (*i.e.*, >100) concentrations of seals decreased ~70%. Further, the number of islands where no seals were observed increased ~80% over the two decades between surveys.

Potential Biases in Comparison of Surveys

Due to differences in the survey protocols used for the 1977–1982 skiff-based surveys *vs.* the 1999 aerial survey, the potential exists for bias in estimates of population

change. The bias could reflect differences in both availability and detectability of seals.

The availability of seals to be counted (*i.e.*, the proportion of seals hauled out) is well known to vary by survey date in Alaska (Frost *et al.* 1999, Boveng *et al.* 2003, Small *et al.* 2003, Jemison *et al.* 2006, Mathews and Pendleton 2006), with a peak in the number of seals hauled out during the May–June pupping period and another peak during August–September associated with molting (Jemison and Kelly 2001, Daniel *et al.* 2003). When comparable and repetitive surveys have been conducted in both the pupping and molting periods, the numbers of seals ashore have been higher in the molting period. For example, in seven years of monitoring at Tugidak Island the adjusted mean counts from the molting period were on average about 12% greater than those from the pupping period, and at Nanvak Bay ($n = 10$ yr) the difference was >100% (derived from figures in Jemison *et al.* 2006). Mean counts from surveys of Cook Inlet in 2003–2005 were 15% greater during August (molt) than during June (pupping).[3]

The proportion of seals hauled out is also influenced by tide stage, with larger proportions typically hauled out closer to low tide (Frost *et al.* 1999, Boveng *et al.* 2003, Small *et al.* 2003, Jemison *et al.* 2006). The dates for the 10-d survey in 1999 (6–15 August) were selected, in large part, to coincide with both the assumed peak molting period and a minimal low tide cycle. The survey was flown during the two hours before and after low tide, such that counts were obtained when we expected a greater proportion of seals would be hauled out. In contrast, the surveys in 1977–1982 were performed throughout the summer months, as weather permitted, without regard to the peak molting period and daily low tides. Therefore, from considerations of timing, we would expect that more seals would be ashore and available for counting in the 1999 survey than in the earlier surveys, all else being equal.

The relative detectability of seals also probably differed between the surveys in 1977–1982 and the 1999 survey due to differences in skiff-based *vs.* aerial techniques. The skiff-based counts did not include those seals present on a small but unknown portion of shoreline that was not surveyed, whereas the aerial surveys were of the complete shoreline for the islands in our analysis. At most sites, the aerial surveys included more than one daily replicate, from which we selected the maximum count, whereas a single count was made from skiffs. On the other hand, a few seals in the water (some of which may have entered the water at the approach of the skiffs) were counted during the skiff-based surveys. In contrast, only seals observed on land were counted during aerial surveys, thus slightly increasing the skiff-based counts relative to aerial counts. In our experience with both methods in a variety of contexts throughout Alaska, the overriding difference between the two methods is the greater detectability afforded by the high viewing angle in aerial surveys (*e.g.*, Lowry 1999), reducing the number of seals that would be obscured by terrain, rocks, or other seals from the water-level vantage of skiff-based surveys.

We are not aware of any direct comparisons based on simultaneous aerial and skiff-based counts of harbor seals. However, Thompson and Harwood (1990) compared counts from an August (molt period) aerial survey and a June–July (pupping period) skiff-based survey of the same population. In that comparison, which included similar

[3] Boveng, P. L., O. Badajos, J. L. Bengtson, J. M. London, R. A. Montgomery, M. A. Simpkins, and J. M. Ver Hoef. 2007. Use of haul-outs by harbor seals in Cook Inlet. Draft Final Report for Minerals Management Service by National Marine Mammal Laboratory, NOAA Fisheries, 7600 Sand Point Way NE, Seattle, WA.

aspects to ours in both timing (*i.e.*, availability) and survey methods (detectability), the aerial counts were more than double the skiff-based counts. Considering the differences in both availability and detectability of seals between the early (1977–1982) and recent (1999) surveys in our study, we believe a 67% decline in the abundance of harbor seals in the Aleutian Islands is an underestimate. However, in the absence of data that would allow more direct evaluation of the differences between these two survey methods, the most we can conclude with certainty is that there has been a substantial (*i.e.*, 67%) decline.

Regional Variability in Population Decline

Declines in the abundance of harbor seals differed substantially among the three Aleutian regions. Specifically, the decline in the western Aleutians (86%) was greater than the central (66%) and eastern Aleutians (45%). These different rates of population decline indicate that factors affecting seal population dynamics (*e.g.*, food availability, rate of predation, disease) varied among the three regions between 1977–1982 and 1999. Such regional variability is plausible, based on the physical and environmental variables that contribute to ecosystem structure within the Aleutian Islands (Hunt and Stabeno 2005), including a pronounced ecological boundary at Samalga Pass, the area between the eastern and central regions in our comparisons. Such ecological boundaries affect marine mammal, bird, and fish distributions in the Aleutians (Byrd *et al.* 2005, Logerwell *et al.* 2005, Sinclair *et al.* 2005), and may also delineate areas of relatively distinct habitat that influence prey distribution and foraging behavior of top-level predators (Call and Loughlin 2005, Fadely *et al.* 2005).

In contrast to the decline in the abundance of harbor seals in the Aleutian Islands, the number of seals on the Commander Islands in Russian waters ~300 km west of Attu Island (western Aleutians) remained relatively stable during the period of our study. Surveys of the Commander Islands, which include Bering, Medny, and all nearby smaller islands, have been conducted regularly since 1983 with a relatively constant survey effort, typically by the same observers, located 100–200 m from haulouts in either a small skiff or on land. The number of seals counted during 1983–1999 remained relatively stable at ~2,500, with a maximum count of ~3,000 in 1999, and a minimum of ~2,100 in both 1985 and 1989.[4] The relative stability in the Commanders compared to a sharp decline in the western Aleutians for harbor seals is similar to that observed for sea otters and Steller sea lions during the 1990s (Bodkin *et al.* 2000, Doroff *et al.* 2003, Burkanov and Loughlin 2005, Fritz and Stinchcomb 2005), providing additional evidence of divergent ecosystem dynamics between the Commander and Aleutian archipelagos with respect to marine mammals.

Relationship to Population Declines of other Marine Mammals

A paucity of reliable counts of harbor seals prior to the 1977–1982 skiff-based surveys precludes a determination of when the population decline began in the Aleutian Islands. Further, the few counts obtained from some islands after the skiff-based surveys and before the 1999 aerial survey were insufficient to provide details about the timing of the decline between the two survey efforts. In contrast, the decline

[4] Personal communication from Vladimir N. Burkanov, Kamchatka Branch, Pacific Institute of Geography, Far East Division of Russian Academy of Sciences, Petropavlovsk-Kamchatsky, Russia, April 2007.

in abundance of Steller sea lions across the Aleutian Islands has been documented by counts from aerial surveys with relatively consistent protocols and on a finer temporal scale; *i.e.*, one count for each region during the late 1970s (1976 eastern Aleutians, 1979 central and western Aleutians), counts in 1985 and 1989 for the eastern and central Aleutians, and seven annual counts for each region between 1990 and 2000 (Sease *et al.* 1993, Fritz and Stinchcomb 2005). The decline of Steller sea lions during the 1970s to 2000 period (using non-pup counts at rookery and haul-out trend sites) was similar across regions (81% to 92%) to what we report for harbor seals in the western Aleutians (86%). Nevertheless, the rate of sea lion decline during 1985–2000 and the rate of harbor seal decline between the late 1970s and 1999 varied similarly by region, being lowest in the eastern Aleutians for both sea lions and harbor seals (49% *vs.* 45%) and higher in the central (75% *vs.* 66%) and western (76% *vs.* 86%) regions.

Due to the absence of any studies on harbor seal ecology (*e.g.*, diet, foraging patterns, body condition, dispersal, habitat use, vital rates) in the Aleutian Islands during the period of decline, there is no empirical evidence pertaining to the factors that caused the decline. Thus, although our analysis indicates harbor seals declined in the Aleutian Islands during the same general period as the declines in the Steller sea lion, northern fur seal, and northern sea otter, our results do not provide evidence that can be used to evaluate either "bottom-up" (*e.g.*, Trites and Donnelly 2003) or "top-down" (*e.g.*, Springer *et al.* 2003) hypotheses regarding marine mammal population dynamics in the Bering Sea and Aleutian Islands.

Significance of Decline for Status of the Gulf of Alaska Stock

The Gulf of Alaska stock of harbor seals has the largest spatial extent of the three currently recognized stocks in Alaska, and includes the entire U.S. Aleutian Island region and the Gulf of Alaska east to Cape Suckling. Available information on population trend in the Gulf of Alaska includes a severe decline (85%) at the southwest beach of Tugidak Island from 1976 to 1988 (Pitcher 1990), and a substantial decline in the eastern Kodiak Island area during the same period (Small *et al.* 2003). Seal numbers also declined 63% in eastern and central Prince William Sound from 1984 to 1997 (Frost *et al.* 1999), and 84% at a nearby glacial site in Aialik Bay (Hoover-Miller *et al.* 2006). Since the early 1990s, the population trend at all these areas has either stabilized or increased slightly, yet seal numbers remain substantially reduced; *e.g.*, the abundance on Tugidak in 2000 was ~80% lower than 1970s levels (Jemison *et al.* 2006). Due to the lack of data from the relatively large areas on the south side of the Alaska Peninsula, the west side of Kodiak Island in the Gulf of Alaska, and from the Aleutian Islands the status of the overall stock is currently unknown (Angliss and Outlaw 2007). Despite the differing methodologies, the substantial decline in counts across the Aleutian Islands from 1977–1982 to 1999 provides additional evidence that harbor seal numbers in the Gulf of Alaska stock were substantially lower in the late 1990s than in the 1970s and 1980s. The status of the Gulf of Alaska stock, including current abundance, trends, and sources of mortality should be thoroughly assessed to identify management needs and to guide further monitoring and research.

Acknowledgments

Lloyd Lowry provided the inspiration, unwittingly, for R.J.S. to initiate the search for the earliest population estimate of harbor seals in the Aleutian Islands. We thank all the people

involved in the skiff-based surveys of 1977–1982. Ed Bailey, Dave Nysewander, and Karl Schneider provided insights on surveys of harbor seals they conducted during the 1960s, 1970s, and 1980s, and Sonja Kromann and Celia Rosen searched for and located several reports on marine mammal surveys during those decades. We are grateful to Jack Cesarone, John Jansen, Peter Olesiuk, and Dana Seagars for conducting aerial surveys in 1999 and analyzing photographs, and to the pilots who flew the aircraft during the 1999 surveys. John Jansen prepared Figure 1. Comments provided by reviewers improved earlier versions of this manuscript.

Literature Cited

Abegglen, C. E. 1977. Sea mammals: Resources and population. Pages 493–510 *in* M. L. Merritt and R. Glen Fuller, eds. The environment of Amchitka Island, Alaska. Prepared for Division of Military Application, Energy Research and Development Administration. Published by Technical Information Center, Energy Research and Development Administration, Oak Ridge, TN.

Angliss, R. P., and R. B. Outlaw. 2007. Alaska marine mammal stock assessments, 2006. U.S. Department of Commerce, NOAA Technical Memorandum NMFS-AFSC-168. 244 pp.

Bailey, E. P, and J. L. Trapp. 1983. A reconnaissance of breeding marine birds and mammals in the east-central Aleutian Islands, Kasatochi to the Islands of Four Mountains, summer 1982. U.S. Fish and Wildlife Service Report, Aleutian Islands Unit, Alaska Maritime National Wildlife Refuge, Adak, Alaska (unpublished). 83 pp. Available from Alaska Maritime National Wildlife Refuge, 95 Sterling Hwy, Homer, AK 99603.

Bodkin, J. L., A. M. Burdin and D. A. Ryazanov. 2000. Age- and sex-specific mortality and population structure in sea otters. Marine Mammal Science 16:201–219.

Boveng, P. L., J. L. Bengtson, D. E. Withrow, J. C. Cesarone, M. A. Simpkins, K. J. Frost and J. J. Burns. 2003. The abundance of harbor seals in the Gulf of Alaska. Marine Mammal Science 19:111–127.

Brueggeman, J. J., G. A. Green, R. A. Grotefendt and D. G. Chapman. 1988. Aerial surveys of sea otters in the northwestern Gulf of Alaska and southeastern Bering Sea. Prepared for Minerals Management Service and NOAA. Final Report. Contract 85-ABC-00093. 94 pp.

Burkanov, V. N., and T. R. Loughlin. 2005. Distribution and abundance of Steller sea lions, *Eumetopias jubatus*, on the Asian Coast, 1720's–2005. Marine Fisheries Review 67:1–62.

Byrd, G. V. 1984. Vascular vegetation of Buldir Island, Aleutian Islands, Alaska, compared to another Aleutian Island. Arctic 37:37–48.

Byrd, G. V., H. M. Renner and M. Renner. 2005. Distribution patterns and population trends of breeding seabirds in the Aleutian Islands. Fisheries Oceanography 14(Suppl. 1):139–159.

Calambokidis, J., B. L. Taylor, S. D. Carter, G. H. Steiger, P. K. Dawson and L. D. Antrim. 1987. Distribution and haul-out behavior of harbor seals in Glacier Bay, Alaska. Canadian Journal of Zoology 65:1391–1396.

Call, K. A., and T. R. Loughlin. 2005. An ecological classification of Alaskan Steller sea lion (*Eumetopias jubatus*) rookeries: A tool for conservation/management. Fisheries Oceanography 14(Suppl. 1):212–222.

Daniel, R. G., L. A. Jemsion, G. W. Pendleton and S. M. Crowley. 2003. Molting phenology of harbor seals on Tugidak Island, Alaska. Marine Mammal Science 19:128–140.

Day, R. H., T. J. Early and E. P. Knudtson. 1978. A bird and mammal survey of the west-central Aleutians, Summer 1977. U.S. Fish and Wildlife Service Report, Aleutian Islands National Wildlife Refuge, Adak, Alaska (unpublished). 205 pp, plus appendix. Available from Alaska Maritime National Wildlife Refuge, 95 Sterling Hwy, Homer, AK 99603.

DAY, R. H., B. E. LAWHEAD, T. J. EARLY AND E. B. RHODE. 1979. Results of a marine bird and mammal survey of the western Aleutian Islands, Summer 1978. U.S. Fish and Wildlife Service Report, Aleutian Islands National Wildlife Refuge, Adak, Alaska (unpublished). 243 pp. Available from Alaska Maritime National Wildlife Refuge, 95 Sterling Hwy, Homer, AK 99603.

DEMASTER, D. P., A. W. TRITES, P. CLAPHAM, S. MIZROCH, P. WADE, R. J. SMALL AND J. VER HOEF. 2006. The sequential megafaunal collapse hypothesis: Testing with existing data. Progress in Oceanography 68:329–342.

DOROFF, A. G., J. A. ESTES, M. T. TINKER, D. M. BURN AND T. J. EVANS. 2003. Sea otter population declines in the Aleutian Archipelago. Journal of Mammalogy 84:55–64.

DRAGOO, D., AND F. DEINES. 1983. Results of a bird and mammal survey in the west-central Aleutians, summer 1982. U.S. Fish and Wildlife Service Report, Aleutian Islands Unit, Alaska Maritime National Wildlife Refuge, Adak, Alaska (unpublished). 32 pp. Available from Alaska Maritime National Wildlife Refuge, 95 Sterling Hwy, Homer, AK 99603.

EARLY, T. J., J. BEALL, W. HENRY AND A. TABER. 1980. Results of bird and mammal surveys of the western Aleutians, Summer 1979. U.S. Fish and Wildlife Service Report, Aleutian Islands National Wildlife Refuge, Adak, Alaska (unpublished). 140 pp. Available from Alaska Maritime National Wildlife Refuge, 95 Sterling Hwy, Homer, AK 99603.

EARLY, T. J., K. HALL AND B. MINN. 1981. Results of a bird and mammal survey in the central Aleutian Islands, Summer 1980. U.S. Fish and Wildlife Service Report, Aleutian Islands National Wildlife Refuge, Adak, Alaska (unpublished). 185 pp. Available from Alaska Maritime National Wildlife Refuge, 95 Sterling Hwy, Homer, AK 99603.

ESTES, J. A., M. T. TINKER, T. M. WILLIAMS AND D. F. DOAK. 1998. Killer whale predation on sea otters linking oceanic and nearshore ecosystems. Science 282:473–476.

EVERITT, R. D., AND H. W. BRAHAM. 1980. Aerial survey of Pacific harbor seals in the southeastern Bering Sea. Northwest Science 54:281–288.

FADELY, B. S., B. W. ROBSON, J. T. STERLING, A. GREIG AND K. A. CALL. 2005. Immature Steller sea lion (*Eumetopias jubatus*) dive activity in relation to habitat features of the eastern Aleutian Islands. Fisheries Oceanography 14(Suppl. 1):243–258.

FISCUS, C. H., D. J. RUGH AND T. R. LOUGHLIN. 1981. Census of northern sea lion (*Eumetopias jubatus*) in central Aleutian Islands, Alaska, 17 June–15 July 1979. NOAA Technical Memorandum NMFS F/NWC-17. 109 pp.

FRITZ, L. W., AND C. STINCHCOMB. 2005. Aerial, ship, and land-based surveys of Steller sea lions (*Eumetopias jubatus*) in the western stock in Alaska, June and July 2003 and 2004. U.S. Department of Commerce, NOAA Technical Memorandum NMFS-AFSC-153. 56 pp.

FROST, K. J., L. F. LOWRY AND J. M. VER HOEF. 1999. Monitoring the trend of harbor seals in Prince William Sound, Alaska. Marine Mammal Science 15:494–506.

GIBSON, D. D., AND G. V. BYRD. 2007. Birds of the Aleutian Islands, Alaska. Series in Ornithology No. 1. The Nuttall Ornithological Club and the American Ornithologists' Union.

HOOVER-MILLER, A., C. JEZIERSKI, S. CONLON AND S. ATKINSON. 2006. Harbor seal population dynamics and responses to visitors in Aialik Bay, Alaska. 2005 Report to the Ocean Alaska Science and Learning Center and the National Park Service (unpublished). 44 pp. Available from the Alaska SeaLife Center, P. O. Box 1329, Seward. AK 99664.

HUNT, G. L., AND P. J. STABENO. 2005. Oceanography and ecology of the Aleutian Archipelago: spatial and temporal variation. Fisheries Oceanography 14(Suppl. 1):292–306.

JEMISON, L. A., AND B. P. KELLY. 2001. Pupping phenology and demography of harbor seals (*Phoca vitulina richardsi*) on Tugidak Island, Alaska. Marine Mammal Science 17:585–600.

JEMISON, L. A., G. W. PENDLETON, C. A. WILSON AND R. J. SMALL. 2006. Long-term trends in harbor seal numbers at Tugidak Island and Nanvak Bay, Alaska. Marine Mammal Science 22:339–360.

KENYON, K. W. 1960. Aerial survey of sea otters, eastern Aleutians, 3–5 March 1960. Proceedings Report, U.S. Fish and Wildlife Service, Branch of Wildlife Research, Seattle, Washington. 24 pp.

KENYON, K. W. 1962. Sea otter studies, population and distribution (with notes on the Steller sea lion and emperor goose). Proceedings Report, U.S. Fish and Wildlife Service, Branch of Wildlife Research, Seattle, Washington. 47 pp.

KENYON, K. W., AND D. W. RICE. 1961. Abundance and distribution of the Steller sea lion. Journal of Mammalogy 42:223–234.

KENYON, K. W., AND J. G. KING. 1965. Aerial survey of sea otters and other marine mammals, Alaska Peninsula and Aleutian Islands, 19 April to 9 May 1095. Proceedings Report, U.S. Fish and Wildlife Service, Bureau of Sport Fish and Wildlife, Seattle, WA. 52 pp.

LOGERWELL, E. A., K. AYDIN, S. BARBEAUX, E. BROWN, M. E. CONNERS, S. LOWE, J. W. ORR, I. ORTIZ, R. REUTER AND P. SPENCER. 2005. Geographic patterns in the demersal ichthyofauna of the Aleutian Islands. Fisheries Oceanography 14(Suppl. 1):93–112.

LOWRY, M. S. 1999. Counts of California sea lion (*Zalophus californianus*) pups from aerial color photographs and from the ground: A comparison of two methods. Marine Mammal Science 15:143–158.

MATHEWS, E. A., AND G. W. PENDLETON. 2006. Declines in harbor seal (*Phoca vitulina*) numbers in Glacier Bay National Park, 1982–2002. Marine Mammal Science 22:167–189.

MATHISEN, O. A., AND R. J. LOPP. 1963. Photographic census of the Steller sea lion herds in Alaska, 1956–58. U.S. Fish and Wildlife Service Special Report Fish. No. 424. 20 pp.

MURIE, O. J. 1959. Fauna of the Aleutian Islands and Alaska Peninsula. Pages 1–364 *in* O. J. Murie and V. B. Scheffer, eds. Fauna of the Aleutian Islands and Alaska Peninsula, with notes on invertebrates and fishes collected in the Aleutians, 1936–1938. North American Fauna 61. U.S. Fish and Wildlife Service, Washington, DC.

NRC (NATIONAL RESEARCH COUNCIL). 2003. Decline of the Steller sea lion in Alaskan waters: Untangling food webs and fishing nets. The National Academies Press, Washington, DC.

NYSEWANDER, D. R., D. J. FORSELL, P. A. BAIRD, D. J. SHIELDS, G. J. WEILER AND J. H. KOGAN. 1982. Marine bird and mammal survey of the eastern Aleutian Islands, summers of 1980–81. U.S. Fish and Wildlife Service Report, Aleutian Islands National Wildlife Refuge, Adak, Alaska (unpublished). 139 pp. Available from Alaska Maritime National Wildlife Refuge, 95 Sterling Hwy, Homer, AK 99603.

PITCHER, K. W. 1985. The harbor seal (*Phoca vitulina richardsi*). Pages 65–70 *in* J. J. Burns, K. J. Frost and L. L. Lowry, eds. Marine mammals species accounts. Game Technical Bulletin No. 7. Alaska Department of Fish and Game, Juneau, Alaska.

PITCHER, K. W. 1990. Major decline in number of harbor seals, *Phoca vitulina richardsi*, on Tugidak Island, Gulf of Alaska. Marine Mammal Science 6:121–134.

PITCHER, K. W., AND D. G. CALKINS. 1979. Biology of the harbor seal (*Phoca vitulina richardsi*) in the Gulf of Alaska. U.S. Department of Commerce, NOAA, OCSEAP Final Report 19(1983):231–310.

SEASE, J. L., J. P. LEWIS, D. C. MCALLISTER, R. L. MERRICK AND S. M. MELLO. 1993. Aerial and ship-based surveys of Steller sea lions (*Eumetopias jubatus)* in Southeast Alaska, the Gulf of Alaska, and Aleutian Islands during June and July 1992. U.S. Department of Commerce., NOAA Technical Memorandum NMFS-AFSC-17. 57 pp.

SINCLAIR, E. H., S. E. MOORE, N. A. FRIDAY, T. K. ZEPPELIN AND J. M. WAITE. 2005. Do patterns of Steller sea lion (*Eumetopias jubatus*) diet, population trend and cetacean occurrence reflect oceanographic domains from the Alaska Peninsula to the central Aleutian Islands? Fisheries Oceanography 14(Suppl. 1):223–242.

SPRINGER, A. M., J. A. ESTES, G. B. VAN VLIET, T. M. WILLIAMS, D. F. DOAK, E. M. DANNER, K. A. FORNEY AND B. PFISTER. 2003. Sequential megafaunal collapse in the North Pacific Ocean: An ongoing legacy of industrial whaling? Proceedings of the National Academy of Sciences 100:12223–12228.

SIMPKINS, M. A., D. E. WITHROW, J. C. CESARONE AND P. L. BOVENG. 2003. Stability in the proportion of harbor seals hauled out under locally ideal conditions. Marine Mammal Science 19:791–805.

SMALL, R. J., G. W. PENDLETON AND K. W. PITCHER. 2003. Trends in abundance of Alaska harbor seals, 1983–2001. Marine Mammal Science 19:96–114.

THOMPSON, P. M., AND J. HARWOOD. 1990. Methods for estimating the population size of common seals, *Phoca vitulina*. Journal of Applied Ecology 27:924–938.

TRITES, A. W., AND C. P. DONNELLY. 2003. The decline of Steller sea lions in Alaska: A review of the nutritional stress hypothesis. Mammalian Review 33:3–28.

WADE, P. R., V. N. BURKANOV, M. E. DAHLHEIM, N. A. FRIDAY, L. W. FRITZ, T. R. LOUGHLIN, S. A. MIZROCH, M. M. MUTO, D. W. RICE, L. G. BARRETT-LENNARD, N. A. BLACK, A. M. BURDIN, J. CALAMBOKIDIS, S. CERCHIO, J. K. B. FORD, J. K. JACOBSEN, C. O. MATKIN, D. R. MATKIN, A. V. MEHTA, R. J. SMALL, J. M. STRALEY, S. M. MCCLUSKEY, G. R. VAN BLARICOM AND P. J. CLAPHAM. 2007. Killer whales and marine mammal trends in the North Pacific—a re-examination of evidence for sequential megafauna collapse and the prey-switching hypothesis. Marine Mammal Science 23:766–802. http://dx.doi.org/10.1111/j.1748-7692.2006.00093.x

Received: 21 May 2007
Accepted: 13 April 2008

Appendix 1. Counts of harbor seals in the Aleutian Islands, Alaska, obtained through skiff–based surveys conducted during 1977–1982 (mid-May to mid-August; survey dates listed for each island) and aerial surveys in 1999 (6–15 August).

Region and island group	Island name	Latitude	Longitude	Count		Date	
				1999	1977–1982	Year	Day
Western Near Islands							
	Attu Island	52°55 N	172°55 E	120	913	1979	8, 10, 11 July
	Agattu Island	52°26 N	173°36 E	67	294	1979	5–7 July
	Alaid Island	52°45 N	173°54 E	43	205	1979	13, 14 July
	Nizki Island	52°44 N	173°59 E	21	103	1979	13, 14 July
	Shemya Island	52°43 N	174°07 E	8	116	1979	18 July
	Shemya Pass group	52°43 N	174°07 E	0	222	1979	13 July
Western Rat Islands							
	Buldir Island	52°21 N	175°56 E	0	22	1979	23 June
Central Rat Islands							
	Kiska Island	51°58 N	177°30 E	55	469	1978	26 July and 9–11 August
	Little Kiska Island	51°57 N	177°39 E	0	303	1978	12 August
	Tanadak Island	51°56 N	177°47 E	6	105	1978	12 August
	Segula Island	52°01 N	178°07 E	0	18	1979	24 July
	Khvostof Island	51°58 N	178°17 E	0	12	1979	24 July
	Pyramid Island	51°58 N	178°18 E	0	5	1979	24 July
	Rat Island	51°48 N	178°19 E	93	115	1982	1 July
	Davidof Island	51°58 N	178°21 E	0	46	1979	24 July
	Little Sitkin Island	51°57 N	178°31 E	50	14	1982	30 June
	Amchitka Island	51°32 N	179°00 E	158	900	1971	
	Semisopochnoi Island	51°55 N	179°36 E	5	265	1977	20–27 July

Continued.

Appendix 1. Continued.

Region and island group	Island name	Latitude	Longitude	Count		Date	
				1999	1977–1982	Year	Day
Central Delarof Islands							
	Amatignak Island	51°16 N	179°06 W	25	11	1977	1 August
	Dinkum Rocks	51°34 N	179°04 W	0	0	1977	31 July
	Ulak Island	51°22 N	178°57 W	25	2	1977	1 August
	Gareloi Island	51°48 N	178°48 W	0	2	1977	12–13 July
	Kavalaga Island	51°33 N	178°48 W	11	9	1977	30 July
	Ogliuga Island	51°36 N	178°39 W	36	25	1977	30 July
	Skagul Island	51°36 N	178°35 W	0	101	1977	30 July
	Tag Islands	51°33 N	178°34 W	4	0	1977	31 July
	Ilak Island	51°28 N	178°17 W	2	13	1977	31 July
Central Andreanof Islands							
	Tidgituk Island	51°38 N	178°00 W	0	10	1982	5 July
	Tanaga Island	51°48 N	177°53 W	98	521	1982	2–5 July
	Castle Island	51°39 N	177°40 W	11	18	1977	7 July
	Round Point	51°42 N	177°31 W	0	1	1982	4 June
	Sentry Rock	51°41 N	177°30 W	0	0	1977	7 July
	Bobrof Island	51°54 N	177°27 W	10	17	1977	9 July
	Kanaga Island	51°45 N	177°22 W	212	171	1977	5–8 July
	Adak Island	51°45 N	176°45 W	107	639	1980	3–8 June
	Kagalaska Island	51°48 N	176°21 W	35	99	1980	21–23 June
	Aziak Island	51°57 N	176°09 W	4	34	1980	26 June
	Little Tanaga Island	51°50 N	176°08 W	30	81	1980	23–24 June
	Asuksak Island	51°56 N	176°06 W	2	9	1980	26 June
	Great Sitkin Island	52°03 N	176°06 W	10	100	1980	15 July
	Tanaklak Island	51°57 N	176°06 W	0	8	1980	26 June

Continued.

Appendix 1. Continued.

Region and island group	Island name	Latitude	Longitude	Count		Date	
				1999	1977–1982	Year	Day
Central Andreanof Islands							
	Box Island	51°57 N	176°02 W	0	0	1980	26 June
	Kanu Island	51°56 N	176°02 W	0	8	1980	26 June
	Umak Island	51°53 N	176°02 W	18	46	1980	25 June
	Tagadak Island	51°57 N	176°00 W	0	16	1980	26 June
	Igitkin Island	51°59 N	175°54 W	0	39	1980	29 June
	Ulak Island	52°02 N	175°54 W	19	22	1980	29 June
	Anagaksik Island	51°51 N	175°53 W	0	0	1980	2 July
	Chugul Island	51°56 N	175°48 W	21	77	1980	2 July
	Tagalak Island	51°57 N	175°43 W	31	187	1980	14 July
	Fenimore Rock	51°58 N	175°32 W	0	0	1980	13 July
	Kasatochi Island	52°10 N	175°31 W	4	2	1980	13 July
	Ikiginak Island	51°58 N	175°29 W	0	18	1980	13 July
	Oglodak Island	51°59 N	175°27 W	11	46	1980	13 July
	Koniuji Island	52°13 N	175°08 W	15	2	1982	18–19 July
	Salt Island	52°10 N	174°38 W	19	1	1982	3 June
	Sagchudak Island	52°01 N	174°29 W	12	104	1982	14 July
	Egg Island	52°10 N	174°26 W	0	9	1977	31 July
	Amtagis Islands	52°01 N	174°25 W	6	0	1982	14 July
	Sadatanak Island	52°02 N	174°25 W	0	0	1982	15 July
	Amlia Island	52°04 N	173°30 W	206	110	1982	4–5 June and 17 July
	Tanadak Island	52°04 N	172°57 W	32	0	1982	5 June
	Seguam Island	52°19 N	172°30 W	3	0	1982	12 June

Continued.

Appendix 1. Continued.

Region and island group	Island name	Latitude	Longitude	Count		Date	
				1999	1977–1982	Year	Day
Central							
Islands of Four Mountains							
	Amukta Island	52°30 N	171°16 W	20	77	1982	13 June
	Chagulak Island	52°34 N	171°08 W	4	7	1982	17 June
	Yunaska Island	52°38 N	170°40 W	18	0	1982	18 June
	Carlisle Island	52°53 N	170°03 W	61	46	1982	20 June
	Herbert Island	52°49 N	169°56 W	15	13	1982	19 June
	Chuginadak Island	52°50 N	169°45 W	99	110	1982	28 June
	Kagamil Island	53°00 N	169°43 W	111	42	1982	26 June
	Uliaga Island	53°04 N	169°05 W	2	2	1982	23 June
Eastern							
Fox Islands							
	Breadloaf Island	52°49 N	169°03 W	7	1	1980	1 August
	Pancake Rock	52°56 N	169°01 W	28	0	1980	2 August
	Ananiuliak Island	53°00 N	168°54 W	0	3	1980	4–5 August
	Vsevidof Island	52°59 N	168°28 W	0	138	1980	24 July
	Kigul Island	53°02 N	168°26 W	4	224	1980	20–23 July
	Kigul Islets #1–5	53°02 N	168°26 W	2	17	1980	20–23 July
	Kigul Islets #6	53°02 N	168°26 W	13	0	1980	20–23 July
	Kigul Islets #7	53°02 N	168°26 W	20	0	1980	20–23 July
	The Pillars	53°11 N	168°14 W	0	0	1981	10–11 June
	Emerald Island	53°17 N	167°51 W	55	132	1981	27 June
	Ship Rock	53°22 N	167°50 W	41	34	1980	17–19 July
	Pustoi Island	53°23 N	167°49 W	0	34	1980	17–19 July
	Cape Izigan	53°14 N	167°39 W	0	0	1981	4–6 July
	Huddle Rocks	53°19 N	167°20 W	16	17	1981	10–13 July
	Seal Island and Sedanka Point	53°28 N	167°18 W	145	121	1981	17–19 July

Continued.

Appendix 1. Continued.

Region and island group	Island name	Latitude	Longitude	Count		Date	
				1999	1977–1982	Year	Day
Eastern Fox Islands							
	Akutan South & East Coasts	53°27 N	166°55 W	0	14	1980	3–5 June
	Ogangen Island	53°26 N	166°52 W	0	4	1981	14–17 July
	Peter Island	53°41 N	166°50 W	9	14	1981	17–21 June
	Wislow Island	54°00 N	166°43 W	0	0	1981	13 June
	Three Islands Bay	53°34 N	166°38 W	0	18	1981	18 July
	Kisselen/Erskine Bay Islets	53°43 N	166°34 W	27	53	1981	18 July
	Dushkot Island	53°45 N	166°30 W	16	0	1981	19 July
	Tanaskan Bay Islets	53°43 N	166°29 W	4	22	1981	18 July
	Round Island	53°46 N	166°23 W	11	33	1980	25–26 May
	Baby Islands	53°59 N	166°04 W	230	117	1980	17–23 May and 3–5 June
	Egg Island	53°51 N	166°03 W	25	0	1980	23–29 May
	Cape Morgan Islet	54°03 N	166°02 W	0	6	1980	3–5 June
	Puffin Island	54°08 N	165°31 W	7	18	1980	15–16 June
	Rootok Island	54°02 N	165°31 W	66	67	1980	3–5 July
	Poa Island	54°07 N	165°29 W	54	33	1980	14–16 June
	Tangik Island	54°08 N	165°29 W	19	23	1980	13 June
	Derbin Island	54°07 N	165°07 W	0	12	1980	18–19 June
	Kaligagan Island	54°08 N	164°55 W	45	245	1980	19–24 June
	Kaligagan Islets	54°08 N	164°55 W	24	125	1980	22 June and 2 July
	Aiktak Island	54°11 N	164°50 W	16	94	1980	25 June