

ABUNDANCE AND DISTRIBUTION OF MARINE MAMMALS
IN NORTHERN BRISTOL BAY

--A Status Report of the 1990 Marine Mammal
Monitoring Effort at Togiak National Wildlife
Refuge

BY
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KEY WORDS:

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Bristol Bay	radio transmitter
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haulout	Pacific walrus

A COOPERATIVE EFFORT BETWEEN

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SUMMARY

The number of walrus hauling out at Cape Peirce has declined since 1985. The peak walrus count in 1990 was 1474, the lowest peak since the haulout was re-established in 1981. The number of walrus at Round Island declined in 1987 and 1988, but increased in 1989 and 1990. The yellowfin sole fishery first arrived in northern Bristol bay in 1987 and returned again in 1988. The increase in vessel traffic and noise associated with this fishery may be a factor in the change in distribution and number of walrus in northern Bristol Bay.

Fifteen VHF and nine satellite-linked radio transmitters were deployed in 1990. Transmitted walrus were tracked during coastal flights and monitored for at the Cape Peirce and Round Island haulouts. Analysis of the transmitter data may clarify walrus movement patterns in Bristol Bay and determine the approximate time walrus spend hauled out and in the water.

Walrus carcasses on the beach were mapped during coastal survey flights in northern Bristol Bay. Continued monitoring of the coastline will detect significant increases in the number of carcasses and may imply an increase in mortality.

Number of seals in Nanvak Bay was significantly lower in 1990 than in 1975. This decline in abundance parallels harbor seal population trends throughout the state of Alaska; the causes of the decline are unknown and must be further investigated.

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 are two areas particularly rich in marine mammals, providing haulout areas for walrus (Odobenus rosmarus divergens), harbor seals (Phoca vitulina), spotted seals (Phoca largha) and northern sea lions (Eumetopias jubatus).

Round Island and Cape Peirce are the only two regularly used terrestrial haulouts for Pacific walrus in the United States. The female and young walrus that winter near Bristol and Kuskokwim bays migrate north in the spring, however the males remain behind and use the Cape Peirce and Round Island haulouts (Fay 1982). Cape Peirce was historically used as a haulout but was abandoned sometime during the first half of this century. Walrus began reusing the haulout in 1981 and have returned every summer since.

In 1987 and 1988 the number of walruses hauling out at Cape Peirce and Round Island declined. During this time fishing for yellowfin sole in northern Bristol Bay began, 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 yellowfin sole fishery resulted in the National Pacific Fisheries Management Council's (NPFMC) decision to temporarily limit the fishing activity near both Cape Peirce and Round Island. The U.S. Fish and Wildlife Service (USFWS) has commitments to NPFMC, the National Marine Fisheries Service (NMFS) and the Alaska Department of Fish and Game (ADFG) to continue monitoring the walruses at Cape Peirce in order to assess the effects of the fishery.

Harbor (and some spotted) seals haul out along the northern Bristol Bay coast, with highest concentrations at Nanvak Bay and Hagemeister Island. Nanvak Bay is the northern most 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 significantly over the past 15 years. Population trends examined in the Gulf of Alaska indicate a similar population decline. Limited data from Prince William Sound and the southeastern Bering Sea also suggests that since the mid 1970s harbor seal numbers have declined (Pitcher 1990).

The major haulouts for northern sea lions in northern Bristol Bay are on Round Island and at Cape Newenham. Sea lion populations have been monitored by ADFG staff at Round Island since the late 1970s. Sea lions at Cape Newenham have never been censused regularly; it is not known if pupping occurs there. From the late 1950s to the mid 1980s, sea lion numbers have declined throughout their range in Alaska (Twiss et al. 1988). In 1990 the northern sea lion was listed as a threatened species, making this a critical time to monitor sea lion haulout sites and identify all pupping areas.

During 1990 joint efforts between USFWS, Alaska Fish and Wildlife Research Center-Fairbanks (AFWRCF), ADFG, and NMFS have worked to determine abundance and distribution of walruses, seals, and northern sea lions in northern Bristol Bay. A continued cooperative effort will help insure responsible management of these species.

OBJECTIVES

1. Determine walrus abundance, number and average length of haulout peaks, and long-term population trends at Cape Peirce.
2. Establish baseline data on walrus behavioral response to aircraft and boat traffic.

3. Determine yearly changes in the number of walrus carcasses on the beaches of northern Bristol Bay. Determine the characteristics of carcass decay over time.
4. Assist AFWRCF in determining movements and distribution of walruses in northern Bristol Bay.
5. Support ongoing international walrus research through the collection and preservation of sensory organs from fresh carcasses.
6. Determine abundance, number of pups, peak numbers during pupping and molting and long-term population trends of seal haulout in Nanvak Bay.
7. Determine the location and numbers of harbor seal and sea lion haulouts in northern Bristol Bay.
8. Determine the number of sea lions that haul out at Cape Newenham.
9. Compile and computerize all walrus data gathered at Togiak Refuge (1985-1990).

STUDY AREA

The study area covers approximately 300 miles of coastline in southwest Alaska from Protection Point to Carter Spit (Fig. 1). Hagemeister Island (Alaska Maritime National Wildlife Refuge) and Walrus Islands State Game Sanctuary (ADFG) are also part of the study area. The Cape Peirce-Cape Newenham area is located approximately 120 miles southwest of Dillingham within Togiak National Wildlife Refuge. Steep, jagged cliffs above rock and sand beaches characterize the coastline in this area. Nanvak Bay is located two miles north of Cape Peirce Point.

METHODS

Walrus Haulout-Cape Peirce

Beaches where marine mammals haulout in the Cape Peirce area were checked daily and the following information recorded: date, time, weather (wind direction and speed, cloud cover, visibility, precipitation, temperature, barometric pressure), tide, beach conditions, number of animals hauled out, number of animals in the water, unusual scars or features on walruses.

Animals were counted using binoculars and a tally whacker from the same observation points each day to minimize inconsistencies. Each haulout was counted two times and the counts averaged. If the two counts were not within 5% of each other the animals were counted a third time and the two closest counts were averaged. Haulouts on Maggy Beach were photographed to verify ground counts.

Radio contact was made with personnel on Round Island each night to compare walrus activity at the two haulouts.

Behavioral Response to Disturbance

Seven flights were made over hauled out walruses at Cape Peirce. Flights varied in altitude and distance from the haulout. Walruses response to the flights were recorded and categorized based on Salter (1979):

- Level 1: Walruses raise heads or move bodies, seen as a wave or ripple within a group of walruses.
- Level 3: Walruses move toward water, usually stopping on the beach or at the waterline.
- Level 5: Walruses move directly into water, usually do not mill, and do not haul again for at least several hours.

The number of walruses disturbed at a particular level is multiplied by the value of that level. The product of these numbers determines the index category and associated severity of disturbance (Hessing & Sheffield 1989).

INDEX	SEVERITY OF DISTURBANCE
0-100	LOW
101-1000	MODERATE
1000+	SEVERE

Five flights were made in a Cessna 185, one in a Grumman widgeon and one in a Citabria. Altitudes ranged from 250 to 900 feet and lateral distance 1/4 to 1 mile from the hauled out walruses. Walruses response to an approaching boat was also documented.

Aerial Surveys

Eight surveys were flown along the northern Bristol Bay coast from late May through October in a Cessna 185 at an altitude of 200-300 feet and an airspeed of 110 knots. Location and numbers of marine mammals were recorded. Walrus, seal, and sea lion haulouts were photographed with slide film and the number of animals counted.

Marine mammal carcass locations were mapped and degree of decay was estimated. The coastline between Protection Point and Carter Spit was divided into 33 areas based on beach type (sand/gravel or rocky) and/or exposure. Islands (except for Hagemeister) were considered separate, single areas. Only one survey covered the area from Chagvan Bay to Carter Spit.

Three fresh walrus carcasses were marked at Cape Peirce and photographed once a week to determine characteristics of decay over time.

Immobilization and Radio-Tracking

Togiak Refuge staff assisted AFWRCF Biologist in the deployment of VHF and satellite-linked radio transmitters at Cape Seniavin, Round Island and Cape Peirce. During the coastal survey flights transmittered walruses were tracked with VHF Telonics and ATS receivers. From June 1 to September 24 the haulouts at Cape Peirce were monitored daily from the ground with a VHF receiver.

Tissue Collection

Sensory organs (eyes, tongue, vibrissae and ear tubes) were collected from two fresh walrus carcasses at Cape Peirce. Tissues were stored in a 10% formalin solution and sent to Ron Kastelein, walrus biologist at the Harderwijk Marine Mammal Park, Holland.

Seal Haulout-Nanvak Bay

An observation point was established on North Spit to census the seal haulout on the mid-bay bars in Nanvak Bay. A Klepper kayak was used to cross Nanvak channel and access North Spit. A secondary observation point 1/3 mile 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. Counts were made primarily with a 600mm spotting scope, occasionally with a pair of binoculars. Data recorded during the census were: date, time, weather, tide, number of seals hauled out, number in the water, number of pups, wounded or scarred seals.

Data Organization

Walrus census data from Cape Peirce and Round Island, 1985-1990, and seal census data from Nanvak Bay, 1990, was compiled, corrected, and entered on the refuge computer using Lotus 123.

RESULTS

Walruses

Abundance/Haulout Patterns-Cape Peirce: Walrus haulout beaches were censused daily at Cape Peirce from May 7-September 24. The census was not done on 5 days during this period. Walruses began hauling out at Cape Peirce on May 10, but the numbers were low and sporadic until July 13, after which time 100 animals or more were usually present on at least one of the beaches. Maximum number of walruses hauled out was 1474 on August 15. Twelve peaks in the number of walruses hauled out occurred between June 7 and September 24 (Fig. 2). Length of haulout periods (the number of days from one low count to the next) ranged from 4 to 12 days with a mean length of 6 days. Number of days between peaks ranged from 3 to 35 days with a mean of 7.92 days (Table 1).

Walruses primarily hauled out on South Firebaugh Beach and Odobenus Cove, the smaller, more protected beaches below the cliffs (Fig. 3). On August 14 walruses began hauling out on Maggy Beach, the large, sandy, exposed beach located 2 miles north of Cape Peirce Point. Although used extensively in past years, Maggy Beach was used only 12 times in 1990.

Other Walrus Observations: During the aerial surveys, one walrus was seen hauled out on Asigyukpak Spit and 75 walruses were seen hauled out on Big Twin. Walruses were observed in the water near Hagemeister Island, Rugged Point, and the tip of Cape Newenham.

Disturbances: Seven aircraft and one boat disturbance were documented between June 23 and August 31. Four of the 7 aircraft disturbances were intentional. Six of the disturbances occurred on South Firebaugh Beach and two occurred on Maggy Beach. The severity of disturbance ranged from low to moderate (Table 2).

Aerial Surveys: Eight aerial surveys of northern Bristol Bay were flown between May 31 and October 16, however the September 24 and October 16 surveys were incomplete. Five of the surveys began about 2 miles south of Tvativak Bay on the northwest edge of the Nushagak Peninsula, two surveys began at Protection Point and one at Togiak Bay. Area 5 (Metervik Bay to Right Hand Point), area 21 (Security Cove to Chagvan Bay) and area 31 (Black Rock) were each only surveyed 4 times.

Low level flights were not made over the Cape Peirce and Round Island haulouts during the coastal surveys. As a result the Maggy Beach section of area 17 was only surveyed once from the ground in June. Twenty four carcasses were counted on the sand beach between the base of the cliffs and the mouth of Nanvak Bay. These carcasses were represented in Figure 4 but were not included in Table 3.

Carcass Locations: Eight areas were identified where walrus carcasses concentrate: area 11 (Togiak Bay to Tongue Point), area 12 (Tongue Point to Osviak Bay), area 14 (Asigyukpak Spit to Shaiak Island), area 17 (Cape Peirce Point to the northern end of North Spit), area 25 (the southeastern side of Hagemeister Island), area 27 (Summit Island), area 28 (High Island), and area 29 (Crooked Island) (Fig. 4). The highest concentration occurred along the southeastern side of Hagemeister Island (mean: 12, standard deviation: 4.2, number of surveys: 7). The maximum number of carcasses observed during a survey was 54 on the August 3-4 survey (Table 3). Most of the concentration areas were on sand/gravel beaches with a southeast exposure (Table 4).

Transmitters: Fifteen VHF and 9 satellite-linked radio transmitters were deployed in Bristol Bay. Seven different transmittered walruses were observed 30 times at Cape Peirce in 1990 (Table 5). One transmitter seen was not emitting a signal and so the walrus was not identified. One VHF and two satellite transmitters were shed by the end of September and one VHF transmitter stopped functioning in mid September.

Seals

Abundance/Haulout Patterns - Nanvak Bay: Seals hauling out in Nanvak Bay were censused daily from April 25-September 23. The census was not done 13 days during this period. Seals began hauling out on the mid-bay bars on April 28. The bars were used exclusively until August 19 when seals began to use North Spit as well. North Spit was the most heavily used haulout from late August to mid September. Six to ten seals were often seen hauled out on the rocks below Rugged Point east of Cape Peirce Point, however this area was not censused regularly. The number of seals in the bay increased throughout the season until a peak of 470 animals was reached on August 28 (Fig. 5). Both harbor and spotted seals haul out in Nanvak Bay, however the percentage of each was not determined in 1990.

Pupping: In general, harbor seals pup from late May to early July. The first pups in Nanvak Bay were observed on June 1 and the number increased until a high count of 19 was recorded on July 5 (Fig. 6). It is unknown how many of these pups were born in the bay, however one pup was seen with amniotic sac still attached on June 14. The peak haulout during this period was 145 seals on June 14.

Molting: By late July most of the seals in Nanvak Bay appeared to be molting. Molting probably peaks in late August and early September (Johnson 1976). The peak haulout count for the molting period as well as the high count for the year occurred on August 28 with a total of 470 animals hauled out on the mid-bay bars and North Spit.

Haulout Locations: The coastal surveys identified other haulout areas of harbor (and possibly spotted) seals in northern Bristol Bay (Fig. 7). Small (<100 animals) regularly used hauling areas include: Metervik Bay, Estus Point, Pyrite Point, Rugged Point, the southern coast of Cape Newenham, the western coast of Security Cove, the north-eastern coast of Hagemeister Island, the southern and western coasts of High Island, the southern end of Crooked Island and Black Rock. The two largest (>100 animals) hauling areas are in Nanvak Bay and on the south-western tip of Hagemeister Island.

Sea Lions

The northern sea lion haulout at the tip of Cape Newenham was surveyed nine times from May 31 to December 18. The high count of 489 animals occurred on June 23, the low count of 30 on December 18 (Table 6).

DISCUSSION

Walrus

Limitations of data: Many 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 2500 walrus were observed on Maggy beach (Annual Narrative, Togiak N.W.R. 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 many volunteers rotated through the field camp and censused the walrus, producing inconsistent counts. A photo was enlarged of the peak haulout in 1986. The ground estimate proved to be 35% to 40% higher than the estimate from the photo (11800 ground estimate vs 7100-7500 photo estimate). As a result, the 1984-1986 peak estimates are probably high.

The primary purpose of the Cape Peirce field camp from 1984 through 1986 was to maintain a presence in order to deter wasteful taking of walrus. Walrus counts became more reliable from 1987 through 1990 as personnel at Cape Peirce remained the entire season and focused on obtaining accurate counts.

The Round Island walrus census is 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 (Taylor pers. comm.).

With these limitations in mind, the haulout numbers from Cape Peirce and Round Island have been used to determine approximate

abundance, general patterns in haulout behavior and population trends over time.

Abundance/Haulout Patterns: The number of walruses using the Cape Peirce haulout steadily increased from 1981 to 1985, when a high count of 12,500 walruses was recorded. Numbers declined in 1986 and declined further in 1987 and 1988. In 1989 and 1990 a more drastic reduction in the number of walruses at Cape Peirce was observed. The 1990 peak of 1474 walrus was the lowest recorded since the haulout was re-established in 1981.

A comparison of the monthly peaks from 1985 to 1990 at both haulouts indicate large numbers at Cape Peirce in 1985 and large numbers at Cape Peirce and Round Island in 1986 (Fig. 8 & 9). In 1987 the number of walruses at both haulouts declined and this trend continued in 1988. In 1989 and 1990 the numbers of walruses at Round Island increased while haulouts at Cape Peirce continued to decline.

Coincident with the decline in walruses in 1987 was the initiation of the yellowfin sole fishery in the waters surrounding Round Island. Vessel traffic increased significantly; the fishery returned again in 1988 but was not present in northern Bristol Bay in 1989 or 1990. ADFG personnel on Round Island reported hearing loud noises from yellowfin sole vessels operating near the island (Hessing and Brant 1988). The increase in vessel traffic and noise in 1987 and 1988 may be a factor in the change in distribution and number of walruses hauling out in northern Bristol Bay.

Seasonal peaks at Cape Peirce typically occur later in the year (July-August) than do the peaks at Round Island (May-early July). This may be due in part to the walruses movement north in the fall to join the females that are moving south ahead of the ice edge.

Movement of walruses between Cape Peirce and Round Island has been confirmed through telemetry studies (Hills 1987 & 1990, Sheffield 1988), however the degree of interchange and the amount of time walruses spend in and out of the water is unknown. Research Biologist Sue Hills is analyzing VHF and satellite-linked radio transmitter data collected from the walruses transmitted in Bristol Bay in 1990. Analysis may clarify walrus movement patterns in Bristol Bay and determine the approximate time walruses spend hauled out and in the water. This information will prove useful for walrus population estimates.

Behavioral Response to Disturbances: Based on the limited data available, an aircraft's lateral distance from hauled out walruses may be a more significant factor in disturbance than the altitude of the aircraft.

Carcass Concentrations: Walrus carcass concentration areas are predominantly on sand/gravel beaches with a southeast exposure. Currents and tides probably play a significant role in the movements of carcasses in the water and in their southeast deposition. During high tides and storms carcasses can be washed higher on sand/gravel beaches than on rocky beaches and are likely to remain there longer.

Seals

Limitations of Data: In 1975 an intensive study was done on the seal population in Nanvak Bay (Johnson 1976). From 1976 to 1983 occasional aerial surveys were flown over the Nanvak haulout, but not until 1984 were ground counts resumed. In order to accurately census the mid-bay bars haulout it is necessary to cross Nanvak channel and view the haulout from a high point on North Spit. From 1984 through 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 counted using both North Spit and Cape Peirce observation points.

Abundance/Haulout Patterns: Seal use of Nanvak Bay has changed significantly between 1975 and 1990. In 1975 an estimated 3100 seals were present in the bay in late August. The maximum number of pups observed was 36. Channel bar was used primarily as a birth site in June then used heavily during the molt. In 1990 the peak count for the season was 470 seals and 19 pups were observed. Channel bar was only used five times in late September.

The large decline in the seal population at the Nanvak Bay haulout parallels population trends observed in many parts of Alaska. A variety of factors may play a role in the decline, some of these include (Lowry 1990):

1. Changes in distribution
2. Disease or pollution
3. Subsistence harvest
4. Entanglement in nets or other debris
5. Incidental fishery take
6. Direct killing by fishermen
7. Changes in prey abundance and availability

The Nanvak Bay seal haulout is unique: it is the northern-most pupping area for harbor seals in Bristol Bay and as the season progresses, the number of seals increases until it peaks in late August/early September during the molt. These factors coupled with the significant population decline makes the Nanvak haulout one of great interest and importance.

Sea Lions

The two largest sea lion haulouts in northern Bristol Bay occur at Cape Newenham and on Round Island. As a threatened species that is declining throughout Alaska, it is important for the Refuge to monitor the sea lion haulout to contribute to the overall picture of sea lion biology.

RECOMMENDATIONS

1. Develop a comprehensive inter-/intra-agency inventory plan to monitor marine mammals in northern Bristol Bay.
2. Continue monitoring haulouts at Cape Peirce, coordinating efforts with ADFG.
3. Continue monitoring seals at Nanvak Bay. Develop a study plan for the capture/marketing of these seals to determine their movement patterns in Bristol Bay. Analyze the seal scat collected at the Nanvak Bay haulout to determine main prey species. Continue scat collection each year to detect changes in prey species.
4. Monitor the sea lion population on Cape Newenham; determine if pupping occurs at the haulout. Develop a study plan for the capture/marketing of these sea lions to determine movement patterns in Bristol Bay.
5. Continue bimonthly coastal survey flights to monitor marine mammal haulouts and carcass locations and numbers. Significant changes in the number of carcasses in Bristol Bay in summer may indicate a change in the mortality rate. Potential problems or significant changes in walrus mortality could be quickly realized and action taken immediately to determine the cause of the problem and the steps necessary to resolve it. Trends in the Bristol Bay walrus population may be indicative of trends occurring on a larger scale and could prove valuable to walrus management throughout the state
6. Continue monitoring walruses behavioral response to aircraft and boat traffic. This data will be useful in categorizing disturbances and in setting limits needed to protect haulout areas. This research should be expanded and continued both at Cape Peirce and Round Island.
7. Analyze the walrus carcass photographs taken at Cape Peirce to determine approximate stages of decay.
8. Compile and computerize sea lion data from Round Island to determine if number of sea lions hauling out has declined.

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LITERATURE CITED

- Fay, Francis H. 1982. Ecology and Biology of the Pacific Walrus, Odobenus Rosmarus Divergens Illiger. North American Fauna; no. 74. Dept. Int. Washington, D.C. 279p.
- Frost, K. J., L. F. Lowry, and J. J. Burns. 1982. Distribution of Marine Mammals in the Coastal Zone of the Bering Sea during Summer and Autumn. U.S. Dep. Commer., NOAA, OCSEAP Final Report 20(1983).
- Hessing, P., and J. Brant. 1988. Round Island field report. Unpubl. report, Alaska Dep. Fish and Game, Game Divs. Anchorage, Ak. 37p.
- Hessing, P., and G. Sheffield. 1989. Round Island field report. Unpubl. report, Alaska Dep. Fish and Game, Game Divs. Anchorage, Ak. 12p.
- Hills, Susan. 1987. Unpubl. field report, Alaska Fish and Wildlife Research Center, Fairbanks.
- Hills, Susan. 1990. Unpubl. field report, Alaska Fish and Wildlife Research Center, Fairbanks.
- Johnson, Brian W. 1976. Studies on the northernmost colonies of Pacific Harbor Seals, Phoca vitulina richardsi, in the eastern Bering Sea. Unpubl. manuscript, Alaska Dep. Fish and Game, Fairbanks. 67p.

- Lowry, L. F. 1990. Alaska's Seals and Sea Lions: Where Are They Going? Alaska's Wildlife, Alaska Dep. of Fish and Game. 20(5):37p.
- Pitcher, K. W. 1990. Major decline in number of harbor seals, Phoca Vitulina Richardsi, on Tugidak Island, Gulf of Alaska. Marine Mammal Sci. 6(2):121-134.
- Salter, R. E. 1979. Site Utilization, activity budgets, and disturbance responses of Atlantic Walruses during terrestrial haul-out. Canadian J. of Zoo. 57(6):1169-1180.
- Sheffield, Gay. 1988. Unpubl. field report, Alaska Fish and Wildl. Ser., Togiak N.W.R., Dillingham, Alaska.
- Togiak National Wildlife Refuge, Annual Narrative 1981. U.S. Fish and Wildl. Ser., Dillingham, AK. 99576.
- Twiss, J. R., R. J. Hofman, and J. W. Lentfer. 1988. Selected Marine Mammals of Alaska. Marine Mammal Commission, Washington, D.C. 275p.

PERSONAL COMMUNICATIONS

- Ken Taylor 1990. Wildlife Biologist, Alaska Dep. of Fish and Game, Wildlife Conservation. 1300 College Road, Fairbanks, AK 99701.

Table 1. Length of walrus haulout periods and number of days between haulout peaks at Cape Peirce, southwest Alaska, 1990.

Date of Peaks	Haulout Length (number of days)	Number of Days Between Peaks
June 10	7	35 8 10 6 3 4 3 8 8 3 7
July 15	5	
July 24	12	
August 4	5	
August 11	5	
August 15	4	
August 20	5	
August 24	4	
September 2	8	
September 11	6	
September 15	4	
September 23	7	
Range	4-12	3-35
Mean	6	8
Stand. Dev.	2.2	8.7

Table 2. Walrus response to aircraft and boat disturbances at Cape Peirce, southwest Alaska, 1990.

Date	Vehicle	Ht (ft)	Dist (miles) Estim.	Number of Walruses Hauled Out	Response	Severity
6/23	Cessna 185	500	3/4	6	All into water	6x5=30 Low
8/3	Cessna 185	400	1/4	350	All heads raise 50 move to water 7 enter water	293x1=293 50x3=150 7x5=35 TOT=478 Moderate
8/7	Cessna 185	800	1/2	175	130 heads raise	130x1=130 Moderate
8/9	Skiff	N/A	1/4	200	45 heads raise 50 orient to wtr 105 enter water	45x1=45 50x3=150 105x5=525 TOT=720 Moderate
8/10	Citabria	250	1/3	600	All heads raise 3 orient to wtr	597x1=597 3x3=9 TOT=606 Moderate
8/14	Grumman Widgeon	200	3/4	375	30 heads raise	30x1=30 Low
8/21	Cessna 185	900	1/3	370	All heads raise	370x1=370 Moderate
8/31	Cessna 185	750	1	130	65 heads raise	65x1=65 LOW

Table 3. Number of walrus carcasses observed per area during coastal survey flights from Protection Point to Chagvan Bay, southwest Alaska, May-October 1990.

AREA ¹	5/31	6/23	7/13	8/3-4	8/19	9/6	9/24	10/16	N	MEAN	STAND DEV.
1	-	-	-	-	0	-	0	-	2	0.0	0.0
2	-	-	-	-	1	-	1	-	2	1.0	0.0
3	0	1	1	1	0	0	-	-	6	0.5	0.5
4	0	0	1	0	2	1	-	-	6	0.7	0.7
5	1	0	-	-	5	2	-	-	4	1.8	1.6
6	0	0	1	0	2	1	-	-	6	0.7	0.7
7	0	0	0	0	1	0	-	-	6	0.2	0.4
8	0	0	1	0	3	1	-	-	6	0.8	1.1
9	0	0	0	0	0	2	-	-	6	0.3	0.7
10	0	0	0	0	0	0	-	0	7	0.0	0.0
11	1	2	1	6	5	3	-	1	7	2.7	1.9
12	1	0	2	4	6	3	2	1	8	2.4	1.8
13	1	1	3	3	1	1	0	1	8	1.4	1.0
14	1	0	5	6	4	4	4	4	8	3.5	1.9
15	0	1	1	1	0	1	1	0	8	0.6	0.5
16	0	0	1	0	0	0	0	-	7	0.1	0.3
17+	0	0	0	0	0	0	0	0	8	0.0	0.0
18	0	0	0	0	0	0	0	0	8	0.0	0.0
19	3	4	4	-	0	0	1	0	7	1.7	1.7
20	0	1	0	0	0	0	0	0	8	0.1	0.3
21	-	1	-	-	1	0	0	-	4	0.4	0.5
22	0	0	0	0	0	1	0	-	7	0.1	0.3
23	0	0	0	0	1	0	1	-	7	0.3	0.5
24	0	2	3	3	1	0	0	-	7	1.3	1.3
25	5	8	9	16	15	16	15	-	7	12.0	4.2
26	1	0	1	1	1	1	0	-	7	0.7	0.5
27	-	0	3	4	2	4	-	-	5	2.2	1.7
28	-	1	5	4	0	-	0	-	5	2.0	2.1
29	1	2	4	3	0	-	4	-	6	2.3	1.5
30	-	0	0	1	0	-	0	-	5	0.2	0.4
31	-	0	0	0	0	-	-	-	4	0.0	0.0
32	-	-	-	-	-	-	-	4	1	4.0	0.0
33	-	-	-	-	-	-	-	7	1	7.0	0.0
Total	15	24	48	54	51	41	29	18			

1 = see Figure 4 for areas

- = signifies no survey was conducted

+ = Maggy Beach section of Area 17 not surveyed during flights (24 carcasses observed on Maggy Beach during June ground count)

Table 4. Beach type and exposure of walrus carcass concentration areas, northern Bristol Bay, southwest Alaska, 1990.

Area ¹	Beach Type	Exposure
11	sand/gravel	southeast
12	sand/gravel	southeast
14	sand/gravel	southeast
17	sand/gravel	west
25	sand/gravel	southeast
27	sand/gravel rocky rocky	southwest southeast south
28	sand/gravel sand/gravel	southeast west
29	sand/gravel sand/gravel	east southwest

1 = see Figure 4 for location of areas

Table 5. Observations of transmitted walruses at Cape Peirce, southwest Alaska, June-September 1990

VHF Freq	Tagging Location	Satell Trnsmtr	Total # Days Present	¹ Trnsmtr Status
165.680	Cape Seniavin	Y	3	Lost Sat.
165.800	Round Island	Y	1	Both On
165.810	Cape Peirce	N	3	On
165.840	Round Island	Y	2	Lost VHF
165.890	Round Island	N	10	On
165.900	Cape Seniavin	N	10	Failed
Unknown	Unknown	N	1	Failed

1 = at last sighting
 Satell = Satellite
 Trnsmtr = Transmitter

Table 6. Observations of northern sea lion haulout at Cape Newenham, southwest Alaska, 1990.

Date	Estimate	Slide Count	Count Type
May 31	500	465	Aerial
June 14	275	---	Ground
June 23	600	489	Aerial
July 13	450	349	Aerial
August 3	275	---	Aerial
August 19	450	---	Aerial
August 24	70	---	Ground
September 7	---	236	Aerial
September 24	---	417	Aerial
October 16	450	376	Aerial
December 18	30	---	Aerial

--- = no data

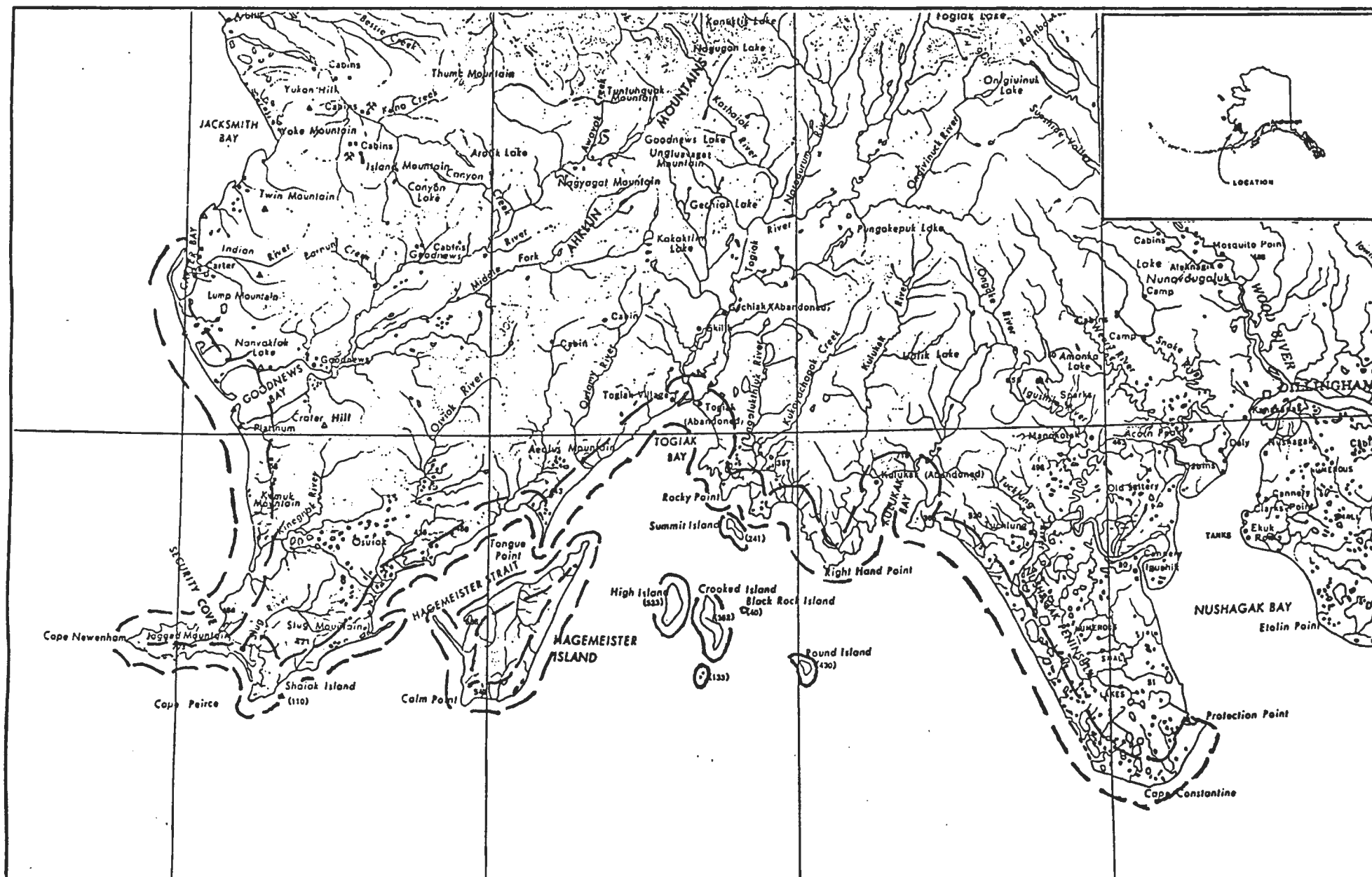
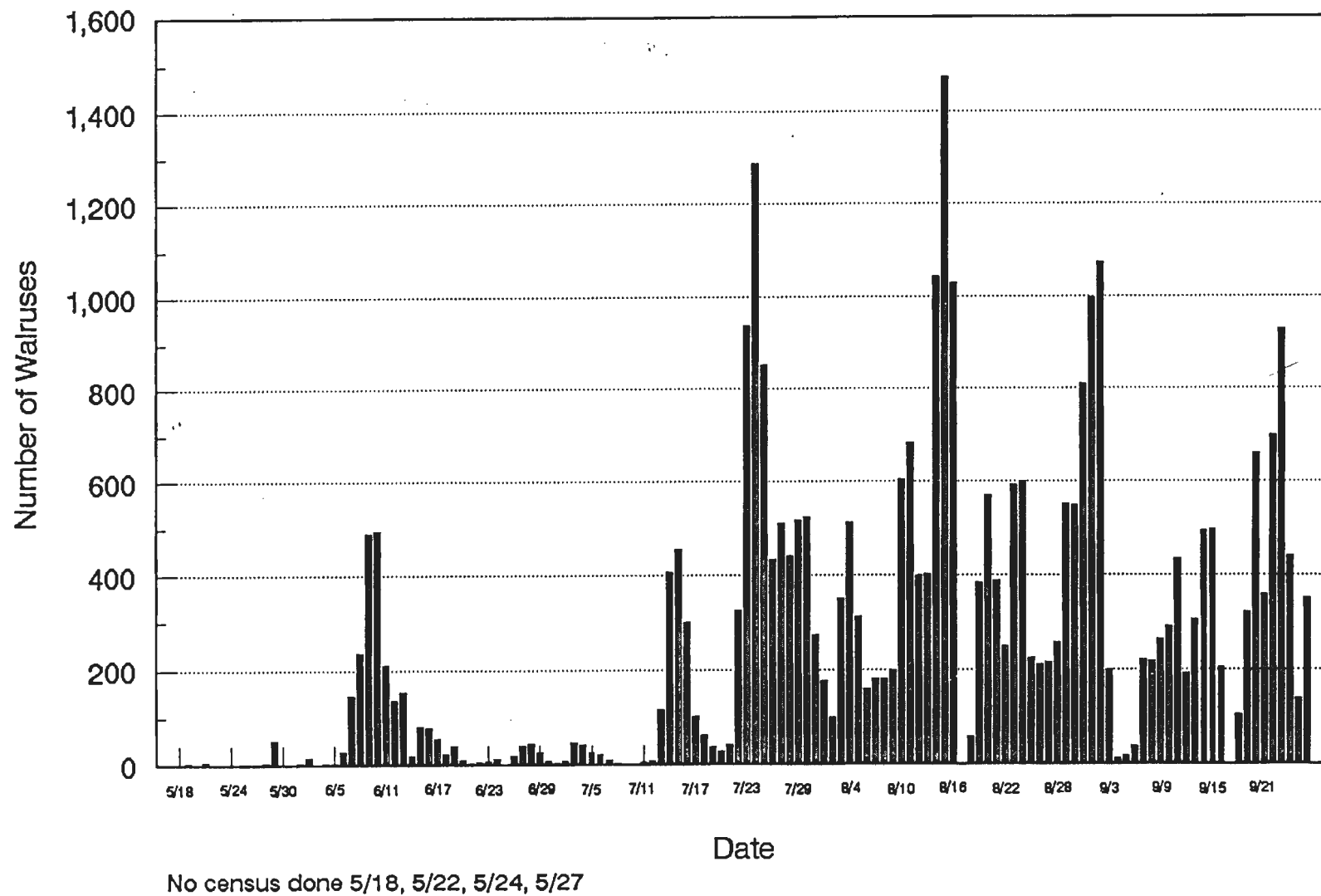


Figure 1. Location of marine mammal study area, southwest Alaska 1990.

Figure 2. Number of walrus hauled out at Cape Peirce, southwest Alaska, May-September 1990.



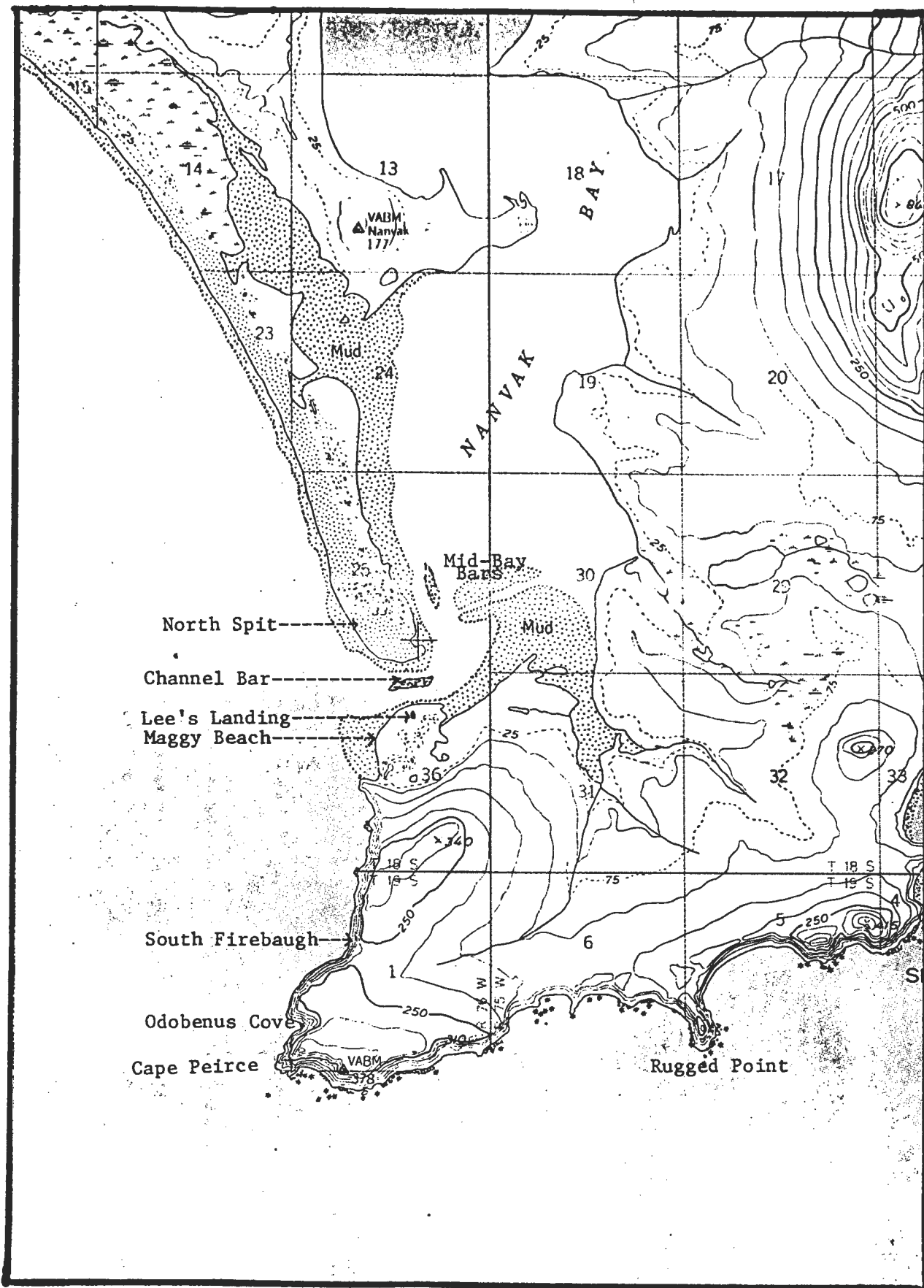


Figure 3. Cape Peirce- Nanvak Bay, southwest Alaska.

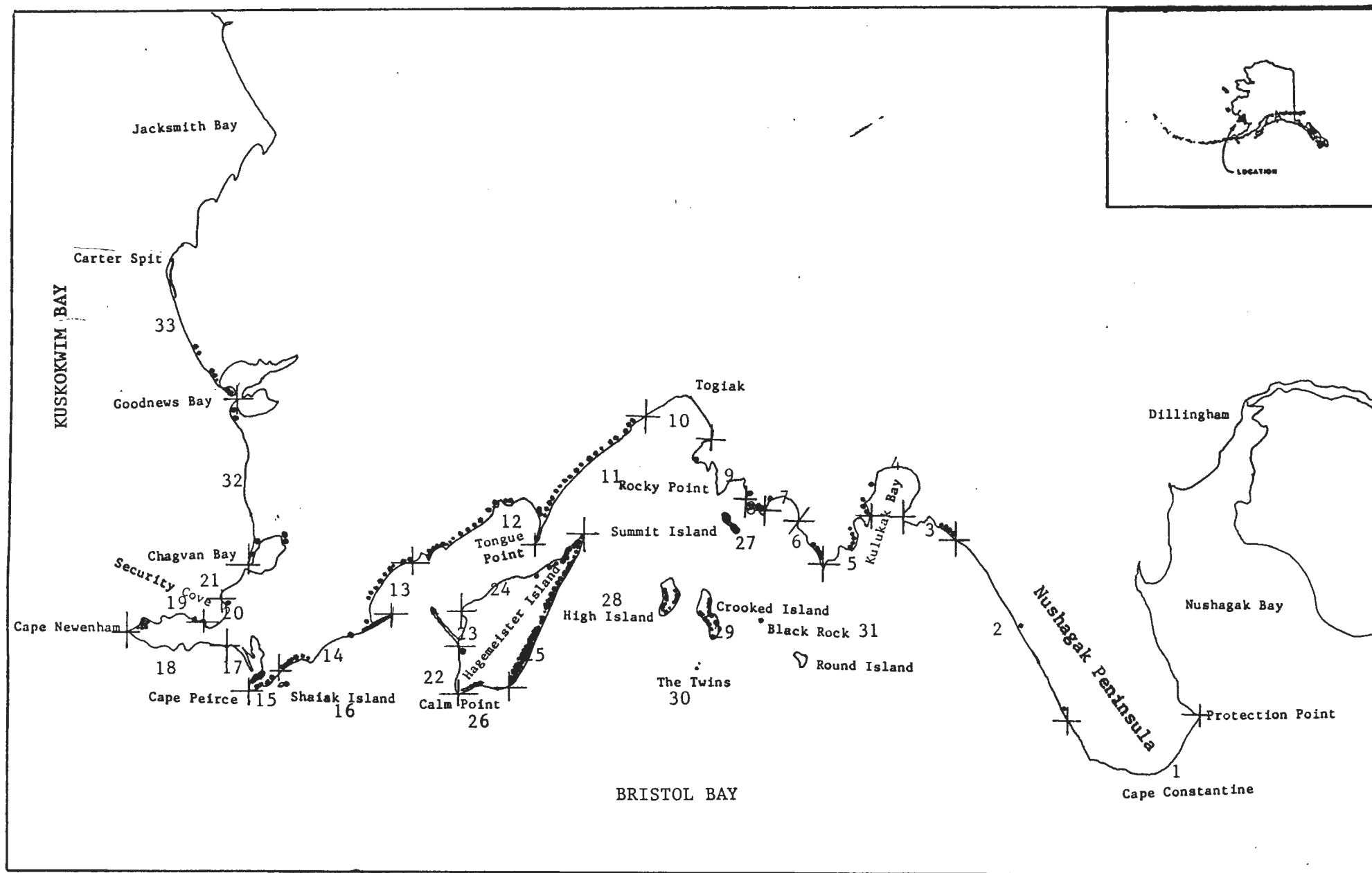
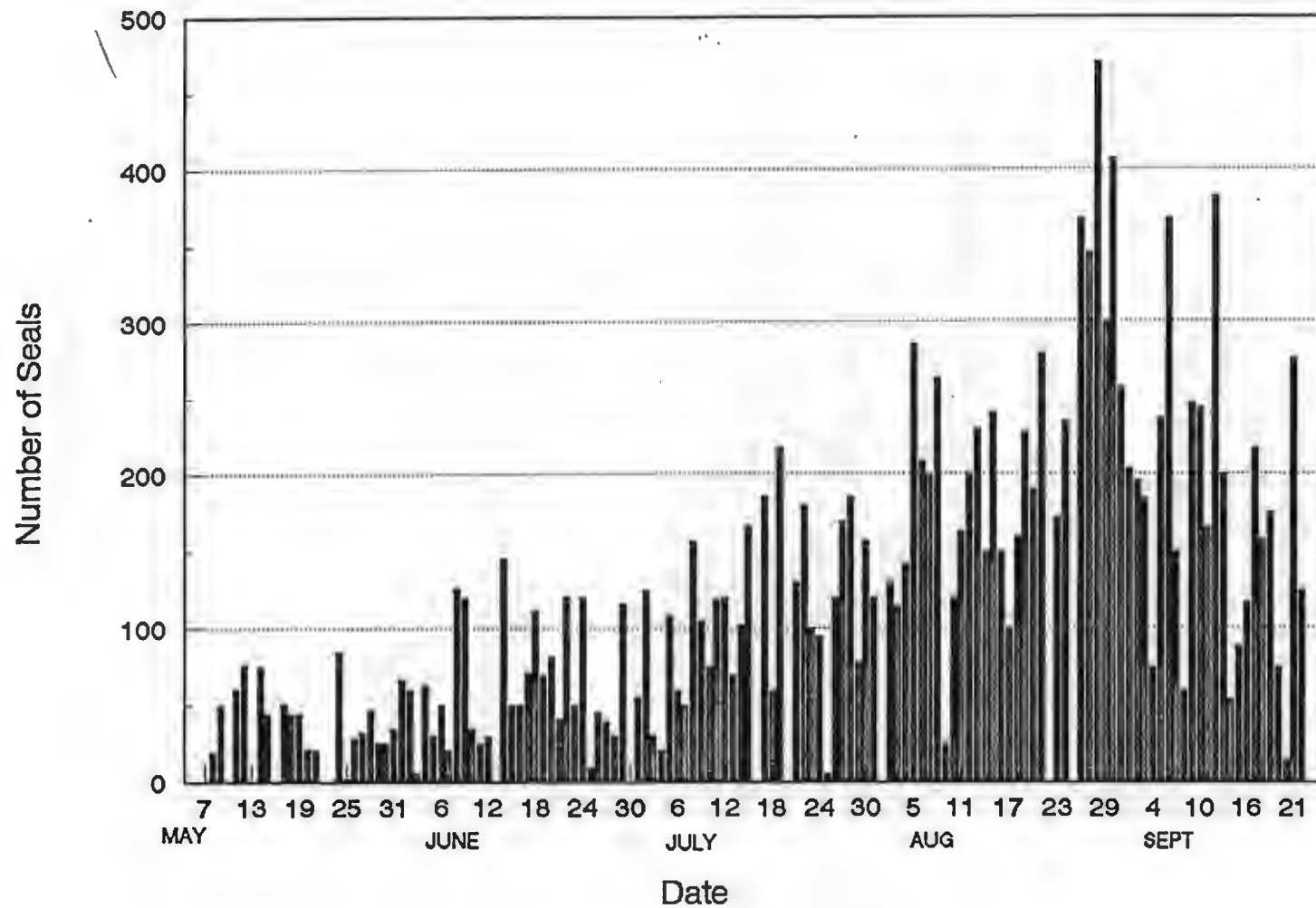


Figure 4. Survey areas and walrus carcass locations observed during aerial and ground surveys of northern Bristol Bay coast, southwest Alaska, May- October 1990.

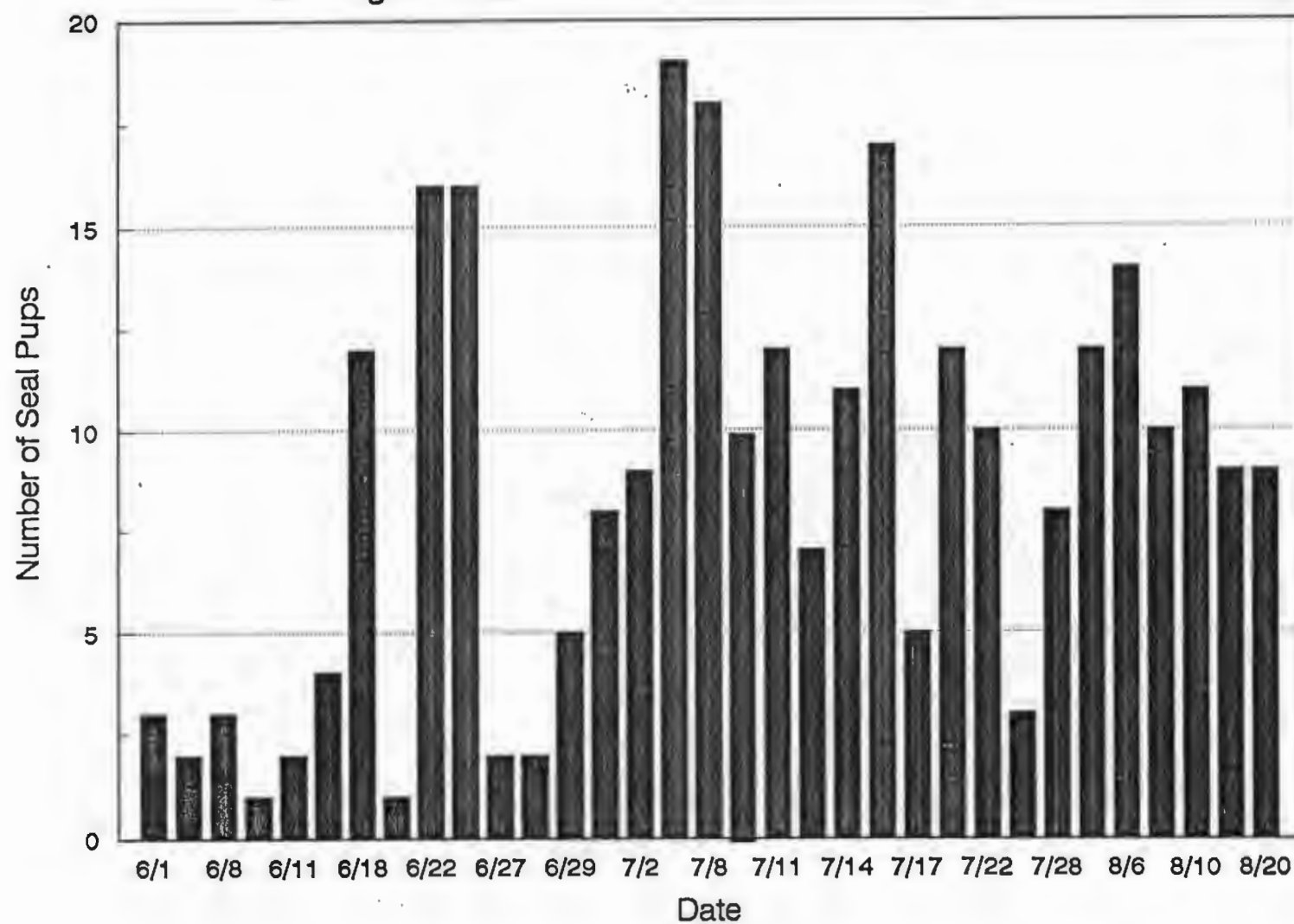
• = walrus carcass
 + = area division

Figure 5. Number of seals hauled out in Nanvak Bay, southwest Alaska, May-September 1990.



No census done 5/10, 5/13, 5/16, 6/13, 6/30, 7/3, 8/22, 8/25.

Figure 6. Number of harbor seal pups observed in Nanvak Bay, southwest Alaska, June-August 1990.



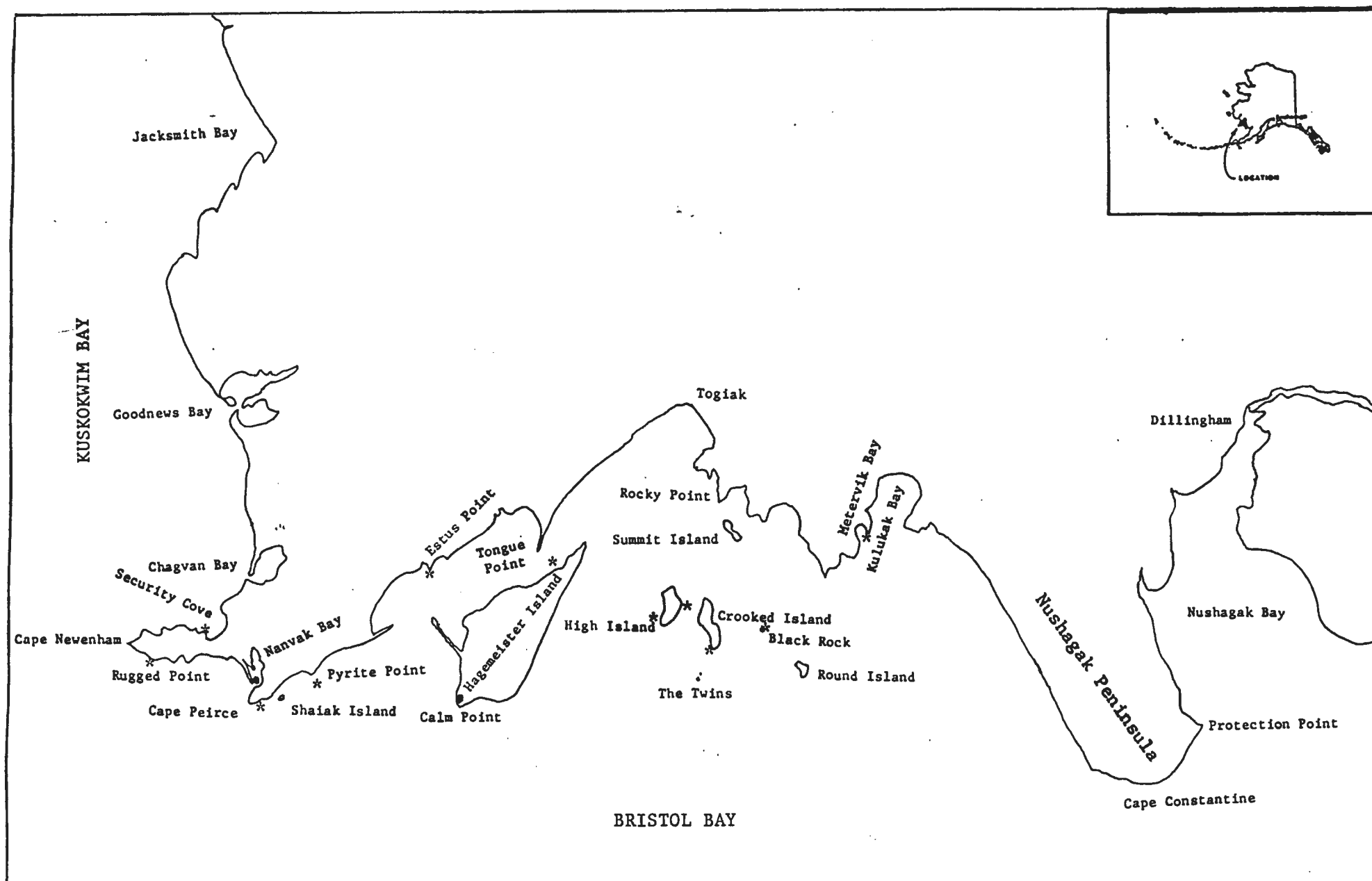


Figure 7. Haulout locations of seals in northern Bristol Bay, southwest Alaska 1990.

* = small concentrations (<100 seals)

• = large concentrations (>100 seals)

Figure 8. Monthly walrus haulout peaks at Cape Peirce 1985-1990.

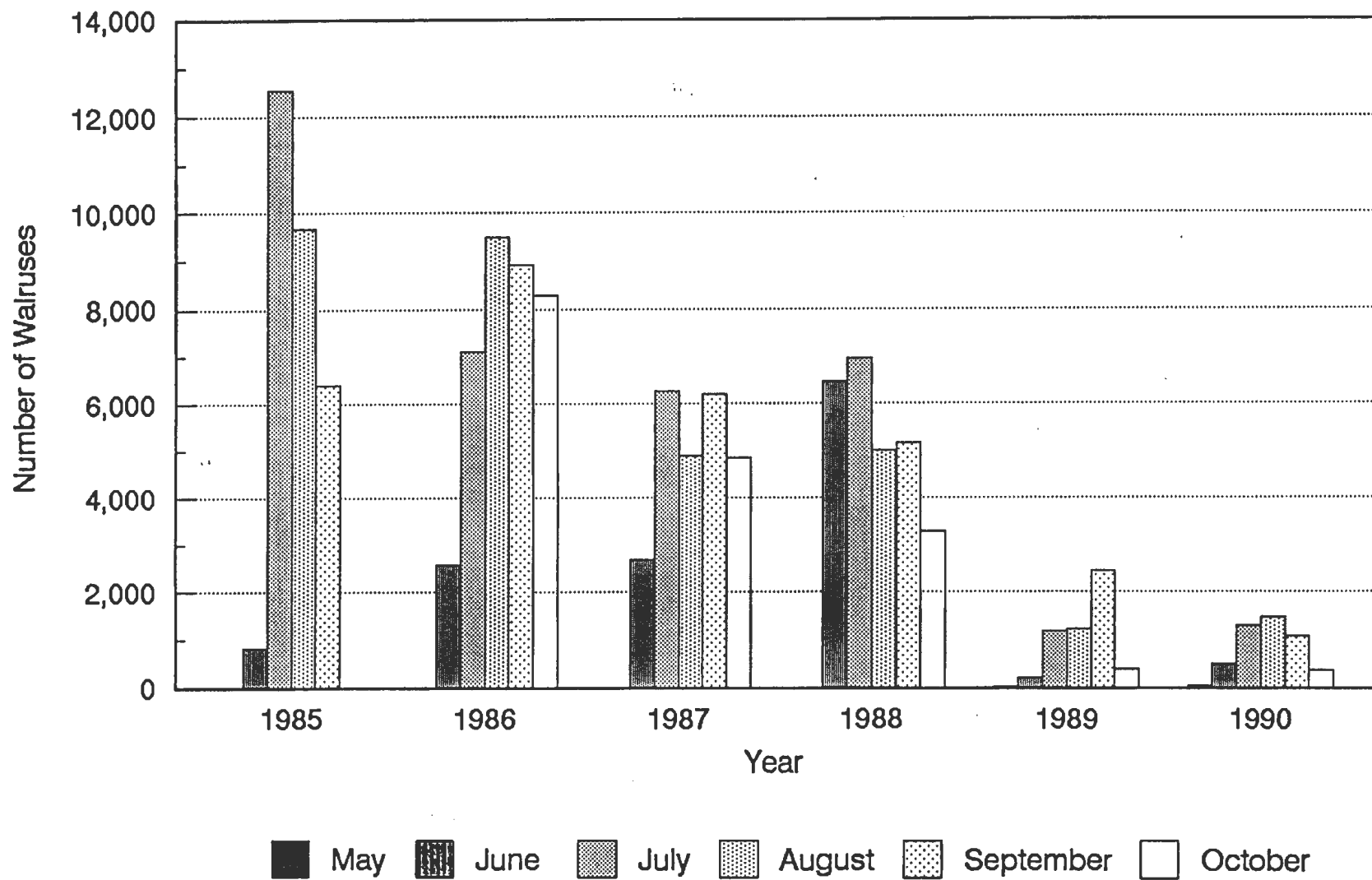
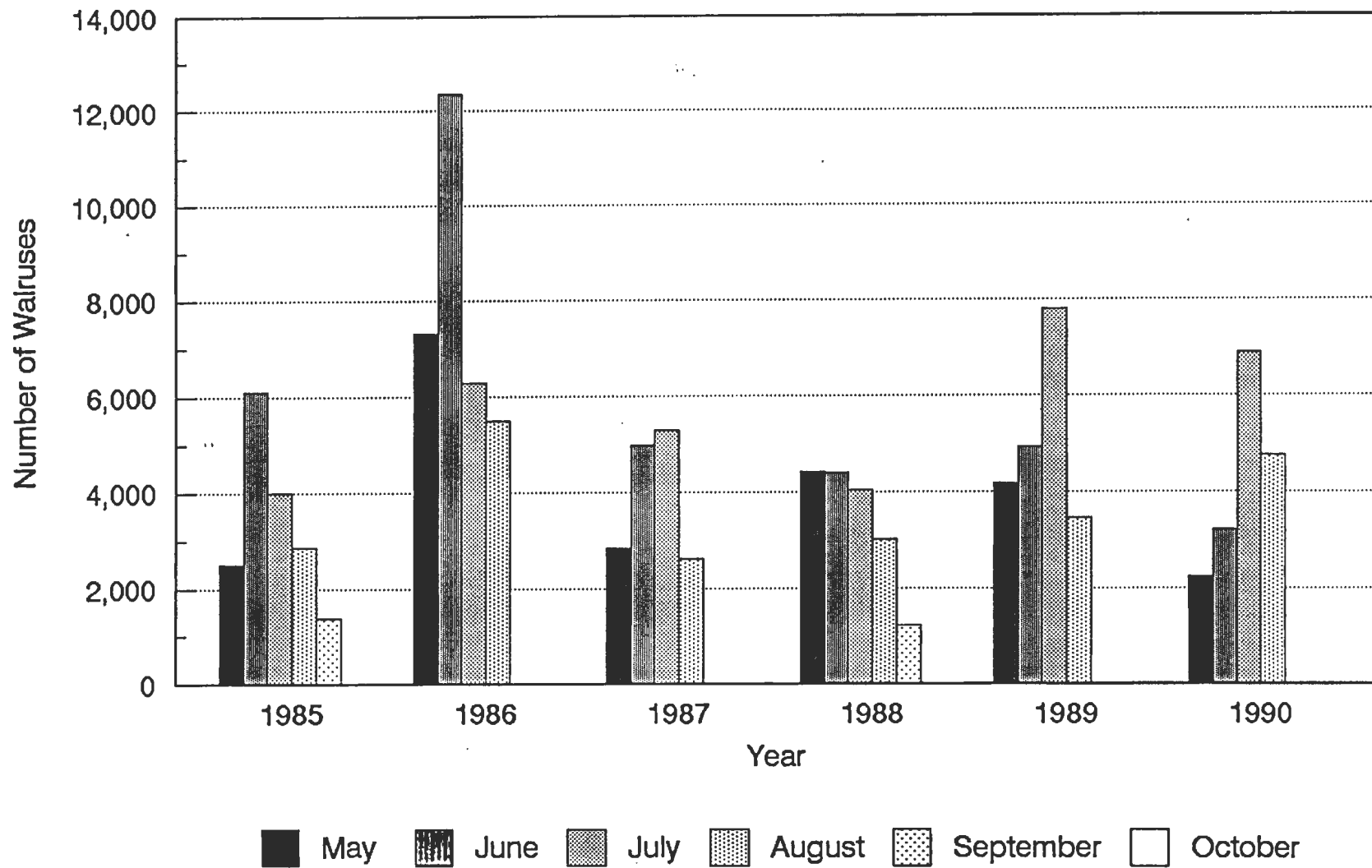


Figure 9. Monthly walrus haulout peaks at Round Island 1985-1990.



APPENDIX 1. WALRUS HAULOUT CENSUS DATA, CAPE PEIRCE AND ROUND ISLAND, SOUTHWEST ALASKA, APRIL-SEPTEMBER 1990.

DAY	MON	YR	TIME	CEILING	VSF	WIND	PC	TD	BAROM	TEMP	BC	LOC	#LND	#WTR	TOTCP	TRNCP	TOTRI	TRNRI
28	APR	90	2000	CLR	UNL	LV	N	L	29.28	0	SFB			12	12			
7	MAY	90	1730	OVC1000	5	S5	Y		28.67	0	OC			9	9		1195	830,930
9	MAY	90	1222	OVC1000	7	E5	N	H	29.08	6	OC			11	11		1450	680,820
10	MAY	90	1400	OVC200	5	LV	Y	M	28.85	2	OC		25		25		1396	
11	MAY	90	1400	OVC700	5	E5	Y	L	28.80	6	OC			13	13		1215	
12	MAY	90	1300	OVC500	7	E5	N	L	28.80	50	SFB			26	26		802	
13	MAY	90	1500	OVC1200	10	E7	Y	L	28.90	42	OC			5	5		853	
14	MAY	90	1400	OVC1500	7	E10	N	L	28.92	55	OC			10	10		2249	
15	MAY	90	1500	OVC900	7	E5	N	L	28.30	47	SFB		20	5	25		227	
16	MAY	90	1230	OVC700	5	E5	N	H	28.65	46	SFB		42	7	49		236	
17	MAY	90	1400	FOG250	1	SE5	N	H	28.50	43	SFB			5	5		221	
18	MAY	90		OVC500	7	LV	N	H	29.60	44					0		172	
19	MAY	90		OVC900	7	W5	N		29.89	40	OC			3	3		415	
20	MAY	90		OVC1500	7	W10	N		29.90	44					0		690	
21	MAY	90		OVC1500	7	W10	N		30.06	44	OC			7	7		550	670,740,840
22	MAY	90		OVC2500	10	E5	N		29.74	40					0		676	
23	MAY	90		OVC800	5	E5	N		29.72	50					0		342	800,880,890
24	MAY	90		OVC600	5	E5	Y		29.74	45					0		577	
25	MAY	90	1700	OVC1200	5	E15	Y		29.66	49	OC			2	2		229	
26	MAY	90		OVC900	5	E20	Y		29.72	47					0		251	
27	MAY	90		BRK2000	10	E20	N		29.53	57					0		413	890
28	MAY	90		BRK2500	UNL	E5	N		29.46	62	OC			5	5		21	
29	MAY	90		OVC1000	5	E5	N	L	29.51	52	SFB		51	2	53		200	
30	MAY	90		OVC1500	7	E20	N		29.56	51	OC			1	1		276	670,740,830
31	MAY	90		BRK2500	10	E10	N		29.61	58	OC			1	1		371	
1	JUN	90		CLR	UNL	CLM	N		29.32	60	SFB			3	3		707	840
2	JUN	90	2200	BRK3000	UNL	LV	N		30.09	55	MB			15	15		2246	680,880
3	JUN	90	1300	OVC3000	UNL	NE15	N	M	30.10	56					0		1138	800
4	JUN	90	1100	FOG200	1	S5	N	M	30.18	56	OC			4	4		1202	
5	JUN	90		CLR	UNL	W10	N		30.27	49	MB			3	3		1144	
6	JUN	90	1730	CLR	UNL	NW25	N	L	30.08	48	3 OC,SFB		17	12	29		1058	
7	JUN	90	1725	OVC800	7	NW20	N	L	30.15	49	3 OC,SFB		147		147		918	
8	JUN	90	1613	OVC900	5	SW5	N	L	30.05	48	2 OC,SFB		233	4	237		662	
9	JUN	90	1728	OVC850	15	S5	Y	L	29.97	53	0 SFB		455	35	490		827	
10	JUN	90	2300	BRK3000	UNL	LV	N	M	29.93	47	0 SFB		490	5	495		259	740,900
11	JUN	90	1735	OVC350	5	W7	Y	L	30.40	54	1 SFB		210		210		728	680,740,800,880,900
12	JUN	90	1730	CLR	UNL	W7	N	L	30.40	50	1 SFB		125	12	137		1178	680,800,830
13	JUN	90	750	BRK4000	UNL	S5	Y	M	30.01	45	1 SFB		136	17	153		925	
14	JUN	90	1130	OVC400	7	W20	N	H	30.13	40	3 SFB		13	8	21		887	
15	JUN	90	1830	OVC400	5	E10	Y	L	29.70	46	1 SFB		75	7	82		2009	
16	JUN	90	1900	OVC200	3	LV	N	L	29.79	50	1 SFB		74	5	79		884	
17	JUN	90	1910	FOG500	5	LV	N	L	29.90	55	1 SFB		54	3	57		2905	
18	JUN	90	1500	BRK4000	UNL	LV	N	M	30.03	58	1 SC		25		25		2778	
19	JUN	90	1030	BRK2000	30	NE5	N	M	30.05	50	2 SC		40		40		2972	
20	JUN	90	1130	BRK1600	25	W15	N	M	30.01	48	3 SC		7	4	11		2052	800,840
21	JUN	90	1600	OVC800	5	SW15	Y	M	30.00	45	2 PAR			5	5		887	
22	JUN	90		OVC400	3	SW7	Y		29.04	47	1 OC		1	6	7		1077	
23	JUN	90	1530	CLR	UNL	SW5	N	M	29.92	60	2 SFB		6	3	9		592	
24	JUN	90	1520	BRK1600	25	E15	N	M	29.95	45	2 SFB		14		14		1379	
25	JUN	90	1500	FOG200	2	LV	Y	M	29.90	45	1 MB				0		888	
26	JUN	90	1340	FOG150	2	LV	N	M	30.19	48	1 MB			20	20		4374	
27	JUN	90	2100	OVC100	1	CLM	Y	L	30.29	50	0 SFB		40		40		2585	740,780
28	JUN	90	1730	FOG100	1	CLM	N	L	29.99	55	1 SFB		45		45		3233	740,800
29	JUN	90	1400	BRK3000	UNL	SE10	N	M	29.77	54	2 SC		16	12	28		1649	

VSF=VISIBILITY, PC=PRECIPITATION, TD=TIDE, BC=BEACH CONDITIONS, OC=ODOBENUS COVE, SFB=SOUTH FIREBAUGH, MB=MAGGY BEACH, PAR=PARLIER

APPENDIX 1. WALRUS HAULOUT CENSUS DATA, CAPE PEIRCE AND ROUND ISLAND, SOUTHWEST ALASKA, APRIL-SEPTEMBER 1990.

DAY	MON	YR	TIME	CEILING	VSB	WIND	PC	TD	BAROM	TEMP	BC	LOC	#LND	#WTR	TOTCP	TRNCP	TOTRI	TRNRI
30	JUN	90	1500	OVC500	5	SE15	Y	M	29.70	50	1	SC	6	3	9		904	
1	JUL	90	1100	OVC600	5	SE3	Y	H	29.80	50	2	SFB	1	2	3		621	890
2	JUL	90	1800	BRK4000	UNL	CLM	N	L	30.13	60	0	SFB	1	8	9		1026	
3	JUL	90	1045	OVC250	2	S7	Y	H	30.20	50	1	OC,SFB	46	2	48		1105	830
4	JUL	90	1550	OVC400	7	CLM	Y	M	29.92	55	1	OC	43	1	44		1435	
5	JUL	90	1450	OVC500	5	LV	Y	M	29.81	50	1	OC	25	1	26		2840	
6	JUL	90	1800	OVC500	7	CLM	Y	L	29.92	12	1	SFB	22		22		2969	680,740,800
7	JUL	90	1800	OVC500	7	CLM	Y	L	29.92	20	1	OC	10		10		3022	
8	JUL	90	1100	BRK3000	UNL	W5	Y	H	29.78	25	1	OC	2	2	4		2347	840,890
9	JUL	90	1200	BRK4000	UNL	LV	N	M	29.74	23	1	NFB	1		1		487	
10	JUL	90	1300	OVC300	3	W10	Y	M	29.85	23	2				0		677	
11	JUL	90	1200	OVC600	7	W10	Y	M	29.98	18	2	SFB		6	6		897	
12	JUL	90	1500	BRK3500	UNL	LV	N	M	30.08	12	1	SFB		8	8		1008	
13	JUL	90	1035	CLR	UNL	LV	N	H	30.10	21	1	OC	112	5	117		732	
14	JUL	90	1055	OVC2000	25	S7	N	H	29.95	25	2	OC	402	7	409		606	740
15	JUL	90	1050	CLR	UNL	E5	N	H	30.01	19	2	OC	445	11	456		3378	
16	JUL	90	802	CLR	UNL	E5	N	M	30.20	24	1	OC	295	6	301		6891	800
17	JUL	90	1300	CLR	UNL	E15	N	M	30.39	21	1	OC	99	4	103		6850	
18	JUL	90	1942	CLR	UNL	SE20	N	L	30.40	29	3	OC	62	2	64		6075	740,840
19	JUL	90	1200	CLR	UNL	SE20	N	M	30.35	27	2	OC	38		38	680	2495	
20	JUL	90	1005	CLR	UNL	E15	N	H	30.30	28	2	OC	23	6	29	680	1936	
21	JUL	90	940	BRK2000	25	E25	N	H	30.10	18	2	OC	40	2	42	810	491	
22	JUL	90	2003	BRK3000	UNL	E20	N	L	29.93	21	2	OC	320	5	325	900	255	
23	JUL	90	1950	OVC500	3	E15	Y	L	29.73	13	1	OC,SFB	910	30	940		250	
24	JUL	90	1700	BRK3000	UNL	W10	N	M	29.71	19	2	OC,SFB	1247	41	1288		272	
25	JUL	90	910	OVC200	1	W7	Y	H	29.75	11	2	OC,SFB	796	59	855		801	
26	JUL	90	1830	OVC1000	7	NE15	Y	L	29.61	19	1	OC,SFB	435		435		946	
27	JUL	90	930	BRK2000	25	E7	Y	M	29.74	17	1	OC,SFB	496	15	511		664	
28	JUL	90	1900	BRK900	15	E5	N	L	29.74	21	1	OC,SFB	429	14	443		1298	
29	JUL	90	1915	OVC800	10	W5	N	L	29.88	21	1	OC,SFB	517	2	519		2017	
30	JUL	90	930	OVC1000	10	SE10	Y	M	29.90	12	1	OC,SFB	520	6	526		3885	
31	JUL	90	920	OVC500	4	E20	Y	L	29.85	16	2	OC,SFB	259	14	273		1152	
1	AUG	90	930	OVC1500	15	NW5	Y	M	29.90	16	1	SFB	175	1	176		707	
2	AUG	90	925	BRK2000	30	NW5	N	M	29.88	20	1	SFB	92	8	100		782	
3	AUG	90	1450	CLR	UNL	NW10	N	M	29.90	25	2	SFB	350		350		1358	
4	AUG	90	947	CLR	UNL	W5	N	H	29.80	27	1	SFB	495	19	514		1256	
5	AUG	90	1911	OVC500	20	CLM	Y	L	29.69	16	1	SFB	310	3	313		643	
6	AUG	90	1040	OVC1000	25	CLM	Y	H	29.71	15	3	SFB	154	6	160		1975	
7	AUG	90	1140	OVC800	15	E15	Y	H	29.71	17	1	SFB	175	5	180		1877	
8	AUG	90	1119	BRK2500	UNL	NE10	N	H	29.76	21	1	SFB	172	9	181		1473	740
9	AUG	90	1010	OVC800	5	NW7	N	H	29.74	22	2	SFB	200		200		4764	800
10	AUG	90	1538	CLR	UNL	E7	N	L	29.95	27	0	SFB	597	8	605	890	1627	800
11	AUG	90	1740	OVC900	3	E25	N	L	29.89	22	1	SFB	675	10	685	890	921	
12	AUG	90	931	OVC1800	15	E25	N	H	30.00	17	1	SFB	398	3	401	890	672	
13	AUG	90	920	CLR	UNL	SE7	N	H	30.20	29	1	SFB	400	4	404	890	1151	830
14	AUG	90	1544	OVC600	20	S7	Y	M	30.05	19	2	MB,SFB	1017	27	1044	810,890	973	
15	AUG	90	936	BRK1400	25	NW10	Y	M	29.95	25	2	MB,SFB	1450	24	1474	810	1635	830
16	AUG	90	927	OVC1000	15	E25	Y	M	29.05	17	2	MB,SFB	924	107	1031		373	
17	AUG	90	1400	OVC1000	5	S40	Y	M	29.38	12	3				0		98	830
18	AUG	90	938	OVC700	20	SW5	N	H	29.80	20	2	SFB	55	3	58		400	
19	AUG	90	1113	OVC800	20	SW7	Y	H	29.75	18	2	SFB	386		386		750	
20	AUG	90	1306	OVC900	20	SW10	N	M	29.88	16	2	SFB	564	8	572		2350	740,830
21	AUG	90	700	OVC800	15	E15	Y	H	30.03	15	2	SFB	360	30	390		2330	
22	AUG	90	1330	OVC500	2	SE25	Y	M	29.95	15	2	SFB	250		250		1056	

VSB=VISIBILITY, PC=PRECIPITATION, TD=TIDE, BC=BEACH CONDITIONS, OC=ODOBENUS COVE, SFB=SOUTH FIREBAUGH, MB=MAGGY BEACH, PAR=PARLIER

APPENDIX 1. WALRUS HAULOUT CENSUS DATA, CAPE PEIRCE AND ROUND ISLAND, SOUTHWEST ALASKA, APRIL-SEPTEMBER 1990.

DAY	MON	YR	TIME	CEILING	VSF	WIND	PC	TD	BAROM	TEMP	BC	LOC	#LND	#WTR	TOTCP	TRNCP	TOTRI	TRNRI
23	AUG	90	1655	OVC750	15	SE10	Y	L	30.38	16	1	SFB	591	3	594		2114	
24	AUG	90	1015	OVC2000	15	SE15	Y	H	30.32	14	1	SFB	583	19	602		2784	
25	AUG	90	1620	OVC500	5	SW40	Y	M	30.06	16	3	SFB	221	3	224		1484	
26	AUG	90	1336	OVC600	7	W35	Y	M	30.22	16	3	SFB	209	1	210		274	
27	AUG	90	1800	OVC1500	20	SW20	N	L	30.24	16	2	SFB	215		215		350	
28	AUG	90	1209	OVC2000	20	W25	N	M	30.24	16	3	SFB	254	3	257			
29	AUG	90	930	OVC1600	20	W15	Y	M	30.20	15	1	MB,SFB	552		552	900		
30	AUG	90	932	OVC800	10	W10	Y	M	30.19	13	2	MB,SFB	542	8	550	900,890		
31	AUG	90	1100	OVC1000	20	W5	Y	L	30.20	16	2	MB,SFB	793	18	811	900,890		
1	SEP	90	1045	OVC500	7	E5	Y	M	30.20	12	2	MB,SFB	978	20	998	900,890		
2	SEP	90	1247	OVC300	2	E7	Y	M	30.20	14	1	MB,SFB	1055	20	1075	900,890		
3	SEP	90	830	OVC1600	20	W35	Y	M	30.20	16	2	MB,SFB	197	3	200	900,890		
4	SEP	90	1800	OVC800	5	W30	Y	M	30.20	12	3	SFB	9	4	13	680		
5	SEP	90	959	OVC700	5	S40	Y	H	30.20	12	3	SFB	17	1	18			
6	SEP	90	1020	BRK2000	25	S15	N	H	30.20	10	3	SFB	39		39			
7	SEP	90	1400	OVC2000	15	E20	Y	M	30.20	14	1	SFB	218	1	219			
8	SEP	90	1003	OVC400	1	E25	Y	M	30.20	12	1	SFB	216	2	218			
9	SEP	90	1231	OVC800	5	SE35	Y	M	30.16	13	3	SFB	264		264	900		
10	SEP	90	1045	CLR	UNL	NW15	N	M	30.16	18	2	SFB	289	3	292	900		
11	SEP	90	1200	OVC1000	15	E15	Y	L	30.15	11	1	SFB	431	5	436	900		
12	SEP	90	1202	OVC900	15	W15	Y	M	30.15	12	2	SFB	191	1	192			
13	SEP	90	1200	BRK2500	UNL	W10	N	M	30.13	14	1	SFB,PA	304		304			
14	SEP	90	1222	OVC2500	UNL	W15	Y	M	30.11	12	2	MB,SFB	491	4	495			
15	SEP	90	907	BRK2500	UNL	E5	Y	H	30.11	12	1	MB,SFB	493	4	497			
16	SEP	90	1022	BRK2500	UNL	E25	Y	H	30.11	12	1	SFB	197	7	204			
17	SEP	90	1045	BRK3000	UNL	W40	Y	H	30.09	10	3	SFB		2	2			
18	SEP	90	1033	CLR	UNL	E5	N	H	30.09	13	2	SFB	98	7	105			
19	SEP	90	1100	OVC3000	UNL	E5	Y	H	30.09	12	1	SFB	315	5	320			
20	SEP	90	1330	OVC900	10	SE35	Y	M	30.09	10	1	SFB	650	10	660			
21	SEP	90	1111	OVC1700	15	S25	Y	H	30.09	11	3	SFB	357	3	360			
22	SEP	90	1200	CLR	UNL	W5	N	H	30.09	12	1	SFB	700		700			
23	SEP	90	1300	BRK2000	UNL	W25	N	M	30.09	10	2	MB,N+SF	928	3	931	800,840		
24	SEP	90										SFB	443		443	840		
29	SEP	90										SFB	140		140			
10	OCT	90										SFB	350		350			

VSF=VISIBILITY, PC=PRECIPITATION, TD=TIDE, BC=BEACH CONDITIONS, OC=ODOBENUS COVE, SFB=SOUTH FIREBAUGH, MB=MAGGY BEACH, PAR=PARLIER

APPENDIX 2. SEAL HAULOUT CENSUS DATA, NANVAK BAY, SOUTHWEST ALASKA, APRIL-OCTOBER 1990.

DAY MON YR TIME WIND PC TD LOC #PUPS #LND #WTR TOTCP CT LOC

25	APR	90	2200	E25	N	L	NB			1	1	WPD
26	APR	90	1100	E15	Y	H	NB			1	1	WPD
27	APR	90	1225	W10	N	H	NB			1	1	WPD
28	APR	90	2015	LV	N	L	SB	21	1		22	E
29	APR	90	2130	E5	Y	L	SB	20			20	WPD
30	APR	90	2230	LV	Y	L	SB	20			20	WPD
1	MAY	90	2000	W15	N	L	NB				0	WPD
2	MAY	90		W15	N							
3	MAY	90	1700	N15	N	L	NB				0	WPD
4	MAY	90	1200	CLM	N	L	SB	45			45	WPD
5	MAY	90		E20	N							
6	MAY	90	1730	E3	Y	L	NB		1		1	WPD
7	MAY	90	1745	S3	Y	L	NB				0	E
8	MAY	90	1618	LV	N	L	SB	16	3		19	WPD
9	MAY	90	1815	LV	Y	L	SB	50			50	WPD
10	MAY	90		E3	N							
11	MAY	90	1500	SE10	Y	L	SB	54	7		61	WPD
12	MAY	90	1500	SE3	N	H	SB	77			77	WPD
13	MAY	90		E3	N							
14	MAY	90	1900	E3	N	H	SB	68	7		75	WPD
15	MAY	90	2100	E7	Y	L	SB	45			45	E
16	MAY	90		E3	Y							
17	MAY	90	2000	SE7	Y	L	SB	50	1		51	WPD
18	MAY	90	1900	S13	N	L	SB	45			45	E
19	MAY	90	1900	W10	N	L	SB	45			45	E
20	MAY	90	2118	W15	N	L	SB	20	1		21	E
21	MAY	90	1800	LV	N	L	SB	20			20	E
22	MAY	90		E10	N	L						
23	MAY	90		E5	N	L						
24	MAY	90	1700	E10	Y	L	SB	85			85	NSD
25	MAY	90	1900	E15	Y	L	NB		2		2	WPD
26	MAY	90	1100	E10	Y	L	SB	23	5		28	WPD
27	MAY	90	1600	E20	N	L	SB	25	7		32	WPD
28	MAY	90	1700	E5	N	L	SB	45	2		47	WPD
29	MAY	90	1730	E5	N	L	SB	25			25	WPD
30	MAY	90	1745	E12	N	L	SB	25			25	WPD
31	MAY	90	1800	N3	N	L	SB	35			35	WPD
1	JUN	90	2100	CLM	N	L	SB	3	67		67	NSD
2	JUN	90		LV	N		SB	60			60	AC
3	JUN	90		NW15	N		NB		5		5	E
4	JUN	90		LV	N		SB	63			63	K
5	JUN	90		NW20	N		SB	30			30	E
6	JUN	90		NW20	N		SB	50			50	K
7	JUN	90		W25	N		SB	2	20		20	WPD
8	JUN	90		SW5	N		SB	3	124	2	126	NSD
9	JUN	90		LV	Y		SB	120			120	WPD
10	JUN	90		NW5	Y		SB	1	20	15	35	NSD
11	JUN	90		W7	Y		SB	2	21	4	25	NSD
12	JUN	90		SW7	N		SB	14	15		29	NSD
13	JUN	90										
14	JUN	90		W5	N		SB	4	141	4	145	NSD
15	JUN	90		LV	Y		SB	50			50	E
16	JUN	90		LV	N		SB	50			50	E
17	JUN	90		W5	N		SB	71			71	WPD

PC=PRECIP,TD=TIDE,NB & SB=MID-BAY BARS,NS(D)=NORTH SPIT(DUNE),CB=CHANNELBAR,CT LOC=LOC'N OF CT,WPD=WATCH PT DUNE,E=ESTIM,AC=AERIAL

APPENDIX 2. SEAL HAULOUT CENSUS DATA, NANVAK BAY, SOUTHWEST ALASKA, APRIL-OCTOBER 1990.

DAY	MON	YR	TIME	WIND	PC	TD	LOC	#PUPS	#LND	#WTR	TOTCP	CT	LOC
18	JUN	90		W5	N		SB	12	110	2	112	NSD	
19	JUN	90		NE5	Y		SB		70		70	E	
20	JUN	90		W20	Y		SB		81		81	WPD	
21	JUN	90		SW10	Y		SB	1	16	25	41	WPD	
22	JUN	90		SW10	Y		SB	16	121		121	NSD	
23	JUN	90		W5	N		SB		50		50	E	
24	JUN	90		E15	N		SB	16	118	2	120	NSD	
25	JUN	90		LV	Y		SB		9		9	E	
26	JUN	90		LV	N		SB		45		45	E	
27	JUN	90		SW5	Y		SB	2	35	4	39	E	
28	JUN	90		CLM	N		SB	2	25	5	30	E	
29	JUN	90		SE12	N		SB	5	115	1	116	NSD	
30	JUN	90											
1	JUL	90		CLM	N		SB	8	51	4	55	NSD	
2	JUL	90		E3	N		SB	9	121	4	125	NSD	
3	JUL	90							30		30	E	
4	JUL	90		CLM	Y		SB		20		20	E	
5	JUL	90		S5	Y		SB	19	105	3	108	NSD	
6	JUL	90		W5	Y		SB		60		60	E	
7	JUL	90		W15	N		SB		50		50	E	
8	JUL	90		W10	Y		SB	18	157		157	NSD	
9	JUL	90		NW10	N		SB	10	105		105	NSD	
10	JUL	90		W20	Y		SB		75		75	WPD	
11	JUL	90		W5	Y		SB	12	119		119	NSD	
12	JUL	90		SE5	N		SB	7	109	11	120	NSD	
13	JUL	90		CLM	N		SB		70		70	E	
14	JUL	90		E7	N		SB	11	103		103	NSD	
15	JUL	90		SE5	N		SB	17	152	15	167	NSD	
16	JUL	90											
17	JUL	90		S7	N		SB	5	186		186	NSD	
18	JUL	90		SE5	N		SB		60		60	E	
19	JUL	90		SE15	N		SB	12	207	10	217	NSD	
20	JUL	90											
21	JUL	90		E15	Y		SB		90	40	130	WPD	
22	JUL	90		E15	N		SB	10	180		180	NSD	
23	JUL	90		E10	Y		SB		100		100	E	
24	JUL	90		W15	N		SB	3	95		95	NSD	
25	JUL	90		E15	Y		SB		5		5	E	
26	JUL	90		NE15	Y		SB		120		120	NSD	
27	JUL	90		NE20	Y		SB		170		170	E	
28	JUL	90		W5	N		SB	8	176	9	185	NSD	
29	JUL	90		W5	N		SB		77	1	78	E	
30	JUL	90		E20	Y		SB		150	7	157	E	
31	JUL	90		E20	Y		SB		120		120	E	
1	AUG	90		SW10	Y		NB				0	E	
2	AUG	90		N5	N		SB		130		130	AC	
3	AUG	90		NW15	N		SB		115		115	AC	
4	AUG	90		W5	N		SB		142		142	K	
5	AUG	90		SW5	Y		SB	12	285		285	NSD	
6	AUG	90		E10	Y		SB	14	199	10	209	NSD	
7	AUG	90		NE10	Y		SB		200		200	E	
8	AUG	90		N15	N		SB	10	263		263	NSD	
9	AUG	90		CLM	N		NB			25	25	NSD	
10	AUG	90		W10	N		SB	11	120		120	NSD	

PC=PRECIP,TD=TIDE,NB & SB=MID-BAY BARS,NS(D)=NORTH SPIT(DUNE),CB=CHANNELBAR,CT LOC=LOC'N OF CT,WPD=WATCH PT DUNE,E=ESTIM,AC=AERIAL

APPENDIX 2. SEAL HAULOUT CENSUS DATA, NANVAK BAY, SOUTHWEST ALASKA, APRIL-OCTOBER 1990.

DAY MON YR TIME WIND PC TD LOC #PUPS #LND #WTR TOTCP CT LOC

11	AUG	90	E25	N	SB		163		163	E
12	AUG	90	SE15	N	SB		200		200	WPD
13	AUG	90	SE5	N	SB		229		229	WPD
14	AUG	90	CLM	Y	SB		150		150	E
15	AUG	90	NW10	Y	SB	9	240		240	NSD
16	AUG	90	E35	Y	SB		150		150	E
17	AUG	90	SW20	Y	SB		100		100	E
18	AUG	90	SW5	N	SB		152	8	160	WPD
19	AUG	90	SW10	Y	SB,NS	9	223	4	227	WPD
20	AUG	90	SW5	Y	SB,NS		190		190	WPD
21	AUG	90	E20	Y	SB		279		279	WPD
22	AUG	90								
23	AUG	90	SE5	Y	SB		169	3	172	WPD
24	AUG	90	SE5	Y	SB		223	11	234	WPD
25	AUG	90								
26	AUG	90	W15	Y	NS		366	1	367	WPD
27	AUG	90	W20	N	NS		345		345	WPD
28	AUG	90	W25	N	NS		470		470	WPD
29	AUG	90	W10	Y	NS		300		300	WPD
30	AUG	90	SW15	Y	NS		407		407	WPD
31	AUG	90	SW10	Y	SB,NS		243	14	257	WPD
1	SEP	90	E15	Y	SB		203		203	WPD
2	SEP	90	E5	Y	SB		196		196	WPD
3	SEP	90	W30	Y	SB,NS		184		184	WPD
4	SEP	90		Y	SB		75		75	E
5	SEP	90		Y	NS		233	3	236	WPD
6	SEP	90		N	NS		367		367	WPD
7	SEP	90		Y	SB		150		150	E
8	SEP	90		Y	SB		60		60	WPD
9	SEP	90		Y	NS		246		246	WPD
10	SEP	90		N	NS		243		243	WPD
11	SEP	90		Y	SB		166		166	WPD
12	SEP	90		Y	NS		382		382	WPD
13	SEP	90		N	NS		200		200	K
14	SEP	90		Y	NS		54		54	E
15	SEP	90		Y	NS		89		89	WPD
16	SEP	90		Y	SB		117		117	WPD
17	SEP	90		Y	NS		216		216	WPD
18	SEP	90		N	SB,NS		158		158	WPD
19	SEP	90		Y	SB		175		175	E
20	SEP	90		Y	SB		75		75	E
21	SEP	90		Y	SB		14		14	
21	SEP	90		Y	SB,NS		275		275	WPD
22	SEP	90		N	NS		125		125	K
23	SEP	90		Y	CB		61		61	K
2	OCT	90		N	CB		80		80	AC