HARBOR SEAL CENSUSES IN GLACIER BAY NATIONAL PARK AND PRESERVE: A COMPARISON OF LAND-BASED AND AERIAL CENSUSING

FINAL REPORT

Submitted to

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by

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ABSTRACT

Land-based counts and, for the first time, aerial photographs were used to census seals in Glacier Bay National Park. Based on the sum of maximum counts, the minimum population estimate for harbor seals is 7,622. The sum of the mean counts in August was 5,973 (95% confidence interval = 4,715 to 7,248). The vast majority (up to 5,801) of harbor seals are found in Johns Hopkins Inlet, a tidewater glacier where seals rest and pup on floating ice bergs. Several terrestrial haulouts are found throughout lower regions of the bay, but the Spider Island reefs in the Beardslee Islands support the second largest aggregation of seals in the park (at least 1,094 seals). Counts from aerial photographs of seals on reefs near Spider Island were consistently higher (by an average of 55%) than simultaneous counts by observers from low-level observation sites. Historic data on harbor seals in the park from as early as 1973 (Streveler 1979, NPS Report; Calambokidis et al. *1987) are summarized and discussed.*

I. INTRODUCTION

Background

The general goal of the work described in this report was to develop and standardize censusing methods for harbor seals in Glacier Bay National Park (GLBA) for long-term monitoring. I also wanted to ensure that methods would be consistent with those used in a statewide pinniped monitoring project being conducted by the National Marine Mammal Lab (NMML). This project was jointly funded by Glacier Bay National Park and the National Marine Mammal Lab and the specific objectives were to: 1) determine a minimum population estimate for harbor seals in GLBA, 2) determine pupping rates at ice and land haulouts, 3) develop standardized censusing protocols, 4) test the use of aerial photography for counting seals at terrestrial haulouts, 5) summarize historic data on seals in the park, and 6) begin compiling a reference library and computerized bibliographic database on harbor seals for the park.

Status of Harbor Seals and Northern Sea Lions In Alaska

Harbor seals *(Phoca vitulina richardsi)* inhabit coastal waters in Alaska from Southeast Alaska to the Aleutian Islands and the Bering Sea (Hoover 1988). Previously considered abundant, surveys in the 1980's indicated declines as great as 86% (Pitcher 1990) in parts of Alaska from southcentral portions of the state to the west (Pitcher 1986, 1989). Harbor seal declines appear to parallel the extreme decline observed in northern sea lion *(Eumetopias jubatus)* populations in the central Gulf of Alaska and areas to the west (Braham, *et al.* 1980, Merrick *et al.* 1987, Loughlin *et al.* 1990). In 1990 the northern, or Steller, sea lion was declared threatened under the Endangered Species Act. While the rate of the harbor seal declines appears to have slowed (Hoover-Miller, in press), harbor seal and northern sea lion numbers in the Gulf and to the west are substantially lower than they were in the early 1970's. Conversely, harbor seal numbers in Southeast Alaska appear stable at least from the 1970's (Hoover-Miller, in press), and there is even some evidence of a population increase in sea lions (Loughlin *et al.* 1992b). However, census data for Southeast Alaska are currently considered inadequate for evaluating the status of harbor seals in this area (Hoover-Miller, in press).

Periodic studies of harbor seals in Glacier Bay have produced valuable information on reproductive timing, diurnal patterns, and other aspects of seal biology and behavior (Streveler 1979, NPS Report; Calambokidis

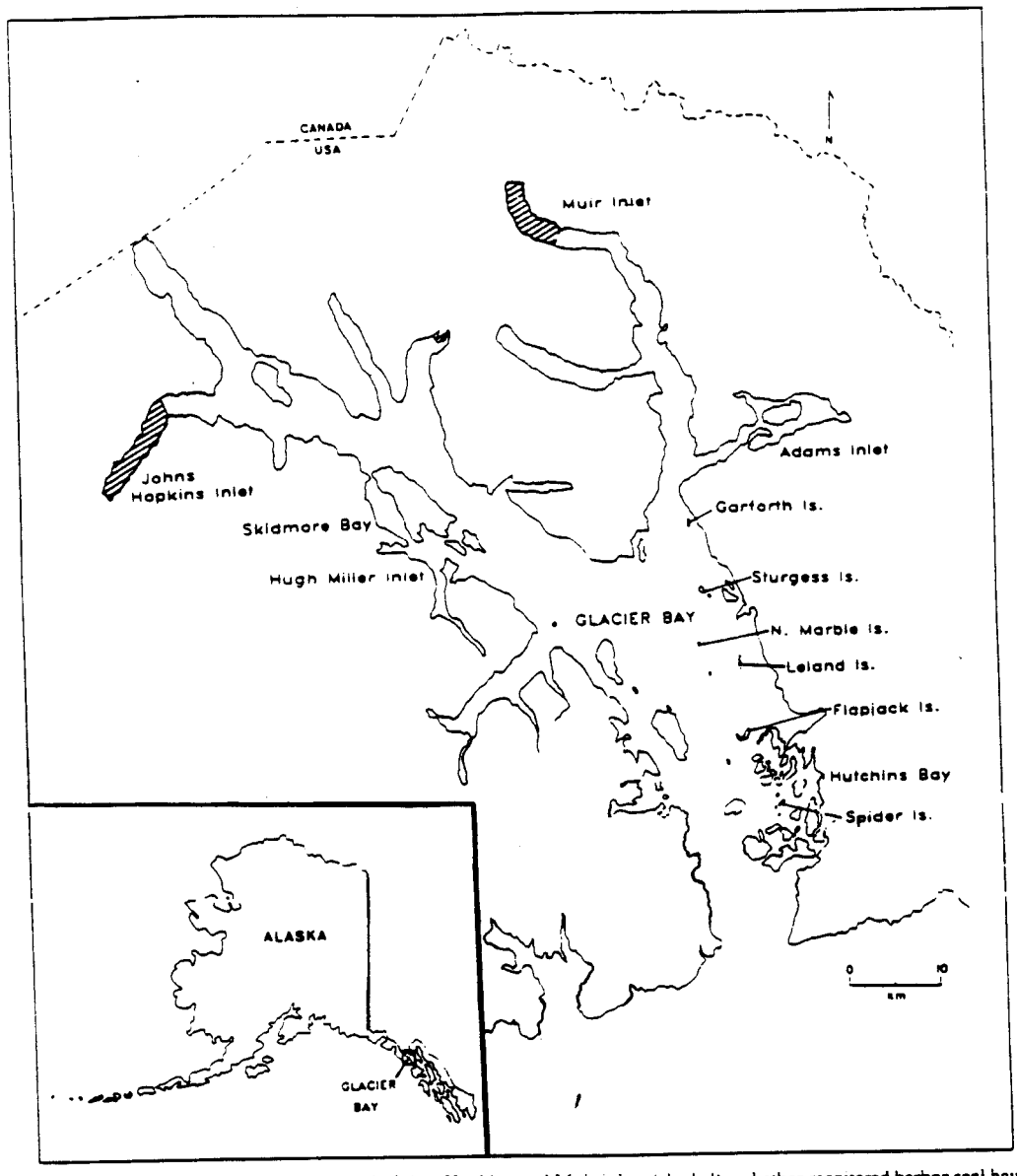

FIG. 1. Glacier Bay, showing principal study areas in Johns Hopkins and Muir inlets (shaded) and other monitored harbor seal haul-out areas.

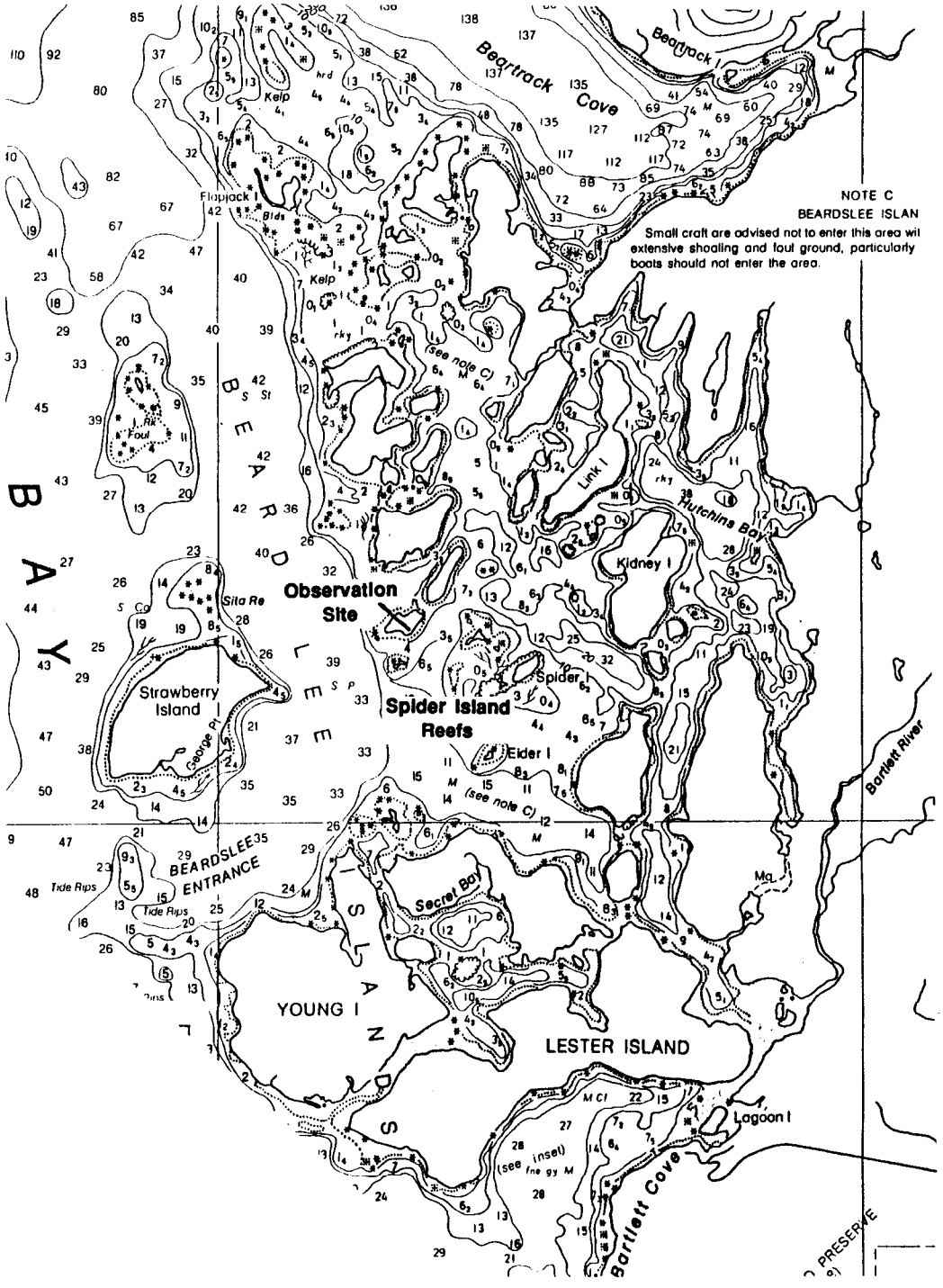

Figure 2. The Beardslee Islands in Glacier Bay showing the Spider Island area which is the main land haulout in the bay. The observation site is also noted.

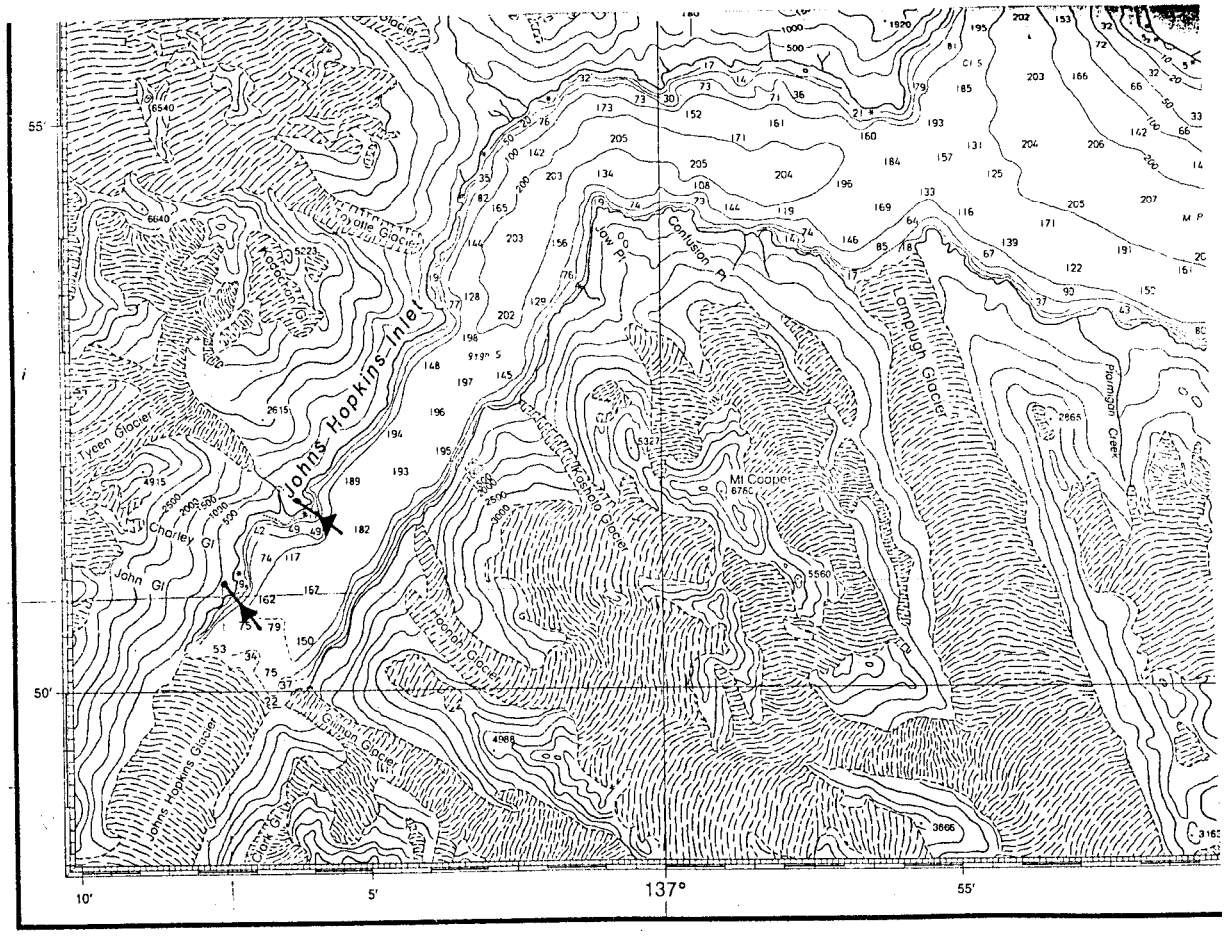

Figure 3. Observation sites (arrows) for harbor seal counts in Johns Hopkins Inlet, Glacier Bay, Alaska.

et al. 1987), including the effects of vessel traffic on seals resting on ice bergs (Calambokidis *et al.* 1983). Glacier Bay encompasses the largest documented breeding area in Southeast Alaska (Calambokidis et al. 1987), and this year's results suggest that it contains one of the largest aggregations of harbor seals in all of Alaska. However, differences in counting methods between years and years when no counts were made have prevented or hindered population trend assessment. Even when standardized methods are employed, assessing pinniped population trends is notoriously difficult (e.g. Estes and Gilbert 1978). Censuses in multiple years using comparable, standardized methods is needed for detecting other than large changes in harbor seal numbers in the park. Or, to take full advantage of the valuable harbor seal data spanning 20 years in Glacier Bay, we need to try to develop correction factors for differences in methods and effort.

No northern sea lion rookeries (breeding sites) have been documented in park waters, but there are several haulouts in Glacier Bay. Over 500 sea lions haul out on Graves Rocks and up to 200 animals have been observed both at Cape Fairweather and the north shore of South Marble Island (NPS files; personal observation). A proposal to categorize as critical habitat all haulouts which have been used by more than 200 Steller sea lions in at least one year since 1970 is under consideration by the Steller Sea Lion Recovery Team (*pers. comm.* S. Mello). If this passes, and it is likely that it will, Glacier Bay would contain three areas of critical habitat. In 1989, park waters were not included in a statewide survey of this species (Loughlin 1992b). From this survey researchers estimated a minimum population of 9,244 sea lions for Southeast Alaska. Thus, Glacier Bay may provide important habitat for close to 10% of the sea lions in Southeast Alaska. Yet, sea lion distribution and abundance in Glacier Bay waters have not been systematically monitored in successive years.

Pinniped Monitoring in Alaska and in Glacier Bay

In response to the alarming declines in parts of Alaska and as directed by the 1988 amendment to the Marine Mammal Protection Act , the NMML (under the direction of Dr. Tom Loughlin, Alaska Fisheries Science Center, NMFS, Seattle) launched a three-year study to determine minimum population estimates (MPE) for certain pinnipeds in Alaska (Loughlin 1992a). In 1991, during the first year of the project, harbor seals in Bristol Bay, along the north side of the Alaska Peninsula, in Prince William Sound and near the Copper River Delta were surveyed. The central and western Gulf of Alaska were censused this year (1992) with Southeastern Alaska scheduled to be surveyed extensively in 1993.

II. METHODS AND MATERIALS

A. Study Sites

The two areas of highest seal concentration in Glacier Bay are currently Johns Hopkins Inlet, where at least 5,800 seals haul out on floating chunks of glacial ice, and the Spider Island Reefs, where over 1,000 seals rest on sand bars and sloping beaches which may be submerged by higher tides (Figure 1). We made multiple counts of these areas from land in June, July and August. Aerial surveys were flown in these same months. In Johns Hopkins Inlet observers counted from elevated sites (100-150 m), whereas for the Spider Island area we counted from a low-level island about a half mile west of the reefs (Figure 2).

Harbor seals are also found in park waters along the outer coast (Jettmar 1984, NPS Report; NPS Files). For example, Jettmar (1984, NPS Report) summarized counts from 1962 to 1984 for Lituya Bay where about 150 harbor seals were seen in the majority of those years. Although on one occasion we flew over Cape Spencer, outer coast waters were not routinely included as part of this census for harbor seals.

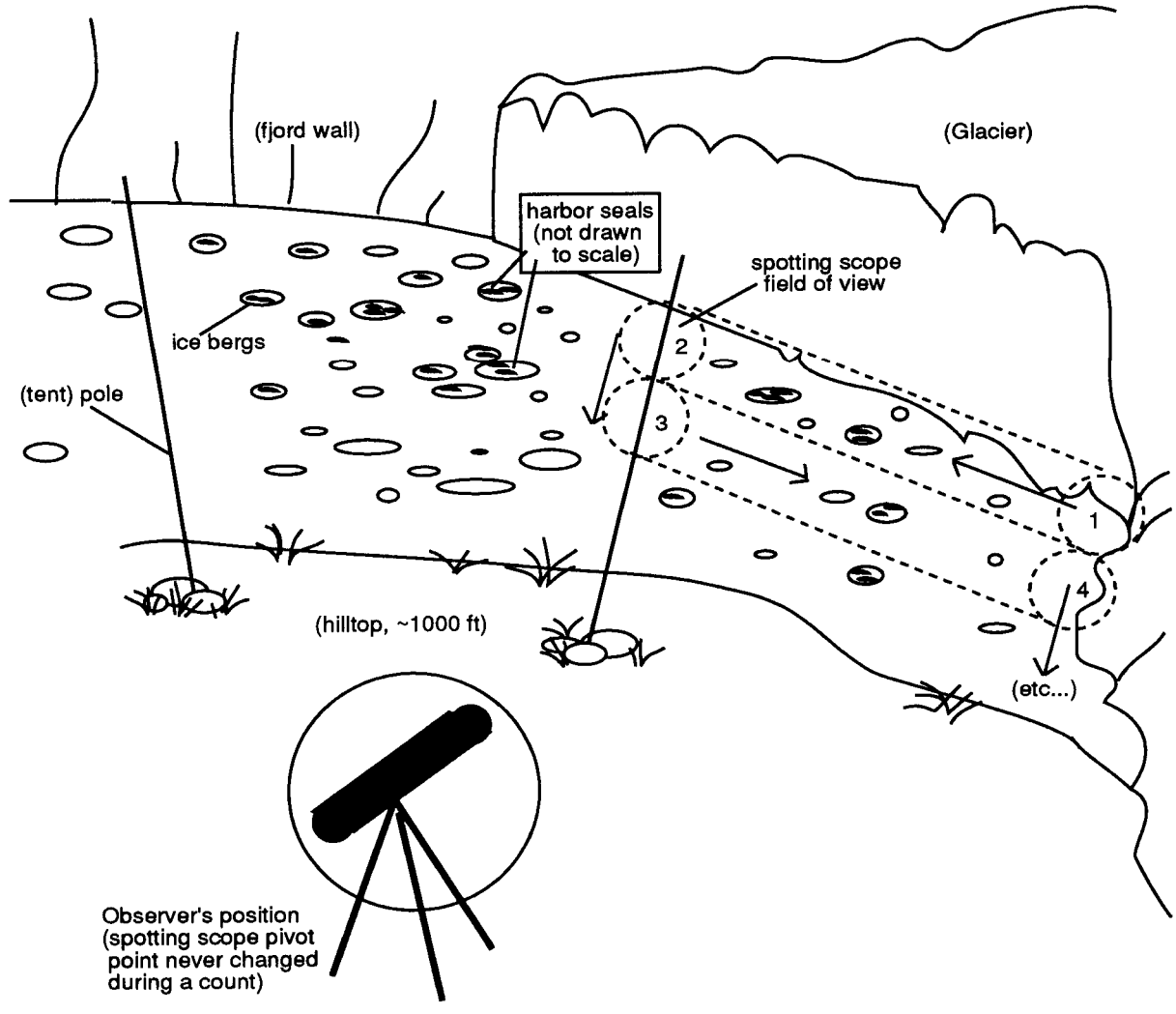

Figure 4. Schematic view of study area in Johns Hopkins Inlet to illustrate scanning method for counting harbor seals on ice.

B. Censusing Methods

1. Johns Hopkins Land Counts

In 1991 and 1992 seals in Johns Hopkins Inlet tended to occur within a mile of the glacier face so that animals could be counted from one vantage point instead of several *(pers. observ.)*. Observers counted seals from elevated sites along the fjord walls. Most counts were from the point closest to the glacier face, sometimes called Glacier Point, on the northwest side of the Inlet (Figure 3). Accessing this area is often difficult, as the ice can be very thick here. A kayak worked best for maneuvering between the dense bergs to get to the campsite. Bringing a larger boat in for a dropoff when the ice was thick was not possible. The ice tended to be less packed during an outgoing or low tide; it tended to be more concentrated in the blind end of the inlet at high tide. Arrivals and departures should be timed accordingly.

Two observers simultaneously counted seals using spotting scopes (Bausch and Lomb 60mm, 15X - 60X zoom; Swift 60mm, 20X) from one of two sites, both at elevations of about 100-150 m (Figure 3). The closer site, below and between Charley and John Glaciers, was substantially better for counting, as it is about a half mile closer to the glacier and to the area where most seals were observed.

Two to three counts per day per observer were made with an attempt to count at least once within two hours of noon, since this is when the highest numbers are typically observed (Calambokidis et al. 1987). Observers tallied each sighting on a three-digit counter (Forestry Supply). In June we categorized seals into the following groups: 1) Adult on Ice, 2) Pup on Ice, 3) Adult in Water, and 4) Pup in Water. The number of seals in the fourth category had to be remembered, but there were never more than 10 pups observed in the water, so this was not a problem. In August no distinction was made between adults and pups, since large weaned pups are sometimes difficult to distinguish from adults. One observer recorded the subtotals and comments on data sheets printed on waterproof paper (Appendix D). Counts were made on June 16-18, July 18-20, and August 20-23. Five different observers (E. Mathews, A. Wakeford, H. Lentfer, C. Soiseth, B. Kelly) with varying degrees of experience were involved in this aspect of the project. Results from the least experienced observer who had difficulties counting in Johns Hopkins Inlet were used only in the analysis of the effects of distance on pup proportions counted and to assess the effects of dividing the counting area into subsections with vertical poles (described in later sections).

In Johns Hopkins Inlet seals can be scattered over more than a square mile. On our first day there we found that it was extremely difficult to scan the entire area without losing track of what sections we had already covered. To solve this problem, I tried placing three long poles (tent poles) within our field of view so that they could be used to arbitrarily subdivide the area (Figure 4). Using this method reduced the average coeficent of variation (Standard Deviation / Mean) between observers from 24% (N = 4) to 17% (N = 7), and the mean percent difference in our counts went from 33% to 21% (Appendix D).

To count seals spread out over such a large area, the spotting scope tripod must be stable and remain in the same position throughout the count. Starting at the right (west) side of the inlet, the scope was positioned so that the distant edge of land (or the foot of the glacier) was just visible in the top of the field. Seals in the field were counted and then the scope was moved field by field to the left. Once a pole came into view, the scope was carefully lowered one field width, tightened, and moved back in the opposite direction (Figure 4). Each of the arbitrary sections were counted in this manner.

2. **Spider Island Land Counts**

There are over 20 historic land haulouts in the Beardslee islands (Streveler 1979, NPS Report; Lentfer and Maier 1989, NPS Report), yet the vast majority of seals in this area use the reefs and low islands to the south and northwest of Spider Island. All land-based counts in the Beardslee Islands were of seals in the Spider Island area.

Two observers counted from a low-level (approx. 5 m above mean high tide) site on a small island situated about one half mile to the west of Spider Island (Figure 2). Beginning at about two hours before low tide, paired, simultaneous counts of haulouts were conducted until about two hours after low tide. Before each count one observer scanned the entire area to determine if seals had hauled out on new reefs in the area. Up to six different beaches could be used by seals in this area, although the majority used two adjacent reefs. An average of 20 counts per day were made on the following days: June 2-6, July 2, July 28-August 1 (5 days), and August 26-28. Observers began each count at the same time, but no attempt to complete them within the same time period was made. We followed basically the same methods and used the same equipment at this study site as described in the previous section. However, we were not elevated above the haulouts and many more counts per day could be made since counts took much less time than in Johns Hopkins Inlet (mean = 8 min., Spider Island Reefs; mean = 73 min., Johns Hopkins Inlet).

3. **Aerial Surveys and Photography of Land Haulouts**

There were two goals of the aerial work: 1) to obtain pup proportions of seals hauled out on ice and 2) to census near a monthly low tide during the annual molt when highest numbers are likely. Six aerial surveys were conducted (May 27, June 7 & 28, July 1, August 27 & 28). Several scheduled flights were canceled due to weather or because the park plane was not available. In particular, 4 flights were scheduled for August 26 - 29 to survey during the monthly low tide and the molt, but two of these were canceled due to scheduling conflicts for the plane.

During the first flights in late May and early June, I experimented with using photographs of seals on ice to determine whether this might be an independent method for determining the proportion of pups in these areas. For the aerial surveys in August we flew as much of the bay as possible in an attempt to check all known land haulouts. In addition, we were constantly scanning for undocumented land haulouts. I flew with GLBA Ranger Pilot Mike Sharp in a Super Cub for all of the surveys except for two. On August 28 Elizabeth Ross (GLBA Research Division) did the survey with Mr. Sharp and on July 1 I flew in a Cessna 185 with a pilot from Glacier Bay Airlines. This last flight was discontinued after 30 minutes due to thick fog.

For the surveys over the Beardslee Islands, where the majority of the land haulouts are located, we flew a grid pattern at about 1000 feet (see sample data sheet in Appendix D). When seals were spotted we dropped to 600 -800 feet and began a wide loop around the haulout. We shot photographs out of the window, using an Olympus OM 2S camera with a motordrive and an 80-200mm zoom lens. Color slide film rated at 200 or 400 ASA was used. A databack was activated to record the day and time; however, the databack was not working during the first three flights. The photographer recorded the locations, times, altitudes, and frame numbers on a data sheet (Appendix D) or on a tape recorder which was transcribed onto a data sheet later. At least two passes around a haulout were made, and multiple photographs were taken. Most haulouts were small enough to fit easily into one frame. When large groups of seals were spread out, such as in the Spider Island area, I took a series of overlapping images.

4. **Aerial Photography: Pup Proportions**

Direct counts from photographs cannot be used to obtain a total count of seals on ice in Johns Hopkins Inlet, because seals are dispersed on ice floes over such a large area. However, I experimented with shooting continuous, overlapping series of photographs as a way to determine the proportion of pups in the area. Sequences were shot as we flew first down one side of the inlet, parallel to the fjord wall. I then shot a second series as we flew back up along the opposite side. In this way, I was certain that the two photographic 'swaths' were non-overlapping. Adults and pups visible in each image will be tallied for both legs.

C. **Slide Analysis**

Analysis of Land Haulouts

Using a dissecting microscope, I selected the two best slides for each photographic series of a haulout. These were then projected with a slide projector onto white paper so that seals could be marked and counted. I used the highest count from the two slides for the summary count of the bay for that day. These results are summarized in Table 1. Because we were only able to fly on two of the scheduled four days during the monthly low tide in August, mean values are derived from only these two numbers, except for the Spider Island Reef where the mean is derived from three counts (two on Aug 27, one on Aug 28). On August 27 we photographed seals on the reefs at low tide (7:50) and two hours after low tide (9:55).

Analysis of Ice Haulouts

I counted seals resting on ice bergs by viewing the slides through a dissecting microscope. Because the seals are much more spread out on the ice than at land haulouts, this method works well and is easier than projecting. I used a three-digit counter to keep a running total of adults and pups. Totals for each slide were entered on a data sheet (Appendix D). Pup proportions were then calculated using the following equation: Pup Proportion = (# Pups) / # Pups + # Adults). However, this analysis is not complete.

D. **Equipment, Materials, and Field Techniques**

A complete list of all equipment used for data collection, camping, and aerial photography is presented in Appendix A. This appendix is designed to be used as a check list for the field work. In addition, a few innovations which improved our counting precision or decreased fatigue are described in the Appendix.

E. **Summary of Historic Data**

For Muir and Johns Hopkins Inlet I compiled count data from reports by Streveler (1979, NPS Report), Calambokidis *et al.* (1987) and from NPS reports and data files. I collected the August 1991 data with assistants while teaching a field course for the School for Field Studies (Beverly, MA) in Glacier Bay. These historic data are tabulated in **Table 2** and summarized in Figure 5.

Table 1. Summary of maximum and mean counts of harbor seals for minimum population estimates (MPE). Data are from land-based counts and aerial photogra during 1992 molt surveys in Glacier Bay, Alaska, August 1992.

	Aerial		Land-based counts						
HAULOUTS	**8/27**	**8/28**	**8/20**	**8/21**	**8/22**	**8/23**	**8/26**	**8/27**	**8/28**
Spider Island	1094	1017					618	782	533
Flapjack Is.	61	126							
Reef S of Leland Is.	209	243							
Muir Inlet (ice)	fog	87							
J.H. Inlet (ice)	fog	NC	3415	3736	**5801**	4154			
Lone Is.	109	145							
Geike Rock	116	203							
Total =	1589	**1821**					(not used for MPE)		
Mean =	**1705**			**4277**				644	
StDev =	164			1060				127	
N =	2			4				3	
Coef. of Var =	9.6%			25%				20%	
95% CI =	1478	tc 1932		3237	to	5316	500.3	to	787.7

Sum of Maximum Counts	**I821**	**+**	**5801**	**=**	**7622**
Sum of Mean Counts	**I705**	**+**	**4277**	**=**	**5982**
Overall 95% CI	**47I5**	**to**	**7248**		

Table 2. Summary of historic harbor seal count data for Johns Hopkins and Muir Inlets, Glacier Bay, Alaska.

	Muir Inlet - JUNE					JH Inlet - JUNE					JH Inlet - AUG				
Year	Max	Mean	SD	N	Source	Max	Mean	SD	N	Source	Max	Mean	SD	N	Source
73	1347	1132	125	5	GPS 1979										
74	1172	1042	118	12	GPS 1979										
75	775	606.2	126	12	GPS 1979	1455	1442	19.1	2	GPS 1979					
76	538	462.8	66.1	5	GPS 1979	2109	1923	183	7	GPS 1979					
77	941	793.3	124	4	GPS 1979	2588	2330	211	4	GPS 1979					
78	1230	1112	95	4	GPS 1979	3419	3305	128	3	GPS 1979					
80															
83	725				JC 1987	1695	1257	334	8	L&B 1983	5208				JC 1987
83						1596	1258								
84	1013					4250				JC 1987					
85															
87						1982	1226	582	17	D&H					
88						4830	3107	1008	10	NPS 91					
89	100			1	NPS 91	1937	1854	73.1	3	NPS 91					
90	100			1	NPS 91	2136	2036	142	2	NPS 91					
91	85			1	NPS 91	1860	1751	75.4	5	NPS 91	3946	2404	852	19	EAM 1992
92	242			1	EAM92	3870	3044	441	6	EAM92	5796	4181	1086	12	EAM 1992

Sources:

GPS 79 Streveler 1979, NPS Report

S&B 83 L. Sharman and P. Brown. 1983. Harbor Seal survey, Johns Hopkins Inlet, June 22-25, 1983. GLBA/NPS Report

JC 87 Calambokidis et. al 1987

D&H 87 Dudgeon and A. Hille 1987. NPS File

NPS 91 Schroeder, M. NPS Data Files

EAM 92 Mathews, 1992 (this report)

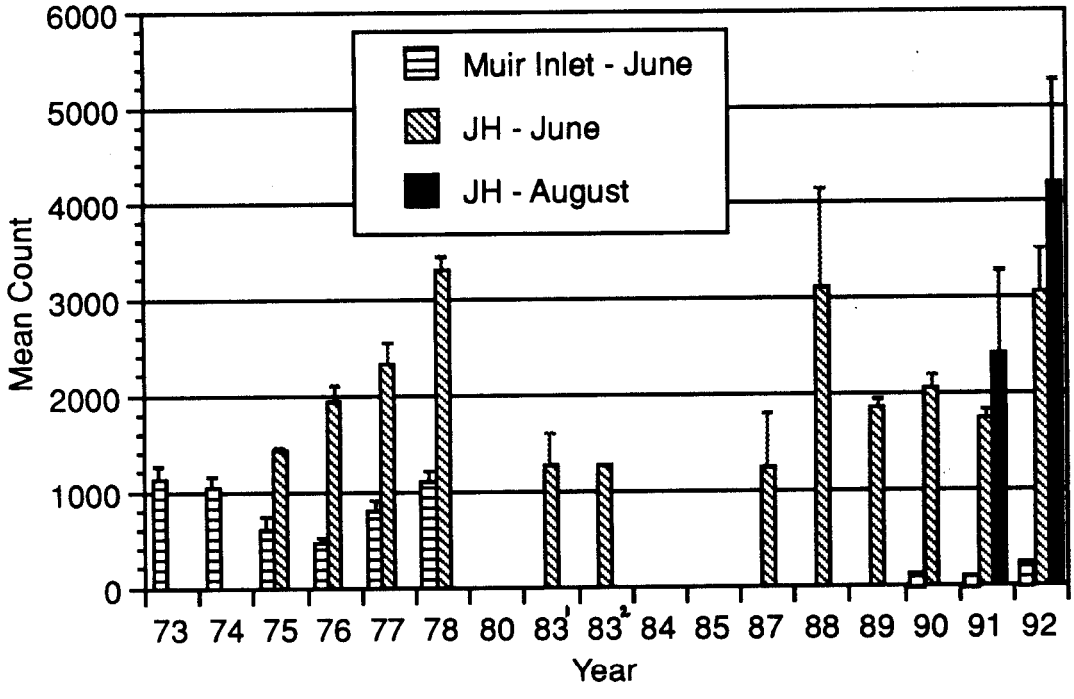

Figure 5. Summary of harbor seal counts for Johns Hopkins (JH) and Muir Inlets, Glacier Bay. Data are from Streveler 1979 , NPS Report (1973-78); Sharman and Brown 1983, NPS Report (1983[1]); Calambokidis, et al. 1987 (1983[2] & 84); Mathews 1992, this report (1991 & 92); and NPS files (1987-91).

(Error bars = 1 SD)

III. RESULTS

A. Spider Island Reefs, Land-based Counts

Daily high counts from the Spider Island Reefs in August are summarized in Table 1. Figure 7 displays daily counts and maxima for all days. As noted by others, the highest counts tended to occur before or at the time of the lowest morning tide. Figure 6 displays count means, standard deviations, and high counts for each of the four obsservation sessions. The highest land-based count (1,197) occurred on July 31.

B. Counts from Aerial Photographs

Harbor Seals: Results from the counts of seals in slide images for August 27 and 28 are summarized in Table 1. Of the seven land haulouts, the Spider Island reefs consistently supported the largest number of seals (maximum = 1,094) (Table 1).

Northern Sea Lions: On two occasions we opportunistically photographed northern sea lions. On May 27, 22 sea lions were photographed as they swam together near South Marble Island, and on August 27 we circled Graves Rocks where over 500 sea lions were documented. Final analysis of these photographs is not complete.

C. Comparison of Counts from Land and from Aerial Photographs

During the three flights over Spider Island on August 27 and 28, observers on land were counting seals simultaneously or within 15 minutes of the flights. I compared mean values of paired counts by land observers to counts from aerial photographs. For the three simultaneous aerial and land-based counts, counts from land, on average, underestimated seal numbers by 55% compared to those from photographs (Figure 6).

D. Minimum Population Estimate: August Counts

Table 1. lists the land-based count maxima for August from Johns Hopkins Inlet (August 20 - 23) and from the Spider Island Reefs (August 26-28). Daily high counts from aerial photographs of seals in the mid and lower bay for August 27 and 28 are also summarized in this table. The lowest tide of the month (-3.6 ft.) occurred on the 28th at about 8:30 am (Appendix E: 1992 Tide Table).

On August 22 we recorded 5,801 seals in Johns Hopkins Inlet, the highest number of the season. The maximum August count (1,094) from aerial photographs for the Spider Island Reefs occurred on the 27th. However, the highest total number of seals (1,821) photographed at all seven land haulouts was observed on the 28th, so this count is used in the sum of maximum counts (Table 1). Based on these maximum counts, the minimum population estimate for Glacier Bay proper (excluding outer coast waters) is 7,622 seals (5,801 + 1821). The sum of the mean counts is 5,982 seals (95% CI = 4,715 - 7,248).

Because the degree of movement between Johns Hopkins Inlet and other haulouts in the park is not known (see IV.B. Assumptions About Movement Patterns), a more conservative approach might be to present a MPE for Johns Hopkins Inlet separately from that for the land haulouts. The MPE for Johns Hopkins is 5,801 and for all land haulouts which were photographed it is 1,821 Table 1.

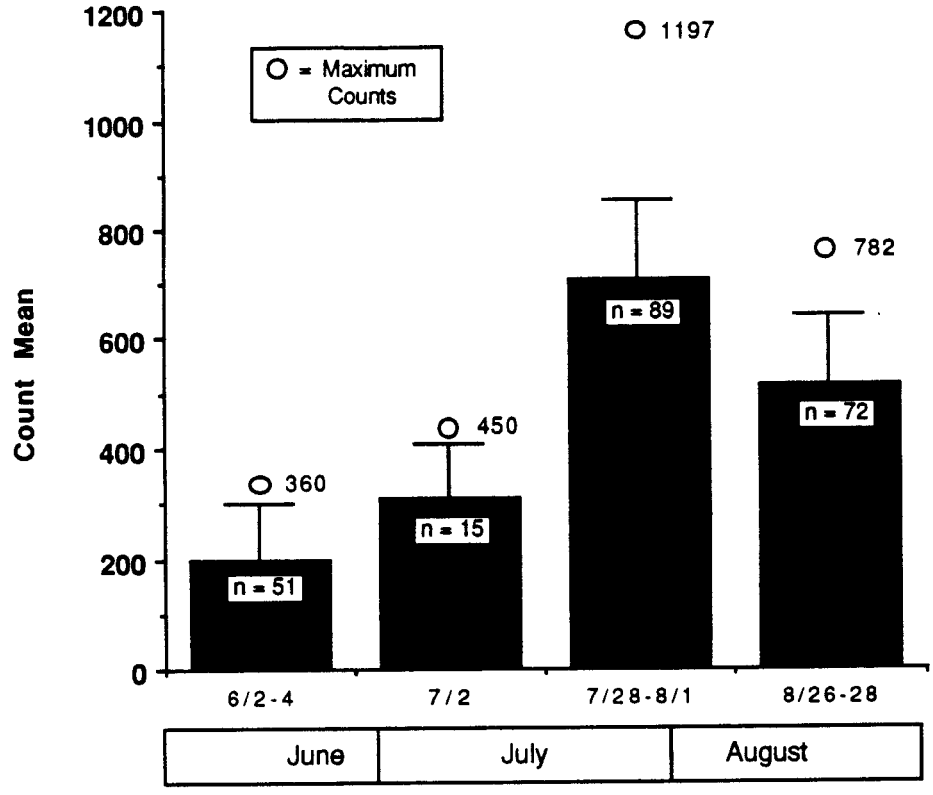

Figure 6. Mean counts of harbor seals hauled out on reefs off Spider Island, Glacier Bay, Alaska 1992. (Error bars = 1 SD)

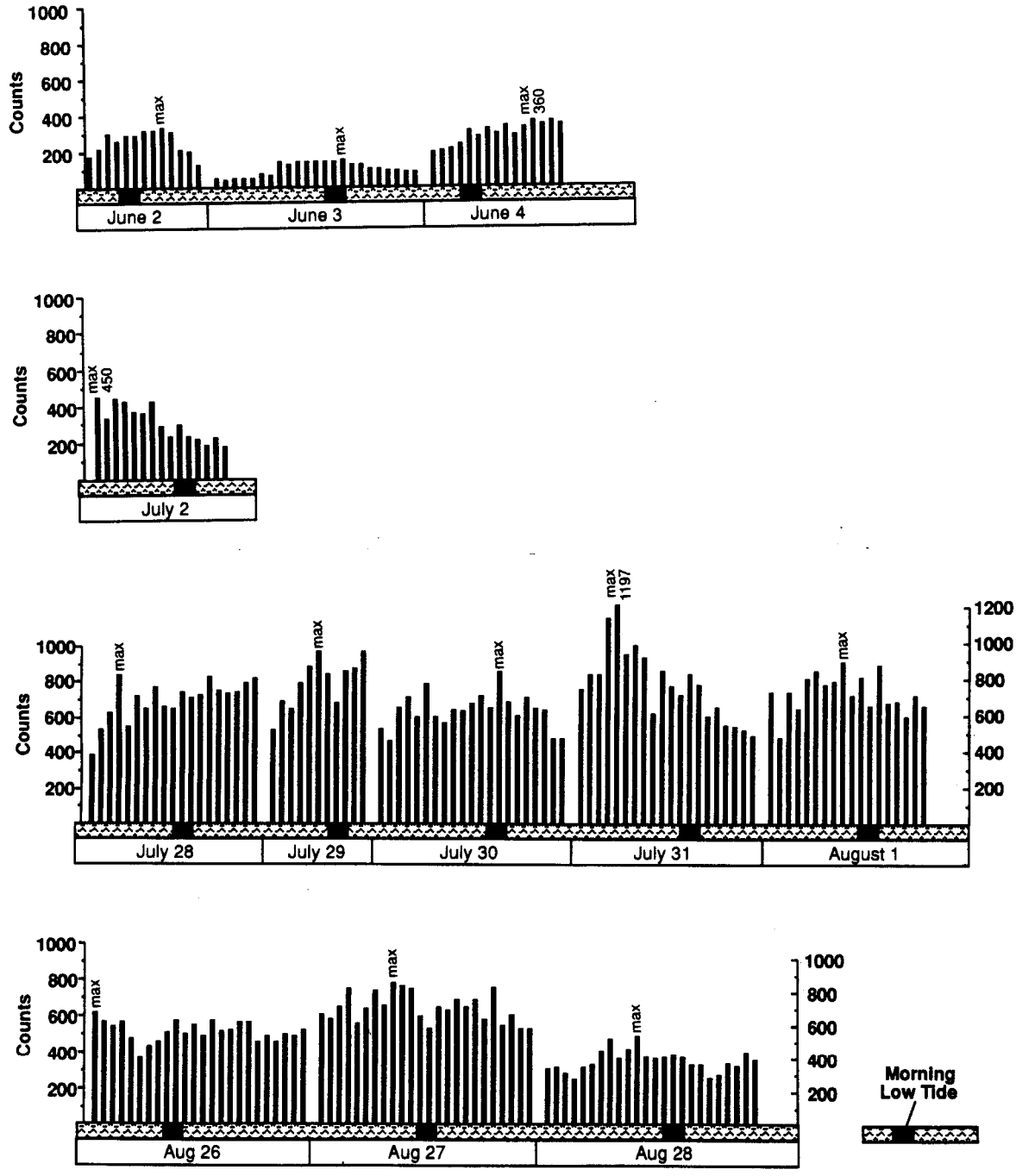

Figure 7. Daily counts of harbor seals hauled out near Spider Island in Glacier Bay with daily morning low tides ( ) and maximum counts. Counts were conducted from about two hours before to two hours after low tide.

E. Pupping Rates

1. Johns Hopkins Inlet

During the June counts of harbor seals in Johns Hopkins Inlet, we categorized seals as either adults or pups. The overall proportion of pups obeserved during the June count was 15.5% (95% Confidence Interval = 13.3-17.8%). To determine if we were missing distant pups, we conducted a test of our ability to discern pups by comparing the overall pup proportion during one count to the pup proportion from a randomly selected nearby area (Figure 8).

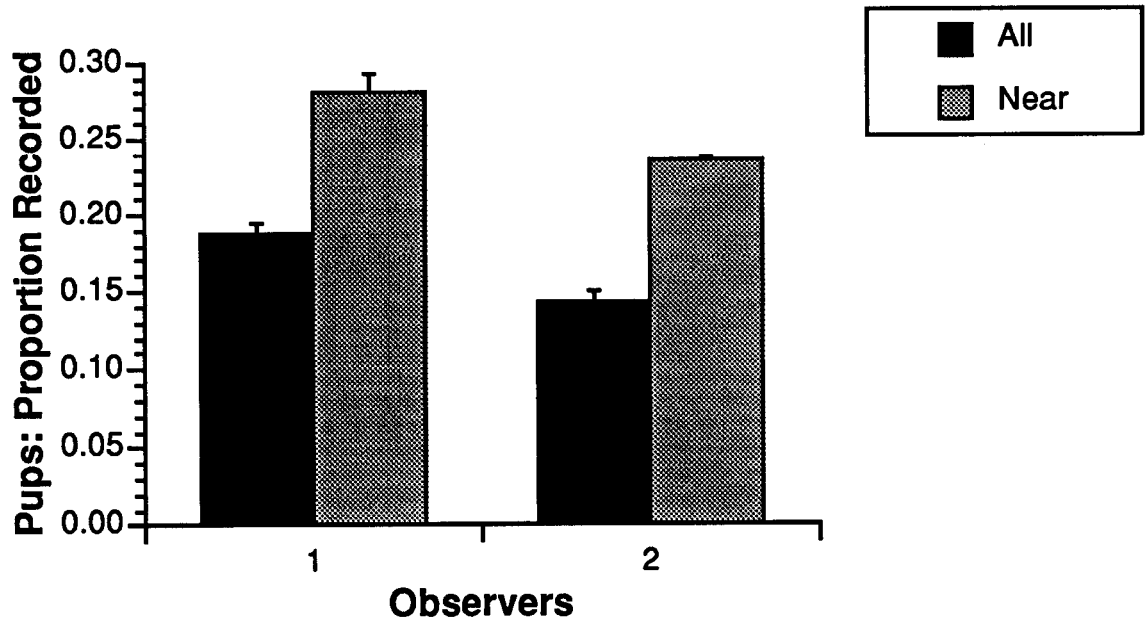

Figure 8. Proportion of seals identified as pups from the overall (All) study area, including animals on distant icebergs, compared to the proportion observed on randomly selected nearby (Near) ice bergs. Pup proportions counted from nearby areas were significantly higher ($p < 0.05$, Mann Whitney U) for both observers. (Error bars = 95% Confidence Intervals).

2. Spider Island Reefs

The overall proportion of pups observed from land at the Spider Island haulout during the June 2 - 4 was 17.4% (N = 51; 95% CI = 3.7%) (Figure 9). These counts were conducted from a distance and pups tend to aggregate closer to the water, where they are more likely to be counted. Consequently, these proportions are not likely representative. Aerial photographs would yield more reliable estimates. Those taken this year were from an elevation too high (700-1000ft) to reliably distinguish pups, although this is possible from lower altitudes.

3. Comparison of Pupping Rates

While the proportion of pups observed at the Spider Island reefs from land was slightly higher than that observed in Johns Hopkins Inlet, the difference was not significant (Figure 9). Furthermore, if we consider the proportion of pups observed from the nearby subsections, the pup proportions in Johns Hopkins appear to be

higher. Because two different methods were used in these two approaches it is not yet possible to assess the difference in pupping rates at these two areas. I am proposing to use aerial photography in both areas to make these comparisons next year.

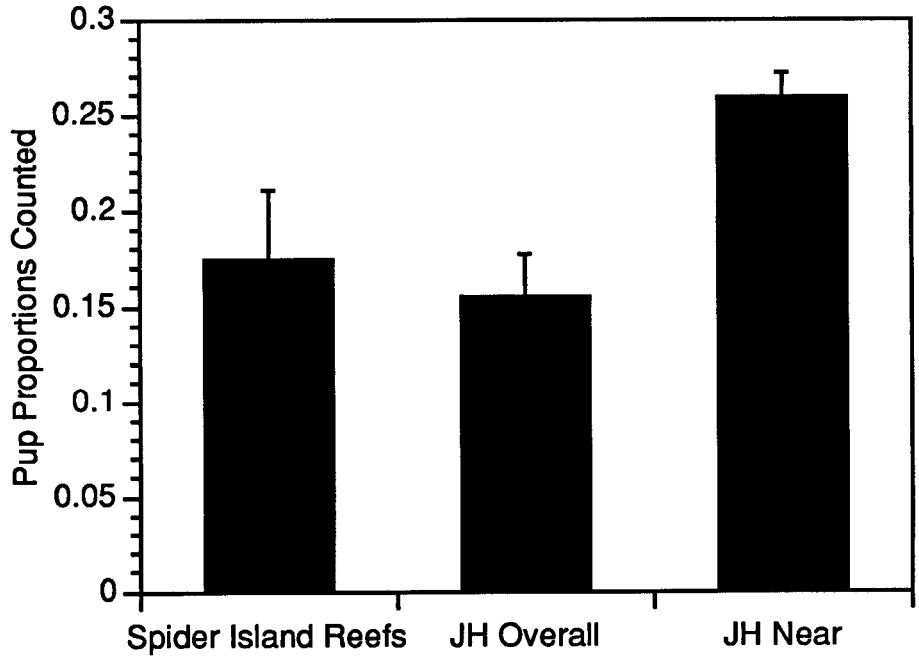

Figure 9. Comparison of observed pup proportions at the two study sites (JH = Johns Hopkins Inlet). All counts are from land, however the 'JH Near' counts (N = 6) were of nearby subsections where pups were presumably more visible than in distant areas. 'JH Overall' (N = 11) is the mean proportion of pups from all counts conducted from June 15-17. The Spider Island counts (N = 51) occurred on June 2-4. (Error bars = 95% confidcence intervals)

F. Effect of Effort on Maximum Counts

One of the problems with analyzing count data from different years is that the effort (number of counts and number of days spent counting) varies considerably. To begin assessing the degree to which the number of counts might affect the maximum count, I plotted increases in chronological counts from all land censuses in Spider Island and Johns Hopkins Inlet (Figure 10). That is, the graph goes up one unit only if a successive count was higher than any of the preceding counts, similar to a rate of discovery curve. Curves level off once the highest count is reached. As is evident in Figure 10, we appear to have reached a reasonable maxima for most counting sessions in the Spider Island area, whereas high counts from Johns Hopkins may not be a good measure of seasonal maxima since they never leveled off. Thus, more counts in Johns Hopkins Inlet are scheduled for next year.

G. Summary of Historic Data

In 12 of the 20 years since 1973 various researchers (Streveler 1979, NPS Report; Calambokidis *et al.* 1987; Mathews 1991, NPS files and this report; NPS files) have conducted land-based counts of seals on floating ice in Johns Hopkins and/or Muir Inlets. Tidewater glaciers feed both of these inlets where seals haul out on ice bergs to rest, pup, and nurse. In the last ten years, Muir glacier has become less active while Hopkins glacier has become increasingly active. Work by Streveler (1979, NPS Report) and Calambokidis *et*

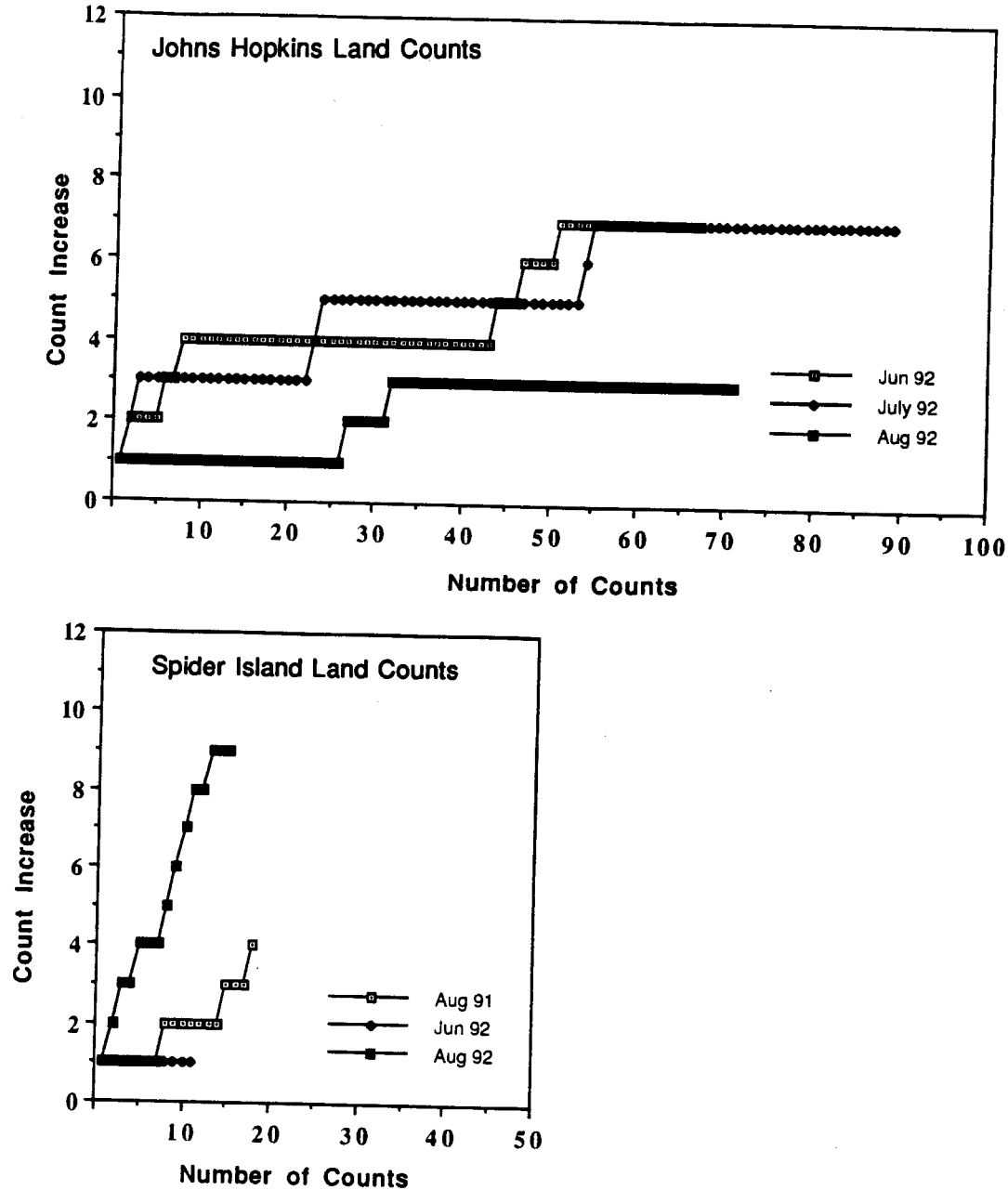

Figure 10. Increase in numbers of harbor seals counted compared to the number of counts. The top graph is from three different censusing sessions in the Spider Island area; the bottom graph is from three censusing sessions in Johns Hopkins Inlet, where fewer counts were made.

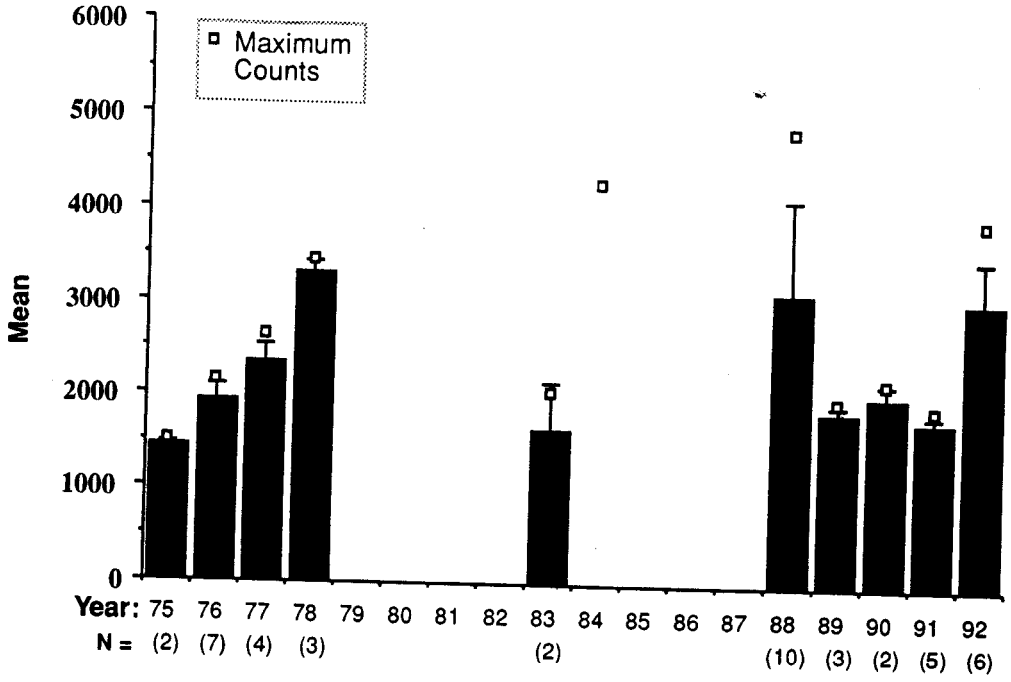

Figure 11. Mean and maximum counts of harbor seals in Johns Hopkins Inlet for June 1975 - 1992. Data are from Streveler 1979; Sharman and Brown 1983, NPS Report; Calambokidis et al. 1987; Mathews 1992 (this report); and NPS files. (Error bars = 1 SD)

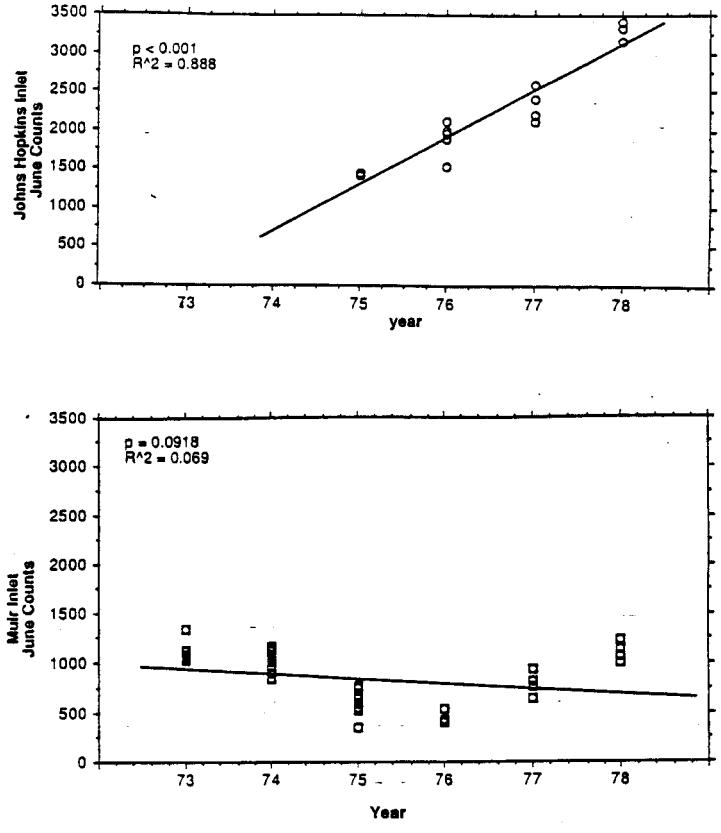

Figure 12. Comparison of counts from 1973 to 1978 in Johns Hopkins Inlet to those from Muir Inlet. Data are from Streveler 1979, NPS Report. (Spearman's Rho test)

al. (1987) documents increases in seal numbers in Hopkins Inlet concurrent with the increased availability of ice habitat (Figure 5 and 11). There has been some suggestion that the increase in seals in Johns Hopkins Inlet might be due to emigration from Muir Inlet. Using a nonparametric test (Spearman's Rho) to test this hypothesis, I analyzed Streveler's data from June counts he conducted in Muir and Hopkins Inlets from 1973 to 1978. Results from this analysis (Figure 12) suggest that there was not a significant decline in seal numbers in Muir Inlet from 1973 to 1978, but the increase in numbers in Hopkins was highly significant ($p = 0.001$) during this same period. This suggests that seals moved in from other areas and/or that the seal population began to grow independent of trends in Muir Inlet.

Because the numbers of counts and days spent counting between different studies are highly variable, and because the probability of obtaining higher counts increases with effort (see Results), corrections for past differences in effort and standardization of effort are needed before population trend assessment is possible.

IV. DISCUSSION

A. Comparison of Census Methods for Seals on Land and Ice

Seals in Glacier Bay may be found on icebergs or at land haulouts. The optimal method for censusing in these two different habitats is not the same. Results from this year's work clearly indicate that counts of seals resting on land are more accurate using aerial photographs than direct counts from low-level observation sites. Boat- (NPS data files) and land-based counts underestimated seal numbers by up to 80% (N=1) and 60% (mean = 55%, N=3), respectively. Aerial photographs offer the advantage of greaterer accuracy and precision for censusing hauled out seals than other counting methods. In addition, they produce archivable images which can be independently verified by several people. Using aerial photographs is a straightforward, effective way to obtain accurate counts of seals, as well as sea lions, in many areas in a short period of time (e.g. within two hours of a low tide) and in otherwise inaccessible areas.

B. Assumptions about Movement Patterns

My minimum population estimates are based on the assumption that large numbers of seals did not move between Johns Hopkins Inlet and land haulouts elsewhere in the bay during the August survey (August 20-28). This assumption is based on strong site fidelity observed for harbor seals in other areas. For example, in a study off California, 81% of 16 radio-tagged seals were resighted only at the site where they were tagged over a a three month period (Yochem *et al.* 1987), however limited coverage of the area inevitably limits our ability to keep track of all haulouts used. In a different study, a female harbor seal which was tagged as a pup was recovered three years later only three miles from where she was tagged (Divinyi 1971). On Tugidak Island, south of Kodiak, Pitcher and McAlister (1981) radio-tagged 35 harbor seals and studied their movements from May to September. They found strong site fidelity to certain haulouts by individual seals; 27 of 35 tagged seals were relocated only at the tagging site. These researchers also recorded an average movement of only 24 km per day. At this rate, travel between Hopkins and the Beardslees would take about four days. The maximum travel distance recorded by Pitcher and Calkins was 194 km, about twice the distance between the two key study sites in Glacier Bay, but the time interval for this distance was not given.

In another study (Brown and Mate 1982), a harbor seal with a plastic flipper tag was repeatedly sighted in the same area for up to 29 months, and five of 11 radio-tagged seals moved between two study sites 25 km apart, which is equal to about one fourth the distance between Johns Hopkins Inlet and the Beardslee Islands. However, these movements occurred over several months - between August 1978, the end of a

breeding season, and March 1979, a month or so before the beginning of the next breeding season. I suspect that females with pups are less likely to move between the glacially influenced waters of Johns Hopkins and the Beardslee Islands, since this would involve the use of two different haulout substrates. Males, on the other hand, might move between the areas to take advantage of different prey sources, or to increase mating opportunities. However, even if there is movement between the areas, it is likely to involve seals going both back and forth, so that the differences should cancel one another. Nevertheless, my assumption that there is no significant movement between the two key haulout areas needs to be tested. We have no information on local movements of seals in park waters, and other researchers have documented movements between haulouts up to 220 km apart (Brown and Mate 1982).

C. Recommendations

1. Minimum Population Estimate (MPE)

During the annual molt, which extends from late July to September in Glacier Bay (Streveler 1979), seals spend more time out of the water than at any other time of the year (Johnson and Johnson 1979, Ashnell-Erikson and Elsner 1981, Calambokidis et al. 1983). As a result, counts during this period typically yield the best minimum population estimates. Yet, almost all of the counts in GLBA have been conducted in June, when pupping occurs. In the four years (1977, 1984, 1991, 1992) in which counts were conducted during both periods, maximum counts from June were consistently lower than those in August by 18% - 57%. In this study, mean counts in Johns Hopkins in June were lower by 40% ($p = 0.06$, Mann Whitney U test) than mean counts in August. While counts during the pupping period yield critical data for monitoring the health of a population, the best minimum population estimates will result from counts conducted during the annual molt. In addition, most of the National Marine Mammal Lab's trend sites are scheduled to be censused near monthly low tides during the molt in August (*pers. comm.*, T. Loughlin, NMML); thus, counts made in GLBA during the same period will be most comparable.

2. Recommended Skills for Field Assistants and Biotechnician

Establishing a field camp in Johns Hopkins Inlet on rugged, barren terrain is not an easy task. Field assistants should be experienced campers, have ocean kayaking skills and experience using a spotting scope, preferably for extended periods. Ideally, assistants should also have experience counting pinnipeds. If not, assistants must be trained before critical counts are needed.

3. Equipment

Camera for Aerial Photography: The Olympus OM-2S is not an ideal camera for this work. This brand is notorious for freezing up so that no more pictures can be taken until the mirror is released. Turning the F-stop to the "B" or "M" (bulb or manual) settings released the mirror. A slight reduction in battery power seemed to trigger this problem. Even the cooling of the batteries, which inevitably occurred while the camera was exposed to icy wind above glacial fjords, often caused the camera to stop shooting. I started carrying a spare set of batteries and tried to keep the camera body warm, but this is a serious problem since continuous series of photographs are needed. I recommend that the park purchase a Nikon camera with a motor drive and a Nikon 80-200 mm lens (F2.8). Then, the Olympus camera could be used as a backup.

4. Future Areas of Investigation

Questions which should be addressed in the future include:

1) Are the numbers of seals or sea lions in each of the park waterschanging or stable?

2) Are pupping rates increasing, decreasing, or stable? Do they differ for seals using terrestrial versus ice haulouts?
3) Is the distribution of seals or sea lions changing within the study area?
4) How much, if any, exchange is there during pupping and molting periods between Johns Hopkins Inlet at land haulouts in the Bay?
4) What is the effect of vessel traffic on harbor seals during critical times such as pupping and molting? (A follow-up of Calambokidis *et al.*, 1987)
5) Are seals on ice or land more susceptible to human disturbance?
6) What are the main prey items for seals in Glacier Bay? How does this vary over time?

D. Harbor Seal References and Bibliography

When I started this project there were only four published references on harbor seals in the files at the park. With the help of the Research Division we have acquired oaver 70 harbor seal papers and more than 40 on other pinniped species. Fifty-six of the harbor seal references have been entered into bibliographic databases at the park (ProCite and End Note) and are available to others there. These references are listed in Appendix F. Copies of the references have been filed by author.

V. CONCLUSIONS

The main conclusions from this work are summarized below:

1. There are more harbor seals in Glacier Bay than previously suspected, making park waters the largest documented breeding area in Southeast Alaska and one of the largest harbor seal aggregations in all of Alaska.

2. Aerial photography is the best method for censusing seals at terrestrial haulouts in Glacier Bay, but this method will not currently work for counting seals on ice bergs in Johns Hopkins Inlet. Development of aerial videography linked with a real-time GPS is worth exploring as a possible method for remotely censusing harbor seals on ice.

3. In Johns Hopkins Inlet, pups at a distance are likely to be undercounted, so pup proportions should be derived from either 1) randomly selected subsamples of nearby animals, 2) aerial photographs, or 3) both methods.

4. For the purpose of obtaining the best minimum population estimate, counts during the molt period (August) are optimal.

5. Pupping rates in Johns Hopkins may be higher than in the Beardslee Islands, however the methods of assessing pup proportions in these twe areas were not the same. More censusing for pups in both areas needs to be done to verify this suggestive result.

6. Trend analysis may be possible using historic data, but determining correction factors for differences in methods and efforts will be needed before trend assessment with some degree of sensitivity (e.g. enough to detect a 20% change) is feasible. Such correction factors may not be feasible, but an effort to fully utilize 20 years of valuable historic data should be explored.

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gloves. (Be sure you can fit another pair of gloves under these.)

D. PERSONAL EQUIPMENT AND SUPPLIES

1. Essential/Useful

___ Sunglasses: U.V. filtering, polarized; with a sturdy strap or cord; ___ Sunscreen
___ Waterproof digital watch with stopwatch and alarm.
___ Field Notebook (e.g. Rite in the Rain)
___ Toiletries: toothbrush, toothpaste, biodegradable soap and shampoo, Personal items.

2. Optional

___ Head lamp (can replace flashlight - much easier to work and read with this)
___ "Power Lounger" chair (very useful for counting from land)
___ Sewing kit
___ electrical tape and duct tape (rewrap to smaller diameter)
___ stuff sack(s)
___ Field Guides (birds, plants, etc.); ___ paperback book
___ Fanny Pack
___ Fingerless gloves, wool or polypropylene
___ Fishing pole (___ Alaska fishing license)
___ Frisbee/Aerobie, Hacky Sack, Harmonica, Recorder, etc.

E. TEAM EQUIPMENT AND SUPPLIES - CAMPING

___ bearproof canisters for all food (check these out from the Back Country office)
___ bungie cords
___ candles or lantern
___ flares
___ large Ziplocs; ___ large plastic bags or extra dry bags
___ lots of spare line (for securing tarp and other needs)
___ marine charts / topographic maps
___ Mountain Smith tent with wood stove (___ supply of split wood)
___ tarp (dull color) and poles (for observations)
___ water bags; ___ water filter or purification tablets
___ First Aid kit
___ Tent(s); ___ ground tarp; ___ line
___ VHF marine radio; ___ spare battery pack
___ light-weight cooking set
___ Food (include extra rations)
___ camp stove or burner; ___ fuel; ___waterproof matches; ___ 2 lighters

F. RESEARCH EQUIPMENT AND SUPPLIES

___ clipboards with attached pencil: ___ large rubber bands
___ data sheets (on waterproof paper)
___ indelible ink pens (fine-tipped)
___ spotting scope(s); ___ tripods
___ tape recorder(s); ___ head phones; ___ blank tapes
___ three digit counters, 2
___ Calculator
___ Camera: waterproof case or drybag
___ Camera; ___ film; ___ batteries; ___ lens tissue; ___ desiccate
___ Carbon paper (to make duplicate field notes, if desired)
___ Laptop computer
___ Pencils (mechanical with extra lead)
___ power loungers, 2
___ spare batteries for equipment

Johns Hopkins Inlet:

___3-4 extra tent poles - long (for subsection counting)
___ exposure suits (optional)

II. AERIAL SURVEYS AND PHOTOGRAPHY

___ Data sheets; ___ Clip board with attached pencil; ___ spare pencil
___ Chart of Glacier Bay
___ Tally Counter: for seals in Muir Inlet or in Hopkins if fewer than ~400 seals (3-digit is essential if counting pups; secure by tying it to thigh))
___ Permanent marker (for labeling film)
___ Tape recorder; ___ blank tape
___ Camera with motor drove
___ 80-200 mm zoom lens
___ spare batteries (for camera, motor drive, and tape recorder)
___ lens paper
___ pocket knife with screwdriver (or a penny)
___ Film
~6 rolls of 200 ASA film, 36 exp
~6 rolls of 200 ASA film, 36 exp
___ Binoculars
___ Sun Glasses
___ Gloves (fingerless or light weight)
___ Fanny Pack or Lap Pack (to keep equipment accessible on lap)
___ Exposure Suit (wear this)
___

Suggestions:

There is very little space in the back seat of the Super Cub. Plan to have everything at your fingertips. If you drop something you may not be able to retriev it. Attach a line to any small object which might fall on the floor (e.g. pencils) and strap the counter, if you will be using it, to your thigh in a position which is easy to access. If you have long hair be sure to tie it back and bring a headband or hat to keep your hair from blowing into the lens or your face.

III. Where to Order Outdoor Gear

There are several catalog companies that specialize in outdoor clothing and camping equipment. Some suggestions of companies from whom you may obtain catalogs follow (in decreasing order of usefulness).

REI (Recreational Equip. Inc.)
P.O. Box 88125
North Seattle, WA 98188-0125
1-800-426-4840

Campmor
810 Route 17, P.O. Box 9970
Paramus, NJ. 07653-0997
800-445-9868

L.L. Bean
Freeport, ME 04033
(207) 865-3111 (orders only)

Wear-Guard
P.O. Box 400
Hingham, MA 02043

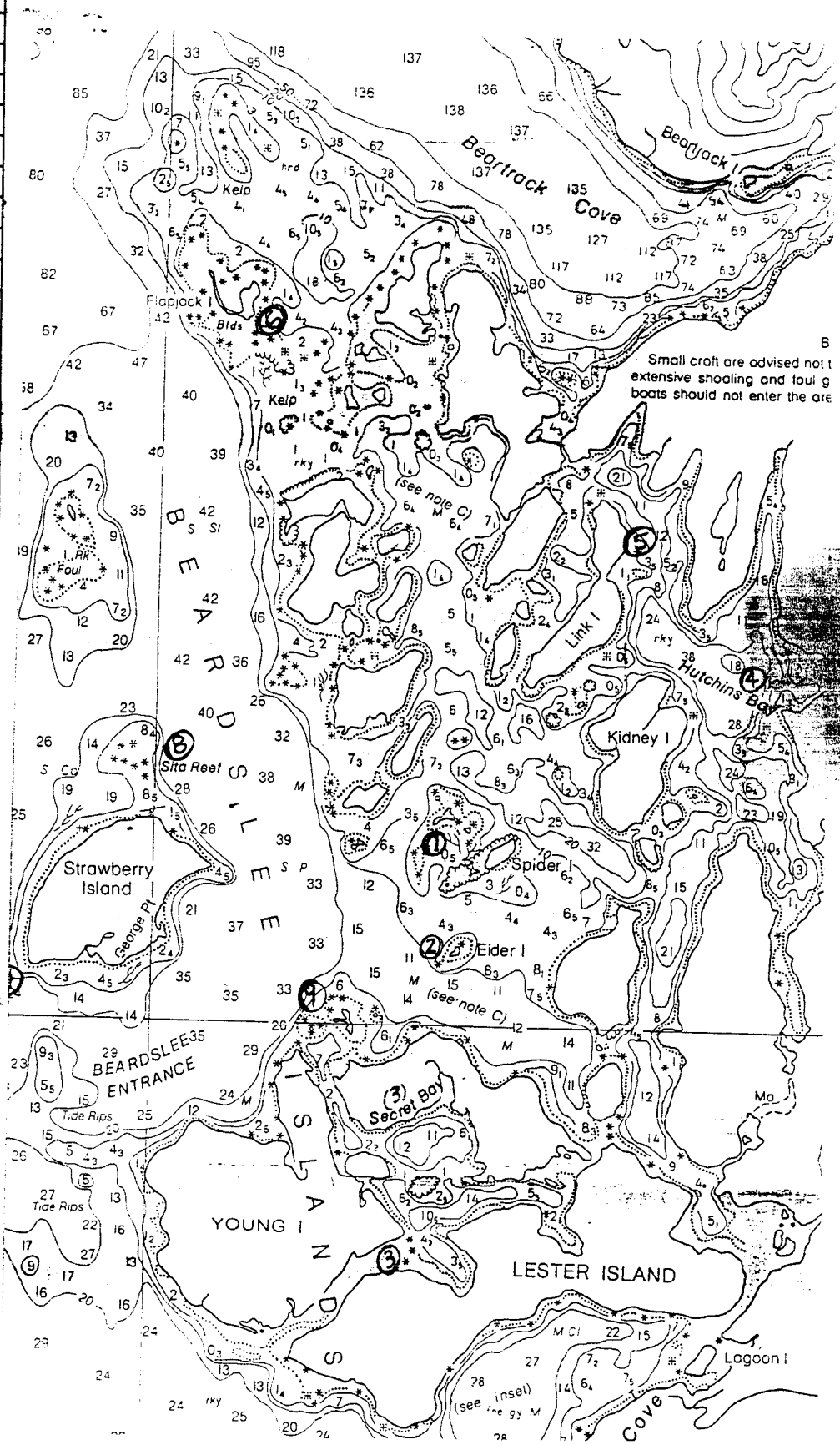
Eddie Bauer
P.O. Box 3700
Seattle, WA 98124
800-426-8020

Cabela's
812 13th Ave.
Sydney, NE 69160
800-237-4444

Check List for Harbor Seal Aerial Census

Date / / (m / d / y)
Photographer:
Plane/Pilot:

			Chkd	Seals
Beardslee Islands			√	Y/N
	1	Spider Island		
	2	Eider Island		
	3	Secret Bay		
	4	Hutchins Bay		
	5	Link Is.		
	6	Flapjack Is.		
	7	Strawberry Is.		
	8	N. of " "		
	9	N. of Young Is.		
	10			
	11			
Mid Bay (East)				
	12	Leland Is.		
	13	N. Marble		
	14	S. Marble		
	15	Sandy Cove		
	16	Sturgess Is.		
	17			
East Arm				
	18	Garforth Is.		
	19	Adams Inlet		
	20	Wachusett I.		
	21	Muir In. (ice)		
	22	Muir In. (land)		
	23			
West Arm				
	24	Tidal In.		
	25	Queen In.		
	26	Rendu In.		
	27	Tarr In.		
	28	J.Hopkins (ice)		
	29	Reid In.		
	30	Skidmore Bay		
	31	Hugh Miller In.		
	32	Blue Mse. Cv.		
	33	Charpentier In.		
	34	Lone Is.		
	35	Geike Rock		
	36			
Mid Bay (West)				
	37	Drake Is.		
	38	Francis Is.		
	39	Willoughby Is.		
	40	Fingers Bay		
	41	Berg Bay		
	42	Lars Is.		
	41			



Harbor Seal Counts: Glacier Bay National Park and Preserve

Date ____/____/____ Page ___of___

Location	Weather
Observation Team	Low Tide at:

Site No.	Times Start	Times End	Hauled Out Adults	Hauled Out Pups	In Water Adults	In Water Pups	Count Total	Obser/ Count#	Count Qual	Viewng Qual	Sea State	Bino/ S.S.	Comments

VQ	Sea State
1-exc	1: glassy, calm
2-good	2: ripples
5-fair	3: chop to 1.5 feet
7-poor	4: waves1.5' to 3'
	5: waves 3' to 6'

B2

Harbor Seal Counts: Spider Island Area, Glacier Bay National Park, 1992

	Times			Hauled Out		In Water		Count	%	Obsr-	Observer Differences		Cnt	View	Sea	Eag
Date	Start	End	Diff	Adults	Pups	Adults	Pups	Total	Pups	ver	Adults	Pups	Qual	Qual	St	Ad
6/2/92	7:20	7:35	0:15	157	9	7		173	5.2%	EM			3	5	2	
6/2/92	7:44	7:55	0:11	195	17	5		217	7.8%	EM			3	4.5	2	
6/2/92	8:57	9:07	0:10	268	29	2		299	9.7%	EM	16.0%	-6.5%	3	3	2	
6/2/92	8:57	9:09	0:12	225	31	2		258	12.0%	AW						
6/2/92	9:19	9:29	0:10	260	31	1		292	10.6%	EM	-2.6%	12.9%	2	3	2	
6/2/92	9:19	9:28	0:09	267	27	0		294	9.2%	AW						
6/2/92	9:38	9:52	0:14	280	37	1		318	11.6%	EM	-0.4%	2.7%	3	2	2	
6/2/92	9:38	9:45	0:07	281	36	0		317	11.4%	AW						
6/2/92	10:37	10:50	0:13	295	36	1		332	10.8%	EM	7.8%	2.8%				
6/2/92	10:37	10:47	0:10	272	35	5		312	11.2%	AW						
6/2/92	11:15	11:27	0:12	184	17	7		208	8.2%	EM	-3.7%	64.7%	5	3	2	
6/2/92	11:15	11:25	0:10	191	6	2		199	3.0%	AW			5	3	2	
6/2/92	12:26	12:37	0:11	107	14	1		122	11.5%	EM			3	4	2	
6/3/92	7:51	7:52	0:01	45	1	5		51	2.0%	EM	15.6%	100.0%	3	1	2	5
6/3/92	7:51	7:52	0:01	38	0	6		44	0.0%	AW			3	1	2	
6/3/92	7:52	7:53	0:01	41	0	5		46	0.0%	AW			3	1	2	
6/3/92	8:04	8:06	0:02	44	3	2	1	50	8.0%	EM	9.1%	100.0%	3	1	2	
6/3/92	8:04	8:06	0:02	40	0	7		47	0.0%	AW			3	1	2	
6/3/92	8:28	8:30	0:02	68	6	4	1	79	8.9%	EM	7.4%	50.0%	3	1	2	0
6/3/92	8:28	8:30	0:02	63	3	3		69	4.3%	AW			3	1	2	
6/3/92	9:16	9:19	0:03	132	11	0		143	7.7%	EM	13.6%	0.0%	3	1	2	2
6/3/92	9:16	9:19	0:03	114	11	0		125	8.8%	AW			3	1	2	
6/3/92	9:20	9:22	0:02	132	10	0		142	7.0%	AW			3	1	2	
6/3/92	9:52	9:55	0:03	137	8	0		145	5.5%	AW			3	1	2	
6/3/92	9:56	10:00	0:04	125	13	0		138	9.4%	EM	-8.8%	38.5%	2	2	2	
6/3/92	9:56	10:00	0:04	137	8	0		145	5.5%	AW			3	1	2	
6/3/92	10:00	10:05	0:05	126	14	0		140	10.0%	EM			2	2	2	5
6/3/92	10:52	10:54	0:02	138	9	0		147	6.1%	AW			3	4	2	
6/3/92	10:55	10:58	0:03	114	10	0		124	8.1%	EM	-4.2%	20.0%	1	2	2	0
6/3/92	10:55	10:58	0:03	119	8	0		127	6.3%	AW			3	4	2	
6/3/92	11:13	11:17	0:04	93	7	1		101	6.9%	EM	-3.1%	28.6%	1	3	2	2
6/3/92	11:13	11:17	0:04	96	5	2		103	4.9%	AW			1	3	2	
6/3/92	11:35	11:38	0:03	80	6	2		88	6.8%	EM	-3.6%	-14.3%	2	2	2	
6/3/92	11:35	11:38	0:03	83	7	3		93	7.5%	AW			2	2	2	
6/3/92	11:49	11:50	0:01	77	3	0		80	3.8%	EM	-1.3%	-25.0%	1	1	2	
6/3/92	11:49	11:50	0:01	78	4	0		82	4.9%	AW			1	1	2	6
6/4/92	8:51	8:54	0:03	173	17	3	1	194	9.3%	EM	1.2%	-32.0%	1	1	1	1
6/4/92	8:51	8:55	0:04	171	25	2		198	12.6%	AW			2	1	1	
6/4/92	8:58	9:02	0:04	187	22	2		211	10.4%	AW			2	1	1	
6/4/92	9:04	9:08	0:04	205	25	0		230	10.9%	EM			2	1	1	
6/4/92	10:25	10:34	0:09	265	46	0		311	14.8%	EM	14.3%	-9.8%	2	1	2	6
6/4/92	10:25	10:34	0:09	227	51	0		278	18.3%	AW			2	1	2	

6/4/92	11:35	11:45	0:10	284	29	0	313	9.3%	EM	8.5%	-17.1%			2	2	
6/4/92	11:35	11:45	0:10	260	35	0	295	11.9%	AW					2		
6/4/92	11:45	11:51	0:06				337	0.0%	EM	16.3%				2		
6/4/92	11:45	11:51	0:06				282	0.0%	AW					2		
6/4/92	11:52	11:56	0:04				322	0.0%	EM					2		
6/4/92	12:00	12:08	0:08	321	39	0	360	10.8%	EM	5.0%	12.8%	2	1	2		
6/4/92	12:00	12:06	0:06	305	34	0	339	10.0%	AW			3	3	2		
6/4/92	12:26	12:34	0:08	328	30	0	358	8.4%	EM	5.2%	-11.8%	2	1	2	4	
6/4/92	12:26	12:34	0:08	311	34	0	345	9.9%	AW			2	1.5	2		
6/4/92	12:35	15:30	2:55													
7/2/92	8:19	8:25	0:06			9	450		EAM			2	1	1	2	
7/2/92	8:37	8:40	0:03				336		LS							
7/2/92	8:37	8:43	0:06	392	50	3	445		EAM			2	1	1		
7/2/92	9:01	9:08	0:07	364	60	6	430		EAM					1		
7/2/92	9:01	9:08	0:07	326	36	5	367		LS							
7/2/92	9:33	9:39	0:06	306	51		357		LS							
7/2/92	9:38	9:47	0:09	365	60	1	423		EAM			2	2	1		
7/2/92	10:24	10:29	0:05	245	42	2	289		EAM			3	1	1		
7/2/92	10:24	10:27	0:03	209	16	4	229		LS			3	2	1		
7/2/92	10:33	10:39	0:06	259	32	1	292		EAM			2	3	1		
7/2/92	10:30	10:40	0:10	202	20	7	229		LS							
7/2/92	12:14	12:18	0:04	186	21	3	210		EAM			2	4	1		
7/2/92	12:14	12:18	0:04	157	19	3	179		LS			3	3	1		
7/2/92	12:23	12:28	0:05	203	18	4	225		EAM			3	4	1		
7/2/92	12:23	12:30	0:07	151	16	6	173		LS				5	1		
7/28/92	5:31	5:38	0:07	326	45	3	374		AW			5	5	1	2	
7/28/92	5:41	5:48	0:07	467	48	8	523		AW			7	7	1	1	
7/28/92	5:35	5:51	0:16	603	7	5	615		MM			7	7	1	1	
7/28/92	6:02	6:15	0:13	783	49	1	833		AW			7	7	1	1	
7/28/92	6:02	6:14	0:12	506	26	3	535		MM			7	7	1	1	
7/28/92	6:29	6:42	0:13	670	39	1	710		AW			5	5	1	1	
7/28/92	6:29	6:40	0:11	589	48	1	638		MM			5	5	1	1	
7/28/92	6:58	7:02	0:04	713	48	2	763		AW			5	5	1	1	
7/28/92	6:58	7:06	0:08	571	79		650		MM			5	5	1	1	
7/28/92	7:30	7:37	0:07	581	59	0	640		AW			3	3	1	1	
7/28/92	7:30	7:37	0:07	674	58	1	733		MM			3	3	1	1	
7/28/92	7:49	7:57	0:08	655	44	0	699		AW				3		0	
7/28/92	7:49	7:57	0:08	662	55	1	718		MM				3		0	
7/28/92	8:14	8:23	0:09	750	70	1	821		AW				3		0	
7/28/92	8:14	8:24	0:10	681	60	2	743		MM				3		0	
7/28/92	8:27	8:35	0:08	658	69	3	730		AW				3		0	
7/28/92	8:27	8:36	0:09	656	75	7	738		MM				3		0	
7/28/92	8:40	8:48	0:08	720	54	10	784		MM				3		0	
7/28/92	8:40	8:49	0:09	738	69	3	810		AW				3		0	
7/29/92	5:34	5:40	0:06	476	37	8	2	523		AW		5	3	2	1	
7/29/92	5:52	6:02	0:10	612	56	12	3	683		AW		5	3	2	0	
7/29/92	6:07	6:17	0:10	602	33	7	2	644		AW		5	5	2	0	
7/29/92	6:32	6:44	0:12	718	54	11	4	787		AW		5	5	2	0	

7/29/92	6:54	7:04	0:10	822	53	6	2	883	AW	5	5	2	0
7/29/92	7:15	7:24	0:09	906	52	5	1	964	AW	7	7	2	0
7/29/92	7:47	7:58	0:11	785	50	4	0	839	AW	7	7	2	0
7/29/92	8:09	8:19	0:10	628	47	2	1	678	AW	7	5	2	0
7/29/92	8:36	8:47	0:11	803	47	4	1	855	AW	7	5	2	0
7/29/92	8:55	9:03	0:08	815	46	6	2	869	AW	7	5	2	0
7/29/92	9:15	9:25	0:10	900	45	12	5	962	AW	7	5	2	0
7/30/92	6:17	6:25	0:08	479	40	11	0	530	AW	5	5	1	2
7/30/92	6:18	6:31	0:13	413	34	16	1	464	WM	5	3	1	1
7/30/92	6:35	6:40	0:05	578	60	11	0	649	AW	5	3	1	1
7/30/92	6:46	6:55	0:09	664	42	5	0	711	AW	5	3	1	
7/30/92	6:46	6:59	0:13	547	43	8	0	598	WM	5	3	1	2
7/30/92	7:08	7:21	0:13	731	50	6	2	789	AW	5	3	1	1
7/30/92	7:08	7:23	0:15	550	32	15	0	597	WM	5	3	1	
7/30/92	7:44	7:52	0:08	511	18	33	0	562	AW	7	5	1	1
7/30/92	7:44	7:55	0:11	568	19	50	0	637	WM	7	5	1	1
7/30/92	8:12	8:21	0:09	602	21	6	0	629	AW	5	5	1	1
7/30/92	8:12	8:24	0:12	638	22	15	0	675	WM	5	5	1	1
7/30/92	8:28	8:38	0:10	704	9	2	0	715	AW	5	5	1	1
7/30/92	8:28	8:41	0:13	618	16	18	0	652	WM	5	5	1	1
7/30/92	9:13	9:25	0:12	812	36	4	0	852	AW	5	3	1	1
7/30/92	9:13	9:27	0:14	664	10	9	0	683	WM	5	3	1	1
7/30/92	9:37	9:47	0:10	579	18	7	0	604	AW	5	3	1	1
7/30/92	9:37	9:51	0:14	695	5	12	0	712	WM	5	3	1	1
7/30/92	9:59	10:08	0:09	631	17	2	1	651	AW	5	5	1	1
7/30/92	9:59	10:10	0:11	620	9	9	0	638	WM	5	5	1	1
7/30/92	10:22	10:28	0:06	467	2	12	0	481	AW	5	5	1	1
7/30/92	10:22	10:31	0:09	460	4	17	0	481	WM	5	5	1	1
7/31/92	7:25	7:34	0:09	670	45	18	2	735	AW	5	5	1	0
7/31/92	7:25	7:39	0:14	777	24	19	0	820	WM	5	5	1	0
7/31/92	7:45	7:59	0:14	775	27	14	0	816	WM	5	5	1	0
7/31/92	7:45	8:00	0:15	1054	59	16	0	1129	AW	5	5	1	0
7/31/92	8:10	8:25	0:15	1144	32	21	0	1197	AW	7	5	1	0
7/31/92	8:10	8:25	0:15	867	43	16	0	926	WM	7	5	1	0
7/31/92	8:33	8:45	0:12	951	4	23	0	978	AW	7	7	1	0
7/31/92	8:33	8:47	0:14	869	20	16	0	905	WM	7	7	1	0
7/31/92	9:01	9:10	0:09	578	13	12	0	603	WM	7	7	1	0
7/31/92	9:01	9:11	0:10	810	4	16	2	832	AW	7	7	1	0
7/31/92	9:29	9:38	0:09	723	6	18	0	747	AW	7	7	1	0
7/31/92	9:29	9:39	0:10	660	22	14	0	696	WM	7	7	1	0
7/31/92	9:58	10:07	0:09	789	21	9	0	819	AW	7	7	1	0
7/31/92	9:58	10:08	0:10	739	6	10	0	755	WM	7	7	1	0
7/31/92	10:25	10:31	0:06	568	16	3	0	587	AW	7	7	1	0
7/31/92	10:25	10:34	0:09	598	12	21	0	631	WM	7	7	1	0
7/31/92	10:43	10:50	0:07	528	1	8	0	537	AW	5	7	1	0
7/31/92	10:43	10:52	0:09	490	7	32	0	529	WM	5	7	1	0
7/31/92	10:59	11:05	0:06	492	7	13	0	512	AW	5	7	1	0
7/31/92	10:59	11:06	0:07	429	8	36	0	473	WM	5	7	1	0

8/1/92	8:08	8:17	0:09	674	18	25	0	717	AW	5	7	1	0
8/1/92	8:08	8:20	0:12	440	13	14	0	467	WM	5	5	1	0
8/1/92	8:32	8:41	0:09	662	45	9	2	718	AW	5	5	1	0
8/1/92	8:32	8:42	0:10	577	27	19	0	623	WM	5	5	1	0
8/1/92	8:49	8:59	0:10	711	65	13	0	789	AW	5	5	1	0
8/1/92	8:49	9:00	0:11	780	38	13	0	831	WM	5	5	1	0
8/1/92	9:18	9:26	0:08	680	58	19	0	757	AW	5	5	1	0
8/1/92	9:18	9:28	0:10	705	38	29	0	772	WM	5	6	1	0
8/1/92	9:44	9:55	0:11	809	68	5	0	882	AW	5	5	1	0
8/1/92	9:44	9:55	0:11	699	1	2	0	702	WM	5	6	1	0
8/1/92	10:16	10:25	0:09	754	44	0	0	798	AW	5	6	1	0
8/1/92	10:16	10:26	0:10	596	48	0	0	644	WM	5	5	1	0
8/1/92	10:36	10:43	0:07	824	42	3	0	869	AW	5	5	1	0
8/1/92	10:36	10:44	0:08	607	44	6	0	657	WM	5	5	1	0
8/1/92	11:05	11:13	0:08	620	42	2	0	664	AW	5	5	1	0
8/1/92	11:05	11:14	0:09	556	22	8	0	586	WM	5	5	1	0
8/1/92	11:19	11:26	0:07	679	18	2	0	699	AW	6	6	1	0
8/1/92	11:19	11:29	0:10	613	10	16	0	639	WM	5	7	1	0
8/26/92	6:15	6:18	0:03	176	20	0		618	AW	7	7	2	0
8/26/92	6:15	6:19	0:04	171	37	0		565	TM	7	7	2	0
8/26/92	6:27	6:31	0:04	232	48	3		541	AW	5	5	2	0
8/26/92	6:27	6:32	0:05	191	71	7		570	TM	5	5	2	0
8/26/92	6:33	6:37	0:04	272	46	3		478	AW	3	3	2	0
8/26/92	6:33	6:39	0:06	258	92	14		364	TM	3	3	2	0
8/26/92	6:42	6:47	0:05	375	57	4		436	AW	1	1	2	0
8/26/92	6:42	6:48	0:06	360	86	12		458	TM	3	1	2	0
8/26/92	7:00	7:06	0:06	432	67	10		509		1	1	2	0
8/26/92	7:00	7:07	0:07	447	110	22		579		1	1	2	0
8/26/92	7:18	7:23	0:05	438	58	2		498		1	1	2	0
8/26/92	7:18	7:26	0:08	447	53	47		547		1	1	2	0
8/26/92	7:41	7:46	0:05	444	43	5		492		1	1	2	0
8/26/92	7:41	7:48	0:07	513	50	10		573		1	1	2	0
8/26/92	7:56	8:00	0:04	479	38	3		520		1	1	2	0
8/26/92	7:56	8:02	0:06	451	66	7		524		1	1	2	0
8/26/92	8:10	8:15	0:05	520	39	7		566		1	1	2	0
8/26/92	8:10	8:17	0:07	546	20	1		567		1	1	2	0
8/26/92	8:23	8:27	0:04	441	11	10		462		3	3	2	0
8/26/92	8:23	8:28	0:05	459	26	5		490		3	3	2	0
8/26/92	8:34	8:37	0:03	413	38	5		456		3	3	2	0
8/26/92	8:34	8:39	0:05	463	30	11		504		3	3	2	0
8/26/92	8:45	8:48	0:03	467	18	3		488		3	3	2	0
8/26/92	8:45	8:50	0:05	498	19	10		527		3	3	2	0
8/27/92	6:12	6:19	0:07	492	108	9		609	AW	1	1	1	0
8/27/92	6:12	6:20	0:08	446	130	7		583	TM	1	1	1	0
8/27/92	6:24	6:31	0:07	477	167	10		654	TM	1	1	1	0
8/27/92	6:24	6:33	0:09	558	184	8		750	AW	1	1	1	0
8/27/92	6:42	6:48	0:06	382	166	7		555	TM	7	1	1	0
8/27/92	6:42	6:50	0:08	437	195	6		638	AW	6	1	1	0
8/27/92	6:57	7:07	0:10	487	240	11		738	TM	3	3	1	0

8/27/92	6:57	7:07	0:10	533	119	7	659	AW	3	3	1	0
8/27/92	7:23	7:32	0:09	696	85	1	782	AW	3	3	1	0
8/27/92	7:23	7:33	0:10	516	243	4	763	TM	3	3	1	0
8/27/92	7:41	7:50	0:09	624	123	4	751	AW	1	1	1	0
8/27/92	7:41	7:50	0:09	408	180	8	596	TM	3	1	1	0
8/27/92	8:00	8:05	0:05	468	58	11	537	AW	3	1	1	0
8/27/92	8:00	8:09	0:09	447	182	18	647	TM	3	1	1	0
8/27/92	8:17	8:23	0:06	582	52	3	637	AW	4	2	1	0
8/27/92	8:17	8:27	0:10	535	149	5	689	TM	3	1	1	0
8/27/92	8:36	8:43	0:07	617	34	3	654	AW	5	1	1	0
8/27/92	8:36	8:46	0:10	545	138	5	688	TM	5	1	1	0
8/27/92	9:11	9:17	0:06	558	22	5	585	AW	5	3	1	0
8/27/92	9:11	9:22	0:11	671	81	10	762	TM	5	1	1	0
8/27/92	9:27	9:32	0:05	500	41	8	549	AW	4	1	1	0
8/27/92	9:27	9:35	0:08	511	87	14	612	TM	5	1	1	0
8/27/92	9:39	9:44	0:05	474	41	19	534	AW	4	1	1	0
8/27/92	9:39	9:47	0:08	523	6	8	537	TM	5	1	1	0
8/28/92	6:33	6:37	0:04	281	51	2	334	AW	1	1	1	0
8/28/92	6:33	6:38	0:05	266	74	5	345	TM	1	1	1	0
8/28/92	6:43	6:47	0:04	250	50	6	306	AW	1	1	1	0
8/28/92	6:43	6:47	0:04	195	68	9	272	TM	1	1	1	0
8/28/92	6:56	7:01	0:05	283	54	4	341	AW	1	1	1	0
8/28/92	6:56	7:01	0:05	284	73	6	363	TM	3	1	1	0
8/28/92	7:15	7:21	0:06	376	63	10	449	TM	3	1	1	0
8/28/92	7:15	7:21	0:06	428	88	5	521	AW	3	1	1	0
8/28/92	7:31	7:36	0:05	319	81	3	403	TM	3	1	1	0
8/28/92	7:31	7:36	0:05	385	69	5	459	AW	3	1	1	0
8/28/92	7:44	7:50	0:06	425	105	3	533	AW	3	1	1	0
8/28/92	7:44	7:50	0:06	292	116	3	411	TM	1	1	1	0
8/28/92	8:15	8:20	0:05	317	81	4	402	AW	3	3	1	
8/28/92	8:15	8:20	0:05	275	121	9	405	TM	3	3	1	
8/28/92	8:28	8:34	0:06	316	108	3	427	AW	3	3	1	
8/28/92	8:28	8:34	0:06	306	100	5	411	TM	3	3	1	
8/28/92	8:44	8:48	0:04	287	69	7	363	AW	3	5	2	
8/28/92	8:44	8:48	0:04	290	70	7	367	TM	3	5	2	
8/28/92	9:02	9:05	0:03	246	33	3	282	TM	7	7	2	
8/28/92	9:02	9:05	0:03	267	26	6	299	AW	7	7	2	
8/28/92	9:10	9:14	0:04	328	40	3	371	AW	6	6	2	
8/28/92	9:10	9:14	0:04	273	73	6	352	TM	6	6	2	
8/28/92	9:24	9:28	0:04	388	43	6	437	AW	5	5	2	
8/28/92	9:24	9:28	0:04	327	59	7	393	TM	5	5	2	

Mean 0:08

Table XX. Summary of maximum counts of harbor seals from land-based counts and aerial photographs in Glacier Bay, Alaska, August 1992.

			Land-based counts				Aerial	
			DATES					
HAULOUT SITES			8/20	8/21	8/22	8/23	8/27	8/28
Beardslee Islands								
	1	Spider Island					1094	1017
	2	Eider Island					0	0
	3	Secret Bay					0	0
	4	Hutchins Bay					0	0
	5	Link Is.					0	0
	6	Flapjack Is.					61	126
	7	Strawberry Is.					0	0
	8	Reef N of Straw. Is.					0	0
Mid Bay (East)								
	9	Reef S of Leland Is.					209	243
	10	N. Marble Is.					0	0
	11	S. Marble Is.					0	0
	12	Sandy Cove					0	0
	13	Sturgess Is.					0	0
East Arm								
	14	Garforth Is.					0	0
	15	Adams Inlet					fog	0
	16	Wachusett Inlet					fog	0
	17	**Muir Inlet (ice)**					fog	87
	18	Muir Inlet (land)					fog	0
	19	Carolyne Schoal					0	0
	20	Sealers Is.					0	0
West Arm								
	21	Tidal Inlet					fog	NC
	22	Queen Inlet					fog	NC
	23	Rendu Inlet					fog	NC
	24	Tarr Inlet					fog	NC
	25	**J.H. Inlet (ice)**	3415	3736	**5801**	4154	fog	NC
	26	Reid Inlet					fog	NC
	27	Skidmore Bay					0	NC
	28	Hugh Miller Inlet					0	NC
	29	Blue Mse. Cv.					0	NC
	30	Charpentier In.					0	NC
	31	Lone Is.(a)					84	114
	32	Lone Is.(b)					25	31
	33	Geike Rock					116	203
Mid Bay (West)								
	34	Drake Is.					0	0
	35	Francis Is.					0	0
	36	Willoughby Is.					0	0
	37	Fingers Bay					0	0
	38	Berg Bay					0	NC
	39	Lars Is.					NC	NC
		Totals:					1589	**1821**
		Mean =		4277			1705	
		StDev =		1060			164	
		N =		4			2	
		95% CI =		3237	5316		1478	1932
		Minimum Pop. Estimate =		**5801**	**+**	**1821**	**=**	**7622**
		Overall 95% CI =		4715	to	7248		

Table . Foreground counts of subsections in Johns Hopkins Inlet which were used to determine if pups in the distance were undercounted.

		Hauled Out		In Water		%	Count	Obsr-	Cnt	View
Date	Time	Adults	Pups	Adults	Pups	Pups	Total	er	Qual	Qual
6/17/92	9:00	50	20	1	0	28.2%	71	AW	1	1
6/17/92	9:15	39	17	0	0	30.4%	56	AW	1	1
6/17/92	9:50	367	127	0	0	25.7%	494	AW	1	1
					Mean =	**28.1%**				
					St Dev =	**2.3%**				
					Coef of Variation =	**8.3%**				

6/17/92	8:16	38	12	1	0	23.5%	51	EM	1	1
6/17/92	9:40	217	65	2	1	23.2%	285	EM	1	1
6/17/92	9:57	82	26	0	0	24.1%	108	EM	1	1
					Mean =	**23.6%**				
					St Dev =	**0.5%**				
					Coef of Variation =	**2.0%**				

Updated Schedule for Land-based and Aerial Counts the Beardslee Islands (B.Is.) and and Johns Hopkins Inlet (JH), Glacier Bay National Park (7/13/92Beth Mathews)

						Counts				
			A.	Low Tide		Land		Aerial		
	Date	Day	W.	Time	Tide	B.Is.	JH	B.Is.	Volunteer	Comments
MAY PUPPING	27-May	Wed		16:29	4.1			√B		All flight times need to begin about one hr before low tide.
JUNE	1-Jun	Mon	√*	8:14	-3.5	√				
	2-Jun	Tues	√*	9:01	**-3.9**	√				
	3-Jun	Wed	√*	9:48	-3.8	√				
	15-Jun	Mon	√				√			JH drop-off & pick-up needed
	16-Jun	Tues	√				√			
	17-Jun	Wed	√				√			
	18-Jun	Thur	√				√			
	30-Jun	Tues	√*	7:58	-3.9					Pick up from Beardslees needed.
JULY	1-Jul	Wed	√*	8:41	**-4.4**			√B		
	2-Jul	Thur	√*	9:24	**-4.4**	√			LS, NMFS	
	18-Jul	Sat					√		BK, UAF	JH drop-off & pick-up needed
	19-Jul	Sun					√		BK, UAF	
	20-Jul	Mon					√		BK, UAF	
	21-Jul	Tues					√			
	22-Jul	Wed					√			
MOLTING	27-Jul	Mon	√			√			MM	Anne W. in charge of land counts. Simultaneous aerial and land counts.
	28-Jul	Tues	√	6:54	-2.8	√			MM	
	29-Jul	Wed	√	7:39	-3.9	√		√ER √	MM--> WM	
	30-Jul	Thur	√	8:21	**-4.5**	√		√ER √	WM	
	31-Jul	Fri	√	9:05	-4.3	√		√ER	WM	
AUGUST	16-Aug	Sun					√		PB	Hank Lentfer in charge of Hopkins counts. (*Dates +/- a day)
	17-Aug	Mon					√		PB	
	18-Aug	Tues					√		PB	
	19-Aug	Wed					√		PB	
	25-Aug	Tues	√						MM	Anne W. in charge of land counts. Simultaneous counts.
	26-Aug	Wed	√	6:33	-2.3	√		√ER √	MM	
	27-Aug	Thur	√	7:18	-3.3	√		√ER √	MM--> WM	
	28-Aug	Fri	√	8:00	**-3.6**	√		√ER	WM	
	29-Aug	Sat	√	8:39	-3.3	√			WM	

(Possibly another flight in September)

Volunteers

LS: Linda Shaw, NMFS, Mar. Mammal Exemption Prog.

WM: Wendy Marten: GLBA Naturalist

MM: Mike Murray, GLBA Naturalist

PB: Paul Barnes, Gustavus

BK: Brendan Kelly, UAF Research Associate (Ringed Seals)

GLBA Participants

Hank Lentfler, Resource Management

ER: Elizabeth Ross, Research Division

Beth's Schedule: Jul 29-Aug 27: Killer Whale census with NMML, Aleutians Islands

- Appendix E. Low tide cycles for study period and area. Add about 40 minutes to table time for low tide at the study site near Spider Island in the Beardslee Islands.

LOW Tides JUNEAU District

JUNE 1992

DATE DAY		DOT'S GUIDE	A.M. TIME	A.M. FT.	P.M. TIME	P.M. FT.
1	Mon	●	8:02	-3.5	8:04	2.5
2	Tues	●	8:44	-3.9	8:49	2.6
3	Wed	●	9:28	-3.8	9:36	2.4
4	Thur	●	10:13	-3.2	10:29	2.5
5	Fri	●	11:01	-2.2	11:26	2.8
6	Sat	●	11:53	-1.0	....	...
7	SUN	●	0:30	2.8	12:51	0.4
8	Mon	●	1:43	2.6	1:53	1.7
9	Tues	●	2:58	2.0	2:57	2.7
10	Wed	•	4:07	1.0	4:03	3.3
11	Thur	•	5:07	-0.1	5:02	3.5
12	Fri	•	5:58	-1.1	5:57	3.5
13	Sat	•	6:45	-1.8	6:43	3.4
14	SUN	•	7:27	-2.2	7:27	3.2
15	Mon	•	8:04	-2.3	8:07	3.2
16	Tues	•	8:41	-2.2	8:46	3.2
17	Wed	•	9:17	-1.8	9:25	3.3
18	Thur	•	9:52	-1.3	10:04	3.6
19	Fri	•	10:28	-0.5	10:45	3.8
20	Sat	•	11:03	0.5	11:30	4.0
21	SUN	•	11:42	1.5	....	...
22	Mon	●	0:20	4.2	12:23	2.7
23	Tues	●	1:21	4.1	1:12	3.7
24	Wed	●	2:25	3.6	2:11	4.5
25	Thur	●	3:29	2.7	3:17	5.0
26	Fri	●	4:32	1.5	4:24	5.9
27	Sat	●	5:25	0.0	5:20	4.7
28	SUN	●	6:15	-1.5	6:13	3.8
29	Mon	●	7:01	-2.8	7:03	2.9
30	Tues	●	7:46	-3.9	7:51	2.1

ALASKA DAYLIGHT TIME

LOW Tides JUNEAU District

JULY 1992

DATE DAY		DOT'S GUIDE	A.M. TIME	A.M. FT.	P.M. TIME	P.M. FT.
1	Wed	●	8:29	-4.4	8:38	1.4
2	Thur	●	9:12	-4.4	9:27	1.0
3	Fri	●	9:57	-3.8	10:16	0.8
4	Sat	●	10:42	-2.6	11:11	0.9
5	SUN	●	11:30	-1.1	....	...
6	Mon	●	0:12	1.2	12:20	0.7
7	Tues	●	1:16	1.5	1:16	2.4
8	Wed	•	2:29	1.5	2:21	3.8
9	Thur	•	3:42	1.2	3:34	4.6
10	Fri	•	4:48	0.6	4:43	4.8
11	Sat	•	5:44	-0.2	5:42	4.5
12	SUN	•	6:32	-0.9	6:30	4.1
13	Mon	•	7:12	-1.4	7:14	3.5
14	Tues	•	7:48	-1.8	7:52	3.1
15	Wed	•	8:23	-1.9	8:29	2.7
16	Thur	•	8:56	-1.8	9:04	2.4
17	Fri	•	9:25	-1.4	9:40	2.4
18	Sat	•	9:57	-0.7	10:15	2.4
19	SUN	•	10:29	0.2	10:53	2.6
20	Mon	●	11:01	1.3	11:38	2.8
21	Tues	●	11:35	2.5	....	...
22	Wed	●	0:28	3.0	12:16	3.7
23	Thur	●	1:29	3.1	1:12	4.9
24	Fri	●	2:43	2.7	2:24	5.6
25	Sat	●	3:55	1.7	3:45	5.6
26	SUN	●	4:59	0.3	4:56	4.9
27	Mon	●	5:54	-1.3	5:55	3.7
28	Tues	●	6:42	-2.8	6:48	2.2
29	Wed	●	7:27	-3.9	7:38	0.9
30	Thur	●	8:09	-4.5	8:24	-0.2
31	Fri	●	8:53	-4.3	9:12	-0.9

ALASKA DAYLIGHT TIME

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LOW Tides JUNEAU District

AUGUST 1992

DATE DAY		DOT'S GUIDE	A.M. TIME	A.M. FT.	P.M. TIME	P.M. FT.
1	Sat	●	9:35	-3.5	9:59	-1.1
2	SUN	●	10:16	-2.2	10:49	-0.8
3	Mon	●	10:59	-0.5	11:43	0.0
4	Tues	●	11:48	1.5	....	...
5	Wed	•	0:44	0.9	12:40	3.4
6	Thur	•	1:54	1.6	1:49	4.9
7	Fri	•	3:13	1.9	3:09	5.7
8	Sat	•	4:30	1.5	4:28	5.6
9	SUN	•	5:28	0.8	5:28	4.9
10	Mon	•	6:16	0.0	6:18	4.0
11	Tues	•	6:53	-0.7	6:58	3.1
12	Wed	•	7:27	-1.1	7:35	2.3
13	Thur	•	7:57	-1.4	8:07	1.6
14	Fri	•	8:28	-1.3	8:40	1.1
15	Sat	•	8:56	-0.9	9:14	0.9
16	SUN	•	9:24	-0.3	9:46	0.9
17	Mon	●	9:52	0.6	10:21	1.1
18	Tues	●	10:21	1.7	11:00	1.5
19	Wed	●	10:55	2.9	11:46	2.0
20	Thur	●	11:35	4.1	....	...
21	Fri	●	0:45	2.5	12:29	5.3
22	Sat	●	2:03	2.6	1:50	6.1
23	SUN	●	3:26	1.9	3:26	5.9
24	Mon	●	4:35	0.6	4:43	4.7
25	Tues	●	5:31	-0.9	5:44	3.0
26	Wed	●	6:21	-2.3	6:34	1.0
27	Thur	●	7:06	-3.3	7:22	-0.7
28	Fri	●	7:48	-3.6	8:07	-1.9
29	Sat	●	8:27	-3.3	8:53	-2.6
30	SUN	●	9:09	-2.4	9:36	-2.6
31	Mon	●	9:49	-1.0	10:23	-1.9

ALASKA DAYLIGHT TIME

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APPENDIX F. References entered into the computerized bibliography at Glacier Bay National Park, Bartlett Cove, Alaska.

This list includes 56 of over 100 published and unpublished papers acquired in 1992. These references are on file at the park, and the computerized bibliography and and hard-copy files will be continuously updated. These references have has not been fully edited. The following list was printed from an End Note file.

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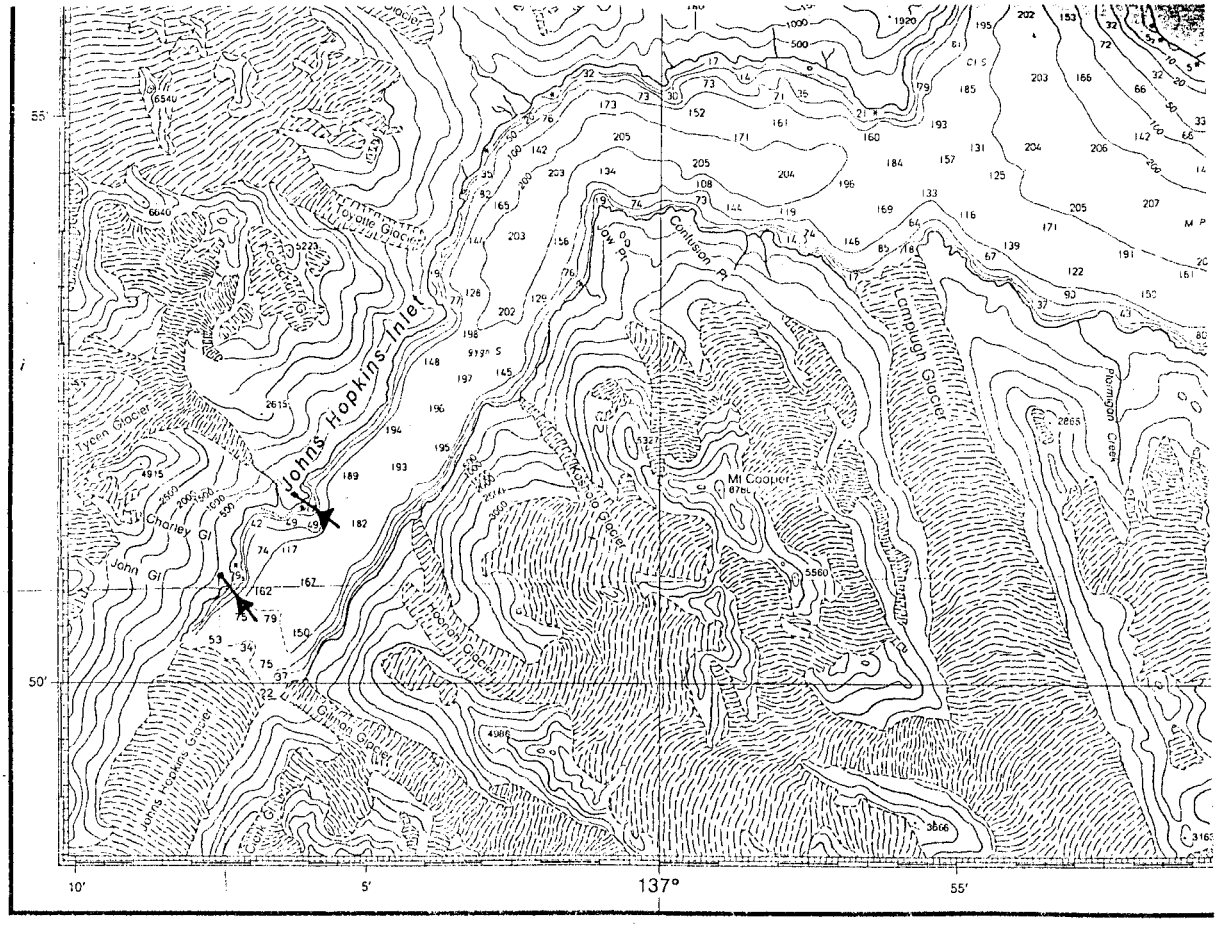

Figure 3. Observation sites (arrows) for harbor seal counts in Johns Hopkins Inlet, Glacier Bay, Alaska.