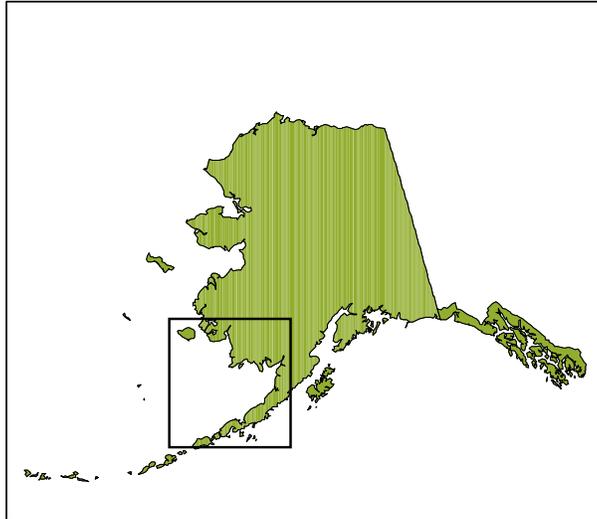


STELLER'S EIDER SPRING MIGRATION SURVEYS
SOUTHWEST ALASKA
2009



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Abstract. Annual spring aerial surveys were conducted most years from 1992 to 2009, to monitor the population status and habitat use of Steller's eiders (*Polysticta stelleri*) staging for spring migration in southwestern Alaska. One to four replicates were conducted per survey year as we attempted to target peak presence of eiders staging within the survey area prior to their departure to arctic nesting grounds. We recorded visual estimates of Steller's eiders and all other identifiable water birds and marine mammals along shorelines and within estuaries and shoals where Steller's eiders and other sea ducks were known to congregate during migration. In each year where multiple surveys were completed, the highest Steller's eider count was used as that year's population estimate for trend analysis. Annual estimates are 72,953 (2000), 60,656 (2001), 56,704 (2002), 77,369 (2003), 82,772 (2004), 79,022 (2005), 87,400 (2007), 70,480 (2008) and 77,777 (2009). We suspect that the low population estimates obtained from 2000 through 2002 were due at least in part to northward movement of eiders during the survey, taking advantage of strong following winds, thus escaping detection by the survey crew. This hypothesis was supported by satellite telemetry data which indicated migration of instrumented eiders during the survey of 2002. Long-term survey data indicate a 2.3 percent average annual decline in Steller's eiders using this migration corridor ($R^2 = 0.34$), but the trend since 2002 has been essentially level (-0.7 percent per year, $R^2 = 0.06$). Maps illustrate the distribution of Steller's eiders and other selected species within the survey area in 2009. A persistent pattern of habitat use by Steller's eiders and most other sea duck species among years is evidence of the importance of certain areas to staging and migrating waterfowl. Many of these sites receive intensive use by waterfowl in other seasons as well.

Key Words: Steller's eider, *Polysticta stelleri*, king eider, *Somateria spectabilis*, migration, population, aerial, survey, waterfowl, Bering Sea, Bristol Bay

INTRODUCTION

The majority of the world population of Steller's eiders migrates along the Bristol Bay coast of the Alaska Peninsula in the spring, crosses Bristol Bay toward Cape Pierce, then continues northward along the Bering Sea coast. Most then cross the Bering Strait to their breeding grounds in Siberia, with a smaller number continuing north to the Alaska North Slope to breed (Gill et al. 1978). They linger en route to feed at the mouths of lagoons and other productive habitats. Concern over apparent declines of eiders prompted the U.S. Fish and Wildlife Service to initiate a special survey in 1992 to monitor the population of Steller's eiders that winters in Alaska waters. Since a comprehensive survey of the species is not currently feasible on its extensive and remote winter range, which includes the Aleutian Islands, the Alaska Peninsula, and the western Gulf of Alaska including Kodiak and lower Cook Inlet, we estimate their numbers as they stage during migration in Bristol Bay and the Yukon-Kuskokwim Delta. Objectives of the survey are:

1. Obtain an annual estimate of the pre-breeding population of Steller's eiders that winter in Alaskan waters.
2. Document distribution of and habitats used by Steller's eiders during migration.
3. Describe populations and distributions of other migrating water birds and marine mammals, to the extent that doing so does not compromise the Steller's eider objectives.

This report summarizes results from the 2009 Steller's eider surveys, with comparisons to data from previous surveys.

STUDY AREA AND METHODS

The survey area included estuarine and near shore habitats along the coast of southwestern Alaska, from the Yukon-Kuskokwim Delta (Y-K Delta) to the west end of the Alaska Peninsula. Steller's eiders are normally found feeding and resting in and near lagoons and shoals rich in benthic invertebrate prey and generally less than 10 meters in depth. Our objective for coverage was to search all such areas within the survey area to census all Steller's eiders, as well as to cover other important sea duck habitats along the route. We flew a Cessna 206 amphibious airplane at 90 to 100 knots (166 to 185 km/hr) airspeed and 150 to 250 feet (46 to 76 m) altitude. Habitats within lagoons and bays were censused using an adaptive contiguous search pattern, while exposed shorelines were surveyed using a single track parallel to the coast within 1 km of the shoreline, with deviations made for flocks sighted at greater distances offshore. The effort required for comparable coverage among surveys/years varied depending upon the net effect of detection factors, such as lighting, sea surface condition, and bird distribution. Therefore the actual survey flight path was left to the discretion of the pilot/primary observer.

The Steller's eider survey total is considered a minimal population estimate because some birds may escape detection by the survey crew by moving northward during the periods between survey flights, while others may be outside the survey area (north or south) during the survey, or simply overlooked. While we strive diligently to minimize such errors, we have not incorporated a method for detecting or measuring bird movements that may occur during the survey, other than comparing contemporaneous satellite telemetry data from small numbers of eiders in a few recent years. No such data from instrumented birds were available for 2009. Since the 2000 survey year offshore shoal areas that are too extensive to cover contiguously within budget and safety parameters were surveyed using a "saw tooth" array of sample strips, 500 or 600m wide, depending on survey conditions. We calculated population estimates for these areas by extrapolating the average density of each species within the samples to the sampled area (Fig. 3). We believe in most cases this procedure produced results more accurate for Steller's eiders and other sea ducks except perhaps king eiders, whose typically highly clustered distribution may have yielded results biased by large sampling error. In 2009 we deviated from the sampling procedure in Kvichak Bay (which contained most of the king eiders in the survey), availing ourselves of excellent survey conditions to simply locate and estimate flocks. The crew felt that all flocks present in the normally-sampled offshore polygon were included in our estimate. Differences among estimates from shoreline counts prior to 2000 vs. those from the "saw tooth" sampling procedure were insignificant for Steller's eiders, as this species was recorded in only one of the sampled areas (Kuskokwim River to Chagvan Bay), and there in very small numbers.

The survey was designed to correspond to the specific distribution of Steller's eiders during the spring staging period, and therefore is not necessarily optimal for other species in route or timing. Data for other species are useful primarily to indicate habitat associations persistent among years, and as an "early warning" of major spatial and/or temporal population changes to signal the need for and help direct specific investigations. This document and other annual survey reports contain brief discussions of results for other important sea ducks, while a more detailed discussion for other selected species is contained in Larned (1998).

For geographic reference, the shoreline was historically divided into 126 numbered segments (Larned et al. 1994), identical to those used for the annual spring emperor goose survey conducted by the U.S. Fish and Wildlife Service, Fairbanks. However, in 1997 we began using a global positioning system (GPS)/laptop computer data collection system which enabled us to electronically record our flight path and the precise location of each observation, so the segments were no longer used. The more recent procedure, utilizing a laptop computer for each observer, wired to the onboard GPS receiver, enabled each observer to record observations vocally directly into his/her computer. A custom program developed by John Hodges (U.S. Fish and Wildlife Service, Migratory Bird Management, Juneau, AK) recorded our flight path and automatically linked GPS coordinates to each recorded observation. Recorded observations were later transcribed using an associated program, also created by Hodges, which produced ASCII data files wherein each line contained a single observation, including species, numerical count or estimate, geographic coordinates, date, and time. We also recorded auxiliary data, including

observers' initials and position in aircraft, tide stage (high, medium, low, and unknown), ice cover in tenths, sea condition (Beaufort scale), wind and sky condition. Auxiliary data are archived, but thus far have not been included in analyses.

In some years we repeated the survey up to three times to bracket the spring migration period, using the highest count as that year's Steller's eider estimate. However, from 1997 to 2007 only one survey per year was flown, due variously to funding shortages and extended periods of inclement weather.

In addition to suboptimal survey timing, another source of error is flock estimation bias. We have attempted to measure and correct for this bias using a representative double sample of oblique aerial photographs of flocks which were also estimated visually. In 1998, visual estimates made by Larned of 17 Steller's eider flocks ranging in size from 94 to 2194 birds, were variable and averaged 35 percent lower than counts made from photographs of the same flocks. The small sample was inadequate for generating a ratio useful for adjusting for observer bias, but suggests that my flock estimates may be low-biased – a tendency common among aerial observers, especially with large dense flocks that are characteristic of wintering and migrating Steller's eiders (Joensen 1974). Unfortunately, attempts to obtain paired photo/visual counts to better understand, and perhaps correct for, estimation bias, have been largely thwarted by the frequent, mostly synchronous diving behavior of Steller's eiders. Our experience suggests that incorporation of this method would require extensive and time-consuming circling maneuvers for each flock, the disturbance of which would often result in dispersal or recombination of other nearby flocks. This would complicate visual flock estimation, and exacerbate fuel reserve issues which are already often critical. In our opinion, if there is potential in this method it lies in use of a second aerial crew dedicated to obtaining comprehensive photo coverage of all eiders in each of a subset of surveyed aggregations, such as those within the lagoons along the Alaska Peninsula.

The aerial survey crew since the inception of the survey in 1992 has consisted of Bill Larned as pilot and port observer, with various starboard observers. We attempted to minimize the effects of inconsistent observer bias by using only experienced aerial observers, and by the pilot/observer intentionally maneuvering the aircraft so that the majority of large eider flocks were on his side for estimation. Observers practiced flock estimation within one week prior to each survey, using a computer simulation program (Wildlife Counts by John Hodges, USFWS, Juneau, AK), and reviewing aerial photographs of eider and other sea duck flocks of known size. In 2009, Karen Bollinger (USFWS, Waterfowl Management, Fairbanks, Alaska) functioned as starboard observer initially until 17 April, when pilot Larned returned home due to a family emergency. The survey was completed with Karen Bollinger as Pilot and Susan Savage (Biologist, Alaska Peninsula/Becharof National Wildlife Refuge) as starboard observer.

RESULTS

Habitat and survey conditions

Spring in southwestern Alaska in 2009 was late and cold for the third consecutive year, with extensive ice cover in Bristol Bay, Kuskokwim Bay and the Yukon-Kuskokwim Delta coast until mid-April. Satellite imagery downloaded from the NASA MODIS Rapid Response System (<http://rapidfire.sci.gsfc.nasa.gov/>) website for 17 and 20 April reveal large amounts of brash ice remaining throughout the region, but plenty of open water adjacent to south-facing shorelines as a result of persistent northerly winds, providing a substantial travel lane for migrating waterfowl (Fig. 1) at least as far as Nunivak Island. However, this same northerly wind pattern is generally believed to discourage and impede northward migration, and this expectation of minimal northward movements during the survey increases confidence in our results. The images also show extensive ice against the Bristol Bay shoreline of upper portion of the Alaska Peninsula, but mostly open water in lower Peninsula lagoons throughout the survey period (Fig. 1) -- a condition during which we expect most Steller's eiders to be staging in the lower Peninsula lagoons, and therefore indicating optimal survey timing.

Our recorded flight paths for the survey are displayed in Fig 3. Total flight time of 44.0 hrs. includes transit flights (Appendix 1).

Itinerary for 2008, survey 1:

- 4/15 3.7-hr flight in survey aircraft, Anchorage to Bethel. 3.3-hr survey flight covering south side of Nunivak Island. Overnight at Bethel, FWS bunkhouse.
- 4/16 5.5-hr survey flight, Kuskokwim River mouth to Toksook Bay. Overnight at Bethel, FWS bunkhouse.
- 4/17 5.6-hr. survey flight, Bethel to King Salmon. Larned leaves via airlines due to family emergency. Bollinger overnight at King Salmon, FWS bunkhouse.
- 4/18 2.1-hr. survey flight, King Salmon to upper Bristol Bay for offshore sea duck survey and aerial photography, and return to King Salmon for fuel. Also 5.9hr survey flight King Salmon to Cold Bay including AK Peninsula lagoons to Nelson Lagoon. Overnight at Cold Bay, FWS bunkhouse.
- 4/19 4.6-hr. survey flight, Izembek and other lagoons in the Cold Bay vicinity. Overnight King Salmon, FWS bunkhouse.
- 4/20 4.4-hr. survey flight to Sanak and Caton Islands, refuel and transit flight to King Salmon. Overnight King Salmon, FWS bunkhouse.
- 4/21 2.6-hr transit flight to Anchorage. End of survey.

Steller's eider results

We believe the timing of the 2009 survey was optimal for a comprehensive count of Steller's eiders, since we recorded very few in either Kuskokwim Bay/Nunivak Island area at the northernmost portion of the survey area (157 total) or Sanak/Caton Islands, south of the survey area (164 eiders) (Table 1, Fig. 3). Results of late winter surveys (Larned 2000) and a satellite

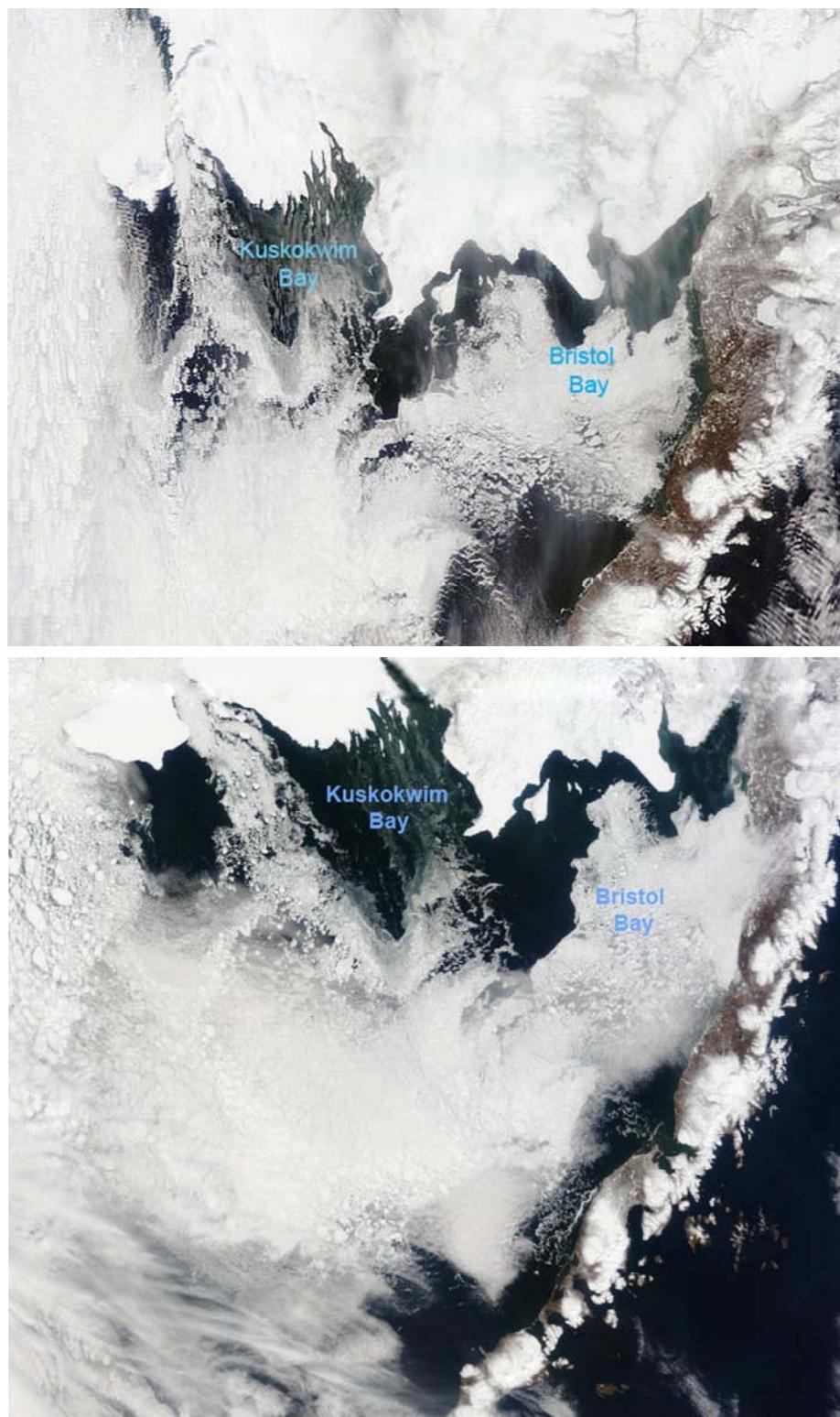


Figure 1. Sea ice distribution, southwest Alaska, 17 April (top) and 20 April (bottom), 2009. Images from <http://rapidfire.sci.gsfc.nasa.gov/realtime/>.

telemetry study (P. Martin, US Fish and Wildlife Service, pers. comm.) suggest that Sanak/Caton Islands provide an important habitat for wintering and staging Steller's eiders, possibly as an ice-free alternative when the preferred lower Alaska Peninsula lagoons are ice covered. Large numbers of eiders remaining at Sanak Islands would suggest that a portion of the population had not yet moved into the lagoons (survey area) for migration staging, while large numbers in the Kuskokwim Bay region might suggest that a portion of the population had already departed the survey area for the breeding grounds in arctic Russia and Alaska. Another consideration is that in the Kuskokwim Bay area eiders tend to be widely scattered, often among large amounts of finely broken sea ice, and are therefore more difficult to accurately estimate compared with those along the Alaska Peninsula, where they are most often found concentrated in compact flocks feeding among tide channels and eelgrass beds.

The 2009 Steller's eider estimate (77,777) is up slightly (+10%) from the estimate from late April 2008 (70,480, Table 2). This difference is insignificant, particularly since there was a change in crew this year, lowering our confidence in comparability, but nonetheless results suggest that the eastern Bering Sea wintering population is relatively stable over the past 7 years at least (Fig. 2).

The pattern of habitat use by concentrations of Steller's eiders in 2009 (Table 1; Fig. 3)

was similar to those of the

previous two years, but slightly more southerly than that seen during surveys in other years with similar timing, which we attribute to the late timing of sea ice breakup. One minor difference noted this year was the presence of an estimated 475 Steller's eiders in Ugashik Bay, a habitat in which we have recorded very few, often none, in other years.

Other Waterfowl

While this survey was not designed to produce high-confidence estimates for species other than Steller's eiders, we have tried to acquire data on non-target sea ducks to help characterize general staging patterns and relative abundance over the long term, to identify large scale changes and anticipate problems associated with proposed projects or changes in marine habitats. Most *King eiders* were recorded in Kvichak Bay, Kuskokwim Bay and in coastal waters off Cape Seniavin (Table 1, Fig. 5). This year fuel management considerations precluded our usual thorough

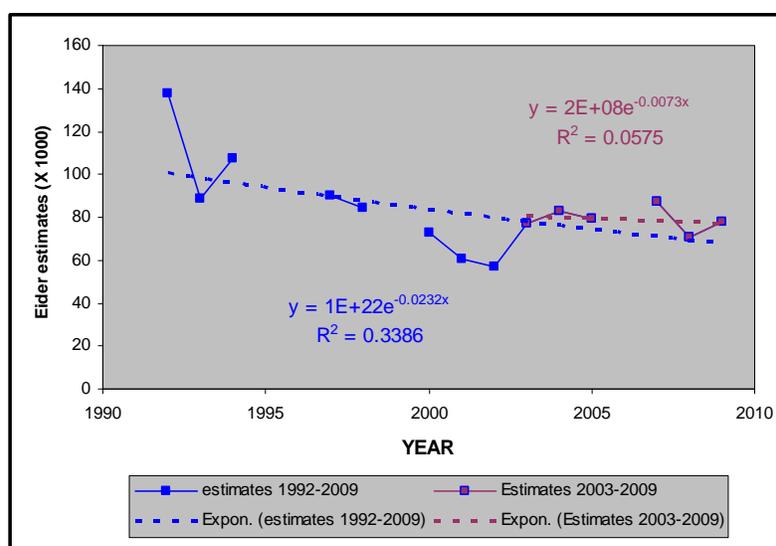


Figure 2. Trend in Steller's eider estimates from aerial surveys, southwest Alaska, April and May, 1992-2009.

coverage of the Kvichak/Nushagak shoals area, which usually contains the bulk of the surveyed population. Our adaptive abbreviated survey resulted in a total of 122,589 king eiders tallied there, plus another 1,807 at nearby Cape Constantine (Table 1). This area typically hosts a large proportion of the Pacific king eider population in the spring, and is an important fall molting area as well (Larned and Tiplady 1997, 1998).

The *common eider* is an early migrant, often migrates well offshore, and is therefore probably typically underestimated on this survey, which is normally past optimal timing for early migrants and shoreline-based. The total estimate from the 2009 survey is 5,934, most of which were recorded in migration flight in upper Kuskokwim Bay (Table 1, Fig. 6). We normally expect most of these early migrants to pass through the survey area prior to mid-April, but a late April survey in 1997 revealed at least 20,000 common eiders lingering to feed offshore of the southern portion of the Yukon River delta, suggesting that area as a possible important staging habitat for that species. *Long-tailed ducks* were present throughout the survey area (Fig. 6), but the total of 7,351 was well below the 2000-2008 average of 21,900. The distribution of *black scoter* observations concentrated mainly in the southern portion of the survey area, including Sanak/Caton Islands (Fig. 7), suggests the survey was not timed optimally for this late-migrating species. Many were probably still in habitats outside of the survey area, such as the south side of the Alaska Peninsula. This, along with the abbreviated coverage of the favored Kvichak/Nushagak shoals habitat in upper Bristol Bay may account for the below-average total (27,910 vs. 2000-2008 average 36,335, Table 1, 2). The effect of the late spring breakup of 2009, similar to that of both 2007 and 2008, was evident in the southerly distribution of both *black brant* and *emperor geese*, with none of either species recorded north of the Alaska Peninsula (Figs. 8, 9). However, brant were present in large numbers in the completely open water of Izembek Lagoons during this survey (74,541 brant, Table 1).

CONCLUSIONS AND RECOMMENDATIONS

1. Long-term data from this survey suggest a fairly level recent trend in Steller's eiders, but at an uncomfortably low mean. An important basic element of prudent Steller's eider management is a consistent comprehensive monitoring program. So far this survey is the only affordable alternative offered to provide such data. We recommend continuing this survey annually.
2. We should continue refinement of methods to estimate optimal timing for this survey, if we are to be limited to a single survey per spring. This will involve use of the steadily improving satellite imagery and other weather data to monitor sea ice breakup and wind flow patterns, as well as reliance on National Wildlife Refuges and other contacts to provide timely intelligence on physical conditions and observations of bird activity.
3. It is time for a plan to fill in temporal data gaps in the annual use of the habitats shown by this and other studies in southwest Alaska to be seasonally important for sea ducks. This is especially urgent for Steller's eiders, king eiders and black scoters, which are all species of

concern and for which estuarine habitats in southwest Alaska are critically important and at some risk from pending resource development projects.

ACKNOWLEDGMENTS

We gratefully acknowledge the assistance of the managers and staffs of Alaska Peninsula/Becharof, Izembek, and Yukon Delta National Wildlife Refuges, who provided for the logistic needs of the survey crew. We also sincerely appreciate the participation of Susan Savage, biologist at Alaska Peninsula National Wildlife Refuge, who volunteered to fill in as observer at very short notice when Bill Larned was called home due to family illness. Thanks also to Ted Swem and other members of the Steller's Eider Recovery Team for their continued support of this project.

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Table 1. Seaduck and goose estimates for geographic aerial survey units, spring Steller's eider survey, southwest Alaska, April 15-21, 2009.

| Survey Unit | Date surveyed | Elapsed Time | Expansion Factor | Common eider | King eider | Steller's eider | Harlequin duck | Long-tailed duck | Surf scoter | Black scoter | White-winged scoter | Goldeneyes |
|--|---------------|--------------|------------------|--------------|----------------|-----------------|----------------|------------------|-------------|---------------|---------------------|------------|
| Nunivak Island | 4/15 | 1:04 | 1.00 | 448 | | 2 | | 217 | | | | |
| Toksook Bay to Kuskokwim R. | 4/16 | 3:30 | 1.00 | 3,511 | 1 | 38 | | 1,541 | | | 4 | |
| Kuskokwim R. to Chagvan Bay ¹ | 4/17 | 1:52 | 9.78 | 636 | 62,436 | 39 | | 24 | | 29 | 127 | |
| Goodnews Bay ² | 4/17 | 0:04 | 1.00 | | | 78 | | | | | | |
| Chagvan Bay ³ | 4/17 | 0:02 | 1.00 | | 6 | | | | | | | |
| Nanvak Bay ⁴ | 4/17 | 0 | 1.00 | | | | | | | | | |
| Nanvak Bay to Togiak Village | 4/17 | 0:48 | 1.00 | 956 | 53 | 70 | | 108 | | 3 | 5 | |
| Togiak Village to Kulukak Bay | 4/17 | 0:24 | 1.00 | | | 182 | 10 | 634 | | 2 | | 16 |
| Kulukak Bay to Cape Constantine | 4/17 | 0:24 | 1.00 | | | 20 | | 182 | | | 2 | 1 |
| Cape Constantine | 4/17 | 0:16 | 5.63 | | 1,807 | | | | | 676 | | |
| Kvichak Bay | 4/17 | 0:49 | 1.00 | | 122,589 | | | 446 | | 1,350 | | |
| Naknek River to Port Heiden | 4/18 | 1:09 | 1.00 | | 110 | 200 | | 141 | | 332 | 93 | |
| Egegik Lagoon | 4/18 | 0:21 | 1.00 | | | | | 10 | | 7 | | |
| Ugashik Lagoon | 4/18 | 0:38 | 1.00 | | | 475 | | 141 | | 24 | | |
| Cinder River Sanctuary | 4/18 | 0:16 | 1.00 | | | | | 2 | | | | |
| Port Heiden | 4/18 | 1:11 | 1.00 | 110 | | 15,220 | | 397 | | 367 | | |
| Port Heiden to Port Moller | 4/18 | 0:47 | 1.00 | | 10,300 | 3,420 | | 5 | | 16,283 | 1,566 | |
| Seal Islands Lagoon | 4/18 | 0:20 | 1.00 | | | 350 | | 206 | | 50 | | 12 |
| Port Moller/Herendeen Bay | 4/18 | 0:47 | 1.00 | | | 9,022 | | 395 | | 3,628 | | |
| Nelson Lagoon | 4/18 | 0:22 | 1.00 | 50 | | 11,140 | | 570 | | 609 | | |
| Nelson Lagoon to Izembek Lagoon | 4/19 | 0:39 | 1.00 | 30 | | 100 | | 96 | | 485 | | |
| Izembek Lagoons | 4/19 | 2:49 | 1.00 | | | 35,011 | 41 | 1,903 | 7 | 1,576 | 8 | |
| Kinzerof Lagoon | 4/19 | 0:14 | 1.00 | | | 1,760 | | 26 | | 28 | | |
| Morzhovoi Bay Lagoons | 4/19 | 0:19 | 1.00 | | | | 120 | | | 10 | | |
| Bechevin Bay | 4/19 | 0:33 | 1.00 | 2 | | 412 | | 3 | 12 | 760 | 23 | |
| Cold Bay | 4/19 | 0:15 | 1.00 | 1 | | 74 | 21 | 20 | | 193 | 5 | |
| Sanak/Caton Islands | 4/20 | 1:39 | 1.00 | 190 | | 164 | 1,038 | 284 | 6 | 1,498 | 14 | |
| Totals | | | | 5,934 | 197,302 | 77,777 | 1,230 | 7,351 | 25 | 27,910 | 1,847 | 29 |

1. Estimates reported herein for these survey units are expanded using a factor calculated as: area of survey unit/(transect length x transect width). Survey areas extrapolated to are illustrated in figures 2 & 2. Goodnews Bay 90 percent ice-covered. 3. chagvan Bay 90 percent ice-covered. 4. Nanvak Bay 100 percent ice-covered. 5. Not included in total.

Table 1. Continued

| Survey Unit | Date surveyed | Elapsed Time | Expansion Factor | Bufflehead | Mergansers | Black brant | Emperor goose |
|--|---------------|--------------|------------------|------------|--------------|---------------|---------------|
| Nunivak Island | 4/15 | 1:04 | 1.00 | | | | |
| Toksook Bay to Kuskokwim R. | 4/16 | 3:30 | 1.00 | | | | |
| Kuskokwim R. to Chagvan Bay ¹ | 4/17 | 1:52 | 9.78 | | | | |
| Goodnews Bay ² | 4/17 | 0:04 | 1.00 | | | | |
| Chagvan Bay ³ | 4/17 | 0:02 | 1.00 | | | | |
| Nanvak Bay ⁴ | 4/17 | 0 | 1.00 | | | | |
| Nanvak Bay to Togiak Village | 4/17 | 0:48 | 1.00 | | 12 | | |
| Togiak Village to Kulukak Bay | 4/17 | 0:24 | 1.00 | | 51 | | |
| Kulukak Bay to Cape Constantine | 4/17 | 0:24 | 1.00 | | 7 | | |
| Cape Constantine | 4/17 | 0:16 | 5.63 | | | | |
| Kvichak Bay | 4/17 | 0:49 | 1.00 | | | | |
| Naknek River to Port Heiden | 4/18 | 1:09 | 1.00 | | 47 | | |
| Egegik Lagoon | 4/18 | 0:21 | 1.00 | | 20 | | 74 |
| Ugashik Lagoon | 4/18 | 0:38 | 1.00 | | 116 | | 57 |
| Cinder River Sanctuary | 4/18 | 0:16 | 1.00 | | 68 | | |
| Port Heiden | 4/18 | 1:11 | 1.00 | | 151 | | 655 |
| Port Heiden to Port Moller | 4/18 | 0:47 | 1.00 | | 54 | | |
| Seal Islands Lagoon | 4/18 | 0:20 | 1.00 | | 60 | | 1,725 |
| Port Moller/Herendeen Bay | 4/18 | 0:47 | 1.00 | | 4 | | 158 |
| Nelson Lagoon | 4/18 | 0:22 | 1.00 | | 50 | | 5,561 |
| Nelson Lagoon to Izembek Lagoon | 4/19 | 0:39 | 1.00 | | | | 447 |
| Izembek Lagoons | 4/19 | 2:49 | 1.00 | | 196 | 74,541 | 4,640 |
| Kinzerof Lagoon | 4/19 | 0:14 | 1.00 | | 23 | 510 | 746 |
| Morzhovoi Bay Lagoons | 4/19 | 0:19 | 1.00 | | 68 | | 65 |
| Bechevin Bay | 4/19 | 0:33 | 1.00 | | 38 | 1 | |
| Cold Bay | 4/19 | 0:15 | 1.00 | | 2 | 507 | 270 |
| Sanak/Caton Islands | 4/20 | 1:39 | 1.00 | 119 | 94 | 69 | 2,996 |
| Totals | | | | 119 | 1,061 | 75,628 | 17,394 |

1. Estimates reported herein for these survey units are expanded using a factor calculated as: area of survey unit/(transect length x transect width). Survey areas extrapolated to are illustrated in figures 2 &

2. Goodnews Bay 90 percent ice-covered. 3. chagvan Bay 90 percent ice-covered. 4. Nanvak Bay 100 percent ice-covered. 5. Not included in total.

Table 2. Survey totals for all species, Spring Steller's eider surveys, southwest Alaska, 1992-2009. For past years with replicate surveys (1992-97) only the survey with the highest Steller's eider count for each year is shown.

| SURVEY DATES: | 5/2-6/1992 | 4/10-13/1993 | 5/6-12/1994 | 4/15-19/1997 | 4/22-29/1998 | 4/17-23/2000 | 4/22-5/1/2001 | 4/21-29/2002 |
|-------------------------|----------------|---------------|----------------|---------------|---------------|---------------|---------------|---------------|
| Birds: | | | | | | | | |
| Pacific loon | 2 | 30 | 34 | 45 | 23 | 5 | 3 | 0 |
| Red-throated loon | 78 | 51 | 270 | 11 | 97 | 61 | 188 | 64 |
| Common loon | 5 | 13 | 13 | 8 | 0 | 0 | 0 | 5 |
| Yellow-billed loon | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 1 |
| Unident. loon | 0 | 0 | 85 | 7 | 24 | 3 | 137 | 23 |
| Red-necked grebe | 32 | 793 | 221 | 178 | 29 | 114 | 316 | 186 |
| Horned grebe | 0 | 0 | 3 | 0 | 0 | 2 | 0 | 0 |
| Cormorants | 979 | 1,082 | 1,618 | 829 | 653 | 335 | 674 | 483 |
| Tundra swan | 2 | 9 | 2 | 24 | 46 | 0 | 7 | 0 |
| Canada goose | 169 | 28 | 34 | 57 | 210 | 26 | 97 | 2 |
| Brant | 5,289 | 81,743 | 71,551 | 80,099 | 34,045 | 58,212 | 74,837 | 35,610 |
| Gr. white-fronted goose | 0 | 430 | 30 | 80 | 54 | 0 | 94 | 0 |
| Emperor goose | 27,876 | 28,542 | 25,816 | 41,279 | 53,926 | 32,562 | 41,800 | 43,014 |
| Mallard | 88 | 27 | 39 | 107 | 2 | 97 | 15 | 20 |
| Gadwall | 5 | 2 | 15 | 0 | 10 | 2 | 0 | 0 |
| Northern pintail | 5,325 | 1,792 | 1,760 | 1,414 | 893 | 857 | 618 | 1,431 |
| Wigeons | 4 | 0 | 8 | 2 | 79 | 2 | 0 | 0 |
| Northern shoveler | 28 | 2 | 14 | 0 | 3 | 0 | 4 | 0 |
| Am. Green-winged teal | 0 | 0 | 75 | 2 | 1 | 0 | 0 | 35 |
| Canvasback | 0 | 3 | 57 | 0 | 2 | 0 | 0 | 0 |
| Scaups | 11,106 | 5,316 | 6,598 | 3,072 | 2,289 | 1,864 | 1,188 | 1,465 |
| Common eider | 5,941 | 5,069 | 6,997 | 21,916 | 3,862 | 8,570 | 5,779 | 669 |
| King eider | 87,954 | 62,544 | 69,638 | 241,992 | 71,438 | 219,403 | 58,128 | 48,077 |
| Spectacled eider | 40 | 26 | 35 | 20 | 16 | 0 | 4 | 0 |
| Steller's eider | 137,904 | 88,636 | 107,589 | 90,269 | 84,459 | 72,953 | 60,656 | 56,704 |
| Harlequin duck | 757 | 608 | 838 | 328 | 243 | 373 | 946 | 438 |
| Long-tailed duck | 20,512 | 13,184 | 22,987 | 25,548 | 22,025 | 48,112 | 18,948 | 18,551 |
| Surf scoter | 23 | 347 | 48 | 359 | 8 | 17 | 17 | 114 |
| Black scoter | 42,382 | 37,985 | 35,672 | 31,750 | 45,312 | 55,538 | 33,586 | 29,250 |
| White-winged scoter | 1,331 | 432 | 484 | 2,080 | 2,520 | 8,484 | 4,399 | 2,706 |
| Unident. scoter | 361 | 0 | 0 | 1,474 | 136 | 0 | 0 | 3,962 |
| Goldeneyes | 711 | 177 | 263 | 365 | 136 | 319 | 181 | 222 |
| Bufflehead | 36 | 66 | 400 | 0 | 0 | 2 | 0 | 0 |
| Common merganser | 0 | 0 | 0 | 10 | 2 | 6 | 0 | 14 |
| Red-breasted merganser | 2,103 | 1,176 | 2,766 | 660 | 1,393 | 208 | 211 | 634 |
| Bald eagle | 24 | 78 | 29 | 23 | 22 | 17 | 24 | 19 |
| Sandhill crane | 4 | 21 | 10 | 0 | 2 | 0 | 0 | 0 |
| Shorebirds | 0 | 0 | 9,784 | 40,540 | 10,012 | 13,990 | 456 | 5,262 |
| Gulls | 18,072 | 49,544 | 25,038 | 27,738 | 25,779 | 7,991 | 9,249 | 15,622 |
| Black-legged kittiwake | 68,888 | 26,579 | 6,614 | 41,957 | 28,333 | 2,624 | 479 | 10,845 |
| Guillemots | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Marine mammals: | | | | | | | | |
| Sea otter | 1,736 | 981 | 809 | 1,554 | 1,068 | 809 | 523 | 442 |
| Pacific walrus | 229 | 315 | 1,030 | 143 | 136 | 110 | 1 | 0 |
| Seal | 588 | 1,976 | 2,130 | 1,156 | 620 | 438 | 1,617 | 4,191 |
| Steller's sea lion | 314 | 902 | 833 | 934 | 1,033 | 42 | 8 | 13 |
| Harbor porpoise | 17 | 9 | 5 | 8 | 1 | 12 | 0 | 6 |
| Belukha whale | 80 | 10 | 67 | 100 | 0 | 62 | 0 | 0 |
| Orca whale | 1 | 0 | 0 | 6 | 0 | 0 | 0 | 0 |
| Humpback whale | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Grey whale | 92 | 114 | 94 | 102 | 57 | 37 | 14 | 30 |

Table 2. (Continued)

| SURVEY DATES: | 3/29-4/11/2003 | 4/1-11/2004 | 4/2-4/8/2005 | 4/11-16/2007 | 4/8-11/2008 | 4/24-29/2008 | 4/15-21/2009 | 2000-08 avg |
|-------------------------|----------------|---------------|---------------|---------------|---------------|---------------|---------------|-------------|
| Birds: | | | | | | | | |
| Pacific loon | 7 | 0 | 0 | 0 | 0 | 12 | 0 | 3 |
| Red-throated loon | 2 | 0 | 1 | 1 | 1 | 4 | 3 | 36 |
| Common loon | 1 | 1 | 0 | 1 | 2 | 0 | 3 | 1 |
| Yellow-billed loon | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Unident. loon | 4 | 10 | 8 | 57 | 1 | 26 | 9 | 30 |
| Red-necked grebe | 54 | 0 | 4 | 5 | 3 | 25 | 7 | 79 |
| Horned grebe | 0 | 0 | 0 | 3 | 0 | 0 | 0 | 1 |
| Cormorants | 217 | 33 | 1,110 | 966 | 619 | 283 | 252 | 524 |
| Tundra swan | 2 | 4 | 1 | 4 | 2 | 3 | 28 | 3 |
| Canada goose | 15 | 0 | 0 | 0 | 0 | 0 | 5 | 16 |
| Brant | 29,293 | 32,875 | 28,365 | 45,047 | 41,581 | 60,124 | 75,628 | 45,105 |
| Gr. white-fronted goose | 0 | 0 | 0 | 0 | 0 | 64 | 7 | 18 |
| Emperor goose | 35,288 | 53,614 | 30,681 | 37,501 | 22,032 | 37,794 | 17,394 | 37,143 |
| Mallard | 6 | 225 | 179 | 251 | 271 | 130 | 335 | 133 |
| Gadwall | 7 | 8 | 15 | 0 | 10 | 3 | 0 | 5 |
| Northern pintail | 1,250 | 1,875 | 3,528 | 2,126 | 0 | 4,438 | 1,963 | 1,791 |
| Wigeons | 10 | 85 | 25 | 145 | 200 | 15 | 113 | 54 |
| Northern shoveler | 0 | 0 | 0 | 0 | 0 | 2 | 0 | 1 |
| Am. Green-winged teal | 0 | 0 | 3 | 6 | 4 | 0 | 0 | 5 |
| Canvasback | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Scaups | 3,557 | 3,310 | 5,618 | 3,832 | 1,567 | 1,749 | 1,865 | 2,683 |
| Common eider | 3,862 | 3,841 | 13,514 | 3,220 | 3,332 | 181 | 5,934 | 4,774 |
| King eider | 109,627 | 195,841 | 146,512 | 575,376 | 285,832 | 15,758 | 197,302 | 183,839 |
| Spectacled eider | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Steller's eider | 77,369 | 82,772 | 79,022 | 87,400 | 60,431 | 70,480 | 77,777 | 71,976 |
| Harlequin duck | 176 | 381 | 378 | 1,774 | 84 | 341 | 1,230 | 543 |
| Long-tailed duck | 25,883 | 9,876 | 32,273 | 9,244 | 12,938 | 21,279 | 7,351 | 21,900 |
| Surf scoter | 13 | 8 | 0 | 52 | 4 | 6 | 25 | 26 |
| Black scoter | 42,698 | 16,980 | 48,040 | 49,392 | 10,306 | 41,223 | 27,910 | 36,335 |
| White-winged scoter | 818 | 102 | 10,623 | 995 | 1,841 | 3,787 | 1,847 | 3,751 |
| Unident. scoter | 4 | 32 | 1,400 | 0 | 0 | 8,000 | 15 | 1,489 |
| Goldeneyes | 610 | 1,175 | 1,079 | 848 | 661 | 255 | 29 | 594 |
| Bufflehead | 29 | 22 | 8 | 123 | 54 | 2 | 119 | 27 |
| Common merganser | 16 | 0 | 12 | 573 | 46 | 1 | 864 | 74 |
| Red-breasted merganser | 931 | 383 | 1,781 | 1,583 | 629 | 961 | 158 | 813 |
| Bald eagle | 16 | 32 | 53 | 145 | 47 | 63 | 67 | 46 |
| Sandhill crane | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Shorebirds | 770 | 842 | 2,900 | 4,842 | 2,002 | 10,305 | 10,014 | 4,597 |
| Gulls | 16,356 | 13,927 | 999 | 20,701 | 8,748 | 21,226 | 10,102 | 12,758 |
| Black-legged kittiwake | 710 | 200 | 756 | 168 | 1,300 | 3,600 | 1,502 | 2,298 |
| Guillemots | 0 | 0 | 0 | 56 | 3 | 0 | 7 | 7 |
| Marine mammals: | | | | | | | | |
| Sea otter | 1,090 | 1,414 | 1,917 | 266 | 703 | 1,629 | 918 | 977 |
| Pacific walrus | 1 | 0 | 1 | 1 | 0 | 0 | 0 | 13 |
| Seal | 1,076 | 1,283 | 978 | 756 | 116 | 620 | 203 | 1,231 |
| Steller's sea lion | 1 | 0 | 22 | 9 | 0 | 38 | 40 | 15 |
| Harbor porpoise | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 2 |
| Belukha whale | 0 | 2 | 34 | 0 | 1 | 0 | 0 | 11 |
| Orca whale | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Humpback whale | 0 | 0 | 0 | 0 | 0 | 0 | 11 | 0 |
| Gray whale | 38 | 39 | 20 | 23 | 2 | 26 | 8 | 25 |

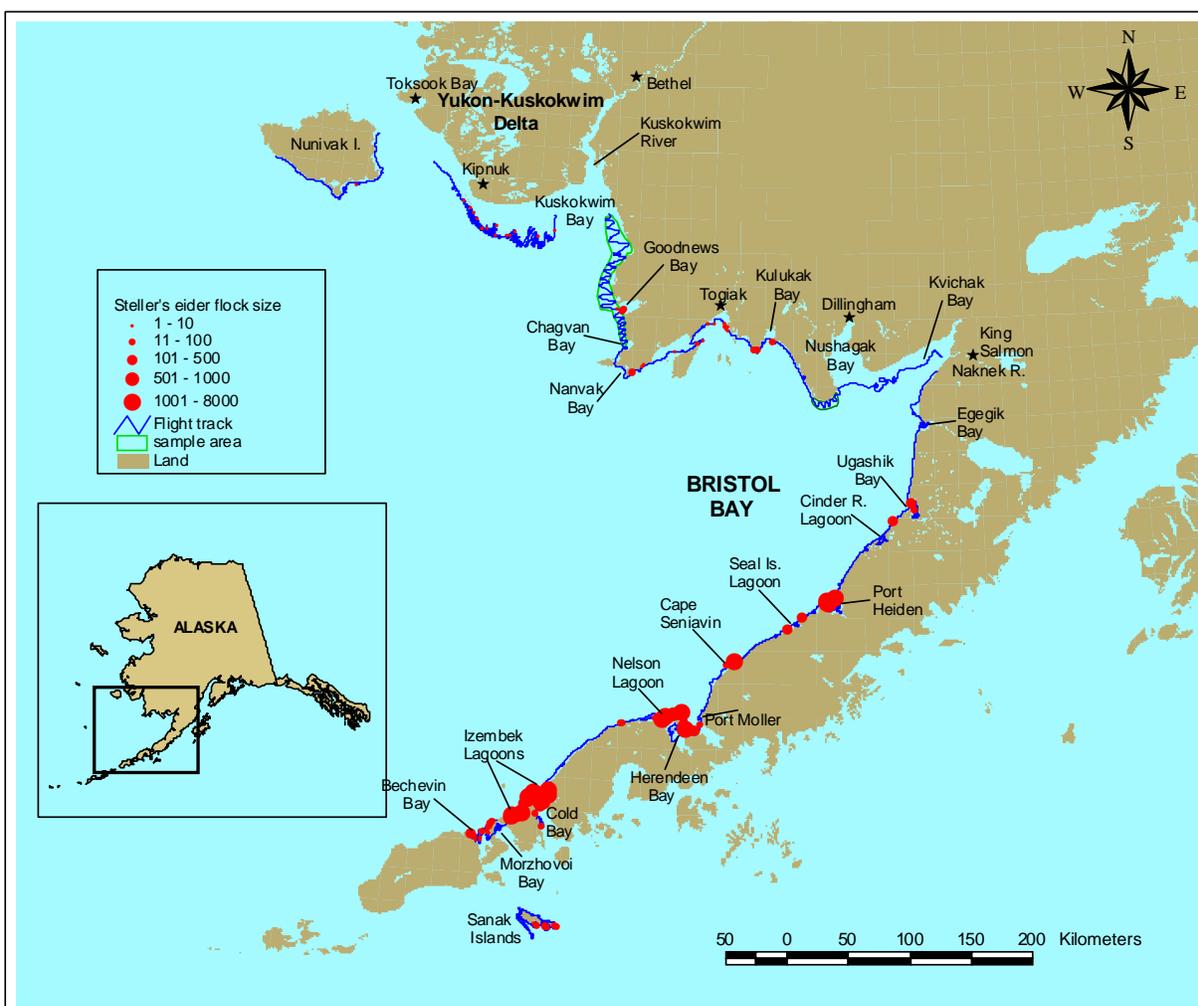


Figure 3. Survey sample areas, flight lines, and Steller's eider flock locations and relative size, Steller's eider spring migration survey, 15-21 April 2008.

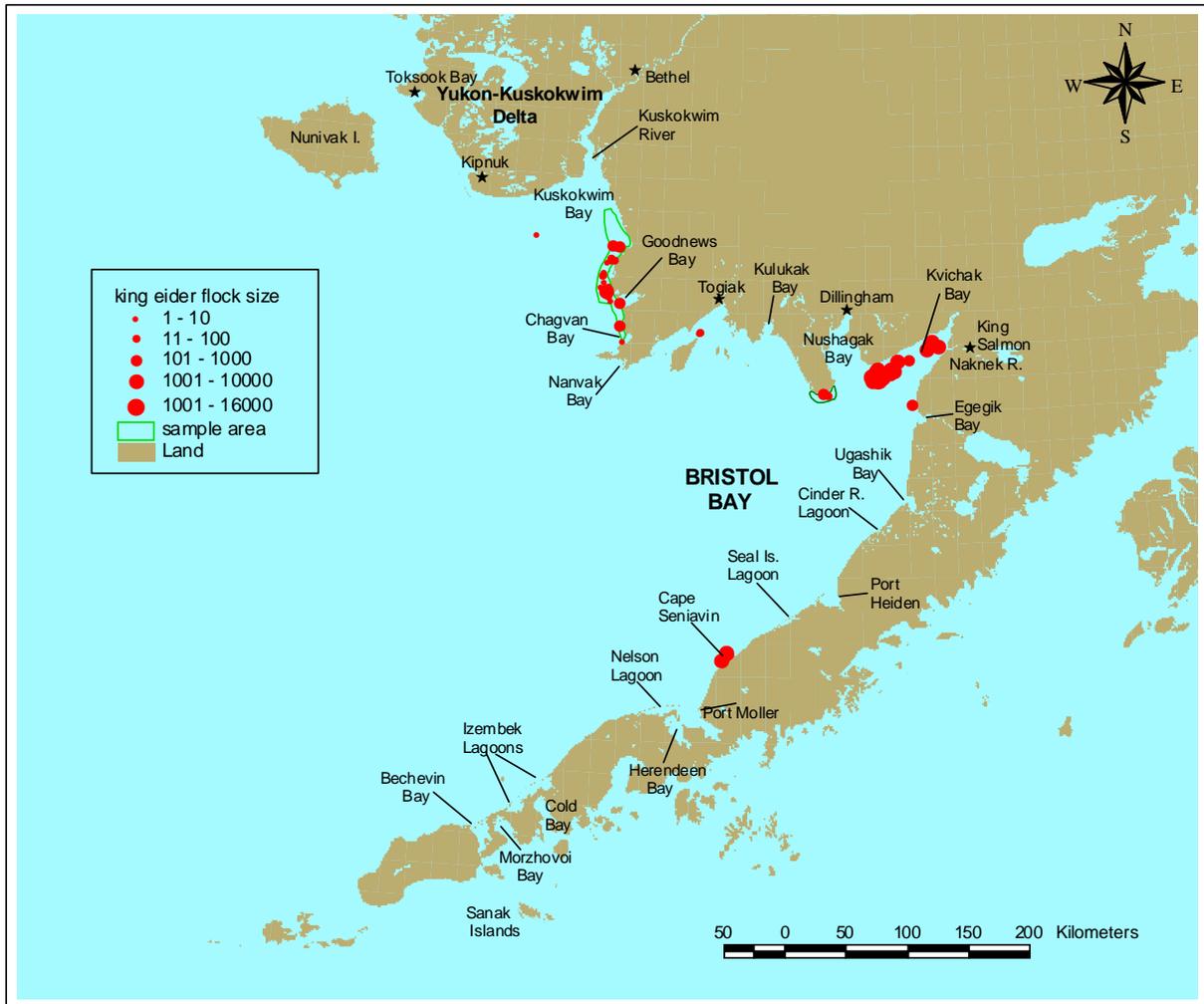


Figure 4. Location and relative size of king eider flocks recorded during Steller's eiders migration surveys, southwest Alaska, 15-21 April 2009.

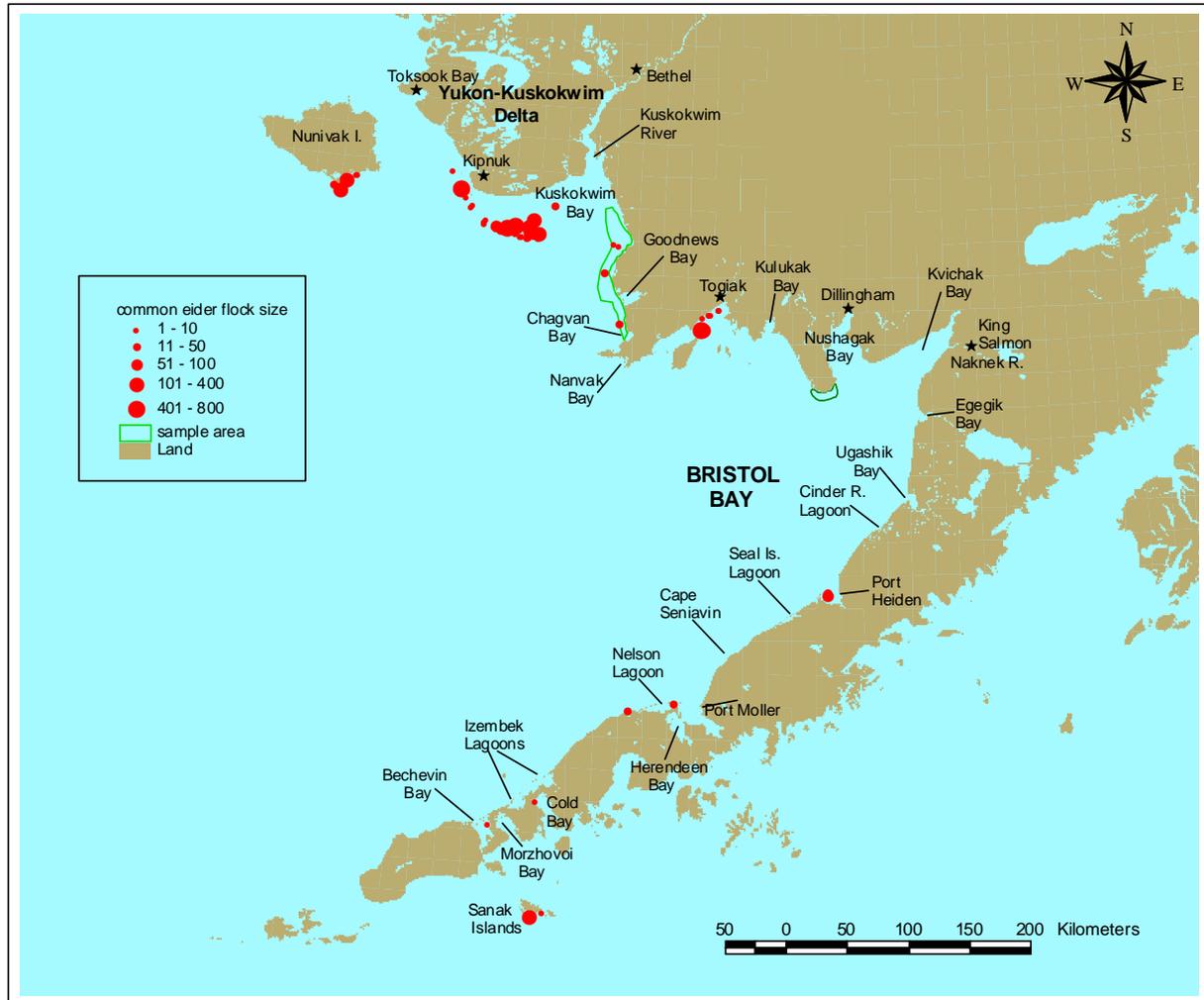


Figure 5. Location and relative size of common eider flocks recorded during Steller's eiders migration surveys, southwest Alaska, 15-21 April 2009.

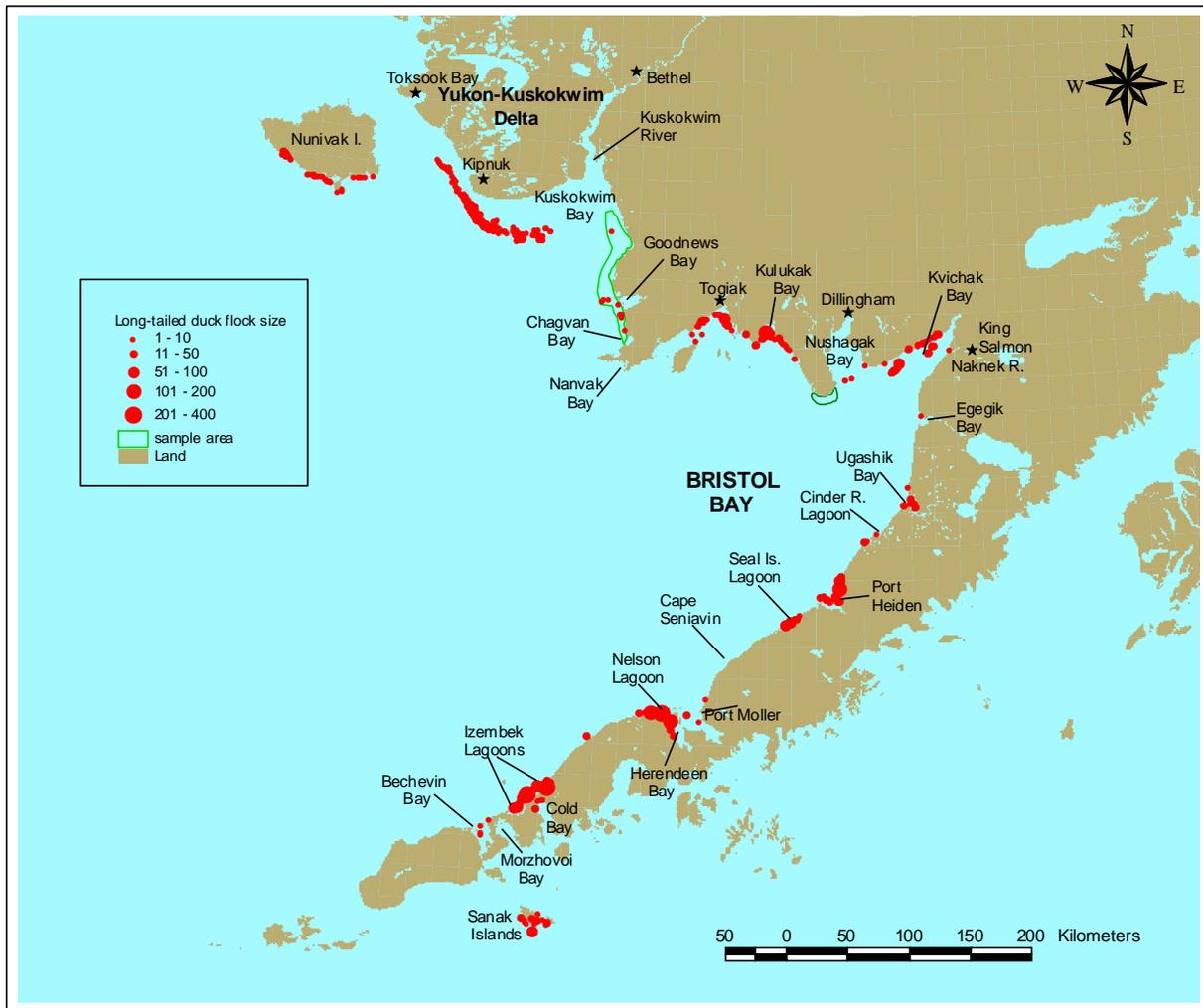


Figure 6. Location and relative size of long-tailed duck flocks recorded during Steller's eiders migration surveys, 15-21 April 2009.

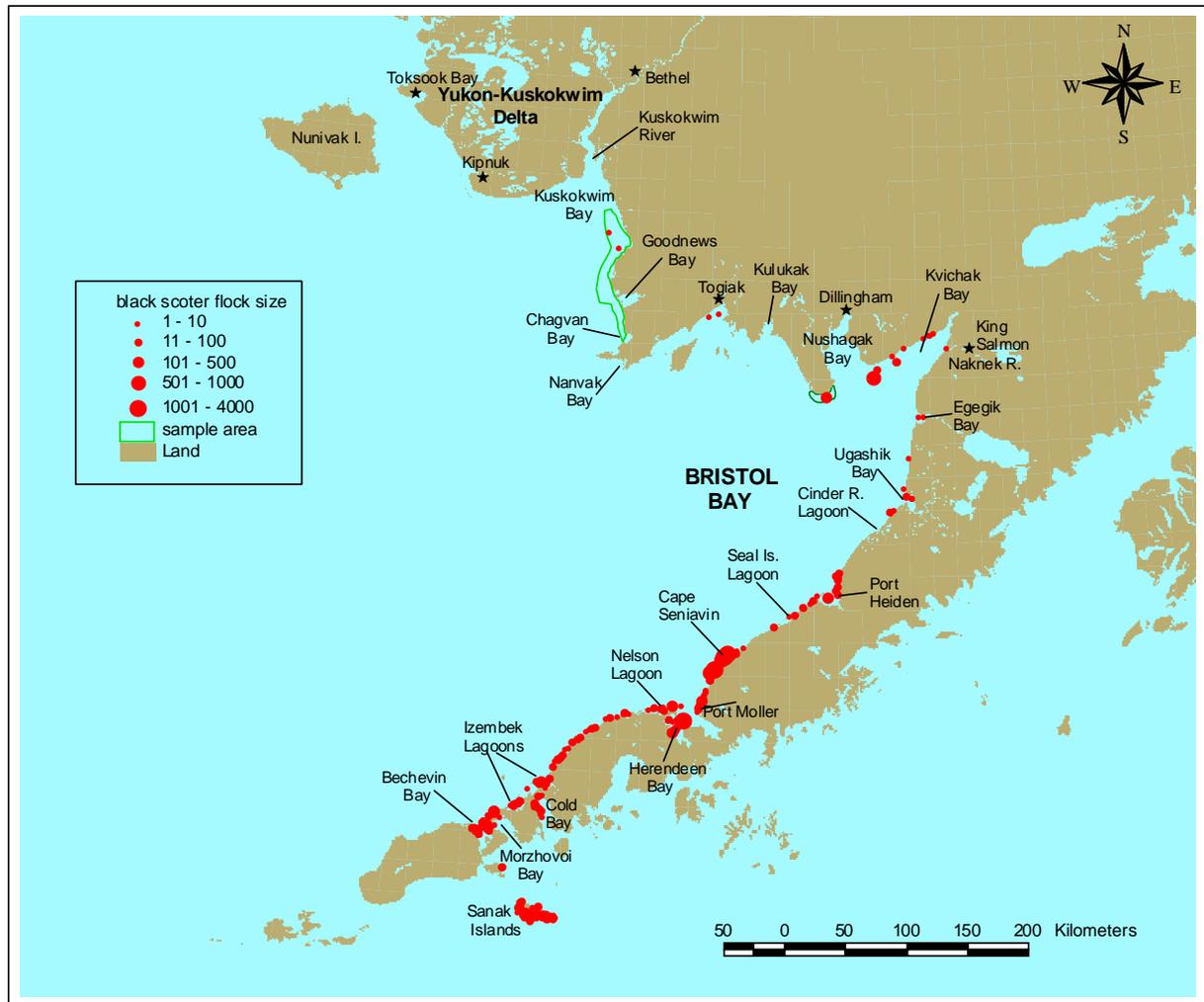


Figure 7. Location and relative size of black scoter flocks recorded during Steller's eiders migration surveys, southwest Alaska, 15-21 April 2009.

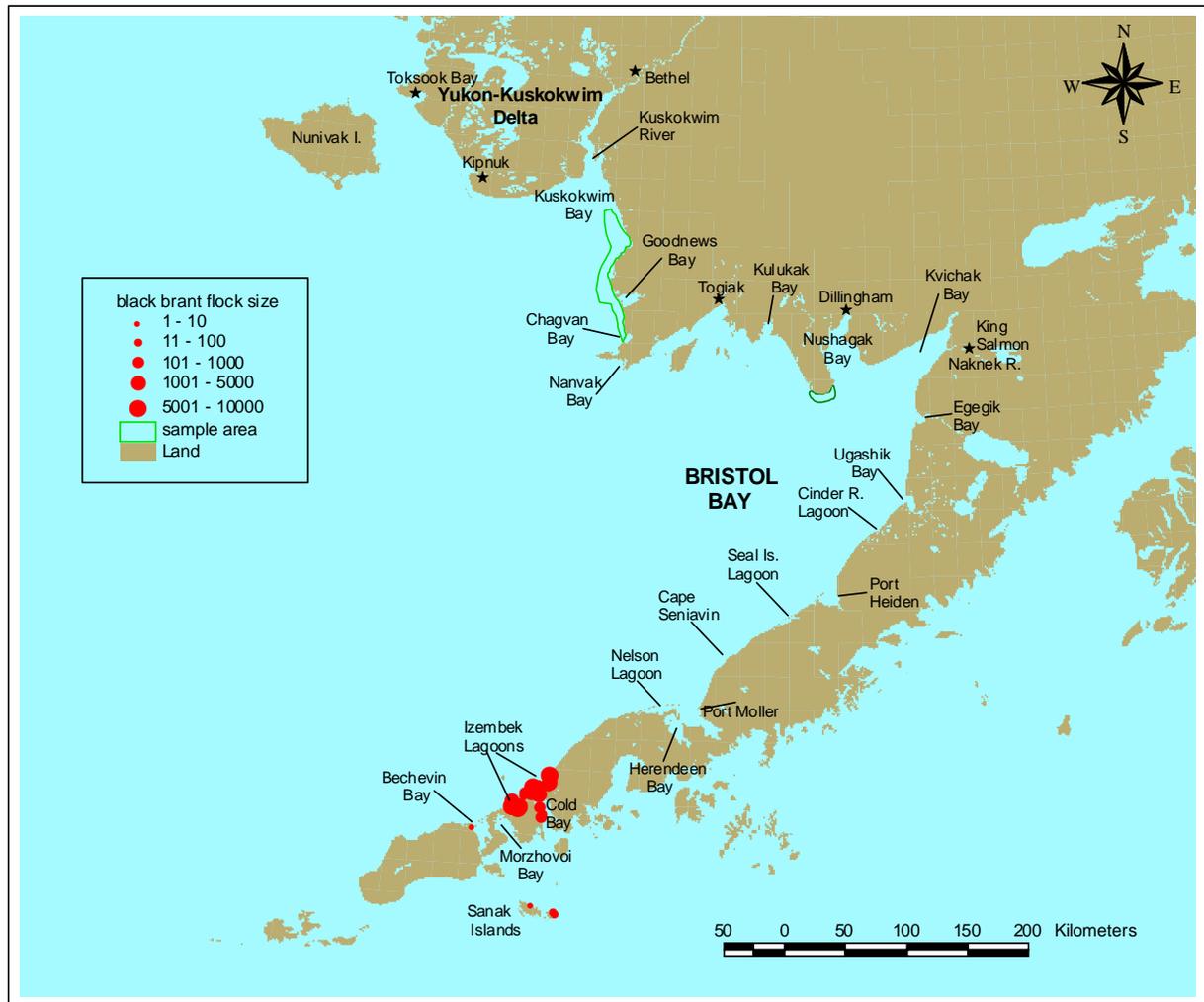


Figure 8. Location and relative size of black brant flocks recorded during Steller's eiders migration surveys, southwest Alaska, 15-21 April 2009.

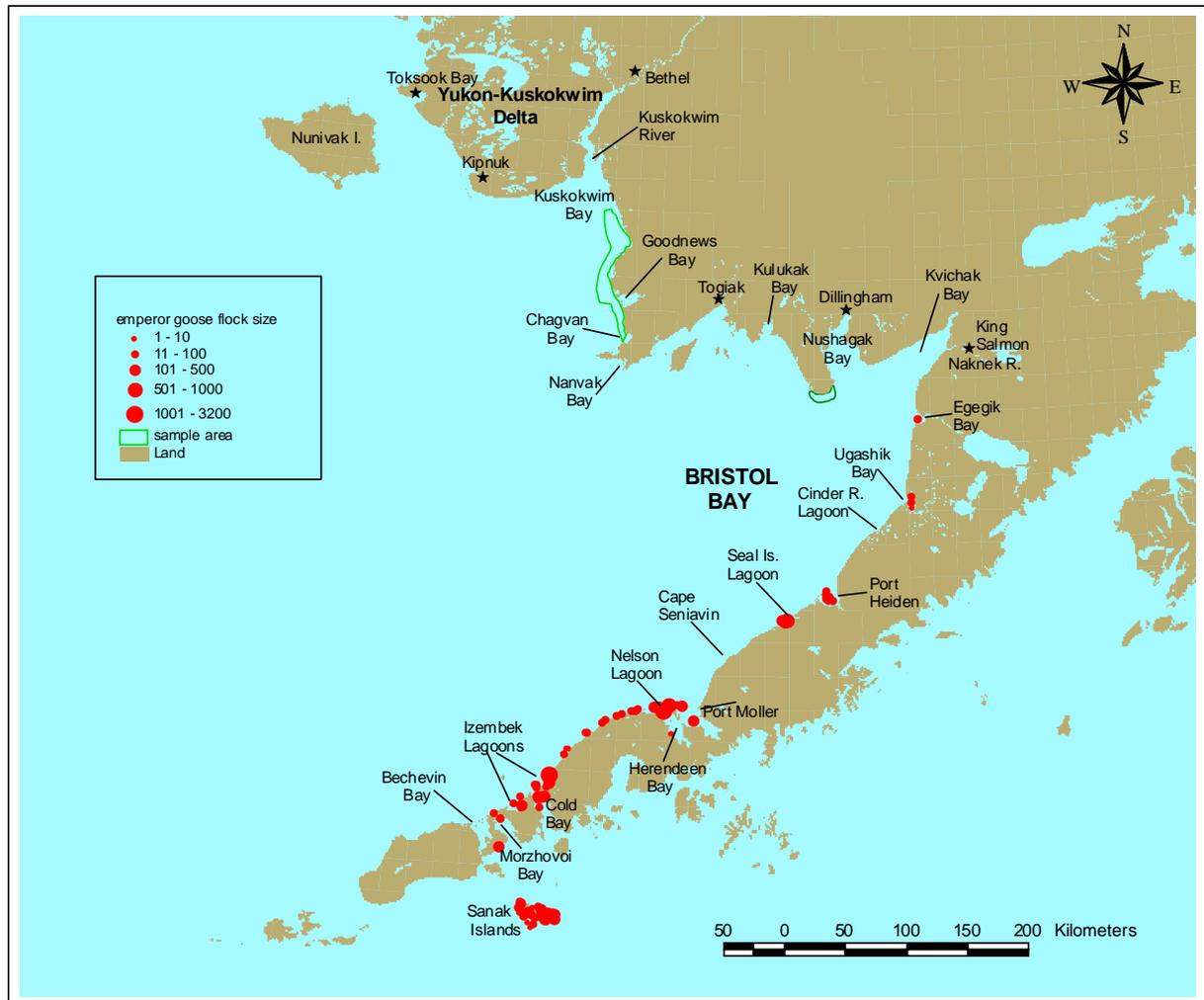


Figure 9. Location and relative size of emperor goose flocks recorded during Steller's eiders migration surveys, southwest Alaska, 15-21 April 2009

APPENDIX 1. Inclusive dates, flight hours, and personnel, Steller's eider spring aerial migration surveys, southwest Alaska, 1992-2009.

| Year | SURVEY 1 | | | SURVEY 2 | | | SURVEY 3 | | |
|------|-----------|--------------|---|----------|--------------|--|----------|--------------|--------------------------|
| | Dates | Flight hours | Personnel* | Dates | Flight hours | Personnel* | Dates | Flight hours | Personnel* |
| 1992 | 4/9-13 | 39.1 | W Larned , W Eldridge | 4/23-27 | 32.1 | W Larned , M Petersen, W Butler , M Wege B McCaffery | 5/2-6 | 31.3 | W Larned , J King |
| 1993 | 4/6-9 | 35.8 | W Larned , K Boden W Butler , M Wege | 4/25-27 | 40.4 | W Larned , K Laing W Butler , M Wege | 5/3-8 | 34.3 | W Larned , J King |
| 1994 | 4/24-5/1 | 40.2 | W Larned , J Pearce | 5/6-12 | 25.0 | W Larned , K Laing | | | |
| 1997 | 4/15-19 | 36.4 | W Larned , T Bowman | 4/26-30 | 34.4 | W Larned , T Tiplady | | | |
| 1998 | 4/22-29 | 35.5 | W Larned , R Platte | | | | | | |
| 2000 | 4/17-23 | 36.9 | W Larned , T Eskelin | | | | | | |
| 2001 | 4/22-5/01 | 41.8 | W Larned , P Anderson | | | | | | |
| 2002 | 4/21-29 | 42.6 | W Larned , P Anderson | | | | | | |
| 2003 | 3/29-4/10 | 38.1 | W Larned , J Fischer | | | | | | |
| 2004 | 4/1-11 | 35.8 | W Larned , P Anderson H Wilson | | | | | | |
| 2005 | 4/2-8 | 33.0 | W Larned , T Bowman | | | | | | |
| 2007 | 4/11-16 | 37.5 | W Larned , K Bollinger | | | | | | |
| 2008 | 4/8-11 | 29.8 | W Larned , K Bollinger | 4/24-29 | 25.9 | W Larned , T Bowman | | | |
| 2009 | 4/15-20 | 44.0 | W Larned , K Bollinger , S Savage | | | | | | |

* Pilot/port observer in bold print

APPENDIX 2. Common and scientific names of species mentioned in this report.

Common Name

Scientific Name

Loons and grebes: (Families *Gaviidae*, *Podicipedidae*)

| | |
|--------------------|---------------------------|
| Pacific loon | <i>Gavia pacifica</i> |
| Red-throated loon | <i>G. stellata</i> |
| Common loon | <i>G. immer</i> |
| Yellow-billed loon | <i>G. adamsii</i> |
| Red-necked grebe | <i>Podiceps grisegena</i> |
| Horned grebe | <i>P. auritus</i> |

Cormorants: (Family *Phalacrocoracidae*)

| | |
|------------|--|
| Cormorants | <i>Phalacrocorax auritus</i> , <i>P. pelagicus</i> , <i>P. urile</i> |
|------------|--|

Swans, geese, ducks: (Family *Anatidae*)

| | |
|-----------------------------|--|
| Tundra swan | <i>Cygnus columbianus</i> |
| Canada goose | <i>Branta canadensis</i> |
| Brant | <i>B. bernicla</i> |
| Greater white-fronted goose | <i>Anser albifrons</i> |
| Emperor goose | <i>Chen canagica</i> |
| Mallard | <i>Anas platyrhynchos</i> |
| Gadwall | <i>A. strepera</i> |
| Northern pintail | <i>A. acuta</i> |
| Wigeons | <i>A. americana</i> , <i>A. penelope</i> |
| Northern shoveler | <i>A. clypeata</i> |
| Am. Green-winged teal | <i>A. crecca</i> |
| Canvasback | <i>Aythya valisineria</i> |
| Scaups | <i>A. marila</i> , <i>A. affinis</i> |
| Common eider | <i>Somateria mollissima</i> |
| King eider | <i>S. spectabilis</i> |
| Spectacled eider | <i>S. fischeri</i> |

| | |
|--|---|
| Steller's eider | <i>Polysticta stelleri</i> |
| Harlequin duck | <i>Histrionicus histrionicus</i> |
| Long-tailed duck | <i>Clangula hyemalis</i> |
| Surf scoter | <i>Melanitta perspicillata</i> |
| Black scoter | <i>M. nigra</i> |
| White-winged scoter | <i>M. fusca</i> |
| Goldeneyes | <i>Bucephala clangula, B. islandica</i> |
| Bufflehead | <i>B. albeola</i> |
| Common merganser | <i>Mergus merganser</i> |
| Red-breasted merganser | <i>M. serrator</i> |
| <u>Eagles: (Family Accipitridae)</u> | |
| Bald eagle | <i>Haliaeetus leucocephalus</i> |
| <u>Cranes: (Gruidae)</u> | |
| Sandhill crane | <i>Grus canadensis</i> |
| <u>Shorebirds: (Families Scolopacidae, Charadriidae, Haematopodidae)</u> | |
| <u>Gulls: (Family Laridae)</u> | |
| Gulls | <i>Xema sabini, Larus spp.,</i> |
| Kittiwakes | <i>Rissa spp.</i> |
| <u>Alcids: (Family Alcidae)</u> | |
| Guillemots | <i>Cepphus spp.</i> |
| <u>Marine mammals:</u> | |
| Sea otter | <i>Enhydra lutris</i> |
| Pacific walrus | <i>Odobenus rosmarus</i> |
| Seal | <i>Phoca spp., esp. Phoca vitulina</i> |
| Steller's sea lion | <i>Eumetopias jubatus</i> |
| Harbor porpoise | <i>Phocoena phocoena</i> |
| Belukha whale | <i>Delphinapterus leucas</i> |
| Orca whale | <i>Orcinus orca</i> |
| Gray whale | <i>Eschrichtius robustus</i> |