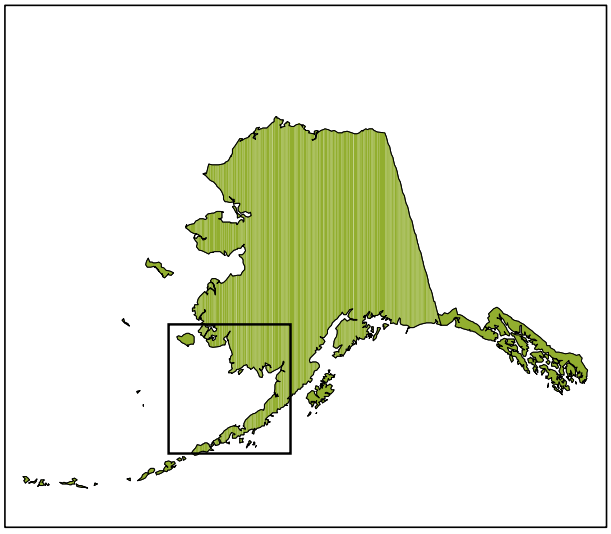
STELLER'S EIDER SPRING MIGRATION SURVEYS
SOUTHWEST ALASKA
2008



by:
William W. Larned

U.S. Fish and Wildlife Service
Migratory Bird Management Office
Waterfowl Branch - Anchorage, Alaska
December 9, 2008

STELLER'S EIDER SPRING MIGRATION SURVEYS, 2008

by
William W. Larned
U.S. Fish and Wildlife Service,Waterfowl Management,
43655 KBeach Rd., Soldotna, Alaska 99669.

Abstract. Annual spring aerial surveys were conducted most years from 1992 to 2008, to monitor the population status and habitat use of Steller's eiders (*Polysticta stelleri)* staging for spring migration in southwestern Alaska. Since the timing of migration varies among years, we conducted two to three replicate shoreline surveys each survey year through 1997, to target peak presence of eiders within the survey area prior to their departure to arctic nesting grounds. Fiscal constraints in subsequent years limited us to one survey per year through 2007, the timing of which was carefully scheduled using available information on sea ice, weather and observations from local contacts. In 2008 we again completed two surveys because of low confidence in timing and results of the early survey. During each survey 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) and 70,480 (2008) . We suspect that the low population estimates obtained from 2000 through 2002 were due in part to poor survey timing (a portion of the eiders moved northward during the survey, thus escaping detection by the survey crew). This hypothesis was supported by satellite telemetry data which indicated migration within the study area during the survey of 2002. Long-term survey data indicate a 2.6 percent average annual decline in Steller's eiders using this migration corridor ($R^2 = 0.32$), but the trend since 2002 has been more level (-1 percent per year, $R^2 = 0.10$). Maps illustrate the distribution of Steller's eiders and other selected species within the survey area in 2008. 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 areas receive consistent 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 2008 Steller's eider surveys, with comparisons to data from previous surveys.

STUDY AREA AND METHODS

The survey area included estuarine and nearshore 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 known important habitats for other sea duck species. 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 covered 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 somewhat, 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, who was the same individual (author, W. Larned) for all years. I believe in most years the assumption of complete census coverage is reasonable for Steller's eiders,

except for some offshore shoal areas that are too extensive to cover contiguously within budget and safety parameters. Since 2000 we have surveyed the latter areas using a "saw tooth" array of sample strips, 500 or 600m wide, depending on survey conditions. We calculated population estimates by extrapolating the average density of each species within the strip sample to the sampled area (Fig. 3). This sampling/extrapolation method was used only from 2000 to present, so caution should be used when comparing recent years' data with those prior to 2000, particularly for black scoters, white-winged scoters, long-tailed ducks, king eiders and Steller's eiders. For this reason Table 4 contains only un-extrapolated raw count data for comparison with earlier surveys.

This year inclement weather and extensive sea ice encountered during the survey in early April led to low confidence in accuracy of results, therefore we conducted a second survey later in April. During the first 2008 survey, sampled areas included a portion of Kuskokwim Bay from the Kuskokwim River mouth to Goodnews Bay, an area along the tip of the Nushagak Peninsula, and the extensive shoals within Kvichak Bay (Figs. 3 & 4). During the second survey, persistent strong winds and turbulent seas precluded the offshore sampling, and a single shoreline transect was substituted. While important for other sea duck species, these areas have rarely contained significant numbers of Steller's eiders in past surveys.

The survey design is configured to correspond to the unique seasonal distribution of the Steller's eider, 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 focused investigations. This document and other annual survey reports contain brief discussions of results for other important sea ducks, while a more detailed interpretive 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. This system, consisting of a laptop computer for each observer, wired to the onboard GPS receiver, enabled observers to record observations vocally directly into the computers. 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 another program written 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. These ancillary data are archived, but thus far have not been included in analysis.

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 missed. 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 2008. 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.

Another possible 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, though we have made several attempts to obtain paired photo/visual counts to better understand, and perhaps correct for, estimation bias, the frequent and sequential diving behavior of Steller's eiders requires extensive and time-consuming circling maneuvers for each flock. This disturbance in turn often results in dispersal or recombination of other nearby flocks, complicating visual flock estimation, and reducing already-critical fuel reserves. Though we have obtained a few good images of flocks each year, which are useful as visual aids for observer training, we have not succeeded in obtaining a sample adequate for data adjustment. Successful completion of a photo-based estimation-bias study would require, at minimum, a second aerial crew dedicated to obtaining comprehensive photo coverage of all eiders in a sample of surveyed habitats.

In several years of this survey we observed flocks in Alaska Peninsula lagoons consisting mostly of light-brown Steller's eiders, usually with relatively small numbers of birds with plumage characteristics of adult males. Chris Dau (pers. comm.), who has conducted occasional late spring surveys in lower Alaska Peninsula lagoons, stated that it is typical in late-May and early June to have Steller's eider flocks in these areas with all or nearly all brown-plumaged birds, often accompanied by a few adult-plumaged males. We suspect that the latter may be after-second-year birds not yet breeding. The majority of other flocks we record during the survey have a fairly even sex ratio, with most males and females paired and therefore homogeneously dispersed within each flock. Most females in these flocks are very dark, with an iridescent blue speculum bordered by white bars which are often visible to aerial observers. Although Dau suggests that females usually do not attain this dark adult plumage until the Alternate II molt, we feel it is reasonable to assume that most of the brown birds in the late-migrating (or non-migrating) predominately brown flocks are second-year birds (based on the very small numbers of adult-plumaged males present, and our assumption that the proportion of after-second-year

females not yet breeding should not be substantially higher than that of males). We have recorded and totaled estimates of the brown bird components of these flocks, and provided the results as a crude index to annual recruitment. We have not attempted to allocate this estimate according to major breeding area (Arctic Russia vs. Alaska North Slope). We have observed most of these immature birds among flocks on the lower Alaska Peninsula; toward the end of the migratory procession.

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 having the pilot intentionally maneuver 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 aerial photographs of eider and other sea duck flocks. In 2008, Karen Bollinger (USFWS, Waterfowl Management, Fairbanks, Alaska) functioned as starboard observer during the first survey, and Tim Bowman (USFWS, Migratory Bird Management, Anchorage, Alaska) on the second.

RESULTS

Habitat and survey conditions

Spring in southwestern Alaska in 2008 was similar to that of 2007 in that it was late, with extensive ice cover in Bristol Bay, Kuskokwim Bay and the Etolin Strait/Nunivak Island areas until mid-April, and in 2008 large remnants were still present in mid-May. We monitored ice cover in Alaska Peninsula lagoons using the NASA MODIS Rapid Response System (http://rapidfire.sci.gsfc.nasa.gov/) website, determining that most were ice-free prior to April 1, so we initiated the survey on April 8. However, once we started the survey a persistent northerly wind pattern moved a large mass of heavy Bristol Bay sea ice against the Alaska Peninsula shoreline and into most lagoons except those south of Port Moller, which remained mostly ice free beginning in late March (Fig. 2, top image). The north wind apparently kept birds from moving north of the Alaska Peninsula, which is favorable for the survey, but it and the ice cover also may have discouraged some eiders from moving into the survey area from more southerly and westerly habitats. Our impression of an unrealistically low Steller's eider estimate and the small number of eiders tallied in the middle and upper Alaska Peninsula convinced us to conduct a second survey beginning April 24. The sea ice was more cooperative during the latter survey, though the amount persisting in Bristol Bay and in more northerly portions of the survey area was still unusually extensive for that time period (Fig. 2, bottom image).

Our recorded flight paths for the surveys of April 2008 are displayed in Figs. 3 & 4. Total flight times (29.8 and 25.9 hrs.), which include transit flights, were similar to prior surveys (Appendix 1).

Itinerary for 2008, survey 1:

4/6 3.8-hr flight in survey aircraft, Anchorage to Bethel. Overnight Yukon Delta National Wildlife Refuge (YDNWR) bunkhouse.
4/7 Grounded due to fog and snow.
4/8 5.3-hr. survey flight, Kuskokwim River mouth to Toksook Bay and Nunivak Island. Overnight Bethel.
4/9 6.2-hr. survey flight, Bethel to King Salmon. Overnight King Salmon.
4/10 6.3-hr. survey flight, King Salmon. to Cold Bay, covering lagoons and shorelines to Moffett Bay. Overnight Cold Bay.
4/11 2.5-hr. survey flight, Izembek and other lagoons in the Cold Bay vicinity to complete survey. 2.3-hour flight direct to King Salmon. Overnight King Salmon.
4/12 3.0-hr. flight to Anchorage via Soldotna. End of survey.

Itinerary for 2008, survey 2:

4/23 3.7-hour flight Anchorage to Bethel. Overnight Bethel.
4/24 3.6-hr survey flight, Kuskokwim River mouth to Kipnuk. Overnight Bethel.
4/25 Grounded in Bethel due to strong wind and snow showers. Overnight Bethel.
4/26 3.7-hr survey flight Bethel to King Salmon. Overnight King Salmon
4/27 Grounded in King Salmon due to strong winds. Overnight King Salmon.
4/28 6.0-hr survey flight King Salmon to Cold Bay, covered Egegik Lagoon to Moffett Bay. Overnight Cold Bay
4/29 2.6-hr survey flight, Izembek/Cold Bay area. Overnight Cold Bay
4/30 6.3-hr flight to Anchorage, survey of Kamishak Bay enroute. End of survey.

Steller's eider results The two 2008 Steller's eider estimates are 60,431 and 70,480, respectively for the first and second surveys (Tables 2 & 3). The estimate from the later survey is 16 percent below the long-term mean (83,606, Table 4). The 1992-2008 trend indicates a 2.6 percent average annual decline ($R^2 = 0.32$) in Steller's eider estimates (Fig. 1), while the trend from 2003 to present suggests a more level trend (-1%, $R^2 = 0.10$). It is likely that some eiders from Kodiak and Cook Inlet had not entered the survey area at the time of the survey, in view of the late spring. Weather conditions did not permit us to survey

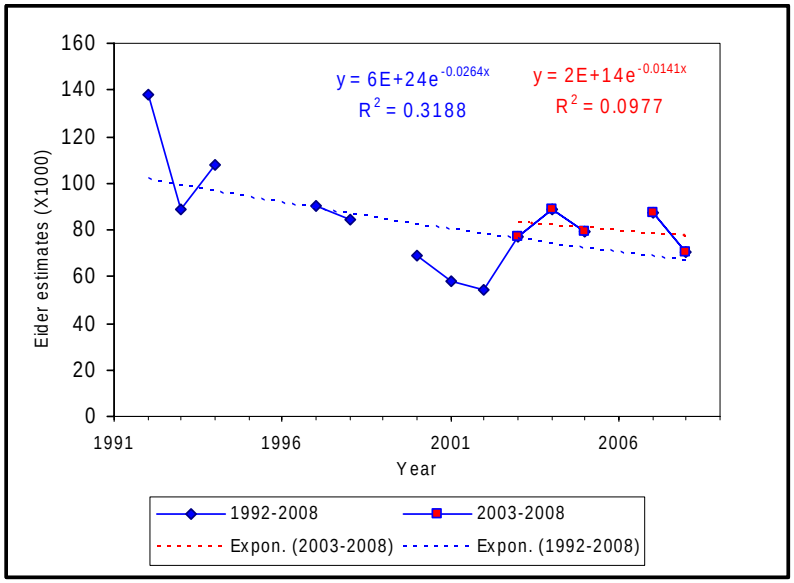


Figure 1. Trend in Steller's eider estimates from aerial surveys, southwest Alaska, April and May, 1992-2008.

Sanak Islands or other habitats south of the Alaska Peninsula. Steller's eiders are known to winter in Sanak Islands, from satellite telemetry (P. Martin, US Fish and Wildlife Service, pers. comm.) and winter aerial surveys (1,578 Steller's eiders recorded there in early march, 2000, Larned 2000). Only 35 eiders were recorded there during our eider survey on 16 April 2007, suggesting they depart for Alaska Peninsula lagoons soon after ice dispersal. This hypothesis is supported by Satellite telemetry data (Martin, unpubl.data).

In 1998, we classified 12,922 birds, or 15.3 percent of the Steller's eiders observed, as second-year birds, based on plumage characteristics (Larned 1998). In 2000, we observed no flocks containing a predominance of brown-plumaged birds, suggesting minimal recruitment from the 1999 breeding season. In 2001, we recorded 4,553, or 8 percent of the total 58,231 Steller's eiders observed, as second-year. Most of these birds were in flocks consisting mostly of brown-plumaged birds, but also containing several birds that had plumage characteristics of adult males (white wings and heads). In 2002, 2003, 2004, 2005, 2007 and 2008 we identified no flocks that appeared subadult. Since all surveys since 2002, with the exception of the second 2008 survey, were flown in early to mid April, it is possible that non-breeding flocks, which normally lag behind the breeders, had not arrived in Bristol Bay lagoons prior to the survey. However, observers based in boats and aircraft looking for juvenile-plumaged Steller's eiders in Chagvan, Nanvak and Goodnews Bays and Kuskokwim Bay in early June 2007 found flocks of adult-plumaged males, but no "brown" juveniles. (Rosenberg, pers. Comm.). These birds were classified as non-breeding subadults based on the timing of their presence there in single-sex flocks, when most breeding adults were normally expected to be paired, and on arctic nesting grounds.

The pattern of habitat use by concentrations of eiders in 2008 (Tables 1, 2; Figs. 3, 4) was similar to that of 2007, but slightly more southerly than that seen during surveys in other previous years with similar timing, which I attribute to the late timing of sea ice breakup.

Other Waterfowl

While this survey was not designed to produce high-confidence estimates for species other than Steller's eiders, I have tried to acquire data on non-target sea ducks to at least 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 near Port Heiden and Port Moller, with fewer birds seen during the later of the two surveys (Tables 2 & 3, Fig. 5). This is the normal pattern for this early migrant. However, on the second survey it is likely we missed most that may have been in Kvichak Bay, Kuskokwim Bay or other habitats covered on 26 April due to weather-induced survey abbreviation. During the first survey, we were uncomfortable with the strip sample coverage of the highly clumped distribution in Kvichak Bay on 9 April, so we conducted a second, census-type survey of the area the following day (Table 2, Fig. 6). There was a huge discrepancy between the two estimates: 573,610 vs. 125,375, respectively. I believe the extrapolated estimate from 9 April was high due to sampling error, while the census count on the 10th likely missed some major flocks and was therefore low (See location of flocks relative to flight paths, Fig. 6). This is a

difficult population to assess without an expensive dedicated survey involving extensive aerial photography, but at least we know that the area hosts a large portion of the Pacific king eider population in the spring, and have a good picture of the spatial pattern of use. The area is also an important fall molting area (Larned and Tiplady 1997, 1998).

The *common eider* is an early migrant, and often migrates offshore, and is therefore probably typically undercounted on this shoreline-based survey. Total estimates from the two 2008 surveys were 3,638 and 181 (Tables 2 and 3, respectively). Comparison with the long-term average (5,783) suggests that both surveys were probably past the peak of common eider presence, and most birds had already left the area by the second survey. Most during the first survey were observed in migrating flocks in upper Kuskokwim Bay, around Nunivak Island, and in Nelson Lagoon (Table 2, Fig. 7). L*ong-tailed ducks* were present in large numbers throughout the survey area (28,210 and 21,279 respectively for the two surveys, Tables 2 & 3). I expect the second survey count would have been higher had the Kuskokwim River to King Salmon section not been abbreviated. Especially interesting was the large aggregation recorded in Port Moller on 28 April (15,180 birds, Table 3). This unprecedented observation also suggests a late migration. The first survey was apparently early for *Black scoters,* whose numbers were low overall (10,370, Table 2), and recorded almost entirely south of Kvichak shoals (Fig. 9). Although numbers were higher than average during the second survey (41,223 vs. average 31,272), black scoters were still not recorded in the northern portions of the survey area, though numbers tallied during the abbreviated Kvichak Shoals area (1,570) suggested counts would have been quite high there if standard coverage had been possible. The late breakup apparently affected the emperor goose migration as well, as none were seen north of Cinder River during the first survey, and only a few hundred during the second (Tables 2 & 3, Fig. 10). The emperor estimate from this years' late April survey (37,794) was nearly identical to those of both 2007 and the long-term average (37,585 and 37,670, respectively, Table 4). Annual estimates for all species are unexpanded in Table 3 to facilitate comparison among years; figures in that table for 2008 do not agree with extrapolated estimates in Tables 2 and 3.

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. I recommend continuing this survey annually, recognizing its limitations in precision.

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 to monitor sea ice breakup, as well as perhaps more 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 most urgent for Steller's eiders, king eiders and black scoters, which are all species of concern, and for which we have a good start through surveys and satellite telemetry data, but still have question marks in space and time.

ACKNOWLEDGMENTS

I 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. I also sincerely appreciate the help of Karen Bollinger and Tim Bowman, who generously donated their time, skill and energy as observers this year. Thanks also to Ted Swem and other members of the Steller's Eider Recovery Team for their continued support of this project.

LITERATURE CITED

Gill, R. Jr., C. Handel, and M. Petersen. 1978. Migration of birds in Alaska Marine Habitats. U.S. Fish and Wildlife Service, Off. of Biol. Serv., Coastal Ecosystems. Unpub. Rept. 41pp.

Joensen, A. H. 1974. Waterfowl populations in Denmark 1965-1973. Danish Review of Game Biology. 9(1) 206pp.

Larned, W. W. 1998. Steller's eider spring migration survey, southwest Alaska, 1998. U. S. Fish and Wildlife Service, Unpub. rept. 41pp.

Larned, W. W. 2000. Aerial surveys of Steller's eiders (Polysticta stelleri) and other waterbirds and marine mammals in southwest Alaska areas proposed for navigation improvements by the U. S. Army Corps. Of Engineers, Alaska. Unpubl. Rpt., U. S. Fish and Wildlife Service, Anchorage, Alaska. 147pp.

Larned, W. W. and T. Tiplady. 1997. Aerial surveys to evaluate king eider molting areas detected by satellite telemetry in western Alaska 1997. U. S. Fish and Wildlife Service, Unpub. rept. 11pp.

Larned, W. W. and T. Tiplady. 1998. Aerial surveys to evaluate king eider molting areas detected by satellite telemetry in western Alaska 1997. U. S. Fish and Wildlife Service, Unpub. rept. 10pp.

Larned, W. W., W. I. Butler, and G. R. Balogh. 1994. Steller's eider spring migration surveys, 1992-93. U. S. Fish and Wildlife Service, Unpub. progress rept. 52pp.

PERSONAL COMMUNICATIONS

Christian Dau, Wildlife Biologist, U. S. Fish and Wildlife Service, Anchorage, AK

Daniel Rosenberg, Wildlife Biologist, Alaska Department of Fish and Game, Anchorage, AK

Table 1. Seaduck and goose estimates for geographic aerial survey units, spring Steller's eider survey, southwest Alaska, April 8-11, 2008.

Survey Unit	Date surveyed	Elapsed Time	Expansion Factor	Steller's eider	King eider	Common eider	Long-tailed duck	Harlequin duck	Black scoter	White-winged scoter	Black brant	Emperor goose
Nunivak Island	4/8	1:06	1.00		699	282	119					
Toksook Bay to Kuskokwim R.	4/8	2:02	1.00		5	2,082	3,876					
Kuskokwim R. to Goodnews Bay [1]	4/9	1:05	9.74	97	4,870	341	4,334					
Goodnews Bay[2]	4/9	0:08	1.00	135	60	2	42					
Goodnews Bay to Chagvan Bay	4/9	0:18	1.00	6		90	14			14		
Chagvan Bay[3]	4/9	0:03	1.00									
Nanvak Bay[4]	4/9	0:02	1.00	completely ice-covered								
Nanvak Bay to Togiak Village	4/9	0:40	1.00	29	12	183	130					
Togiak Vilage to Kulukak Bay	4/9	0:23	1.00	32	200	2	73					
Kulukak Bay to Cape Constantine	4/9	0:29	1.00	2		133	218					
Cape Constantine[1]	4/9	0:16	6.17		18,510		6					
Kvichak Bay[1]	4/9	2:08	6.03	302	573,610		13,640		76			
Kvichak Bay KIEI resurvery1	4/10	1:07	1.00		125,375[5]							
Egegik Bay to Port Heiden	4/10	0:55	1.00				402		231			
Egegik Bay	4/10	0:12	1.00		510	8	299		92	500		
Ugashik Bay	4/10	0:08	1.00				73		5			
Cinder River Sanctuary	4/10	0:06	1.00	91			249					150
Port Heiden	4/10	0:25	1.00	8,826	1,914		857		44			
Port Heiden to Port Moller	4/10	1:02	1.00	2,450	6,282	94	886		1,041	1,140		
Seal Islands Lagoon	4/10	0:13	1.00	725			214					3,136
Port Moller/Herendeen Bay	4/10	0:49	1.00	3,238	700		600		118			1,220
Nelson Lagoon	4/10	0:24	1.00	4,344		400	656		6,025			4,619
Nelson Lagoon to Moffett Bay	4/10	0:40	1.00	206	1,300	19	81		2,144	181		15
Izembek Lagoon	4/11	1:22	1.00	37,802	20	2	1,365	21	278	2	41,462	11,968
Kinzerof Lagoon	4/11	0:08	1.00	1,310			42	35	29		25	434
Morzhovoi Bay Lagoons	4/11	0:10	1.00								40	190
Hook Bay	4/11	0:06	1.00	12			20	20	57	4	54	
Catherine's Cove	4/11	0:13	1.00	774			14	8	73			
Cold Bay	4/11	0:07	1.00	50					157			300
Totals				**60,431**	**608,692**	**3,638**	**28,210**	**84**	**10,370**	**1,841**	**41,581**	**22,032**

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

Table 2. Seaduck and goose estimates for geographic aerial survey units, spring Steller's eider survey, southwest Alaska, April 24-29, 2008.

Survey Unit	Date surveyed	Elapsed Time	Expansion Factor	Steller's eider	King eider	Common eider	Long-tailed duck	Harlequin duck	Black scoter	White-winged scoter	Black brant	Emperor goose
Toksook Bay to Kuskokwim R.	4/24	2:06	1.00	2,231		54	3,123			200		
Kuskokwim R. to Goodnews Bay	4/26	0:31	1.00	124			19					6
Goodnews Bay[1]	4/26	0:11	1.00	2,204	8	13	4					
Goodnews Bay to Chagvan Bay	4/26	0:08	1.00	65			35			8		
Chagvan Bay[2]	4/26	0:06	1.00	820							3,550	310
Nanvak Bay[3]	4/26	0:01	1.00	completely ice covered								
Nanvak Bay to Togiak Village	4/26	0:37	1.00	173			21					
Togiak Vilage to Kulukak Bay	4/26	0:30	1.00	297	240		25	36				
Kulukak Bay to Cape Constantine	4/26	0:29	1.00				38	14	10			
Cape Constantine	4/26	0:10	1.00		70		200		15			
Kvichak Bay[4]	4/26	0:27	1.00		6,202		7		1,570			
Naknek River to Port Heiden	4/28	0:54	1.00		21	1	128	20	418	535		
Egegik Bay	4/28	0:12	1.00	974	4		117		766			504
Ugashik Bay	4/28	0:12	1.00				4		9			215
Cinder River Sanctuary	4/28	0:05	1.00						13			3,836
Port Heiden	4/28	0:29	1.00	6,722		73	45		6	22		10,255
Port Heiden to Port Moller	4/28	1:02	1.00	1,557	6,935	40	971	2	9,930	1,692		96
Seal Islands Lagoon	4/28	0:14	1.00	3,493	28		260		15	60		5,655
Port Moller/Herendeen Bay	4/28	0:49	1.00	2,650	2,210		15,180		27,017	1,202		3,790
Nelson Lagoon	4/28	0:22	1.00	12,800	40		570		50			9,140
Nelson Lagoon to Moffett Bay	4/28	0:38	1.00	228			100	60	495	53		135
Izembek Lagoon	4/29	1:37	1.00	34,556			191	175	678	13	56,524	3,762
Kinzerof Lagoon	4/29	0:09	1.00	760			15		12		35	90
Morzhovoi Bay Lagoons	4/29	0:10	1.00					4	14			
Hook Bay	4/29	0:11	1.00	1			14	28	174		15	
Catherine's Cove	4/29	0:10	1.00	825			212	2	31	2		
Totals				**70,480**	**15,758**	**181**	**21,279**	**341**	**41,223**	**3,787**	**60,124**	**37,794**

1. Goodnews Bay 80 percent ice-covered. 2. chagvan Bay 90 percent ice-covered. 3. Nanvak Bay 100 percent ice-covered. 4. Coverage abbreviated due to high seas.

Table 4. Survey totals for all species, Spring Steller's eider surveys, southwest Alaska, 1992-2008. For past years with replicate surveys (1992-97) only the survey with the highest Steller's eider count for each year is shown. For consistency with data prior to 2000, this table contains only unexpanded estimates from sampled areas. See Tables 2 & 3 for expanded estimates of selected species in 2008.

SURVEY DATES:	5/2-6/92	4/10-13/93	5/6-12/94	4/15-19/97	4/22-29/98	4/17-23/00	4/22-5/1/01	4/21-29/02
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	74,851	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	41,816	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	2,925	3,604	615
King eider	87,954	62,544	69,638	241,992	71,438	211,988	23,302	17,494
Spectacled eider	40	26	35	20	16	0	4	0
Steller's eider	**137,904**	**88,636**	**107,589**	**90,269**	**84,459**	**68,956**	**58,231**	**54,191**
Harlequin duck	757	608	838	328	243	373	946	438
Long-tailed duck	20,512	13,184	22,987	25,548	22,025	11,569	7,756	10,197
Surf scoter	23	347	48	359	8	17	17	41
Black scoter	42,382	37,985	35,672	31,750	45,312	19,931	19,521	15,402
White-winged scoter	1,331	432	484	2,080	2,520	2,696	1,345	1,594
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
Grey whale	92	114	94	102	57	37	14	30

Table 4. (Continued)

SURVEY DATES:	3/29-4/11/03	4/1-11/04	4/2-4/8/05	4/11-16/07	4/8-11/08	4/24-29/08	average[1]
Birds:							
Pacific loon	7	0	0	0	0	12	12
Red-throated loon	2	0	1	1	1	4	64
Common loon	1	1	0	1	2	0	4
Yellow-billed loon	0	0	0	0	0	0	0
Unident. loon	4	10	8	57	1	26	30
Red-necked grebe	54	0	4	5	3	25	151
Horned grebe	0	0	0	3	0	0	1
Cormorants	217	33	1,110	966	619	283	738
Tundra swan	2	4	1	4	2	3	8
Canada goose	15	0	0	0	0	0	49
Brant	29,293	32,964	28,365	45,047	41,581	60,124	49,015
Gr. white-fronted goose	0	0	0	0	0	64	58
Emperor goose	35,288	53,532	30,681	37,585	22,032	37,794	37,670
Mallard	6	225	179	251	271	130	102
Gadwall	7	8	15	0	10	3	6
Northern pintail	1,250	1,875	3,528	2,126	0	4,438	2,101
Wigeons	10	85	25	145	200	15	43
Northern shoveler	0	0	0	0	0	2	4
Am. Green-winged teal	0	0	3	6	4	0	10
Canvasback	0	0	0	0	0	0	5
Scaups	3,557	3,310	5,618	3,832	1,567	1,749	3,920
Common eider	3,826	3,164	11,097	2,832	3,332	181	5,783
King eider	20,848	81,167	146,072	86,192	140,727	15,758	97,027
Spectacled eider	0	0	0	0	0	0	11
Steller's eider	**77,329**	**82,455**	**79,022**	**87,353**	**60,092**	**70,480**	83,606
Harlequin duck	176	381	378	1,774	84	341	583
Long-tailed duck	8,126	9,194	31,982	4,570	12,938	21,279	16,071
Surf scoter	13	8	0	52	4	6	72
Black scoter	27,154	16,980	48,040	25,181	10,306	41,223	31,272
White-winged scoter	436	102	10,623	993	1,841	3,787	2,186
Unident. scoter	4	32	1,400	0	0	8,000	1,182
Goldeneyes	610	1,175	1,079	848	661	255	519
Bufflehead	29	22	8	123	54	2	57
Common merganser	16	0	12	573	46	1	52
Red-breasted merganser	931	383	1,781	1,583	629	961	1,138
Bald eagle	16	32	53	145	47	63	42
Sandhill crane	0	0	0	0	0	0	3
Shorebirds	770	842	2,900	4,842	2,002	10,305	7,669
Gulls	16,356	13,927	999	20,701	8,748	21,226	19,403
Black-legged kittiwake	710	200	756	168	1,300	3,600	14,750
Guillemots	0	0	0	56	3	0	5
Marine mammals:							
Sea otter	1,090	1,414	1,917	266	703	1,629	1,095
Pacific walrus	1	0	1	1	0	0	151
Seal	1,076	1,283	978	756	116	620	1,341
Steller's sea lion	1	0	22	9	0	38	319
Harbor porpoise	0	0	0	0	0	0	4
Belukha whale	0	2	34	0	1	0	27
Orca whale	0	0	0	0	0	0	1
Gray whale	38	39	20	23	2	26	53

1. Mean of highest estimates

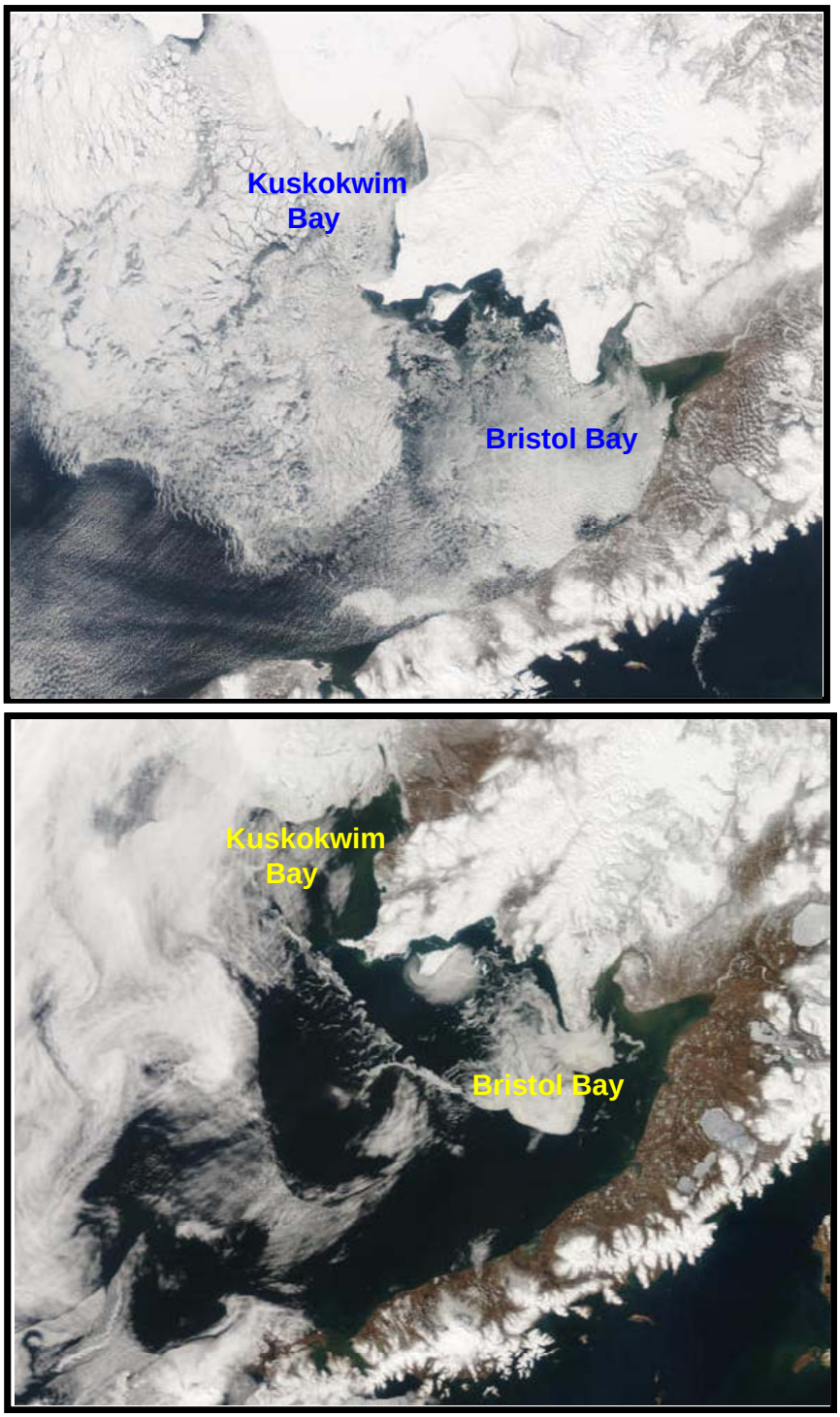


Figure 2. Sea ice distribution, southwest Alaska, 9 April (top) and 23 April (bottom), 2008. Images from http://rapidfire.sci.gsfc.nasa.gov/realtime/.

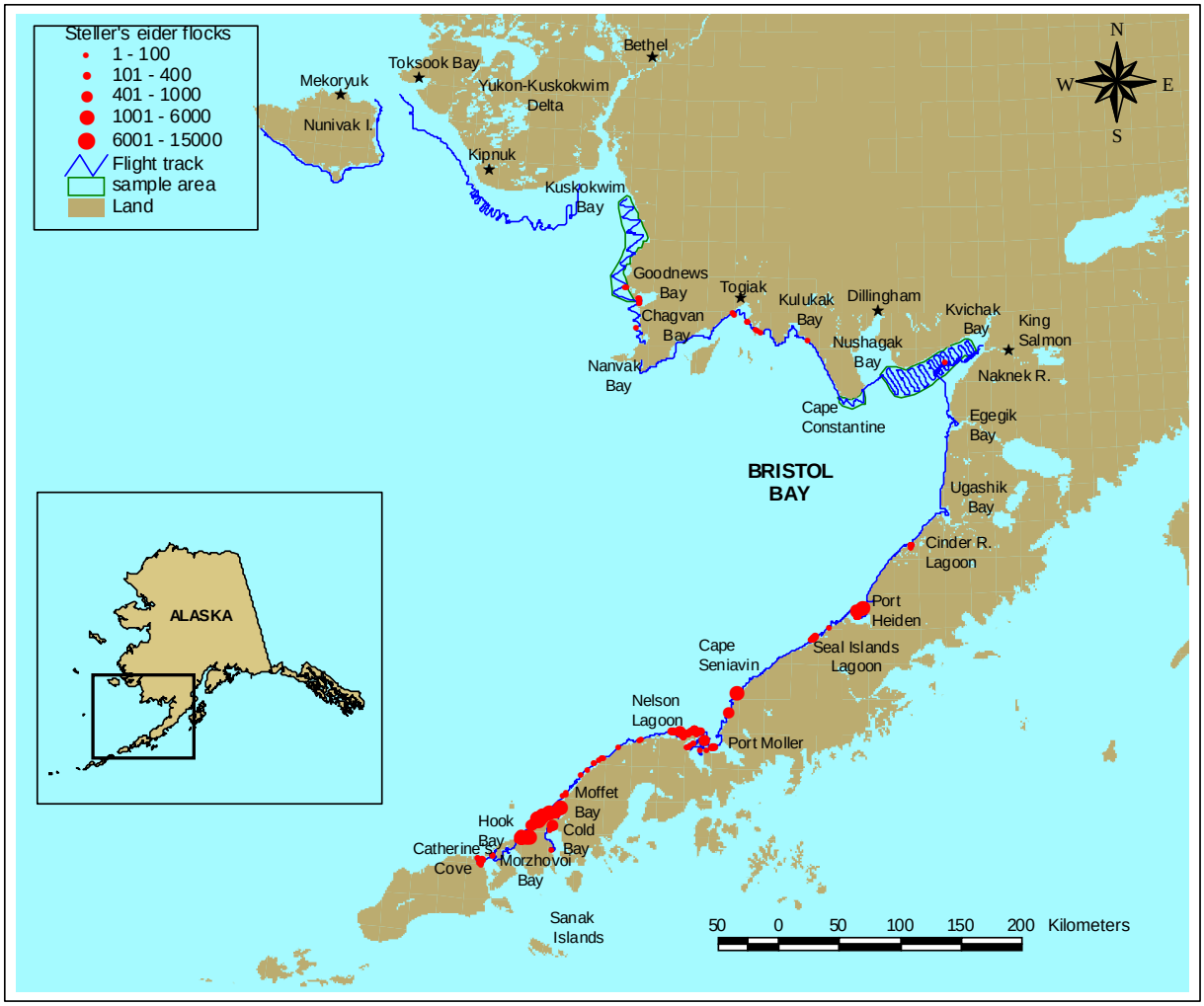


Figure 3. Survey sample areas, flight lines, and Steller's eider flock locations and relative size, Steller's eider spring migration survey, 8-11 April, 2008.

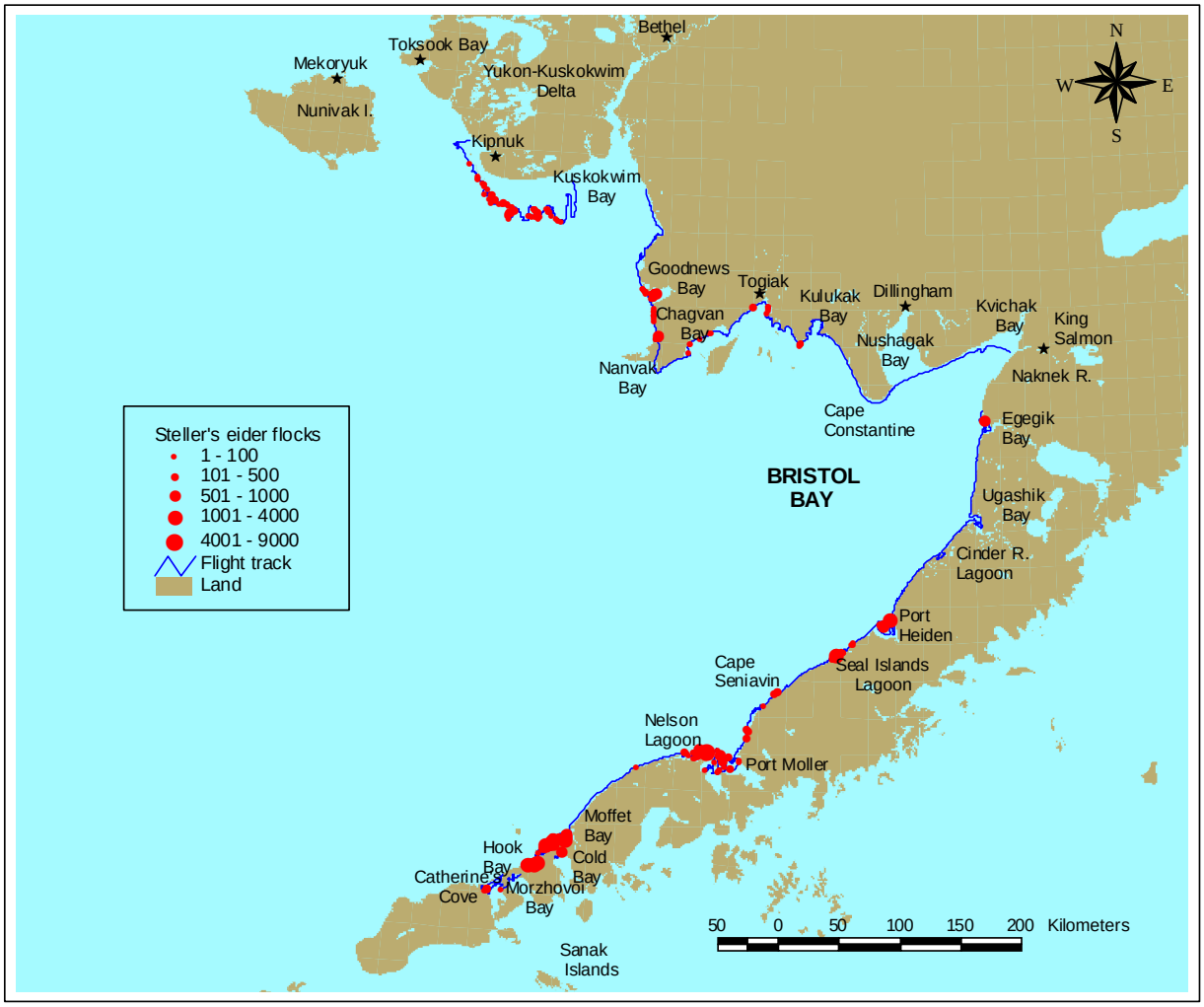


Figure 4. Survey sample areas, flight lines, and Steller's eider flock locations and relative size, Steller's eider spring migration survey, 24-29 April, 2008.

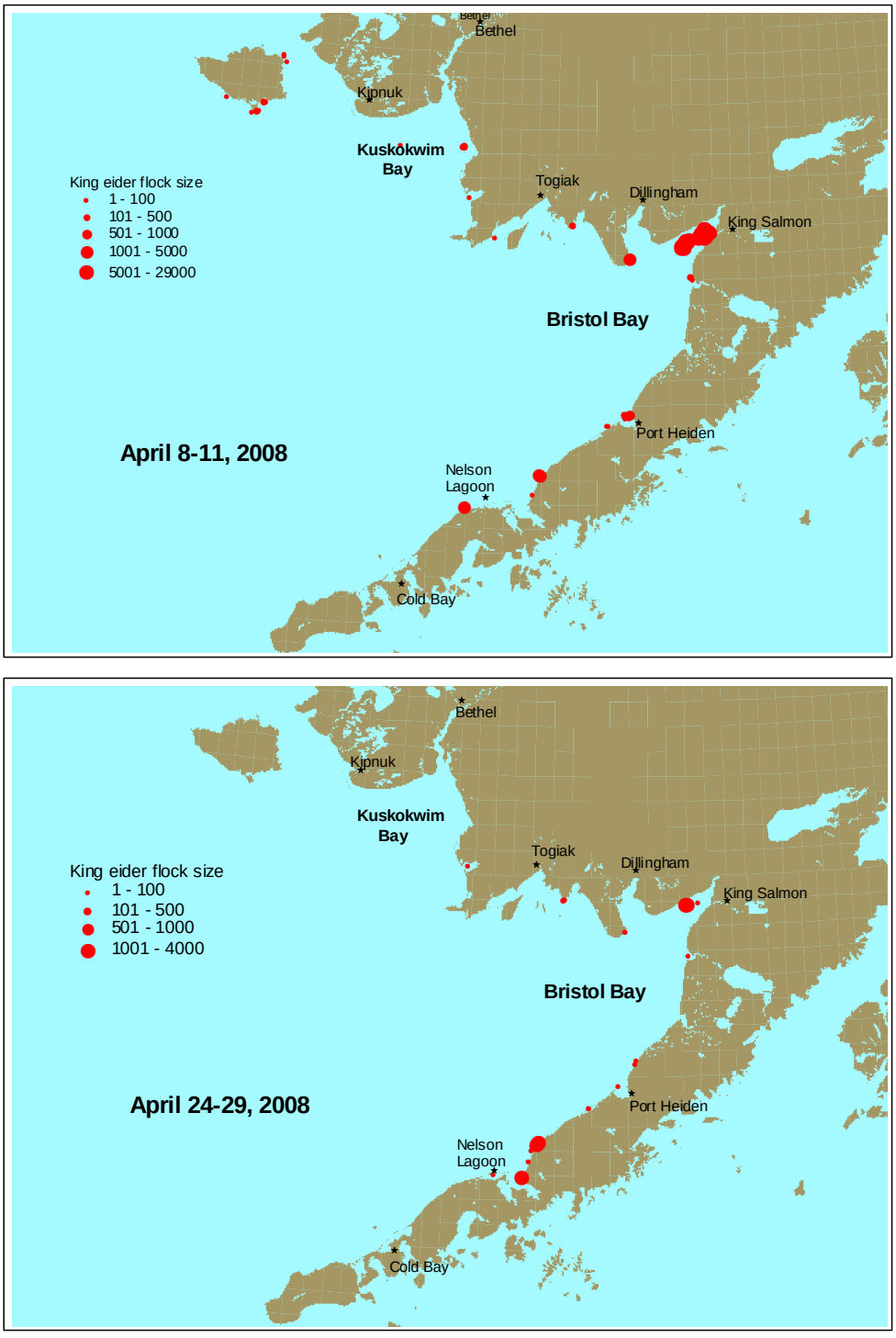


Figure 5. Location and relative size of king eider flocks recorded during Steller's eiders migration surveys, southwest Alaska, 8-11 April (top) and 24-29 April (bottom), 2008.

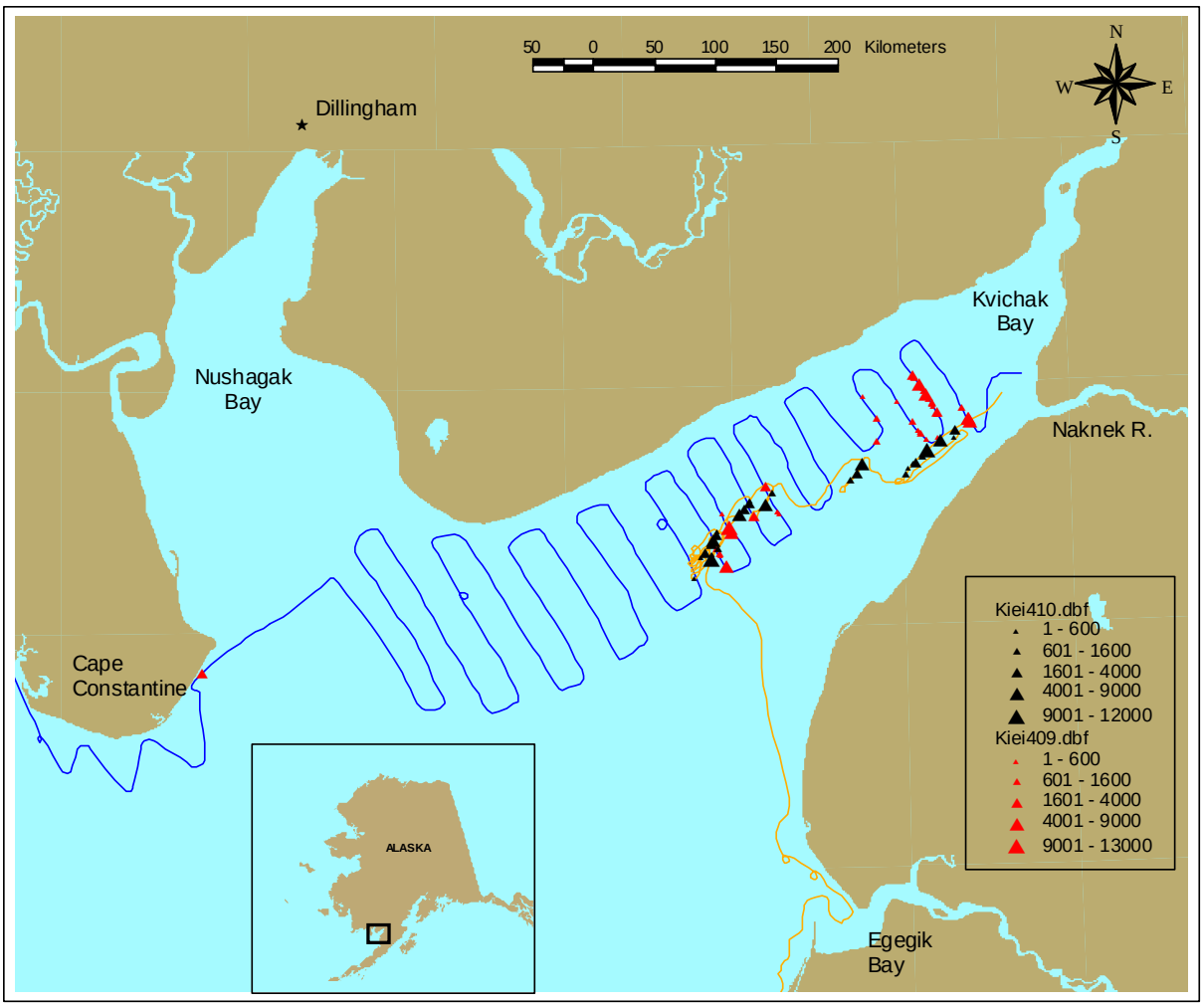


Figure 6. Flight tracks, Location and relative size of king eider flock estimates recorded during Steller's eider spring migration surveys, upper Bristol Bay, Alaska, 4/09/08 (blue line, red symbols) and 4/10/08 (yellow line, black symbols). Observations on 4/09 consisted of all eiders within 300m of the track centerline, while on 4/10 all detected flocks were estimated in their entirety.

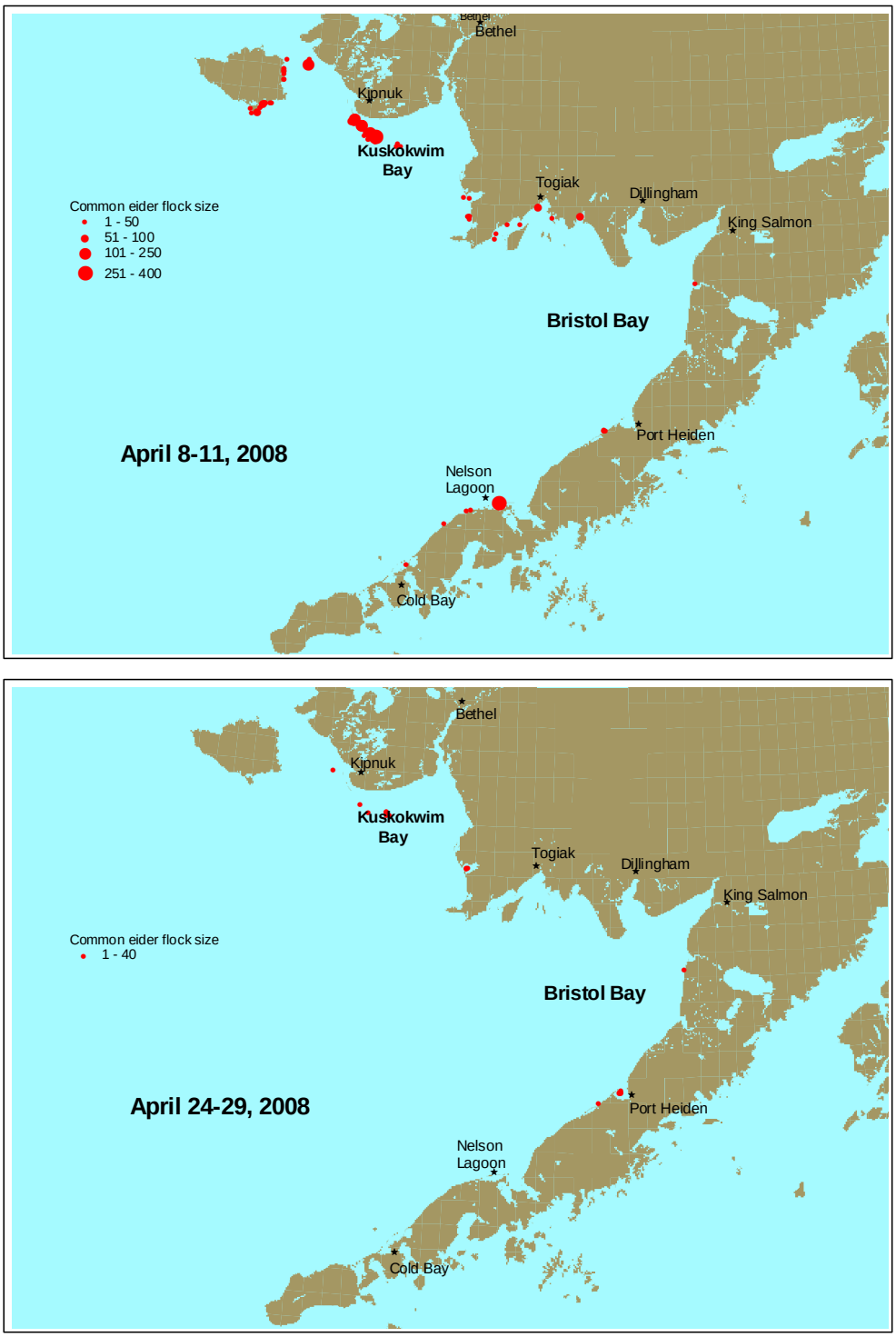


Figure 7. Location and relative size of common eider flocks recorded during Steller's eiders migration surveys, southwest Alaska, 8-11 April (top) and 24-29 April (bottom), 2008

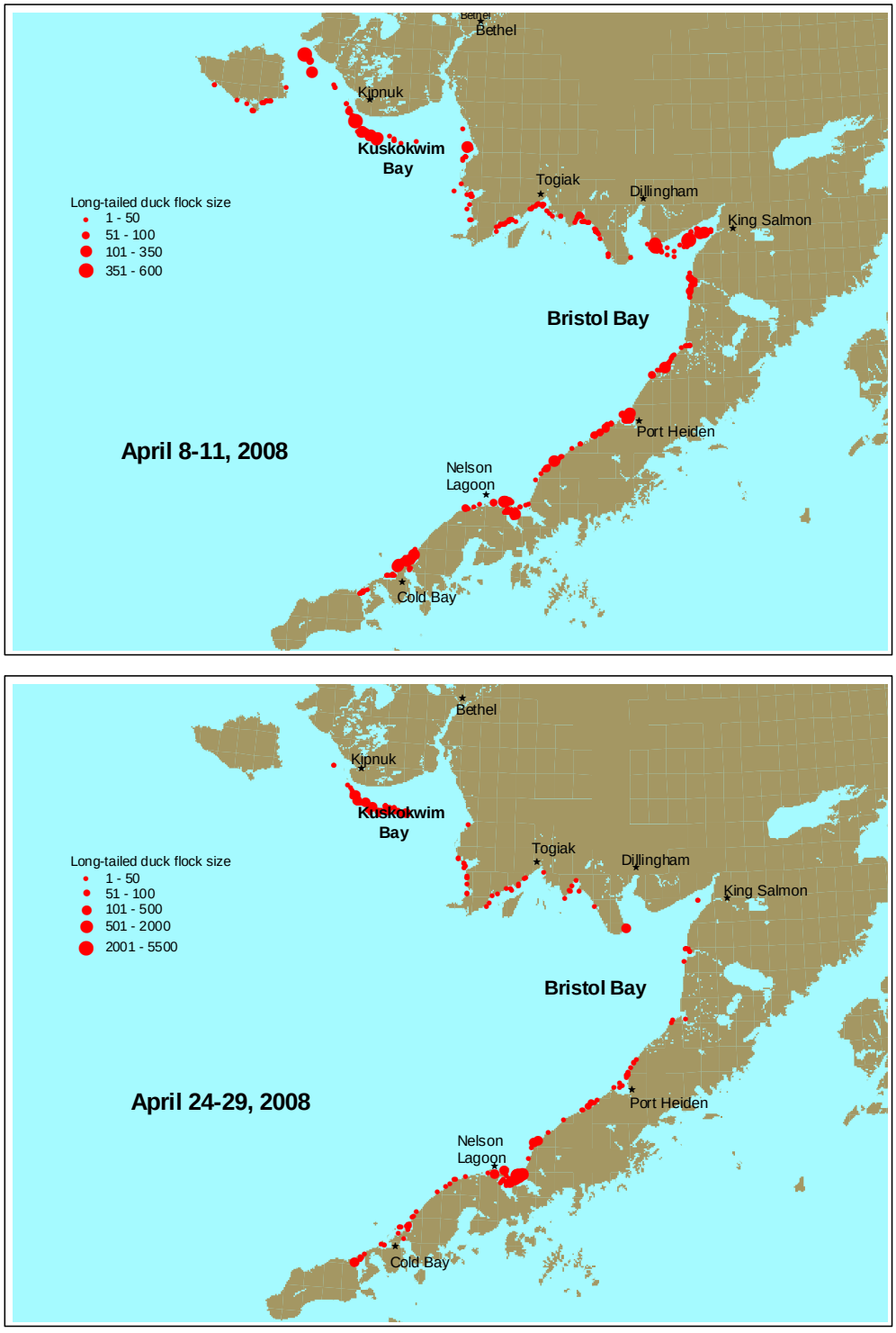


Figure 8. Location and relative size of long-tailed duck flocks recorded during Steller's eiders migration surveys, 8-11 April (top) and 24-29 April (bottom), 2008.

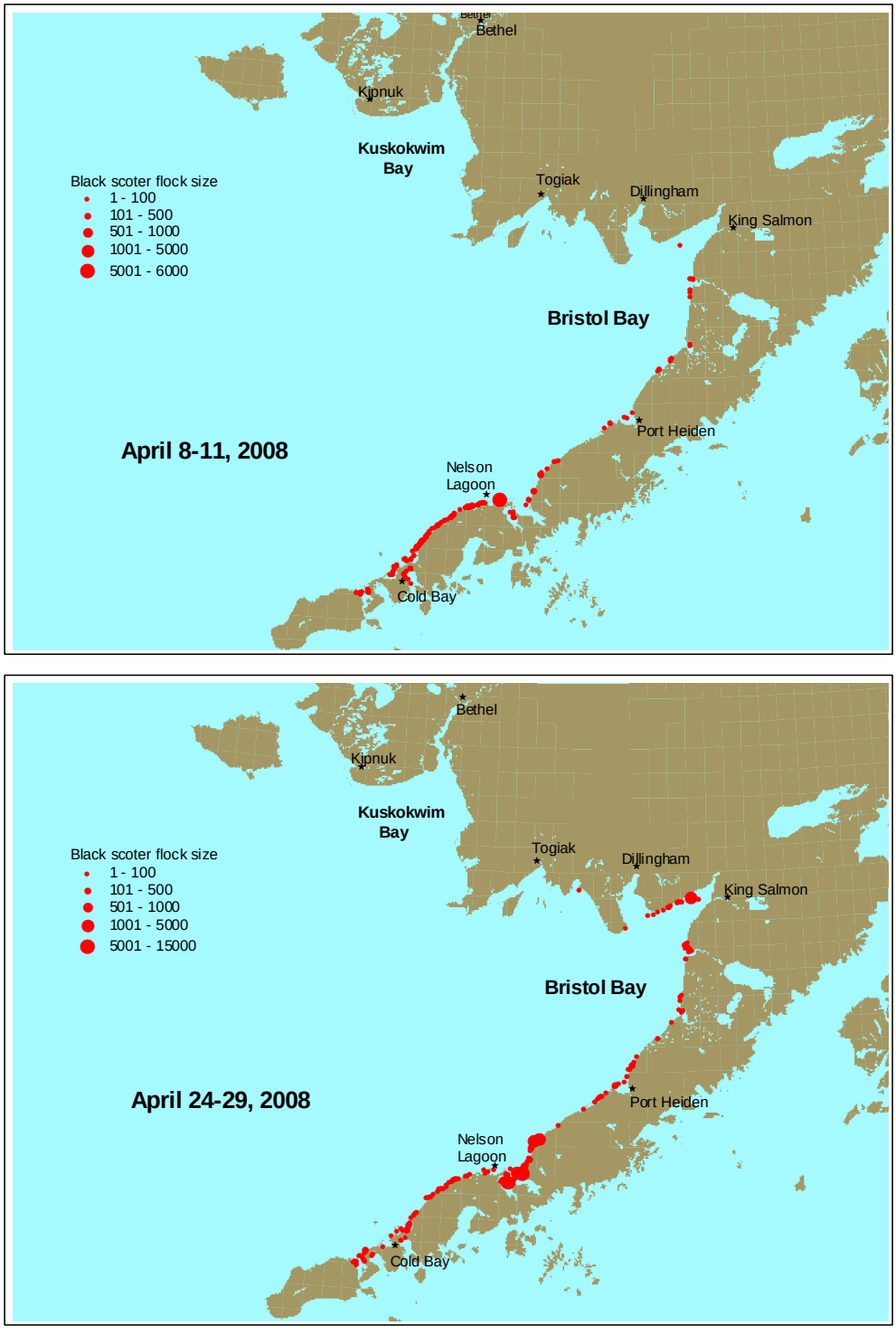


Figure 9. Location and relative size of black scoter flocks recorded during Steller's eiders migration surveys, southwest Alaska, 8-11 April (top) and 24-29 April (bottom), 2008.

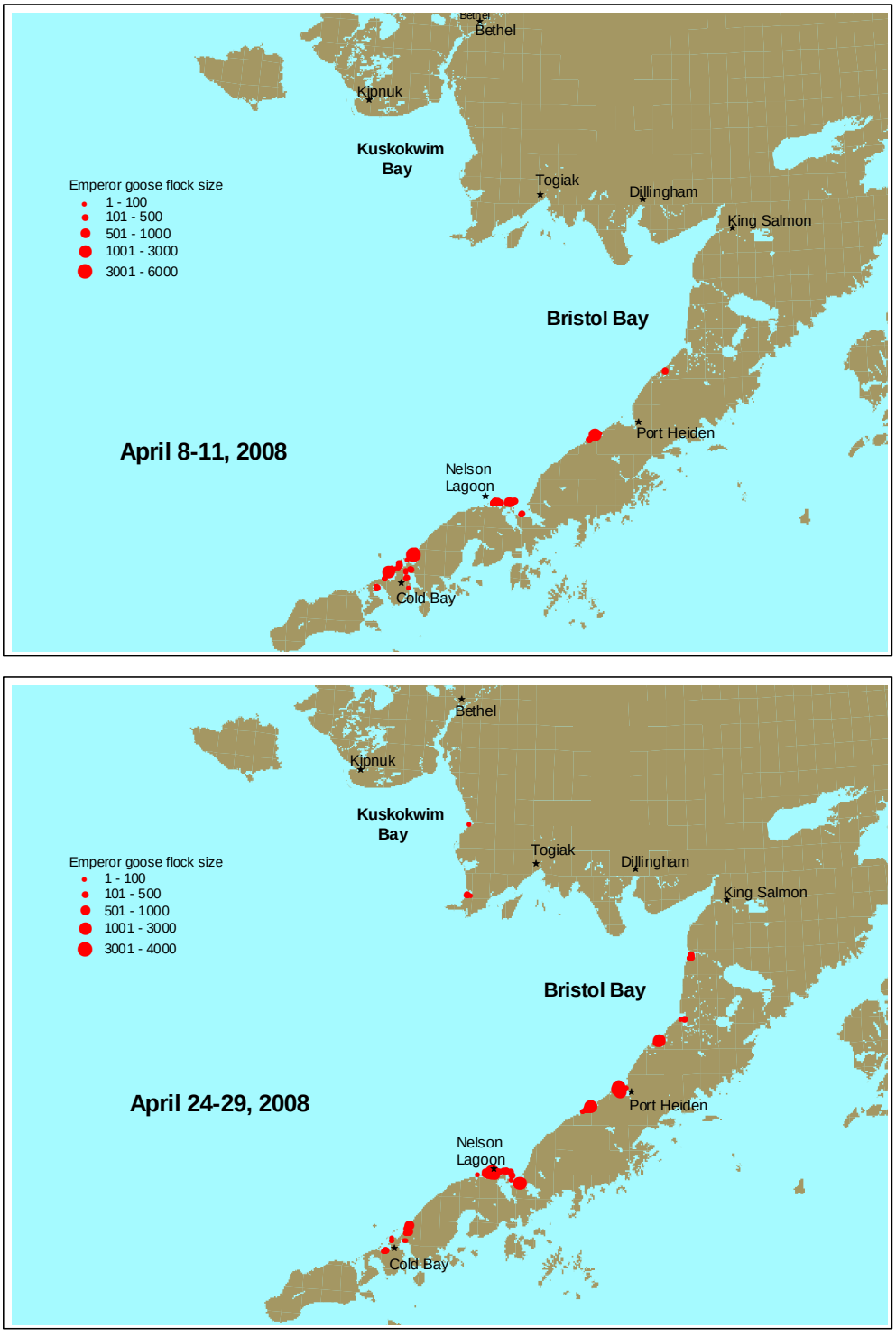


Figure 10. Location and relative size of emperor goose flocks recorded during Steller's eiders migration surveys, southwest Alaska, 8-11 April (top) and 24-29 April (bottom), 2008.

APPENDIX 1. Inclusive dates, flight hours, and personnel, Steller's eider spring aerial migration surveys, southwest Alaska, 1992-2008.

	SURVEY 1			SURVEY 2			SURVEY 3		
Year	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			

* 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	*Gavia pacifica*
Red-throated loon	G. *stellata*
Common loon	*G. immer*
Yellow-billed loon	*G. adamsii*
Red-necked grebe	*Podiceps grisegena*
Horned grebe	*P. auritus*
Cormorants: (Family *Phalacrocoracidae*)	
Cormorants	*Phalacrocorax auritus, P. pelagicus, P. urile*
Swans, geese, ducks: (Family *Anatidae*)	
Tundra swan	*Cygnus columbianus*
Canada goose	*Branta canadensis*
Brant	*B. bernicla*
Greater white-fronted goose	*Anser albifrons*
Emperor goose	*Chen canagica*
Mallard	*Anas platyrhynchos*
Gadwall	*A. strepera*
Northern pintail	*A. acuta*
Wigeons	*A. Americana, A. penelope*
Northern shoveler	*A. clypeata*
Am. Green-winged teal	*A. crecca*
Canvasback	*Aythya valisineria*
Scaups	*A. marila, A. affinis*
Common eider	*Somateria mollissima*
King eider	*S. spectabilis*
Spectacled eider	*S. fischeri*

Steller's eider	*Polysticta stelleri*
Harlequin duck	*Histrionicus histrionicus*
Long-tailed duck	*Clangula hyemalis*
Surf scoter	*Melanitta perspicillata*
Black scoter	*M. nigra*
White-winged scoter	*M. fusca*
Goldeneyes	*Bucephala clangula, B. islandica*
Bufflehead	*B. albeola*
Common merganser	*Mergus merganser*
Red-breasted merganser	*M. serrator*

Eagles: (Family *Accipitridae*)

Bald eagle	*Haliaeetus leucocephalus*

Cranes: (*Gruidae*)

Sandhill crane	*Grus canadensis*

Shorebirds: (Families *Scolopacidae, Charadriidae, Haematopodidae*)

Gulls: (Family *Laridae*)

Gulls	*Xema sabini, Larus spp.,*
Kittiwakes	*Rissa spp.*

Alcids: (Family *Alcidae*)

Guillemots	*Cepphus spp.*

Marine mammals:

Sea otter	*Enhydra lutris*
Pacific walrus	*Odobenus rosmarus*
Seal	*Phoca spp., esp. Phoca vitulina*
Steller's sea lion	*Eumetopias jubatus*
Harbor porpoise	*Phocoena phocoena*
Belukha whale	*Delphinapterus leucas*
Orca whale	*Orcinus orca*
Gray whale	*Eschrichtius robustus*