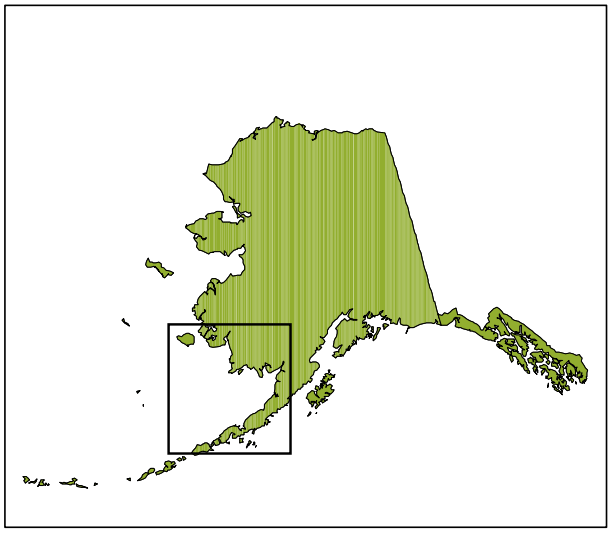
STELLER'S EIDER SPRING MIGRATION SURVEYS
SOUTHWEST ALASKA
2007



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Abstract. Annual spring aerial surveys were initiated in 1992, and repeated in 1993, 1994, 1997, 1998, 2000-2005 and 2007 to monitor the population status of and habitat use by Steller's eiders (*Polysticta stelleri)* staging for spring migration in southwestern Alaska. Since the timing of migration varies, two to three replicate shoreline surveys were conducted each survey year through 1997, to target the optimal timing when most eiders were within the survey area prior to departure to arctic breeding grounds. Fiscal constraints and inclement weather in subsequent years resulted in successful completion of only one survey per year, the timing of which was carefully scheduled using sea ice, weather and observational data from local contacts. We made visual estimates of Steller's eiders and all other identifiable water birds and marine mammals along shorelines, estuaries and shoals where Steller's eiders and other seaducks 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 Steller's eider raw counts are 137,904 (1992); 88,636 (1993); 107,589 (1994); 90,269 (1997), 84,459 (1998), 68,956 (2000), 58,231 (2001), 54,191 (2002), 77,329 (2003), 82,455 (2004), 79,022 (2005) and 87,353 (2007). The long-term average from 1992 to 2007 is 84,700. Correcting recent estimates using extrapolated data from sampled shoal habitats, the totals are 72,953 (2000), 60,656 (2001), 56,704 (2002), 77,369 (2003), 82,772 (2004), 79,022 (2005), and 87,400 (2007). We suspect that the low population estimates obtained from 2000 through 2002 were due in part to a portion of the eiders migrating 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. We therefore initiated the 2003 through 2007 surveys in early April, encountering most eiders before they moved from Alaska Peninsula lagoons to Kuskokwim Bay and other more northerly habitats. Unexpanded long-term survey data indicate a 2.8 percent average annual decline in Steller's eiders using this migration corridor ($R^2 = 0.30$), but the estimated population trend has been level since 2002. Maps illustrate the distribution of Steller's eiders and other selected species within the survey area in 2007. A persistent pattern of habitat use by Steller's eiders and most other sea duck species among years indicates the importance of certain areas to staging and migrating waterfowl. Many of these areas are used heavily by molting and staging birds in the fall 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 and observations from the 2007 Steller's eider survey, 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 (Bill Larned) for all years. I believe the assumption of complete census coverage is reasonable for most of the survey area 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 covered these areas using a "sawtooth" sample of fixed-width transects, extrapolating the resulting density of each species to the sampled area. This year these areas included a portion of Kuskokwim Bay from Quinhagak to Goodnews Bay, an area along the tip of the Nushagak Peninsula, and the extensive shoals within Kvichak Bay (Figs. 2a,b). Since this sampling/extrapolation method was used only from 2000 to present, caution should be used when comparing recent years' data with data from prior to 2000, particularly for black scoters, white-winged scoters, long-tailed ducks, king eiders and Steller's eiders. For this reason Table 2 contains un-extrapolated raw count data for comparison with earlier 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 is 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 seaducks, while a more detailed discussion to help with interpretation of data 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), most 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 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. Later transcription, using another program written by Hodges, produced ASCII data files wherein each line contained a species and number observation plus geographic coordinates, date, and time. We also recorded auxiliary data, including tide stage (high, medium, low, and unknown), ice cover in tenths, sea condition (Beaufort scale), wind and sky condition. These ancillary data are archived with waterfowl data, 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. No data from instrumented birds were available for 2007. In some years we repeated the survey up to three times each year to bracket the spring migration period, using the highest count as that year's Steller's eider estimate. However, since 1997 only one survey per year was flown. We intended to conduct 2 complete

surveys in 2001 and 2002, but extended periods of inclement weather precluded replication. Another source of error is flock estimation bias. We have attempted to measure and correct for this bias by taking a representative sample of oblique aerial photographs of flocks which were also estimated visually, counting the birds in the photos, then using the resulting ratios to develop a correction factor with variance estimate. In 1998, visual estimates made by me (Larned) of 17 Steller's eider flocks ranging in size from 94 to 2194 birds, averaged 35 percent lower than counts made from photographs of the same flocks. The small sample was inadequate for generating a statistically valid correction factor, 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 many 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 re-grouping 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 for observer training, we have not succeeded in obtaining a sample adequate for data adjustment since 1998. My conclusion is that successful completion of a photo-based estimation-bias study would require, at minimum, a second dedicated aerial crew to obtain comprehensive photo coverage of all eiders in a sample of surveyed habitats.

In most 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 see 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 a distinct iridescent blue speculum, bordered by faint white bars that are usually visible in flight to aerial survey 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 would not be substantially higher than that of males). We have recorded and totaled estimates of the brown bird components of these flocks, and provide 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 (consistently the same person, Bill Larned, for all surveys thus far), intentionally maneuver the aircraft so that the majority of larger eider flocks were on his side for estimation. Observers received training in 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. Karen Bollinger (USFWS, Waterfowl Management, Fairbanks, Alaska) functioned as starboard observer in 2007.

RESULTS

Habitat and survey conditions

Spring came late to Bristol Bay and Kuskokwim Bay in 2007, with extensive ice cover in much of Bristol Bay and the Etolin Strait/Nunivak Island areas until mid-April. Using the NASA MODIS Rapid Response System (http://rapidfire.sci.gsfc.nasa.gov/) website, we monitored ice cover in ALASKA Peninsula lagoons almost daily, determining that most were 100 percent ice covered until the first week of April, and personnel at Izembek National Wildlife Refuge verified that birds were slow to return to Izembek Lagoon. These observations indicated that ice dispersal in eider staging habitats in 2007 was later than 2004 and 2005, but similar to 2006, another late year. We therefore did not initiate the survey until 11 April. At that time ice was still nearly continuous in Etolin Strait, Goodnews, Chagvan and Nanvak Bays, but little ice remained in the nearshore and offshore portions of Kuskokwim Bay. These conditions as well as persistent northerly winds apparently discouraged Steller's eiders from moving northward, as few were found north of the Alaska Peninsula during the survey.

Our recorded flight path for the survey of April 2007 is displayed in figs. 2a-2c. Though we experienced moderate winds and choppy seas during the northern portion of the 13 April flight to King Salmon, resulting in a slightly abbreviated coverage of the offshore portion of Kuskokwim Bay, generally favorable weather prevailed during the survey and we had no major delays north of Cold Bay, where we lost one day. On 16 April calm winds enabled us to survey the Sanak Island group south of False Pass – a priority for this year and a habitat never previously visited during this survey project. Total flight hours (37.5) were similar to prior surveys (Table 1).

Table 1. Total flight hours for spring Steller's eider surveys, southwest Alaska, 1992-07.

	Year											
Survey No.	1992	1993	1994	1997	1998	2000	2001	2002	2003	2004	2005	2007
1	39.1	35.8	40.2	36.4	35.5	36.9	41.8	42.6	38.1	35.8	33.0	37.5
2	32.1	40.4	25.0	34.4								
3	31.3	34.3										

Itinerary for 2007 survey

4/10 Flew survey aircraft from Anchorage to Bethel. Overnight Yukon Delta National Wildlife Refuge (YDNWR) bunkhouse.

4/11 Conducted 4.7-hr. survey flight, Kuskokwim River mouth to Toksook Bay. Overnight YDNWR.

4/12 Conducted 4.0-hr. survey flight, south side of Nunivak Island. Overnight YDNWR

4/13 Conducted 6.2-hr. survey flight from Bethel to King Salmon. Overnight Alaska Peninsula/Becharof National Wildlife Refuge (APBNWR) bunkhouse.

4/14 Conducted 5.0-hr. survey flight from King Salmon to Cold Bay, covering lagoons and shorelines to Port Moller. Overnight Izembek National Wildlife Refuge (INWR) bunkhouse.

4/15 Grounded in Cold Bay due to weather. Overnight INWR.

4/16 Conducted 5.3-hr. survey flight including Sanak Islands and lagoons in the Cold Bay vicinity. Refueled and conducted a 4.3-hour flight to survey the shoreline and lagoons from Moffett Bay to Port Moller, then flew direct to King Salmon. Overnight APBNWR bunkhouse.

4/17 Tried to fly direct to Anchorage, but returned to King Salmon due to inclement weather. Overnight APBNWR bunkhouse.

4/18 Larned returned to Kenai via airines, Bollinger remained with aircraft in King Salmon, Overnight APBNWR bunkhouse.

4/19 Bollinger flew aircraft to Anchorage, end of survey.

Steller's eider results The 2007 Steller's eider estimate of 87,853 is 4 percent above the long-term mean (84,700, Table 3). The 1992-2007 trend indicates a 2.8 percent average annual decline ($R^2 = 0.30$) in Steller's eider estimates (Fig. 1). This year was similar to 2004 and 2005 in that very few Steller's eiders were north of the Alaska Peninsula during the survey in mid April. Unfortunately none of the satellite transmitters implanted in eiders in Kodiak during the winter of 2005-06 survived to this spring, to give us a sense of departure dates for those birds. In previous years instrumented Kodiak eiders did not enter the survey area until mid April or later (Rosenberg, pers. Comm.), so Kodiak birds were likely not included in our counts, but the later survey initiation date this year may have given Kodiak birds time to join AK Peninsula birds prior to our survey.

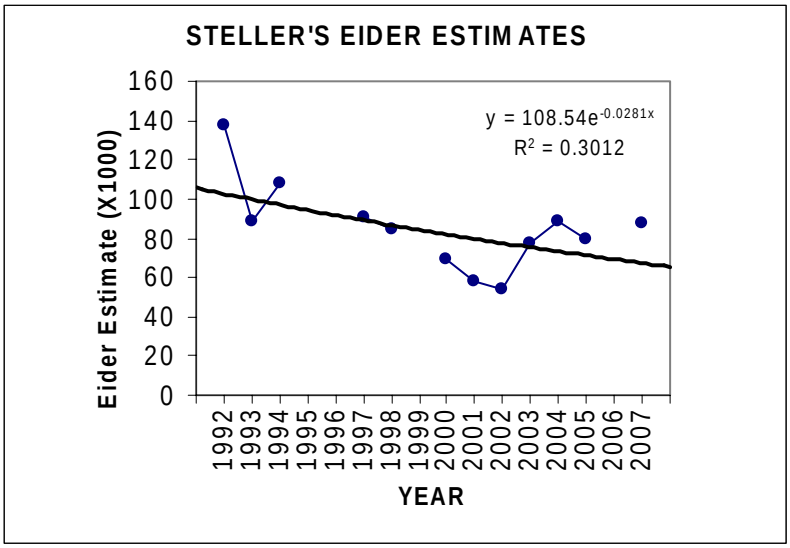

Figure 1 Trend in Steller's eider estimates from aerial surveys conducted in April and May, 1992 through 2007, in southwest Alaska.

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, and 2007 we did not record any obvious second-year flocks. Since all surveys since 2002 were flown in early to mid April, it is possible that non-breeding flocks, that normally lag behind the breeders, were not yet present in Bristol Bay lagoons. Coincidentally, 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, presumably non-breeding subadults, but no "brown" juveniles (Rosenberg, pers. Comm.).

The pattern of habitat use by concentrations of eiders in 2007 (Figs. 2, 3, Table 2) was similar to that seen during previous years' surveys, and particularly that of 2003, 2004, and 2005, which were completed within roughly the same time period. Most of the Steller's eiders were located within the lagoons along the Alaska Peninsula, in fact 96 percent of the survey total were recorded from Port Heiden south. Only 35 Steller's eiders were recorded during an exhaustive search at Sanak Islands (Fig. 2c). In early March, 2000, we recorded 1,578 Steller's eiders there during a comparable aerial Survey (Larned 2000), and Satellite telemetry data revealed that some of the eiders nesting in the Barrow area spent a large portion of the winter around in the Sanak Island group (Martin pers. comm.).

Other Waterfowl

Most of the *King eiders* were recorded in Kvichak Bay, and Kuskokwim Bay offshore near Goodnews Bay (Table 2, Fig. 4). Estimates for both areas were expanded from strip samples, and the survey total (575,376) is about double the next highest estimate (241,992 in 1997). The accuracy of this extrapolated non-replicated sample from a very clumped distribution is certainly questionable, but it is clear that upper Bristol Bay regularly hosts a large proportion of the Pacific king eider population in early spring. The area is also an important fall molting area (Larned and Tiplady 1997, 1998).

The *common eider* is an early migrant, and this year's rather low estimate (3,220) suggests that most of the birds had already moved through the area. Most of the common eiders were recorded in migrating flocks in upper Kuskokwim Bay (Table 2, Fig. 5). L*ong-tailed ducks* were present in normal numbers throughout the survey area (9,244 expanded estimate) – especially common in the Kuskokwim Shoals and Kvichak Bay (Table 2, Fig. 6). *Black scoters* were also present in normal numbers (49,392 expanded estimate), and concentrated primarily in Kvichak Bay and the lower Alaska Peninsula, reflecting the late ice dispersal (Table 2, Fig. 7). Not surprisingly we found no *Emperor geese* north of Egegik, but the estimate(37,501) is very close to the long-term mean (37,660) (Table 2, Fig. 8). Annual estimates for all species are unextrapolated in Table 3 to facilitate comparison among years; figures in that table for 2007 do not agree with expanded estimates in Table 2.

CONCLUSIONS AND RECOMMENDATIONS

This survey has provided two types of information critical for management of Steller's eiders. First, it has provided a map of habitats used during migration and staging, many of which are likely critical for maintenance of this population. For this purpose the early years of the survey in which we conducted several replicates over >1 month were the most valuable in establishing these patterns. During more recent years we have conducted surveys in early to mid April, when most birds are still in Alaska Peninsula habitats, which seems to be better for estimating the population. However, it would also be useful to occasionally conduct a later survey to update our knowledge of the relative use of habitats north of the Peninsula. The temporal use of SW Alaska habitats by migrating, staging and wintering eiders has been described during recent satellite telemetry studies, but such data provide little information on quantitative distribution. In recent and future years, the primary contribution of the spring aerial survey in the realm of habitat associations is in monitoring to detect and evaluate changes due to anthropogenic (and natural) perturbations and disturbances.

The second type of data provided by the survey is estimates of abundance and long-term trend of the spring population – the only such comprehensive data set available for this species. The survey is a rough visual census of a population of Steller's eiders in groups containing up to several thousand birds. Some of these flocks may be actively migrating northward during the survey. We currently have no practical method of estimating the precision of the flock estimates or survey totals. The key to the accuracy of the annual totals generated by this survey lies in our diligence in keeping methods and observers as consistent as possible and avoiding surveying during periods when conditions favor mass migration movements. Confidence in the trend estimate produced by the survey increases as annual data accumulate. There was a consistent downward trend through 2002 (Fig. 1). However, considering some of the individual years, the 1992 figure was the highest by far of three surveys completed that year, and one which I consider an outlier, biased high by a one-time observer who tended to estimate large dense flocks higher than other observers (perhaps more accurately!), and late timing when most Steller's eiders were concentrated in the Kuskokwim Bay shoals area, where they are very active and difficult to estimate. The lowest estimate was in 2002, when there were strong southerly winds during a portion of the survey, which favored migratory movements, and satellite telemetry data which indicated that instrumented Steller's eiders, presumably accompanied by many non-instrumented birds, made major migration flights during the survey, bypassing the survey crew undetected. We suspect that there were similar movements during the 2001survey (another year with a low estimate) as well, based on the presence of southerly winds during the survey, and late survey timing. Fitting an exponential growth curve to the data set after removing these three suspect years results in an average annual trend of only -1.0 percent ($R^2 = 0.20$), while leaving those years in yields the -2.8 percent trend ($R^2 = .30$) presented in this report (Figure 1).

In view of the above analysis and the experience gained since 1992, I believe the best course for this monitoring program is to continue in our present mode of conducting the survey in late March to mid April, avoiding periods of southerly winds as much as possible, and interpreting the resulting data in the long-term context. We should also try to conduct a survey of habitats

from Nanvak Bay to the Yukon River Delta when possible to monitor the relative importance of those habitats to migrating/staging eiders.

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, who generously donated her time, skill and energy as observer this year. 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 2. Seaduck and goose estimates for geographic aerial survey units, spring Steller's eider survey, southwest Alaska, April 2007.

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	4/12	1:00	1.00	73	230	95	56	6		17		
Toksook Bay to Kuskokwim R.	4/11	2:45	1.00	290	200	1,647	1,926			417		
Kuskokwim R. to Goodnews Bay [1]	4/13	1:19	6.03	12	42,650	458	368			72		
Goodnews Bay[2]	4/13	0:12	1.00	779		2	41					
Goodnews Bay to Chagvan Bay	4/13	0:11	1.00				6			19		
Chagvan Bay[3]	4/13	0:08	1.00	528								
Nanvak Bay[4]	4/13	0:03	1.00	16								
Nanvak Bay to Togiak Village	4/13	0:37	1.00	9			9					
Togiak Vilage to Kulukak Bay	4/13	0:26	1.00	199		94	43	2				
Kulukak Bay to Cape Constantine	4/13	0:26	1.00			25	10		1			
Cape Constantine[1]	4/13	0:17	5.37		32		11		16			
Kvichak Bay[1]	4/13	1:29	7.40	44	524,453	7	5,039		27,979	67		
Naknek River to Port Heiden	4/14	1:08	1.00	675	410	20	227		430	21		
Egegik Bay	4/14	0:12	1.00	790	60		243		95			600
Ugashik Bay	4/14	0:22	1.00	1			253	10	12			378
Cinder River Sanctuary	4/14	0:07	1.00	176		6	6		8			1,594
Port Heiden	4/14	0:49	1.00	15,399		16	18		2,526			1,304
Port Heiden to Port Moller	4/14	0:55	1.00	1,445	7,141	150	626	20	5,600	288		2
Seal Islands Lagoon	4/14	0:15	1.00	2,530								11,798
Port Moller/Herendeen Bay	4/16	0:44	1.00	7,471			12		3,003			6,635
Nelson Lagoon	4/16	0:33	1.00	6,194	200	700	9		2,926			2,253
Nelson Lagoon to Moffett Bay	4/16	0:34	1.00	108			200	14	1,945	92		
Izembek Lagoon	4/16	1:52	1.00	46,562			25	39	326		44,857	10,488
Kinzerof Lagoon	4/16	0:10	1.00	2,622			10		30	2	20	
Morzhovoi Bay Lagoons	4/16	0:14	1.00	500				2			50	185
Hook Bay	4/16	0:12	1.00				1	41	97		99	260
Catherine's Cove	4/16	0:12	1.00	942			35		18			504
Sanak Islands	4/16	1:20	1.00	35			70	1,640	4,380	116	21	1,500
Totals				**87,400**	**575,376**	**3,220**	**9,244**	**1,774**	**49,392**	**995**	**45,047**	**37,501**

1. Estimates reported herin 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 & 3.
2. Goodnews Bay 80 percent ice-covered. 3. chagvan Bay 75 percent ice-covered. 4. Nanvak Bay 95 percent ice-covered.

Table 3. Survey totals for all species, Spring Steller's eider surveys, southwest Alaska, 1992 to 2007. For years with replicate surveys (1992-1997) 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 Table 2 for expanded estimates of selected species in 2007.

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
Red-necked grebe	32	793	221	178	29	114	316	186
Horned grebe	0	0	3	0	0	2	0	0
Common loon	5	13	13	8	0	0	0	5
Yellow-billed loon	2	0	0	0	0	0	0	1
Pacific loon	2	30	34	45	23	5	3	0
Red-throated loon	78	51	270	11	97	61	188	64
Unident. loon	0	0	85	7	24	3	137	23
Arctic tern	53	249	836	3	0	0	87	0
Mew gull	3,419	3,872	2,141	3,482	6,699	2,741	2,018	15
Black-legged kittiwake	68,888	26,579	6,614	41,957	28,333	2,624	479	10,845
Sabine's gull	0	166	173	0	10	0	0	0
Mixed gull[1]	18,072	49,378	24,865	27,738	25,769	7,991	9,249	15,622
Pigeon guillemot	0	0	0	0	0	0	0	0
Jaeger	0	4	5	0	1	1	0	3
Cormorant[2]	979	1,082	1,618	829	653	335	674	483
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
Mallard	88	27	39	107	2	97	15	20
American wigeon	4	0	8	2	79	2	0	0
Am. Green-winged teal	0	0	75	2	1	0	0	35
Gadwall	5	2	15	0	10	2	0	0
Northern shoveler	28	2	14	0	3	0	4	0
Northern pintail	5,325	1,792	1,760	1,414	893	857	618	1,431
Canvasback	0	3	57	0	2	0	0	0
Scaup[3]	11,106	5,316	6,598	3,072	2,289	1,864	1,188	1,465
Goldeneye	711	177	263	365	136	319	181	222
Bufflehead	36	66	400	0	0	2	0	0
Long-tailed duck	20,512	13,184	22,987	25,548	22,025	11,569	7,756	10,197
Harlequin duck	757	608	838	328	243	373	946	438
Steller's eider	**137,904**	**88,636**	**107,589**	**90,269**	**84,459**	**68,956**	**58,231**	**54,191**
Spectacled eider	40	26	35	20	16	0	4	0
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
Unident. scoter	361	0	0	1,474	136	0	0	3,962
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
Surf scoter	23	347	48	359	8	17	17	41
White-fronted goose	0	430	30	80	54	0	94	0
Canada goose	169	28	34	57	210	26	97	2
Black Brant	5,289	81,743	71,551	80,099	34,045	58,212	74,851	35,610
Emperor goose	27,876	28,542	25,816	41,279	53,926	32,562	41,816	43,014
Tundra swan	2	9	2	24	46	0	7	0
Sandhill crane	4	21	10	0	2	0	0	0
Small shorebird[4]	0	0	9,737	40,540	9,997	13,990	456	5,262
Large shorebird[5]	0	0	47	0	15	0	0	0
Bald eagle	24	78	29	23	22	17	24	19
Common raven	0	0	1	9	5	0	0	0
Northwest crow	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

1. Lumped due to observer inconsistencies. Includes glaucous, glaucous-winged, mew and other gulls.
2. Lumped due to observer inconsistencies. Includes pelagic, red-faced and double-crested. 3. Mostly greater scaup.
4. Incl. plovers, lesser yellowlegs, all sandpipers, phalaropes, dowitchers, common snipe, turnstones, surfbird, dunlin and others
5. Incl. godwits, whimbrel, Bristle-thighed curlew, greater yellowlegs and others. 6. Mean of highest annual estimates.

Table 3. (continued)

SURVEY DATES:	3/29-4/11/03	4/1-11/04	4/2-4/8/05	4/11-16/07	average[6]
Red-necked grebe	54	0	4	5	161
Horned grebe	0	0	0	3	1
Common loon	1	1	0	1	4
Yellow-billed loon	0	0	0	0	0
Pacific loon	7	0	0	0	12
Red-throated loon	2	0	1	1	69
Unident. loon	4	10	8	57	30
Arctic tern	0	25	0	0	104
Mew gull	23		603	0	2,274
Black-legged kittiwake	710	200	756	168	15,679
Sabine's gull	0		0	0	32
Mixed gull[1]	16,356	13,927	999	20,701	19,222
Pigeon guillemot	0	0	0	56	5
Jaeger	0	0	0	0	1
Cormorant[2]	217	33	1,110	966	748
Common merganser	16	0	12	573	53
Red-breasted merganser	931	383	1,781	1,583	1,152
Mallard	6	225	179	251	88
American wigeon	10	85	25	145	30
Am. Green-winged teal	0	0	3	6	10
Gadwall	7	8	15	0	5
Northern shoveler	0	0	0	0	4
Northern pintail	1,250	1,875	3,528	2,126	1,906
Canvasback	0	0	0	0	5
Scaup[3]	3,557	3,310	5,618	3,832	4,101
Goldeneye	610	1,175	1,079	848	507
Bufflehead	29	22	8	123	57
Long-tailed duck	8,126	9,194	31,982	4,570	15,638
Harlequin duck	176	381	378	1,774	603
Steller's eider	**77,329**	**82,455**	**79,022**	**87,353**	84,700
Spectacled eider	0	0	0	0	12
Common eider	3,826	3,164	11,097	2,832	5,987
King eider	20,848	81,167	146,072	86,192	93,386
Unident. scoter	4	32	1,400	0	614
Black scoter	27,154	16,980	48,040	25,181	30,443
White-winged scoter	436	102	10,623	993	2,053
Surf scoter	13	8	0	52	78
White-fronted goose	0	0	0	0	57
Canada goose	15	0	0	0	53
Black Brant	29,293	32,964	28,365	45,047	48,089
Emperor goose	35,288	53,532	30,681	37,585	37,660
Tundra swan	2	4	1	4	8
Sandhill crane	0	0	0	0	3
Small shorebird[4]	770	822	2,900	4,815	7,441
Large shorebird[5]	0	20	0	27	9
Bald eagle	16	32	53	145	40
Common raven	0	2	0	3	2
Northwest crow	0	0	0	128	11
Marine mammals:					
Sea otter	1,090	1,414	1,917	266	1,051
Pacific walrus	1	0	1	1	164
Seal	1,076	1,283	978	756	1,401
Steller's sea lion	1	0	22	9	343
Harbor porpoise	0	0	0	0	5
Belukha whale	0	2	34	0	30
Orca whale	0	0	0	0	1
Grey whale	38	39	20	23	55

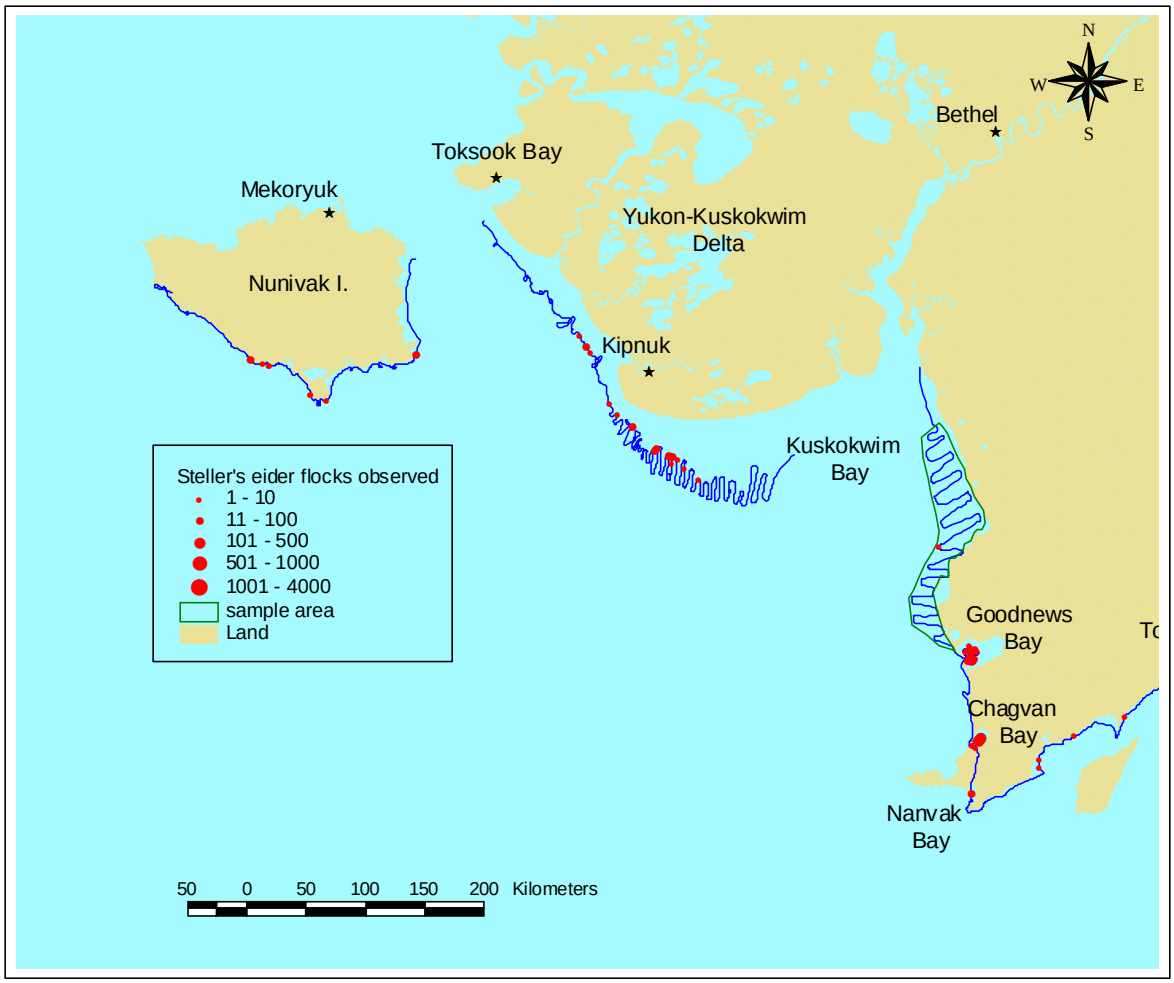

Figure 2a. Survey sample areas, flight lines, and Steller's eider flocks observed, Steller's eider spring migration survey, southwest Alaska, April 2007.

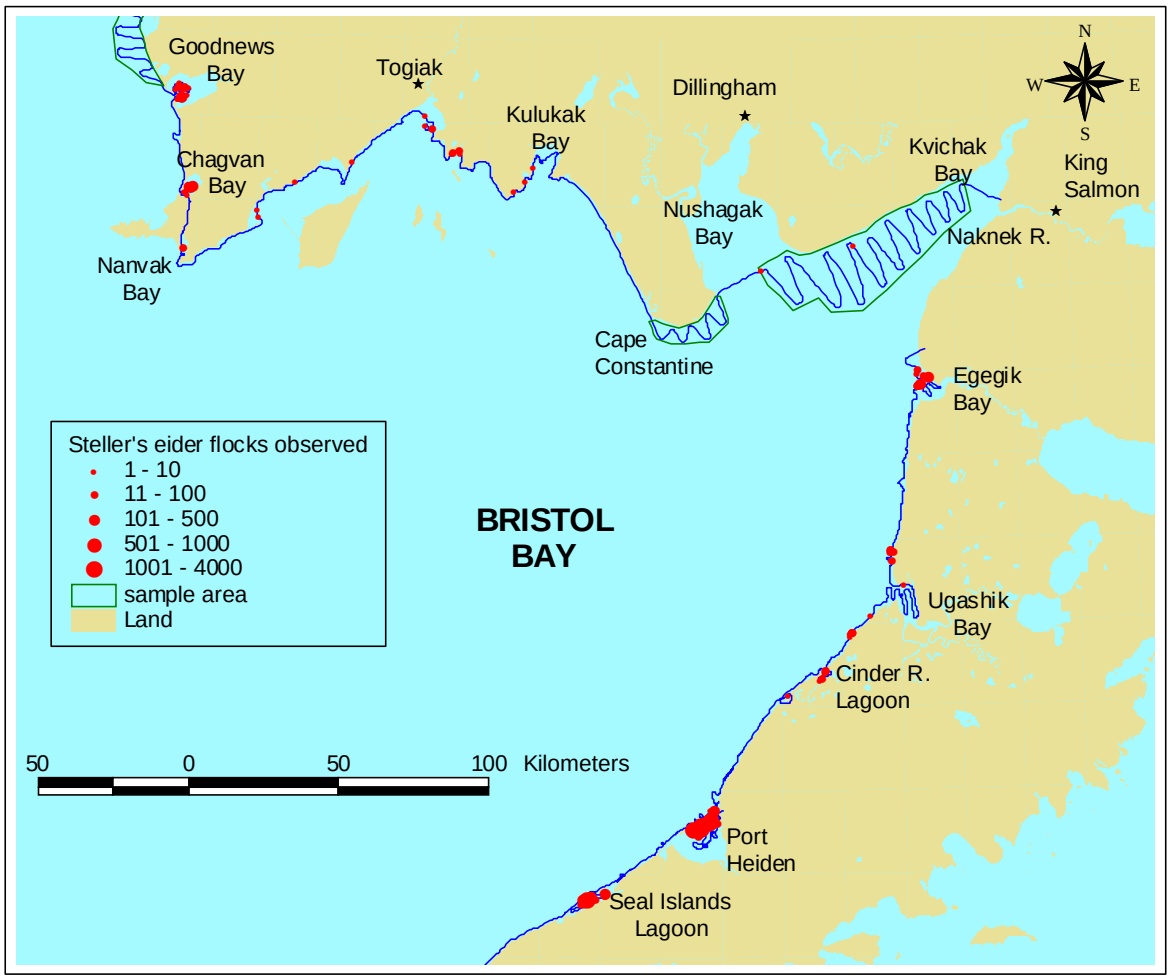

Figure 2b. Survey sample areas, flight lines, and Steller's eider flocks observed, Steller's eider spring migration survey, southwest Alaska, April 2007.

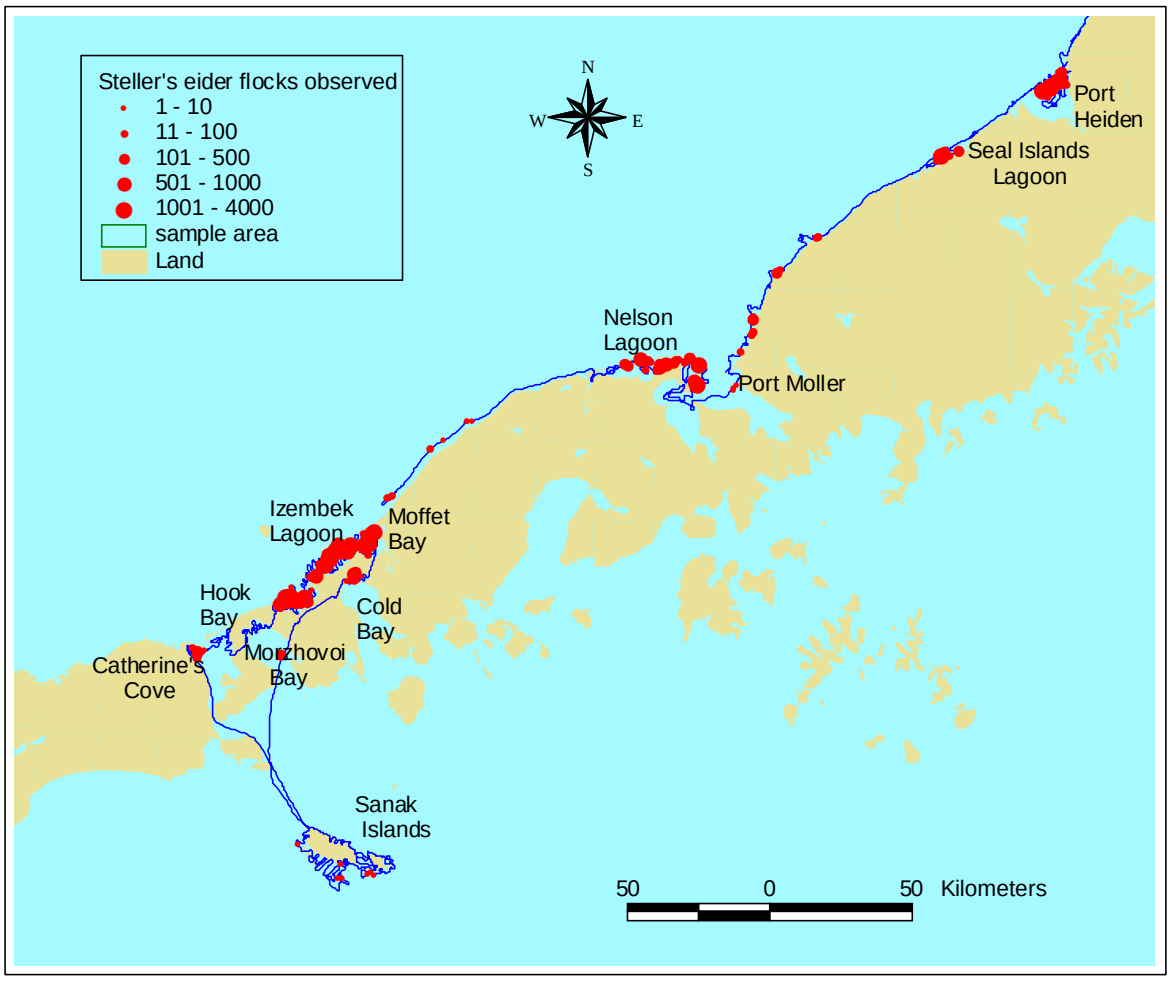

Figure 2c. Survey sample areas, flight lines, and Steller's eider flocks observed, Steller's eider spring migration survey, southwest Alaska, April 2007.

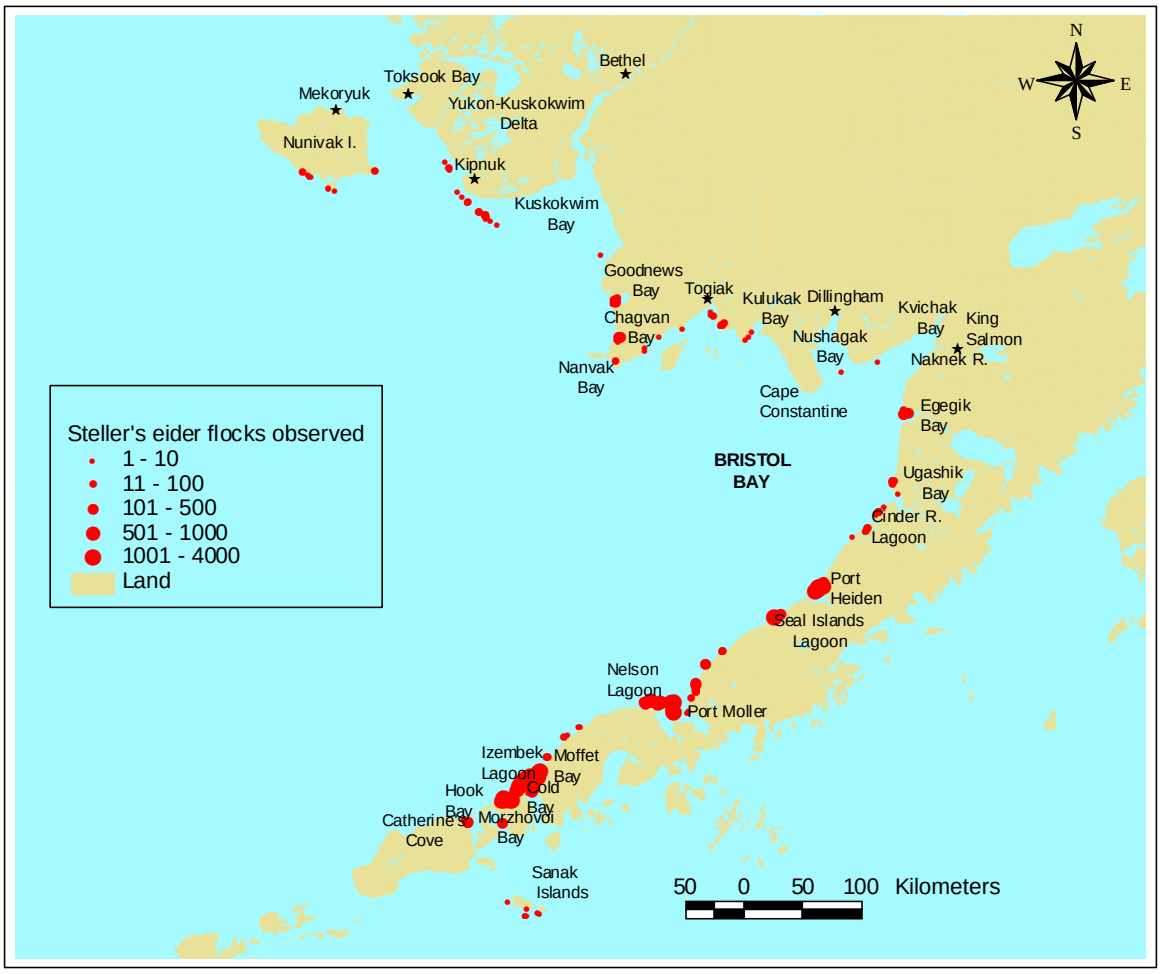

Figure 3. Location and relative sizes of Steller's eider flocks observed, Steller's eider spring migration survey, southwest Alaska, April 2007.

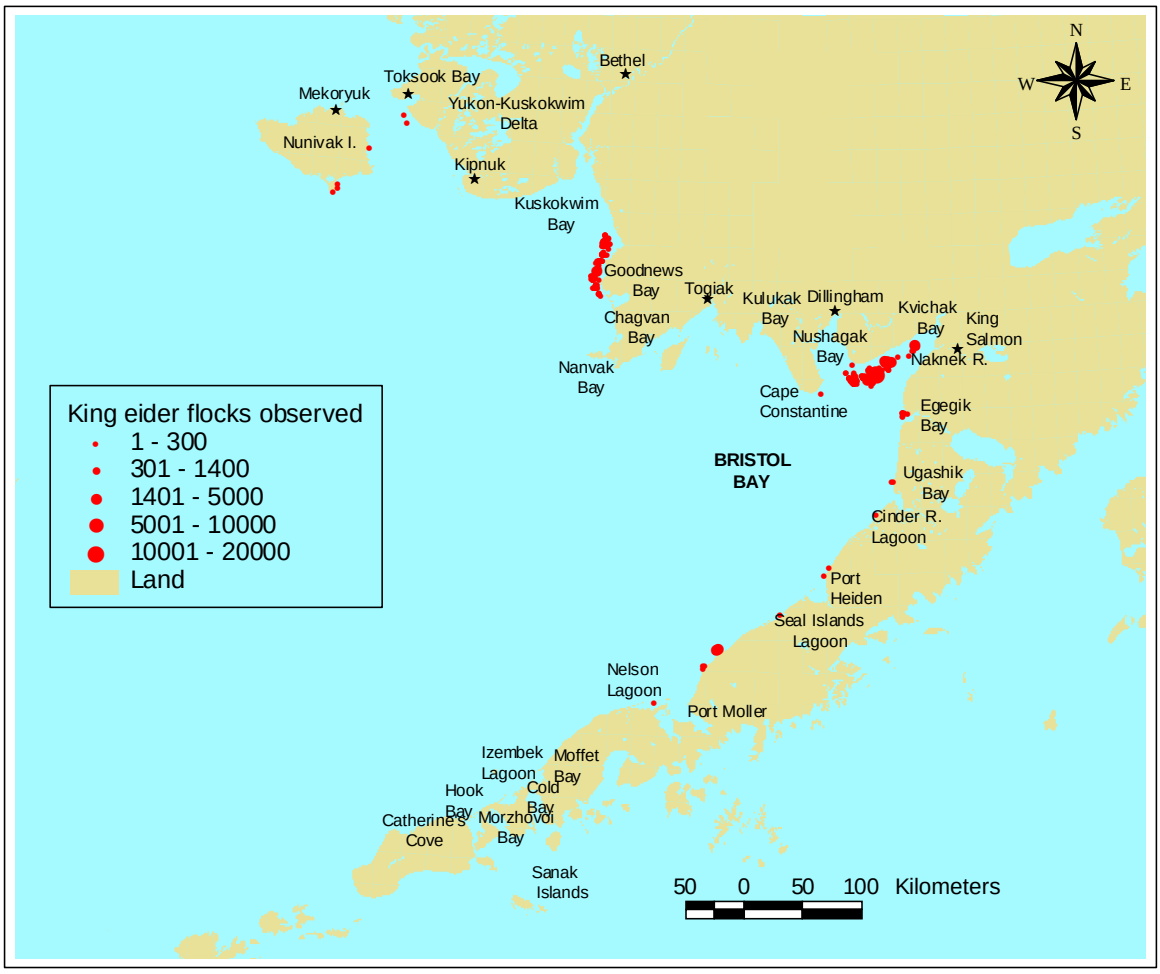

Figure 4. Location and relative sizes of king eider flocks observed during the Steller's eider spring migration survey, southwest Alaska, April 2007.

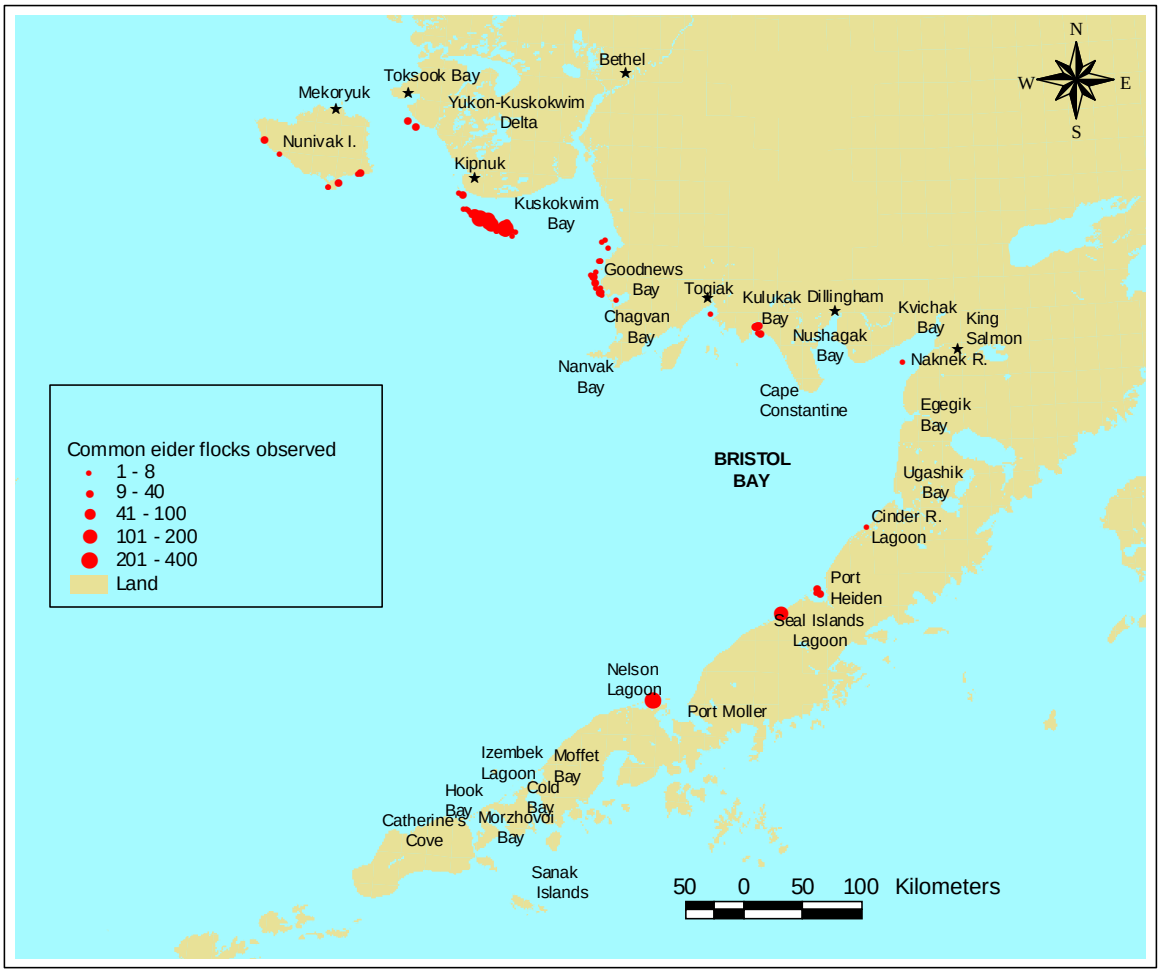

Figure 5. Location and relative sizes of common eider flocks observed during the Steller's eider spring migration survey, southwest Alaska, April 2007.

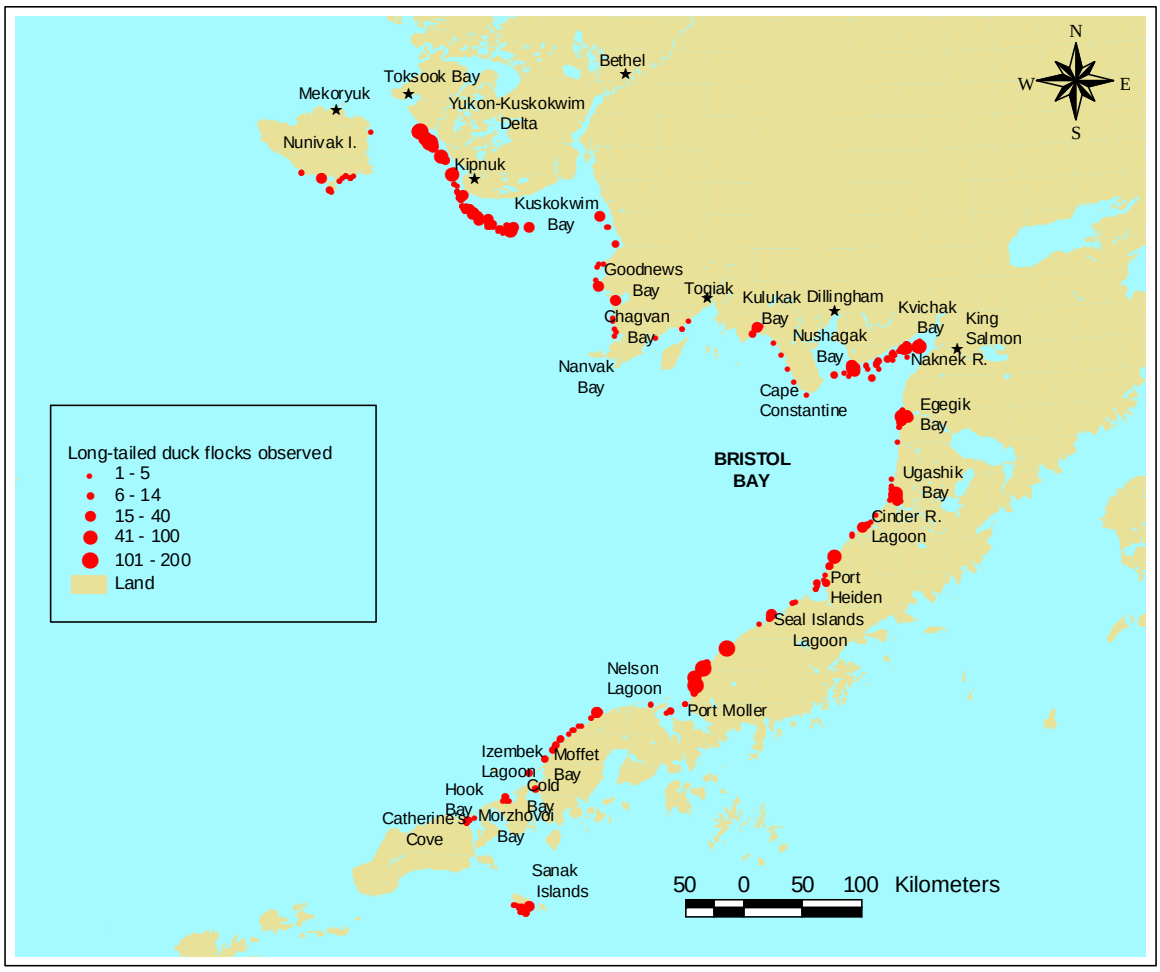

Figure 6. Location and relative sizes of long-tailed duck flocks observed during the Steller's eider spring migration survey, southwest Alaska, April 2007.

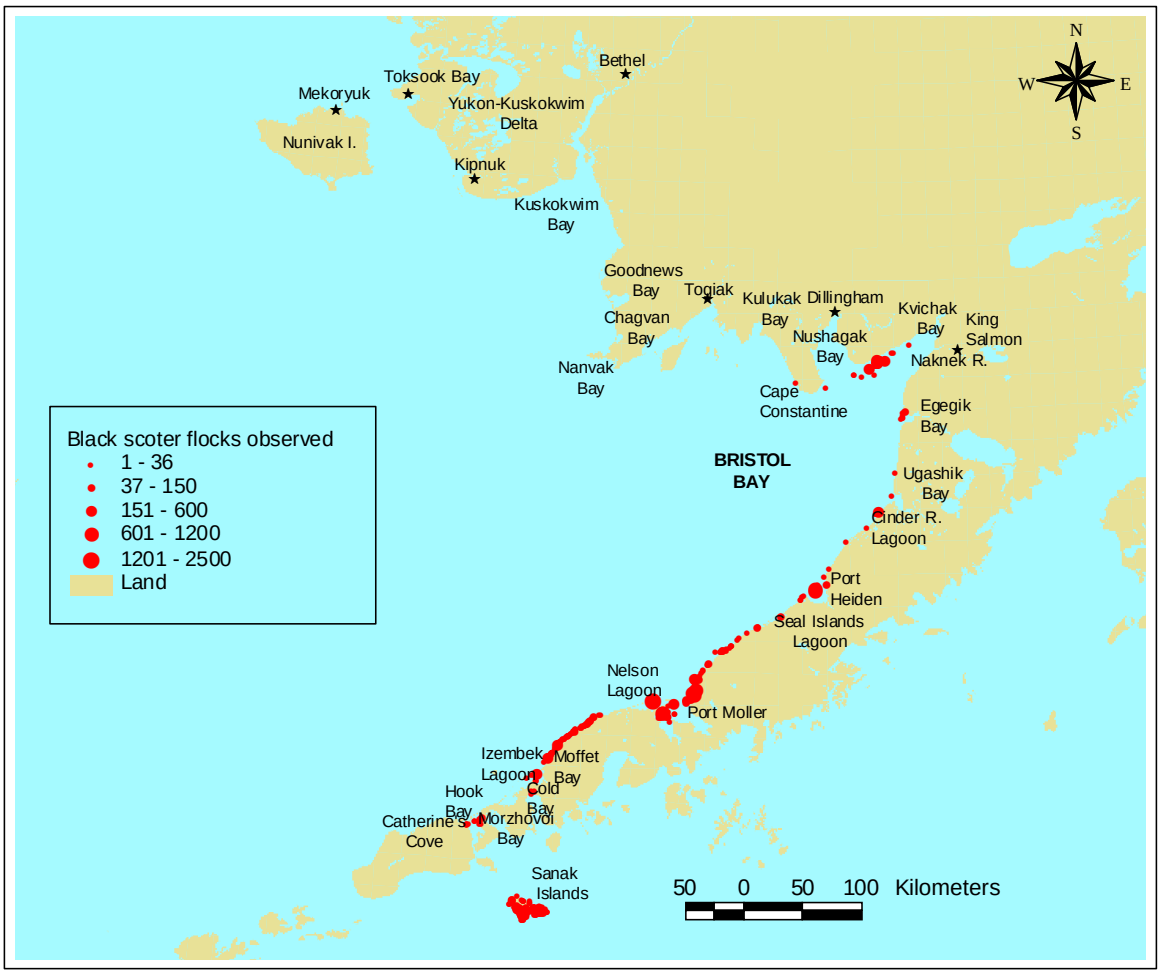

Figure 7. Location and relative sizes of black scoter flocks observed during the Steller's eider spring migration survey, southwest Alaska, April 2007.

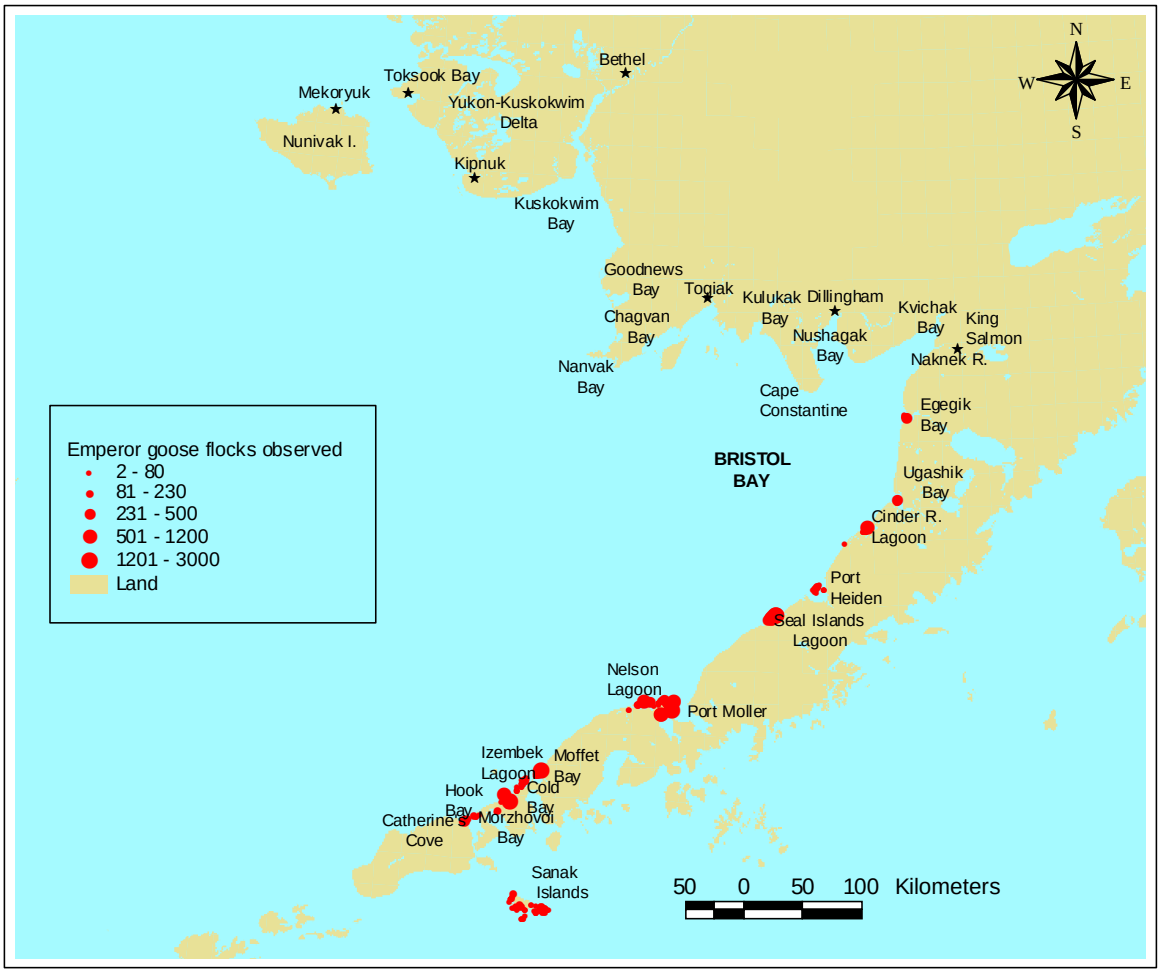

Figure 8. Location and relative sizes of emperor goose flocks observed during the Steller's eider spring migration survey, southwest Alaska, April 2007.

APPENDIX 1. Common and scientific names of species mentioned in the text and tables.

Common Name	Scientific Name
Birds:	
Red-necked grebe	*Podiceps grisegena*
Horned grebe	*Podiceps auritus*
Common loon	*Gavia immer*
Yellow-billed loon	*Gavia adamsii*
Pacific loon	*Gavia pacifica*
Red-throated loon	*Gavia stellata*
Pigeon guillemot	*Cepphus columba*
Unidentified murre	*Uria aalge, U. lomvia*
Arctic tern	*Sterna paradisaea*
Mew gull	*Larus canus*
Sabine's gull	*Xema sabini*
Black-legged kittiwake	*Rissa tridactyla*
Large gull	*Larus glaucescens, L. hyperboreus, L. argentatus, L. schistisagus*
Jaegers	*Stercorarius parasiticus, S. longicaudus*
Cormorant	*Phalacrocorax auritus, P. pelagicus, P. urile*
Common merganser	*Mergus merganser*
Red-breasted merganser	*Mergus serrator*
Mallard	*Anas platyrhynchos*
Gadwall	*Anas strepera*
American wigeon	*Anas americana*
Green-winged teal	*Anas crecca*
Northern shoveler	*Anas clypeata*
Northern pintail	*Anas acuta*
Canvasback	*Aythya valisineria*
Scaup	*Aythya marila, A. affinis*
Goldeneye	*Bucephala clangula, B. islandica*
Bufflehead	*Bucephala albeola*
Harlequin duck	*Histrionicus histrionicus*
Oldsquaw	*Clangula hyemalis*
Spectacled eider	*Somateria fischeri*
Common eider	*Somateria mollissima*
King eider	*Somateria spectabilis*
Steller's eider	*Polysticta stelleri*
Black scoter	*Melanitta nigra*
White-winged scoter	*Melanitta fusca*
Surf scoter	*Melanitta perspicillata*
Canada goose	*Branta canadensis*
Black brant	*Branta bernicla*
White-fronted goose	*Anser albifrons*

Emperor goose	*Chen canagica*
Tundra swan	*Cygnus columbianus*
Sandhill crane	*Grus canadensis*
Bald eagle	*Haliaeetus leucocephalus*
Common raven	*Corvus corax*

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*