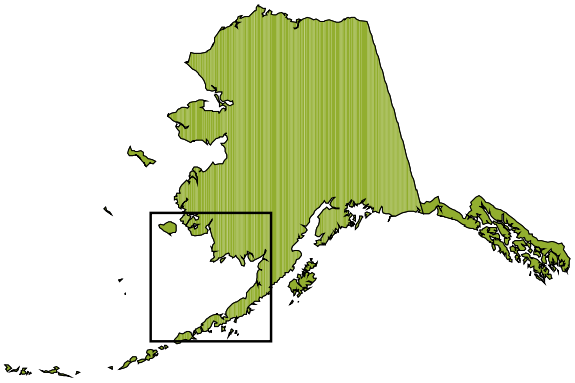
STELLER'S EIDER SPRING MIGRATION SURVEYS
SOUTHWEST ALASKA
2010



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Abstract. Annual spring aerial surveys were conducted most years from 1992 to 2010, to monitor the population status and habitat use of Steller's eiders (*Polysticta stelleri)* staging for spring migration in southwestern Alaska. Two to four replicates were conducted per survey year from 1992-1997, with the highest annual count used to target peak presence of eiders staging within the survey area prior to their departure to arctic nesting grounds, and as the annual point estimate for trend analysis. After 1997, budgets precluded replication in all but one year, and timing of the single annual surveys was based on satellite imagery of sea ice, reconnaissance data from local cooperators and data from telemetry studies. 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. Annual Steller's eider estimates ranged from 137,904 (1992) to 54,888 (2010), mean 73,904. The long-term trend indicates an exponential decline of 2.7 percent per year (R^2=0.43). We suspect a slight negative trend bias resulted from a higher frequency of optimally-timed counts in early years due to free selection from among survey replicates, compared to the single annual counts in subsequent years. There may also be a variable low-bias in most annual estimates due to inaccuracies in timing, observer effects and other uncontrolled variables. We present maps illustrating the 2010 survey flight path and observed distribution of Steller's eiders and other selected species. A persistent pattern of habitat use by Steller's eiders and most other sea duck species among years provides evidence of the relative importance among habitats to staging and migrating waterfowl. Other studies suggest that most of these favored sites are preferentially selected 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, Alaska.

INTRODUCTION

The majority of the world population of Steller's eiders migrates along the Bristol Bay coast of the Alaska Peninsula in the spring, where they linger en route to feed at the mouths of lagoons and other productive habitats. As Steller's eiders move north they cross Bristol Bay toward Cape Pierce, then continue northward along the Bering Sea coast. From there, 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). 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 2010 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, varying relative to tides, ice cover, bird distribution etc. Exposed shorelines were surveyed using a single track parallel to the coast within 1 km of the shoreline, with deviations for flocks sighted at greater distances offshore generally <2km. In other words, the survey flight path (Fig. 3) was left to the discretion of the pilot/primary observer, with the objective of being inclusive and comparable to previous years of this survey. Nearly all surveys to date have been piloted by pilot/biologist Bill Larned, but in cases where the survey is flown by a different pilot, recorded historic flight paths and important habitats are available for guidance and comparability of coverage.

For geographic reference, the shoreline was initially 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 been used only anecdotally rather than in quantitative analyses.

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 interpretation for other selected species is contained in Larned (1998).

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 2010. 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 2010 and some other prior years we deviated from the sampling procedure in Kvichak Bay (which contained most of the king eiders in the survey), as calm sea surface and excellent visibility conditions enabled us to visually detect and estimate most or all flocks. Differences among estimates from shoreline counts prior to 2000 vs. those from the "saw tooth" sampling procedure were not significant for Steller's eiders, as the extrapolated estimates of total observed birds of this species recorded within the sampled areas as a percentage of the survey total ranged from 0 percent (2005) to 7.5 percent (2000).

Survey timing is a critical component of this survey, the objective being to target the period during which all or most of the portion of the Pacific Steller's eider breeding population which migrates through and stages in coastal waters of southwestern Alaska is within the defined survey area between the western end of the Alaska Peninsula and Nunivak Island. The initial strategy was to bracket the assumed migration period with up to 3 or 4 replicate surveys per year and use the highest annual count as that year's Steller's eider estimate. However, due variously to funding shortages and extended periods of inclement weather, from 1998 to 2010 only one survey per year was flown, with the exception of 2008 when two surveys were conducted. Since 1998, optimal timing was estimated using a combination of National Weather Service sea ice data and near-real-time satellite imagery (NASA MODIS Rapid Response System) depicting sea ice coverage of favored staging habitats and migration routes, reconnaissance anecdotes from cooperators based throughout the survey area, and current weather data for wind patterns expected to discourage large northward migratory movements.

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 flock estimates by the primary observer may be biased low – 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 regularly obtain paired photo/visual counts to enable us to adjust 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.

For all survey years since the survey's inception in 1992, with the exception of 2009, the survey crew has consisted of Bill Larned as pilot and port observer, with various starboard observers (Table 3). 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.

RESULTS

Habitat and survey conditions

Spring in southwestern Alaska in 2010 was late and cold for the 4th consecutive year, though with less ice remaining in Bristol Bay and Alaska Peninsula lagoons than 2008 and 2009. Relevant satellite imagery downloaded from the NASA MODIS Rapid Response System (http://rapidfire.sci.gsfc.nasa.gov/) website was obscured by clouds for most of the first half of April, and therefore of little help with survey timing. However, partial views of the area revealed nearly 100 percent ice cover until April 18 for all Bering Sea areas north of Cape Newenham except for a large polynya covering most of the gulf of Anadyr. We delayed survey initiation until 18 April believing that the migration through the survey area was likely late due to this extensive sea ice in combination with cold temperatures and persistent northerly winds and storms. This year we did not survey the Nunivak Island segment due to contiguous ice cover detected in satellite imagery and weather exigencies. The absence of Steller's eiders in the nearby Kuskokwim Bay shoals segment suggested the Nunivak Island segment was likely devoid of eiders as well. We suspect that arrival of Steller's eiders and other sea ducks in high-quality preferred habitats in Izembek and other lower Alaska Peninsula lagoons correlates closely with ice dispersal from those areas. The few available satellite photos from the relevant time period with adequate coverage and cloud windows suggested extensive ice coverage in those lagoons through about 11 April. No April reconnaissance data were available to document ice dispersal or arrival of eiders in lower Alaska Peninsula lagoons. Scant cloud-free satellite imagery suggested most of the ice was gone from these areas by 18 April, however, during the survey we estimated 20 percent ice coverage remaining in Egegik and Ugashik Lagoons, 90 percent in Cinder River Sanctuary, 80 percent in Port Heiden, 60 percent in Seal Islands Lagoon, 20 percent in Nelson Lagoon, and 10-30 percent in Izembek Lagoons. This timing of habitat availability was chronologically later than most survey years on record.

Our recorded flight paths for the survey are displayed in Fig 3. The total flight time of 44.0 hrs. included transit flights to and from the survey area (Appendix 1).

Itinerary for 2008, survey 1:

4/8	3.1-hr flight to ferry survey aircraft Anchorage to Bethel. Returned via commercial air to Anchorage.
4/13	Survey crew returned to Bethel via airlines, overnight at FWS bunkhouse.
4/14-16	Grounded in Bethel due to fog and strong winds.
4/17	1.3-hr survey flight, Kuskokwim River mouth. Aborted due to fog in survey area.
4/18	3.5-hr. survey flight, Kuskokwim river mouth to Kipnuk area, overnight at Bethel.
4/19	6.4-hr survey flight Bethel to King Salmon. Overnight at King Salmon, FWS bunkhouse.
4/20	5.8-hr. survey flight, King Salmon to Cold Bay including AK Peninsula lagoons to Nelson Lagoon. Overnight at Cold Bay, FWS bunkhouse.
4/21	3.4-hr. survey flight, Izembek and other lagoons in the Cold Bay vicinity. Overnight King Salmon, FWS bunkhouse.
4/22	7.3-hr. ferry flight Cold Bay to Anchorage, with stops in King Salmon and Soldotna. End of survey.

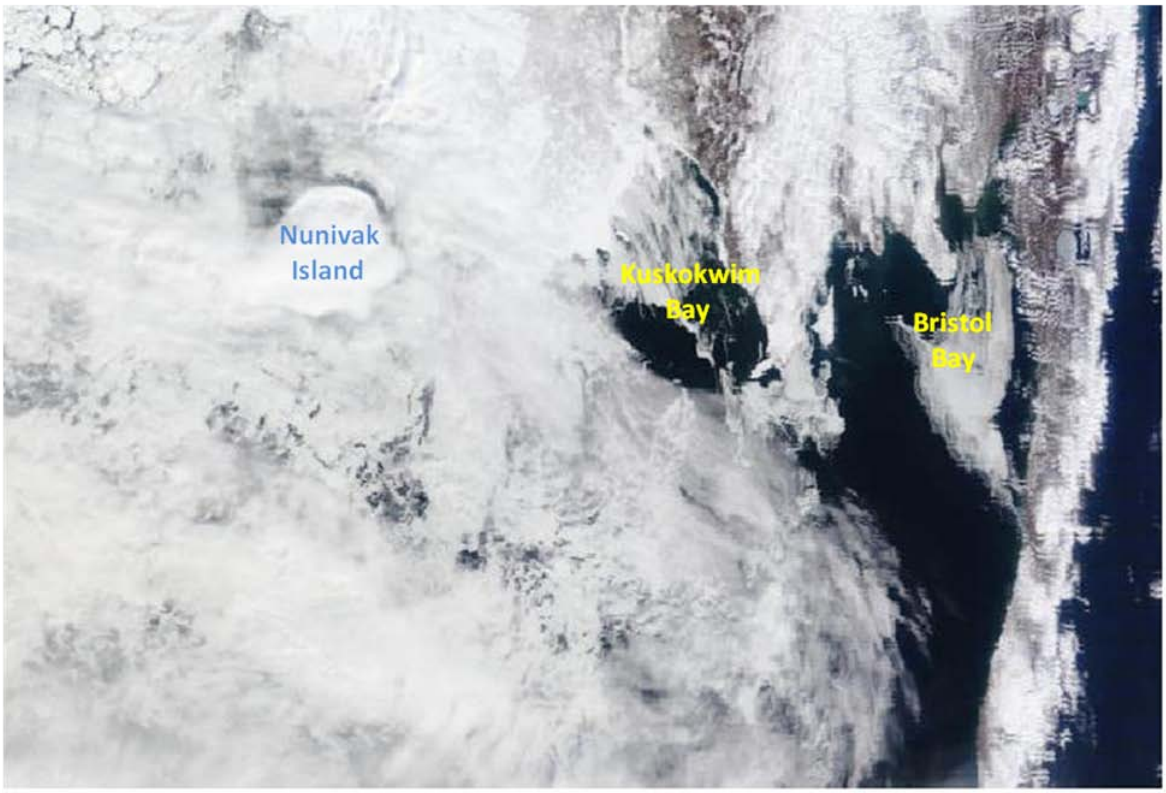

Figure 1. Satellite image of sea ice distribution, southwest Alaska, 18 April 2010. Images from http://rapidfire.sci.gsfc.nasa.gov/realtime/.

Steller's eider results

This year's Steller's eider estimate was 54,888, the lowest in the history of the survey (Table 2). Despite the calendar survey timing being about average (Table 2), Most Steller's eiders were recorded in the lower Alaska Peninsula lagoons (<2 percent were north of Port Heiden, Table 1, Fig. 3). The exponential trend line of our estimates resulted in a greater estimated decline relative to previous years for an average 2.7 percent decline per year (R^2=0.43, Fig. 2). Unfortunately, budget and a medical emergency precluded an additional survey, which was clearly advisable given the uncertainties about timing. Nor were we able to survey the Sanak Islands south of the Alaska Peninsula, which might have provided evidence of a significant portion of the population remaining south of the survey area, thus lowering the count. Reports of late departure of Steller's eiders from wintering habitats in Kodiak (D. Zwiefelhofer, pers. comm.) suggested later than average migration. Also, our survey observations revealed no flocks of predominately immature-plumaged eiders, which are known to linger in wintering areas compared to adults (Fredrickson 2001). This apparent absence of immature birds could mean either this cohort, perhaps along with some adults, had not yet arrived and thus were not counted, or alternately the 2009 breeding year had poor recruitment. It is interesting to note that the distribution pattern, and numbers, of Steller's eiders recorded during this survey were similar to those of the earlier

of two replicate surveys conducted in 2008 (Larned 2008), and that there were 10,000 additional eiders recorded in the second replicate completed that year.

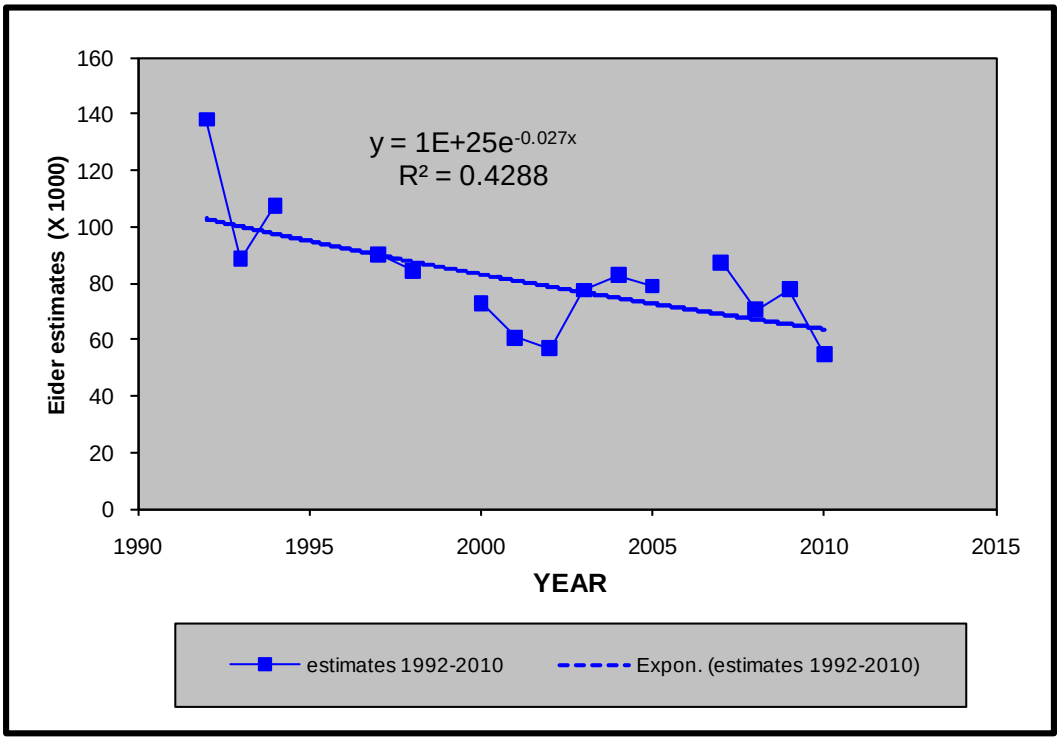

Fig. 2. Trend in Steller's eider estimates from aerial surveys, southwest Alaska, April and May, 1992-2010.

Other Waterfowl

While this survey was not designed to produce high-confidence estimates for species other than Steller's eiders, we have consistently recorded data on non-target sea ducks, geese and other waterbirds 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. Ninety-five percent of the 252,000 **king eiders** estimated during the survey were in their usual wintering/staging aggregations in upper Bristol Bay, while smaller numbers were along the coast in the lower Alaska Peninsula (Table 1, Fig. 4). This year's king eider tally was the third highest in the history of the survey (Table 2).

Our annual observations during this annual survey revealed **common eiders** as among the earliest sea duck migrants, often flying well offshore, and therefore likely underestimated on this relatively late, near-shore survey. The total common eider estimate from the 2010 survey is 2,325, the second lowest in the history of this survey (Table 2). Over one half were recorded migrating over the shoals in upper Kuskokwim Bay, while the rest were in Alaska Peninsula lagoons and various shoreline situations (Table 1, Fig. 5). The 2010 **long-tailed duck** total of 17,134 was slightly below average for the survey

(Table 2) -- roughly 71 percent were recorded in large feeding flocks in upper Bristol Bay (Table 1, Fig. 6). The rest were scattered widely throughout the survey route (Fig. 6), which is typical for this survey during April. The **Black scoter** survey total (33,108) was also below average (Table 2), with 79 percent still in the Port Moller/Nelson Lagoon complex on the lower Alaska Peninsula (Table 1, Fig. 7) – yet another observation consistent with a late spring. White-winged scoter estimates totaled less than 10 percent of average (Table 2), and most were recorded on the lower Alaska Peninsula (Table 1, Fig. 8). Also consistent with a late spring was the complete absence of brant and emperor geese north of the Alaska Peninsula during the survey (Table 1, Figs. 9, 10).

CONCLUSIONS AND RECOMMENDATIONS

Timing is unquestionably a critical component of this annual survey. Sub-optimal timing will nearly always result in a portion of the population not being counted, thus the estimate is expected to be biased low. For trend calculation we have used the highest annual estimate, which we assume to be the most optimally timed and therefore most inclusive. The first 4 years of the survey included 2 to 3 replicates, while only one of the subsequent 11 years (2008) included a replicate count (Table 3). In the absence of a high-confidence alternative method of determining optimal timing of the migration, optimal timing of the oldest subset of survey years was more likely than that of the most recent, and thus estimates of the former are likely to be higher than those of the latter. We feel it is likely this imbalance in the set of 15 survey-years within a 19-year span negatively biased the calculated trend. If this monitoring program is to be continued with a major objective of trend detection, we recommend either reinstating some form of comprehensive telemetry procedure where movements of eiders from various wintering habitats may be monitored, or completing two to three spring migration survey replicates per year, as was done initially.

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. Thanks also to Ted Swem and other members of the Steller's Eider Recovery Team for their continued support of this project.

LITERATURE CITED

Fredrickson, L. H. 2001. Steller's Eider (*Polysticta stelleri*), The Birds of North America Online (A. Poole, Ed.). Ithaca: Cornell Lab of Ornithology; retrieved from The Birds of North America Online: http://bna.birds.cornell.edu/bna/species/571.

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., 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.

Table 1. Seaduck and goose estimates for geographic aerial survey units, spring Steller's eider survey, southwest Alaska, April 18-21, 2010.

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
Toksook Bay to Kuskokwim R.	4/18	1:56	1.00	1,265				2,093			1	
Kuskokwim R. to Chagvan Bay [1]	4/19	1:49	7.35	140	9,055	492		933			96	
Goodnews Bay[2]	4/19	0:03	1.00			27						
Chagvan Bay[3]	4/19	0:03	1.00			22						
Nanvak Bay[4]	4/19	0:01	1.00									
Nanvak Bay to Togiak Village	4/19	1:00	1.00	131		1	2	205		3	13	
Togiak Vilage to Kulukak Bay	4/19	0:33	1.00	5				41		7		68
Kulukak Bay to Cape Constantine	4/19	0:32	1.00	200				38		36	1	
Cape Constantine	4/19	0:13	1.00		12,682			5		29		
Kvichak Bay	4/19	1:21	1.00		226,920			12,197		2,611		
Naknek River to Port Heiden	4/20	0:59	1.00	10		64		16		159	4	
Egegik Lagoon	4/20	0:15	1.00			95		23		365		15
Ugashik Lagoon	4/20	0:14	1.00							6		
Cinder River Sanctuary	4/20	0:02	1.00			250				20		2
Port Heiden	4/20	0:27	1.00			7,853		50		200		6
Port Heiden to Port Moller	4/20	1:02	1.00	103	1,505	1,200	93	257		9,000	210	
Seal Islands Lagoon	4/20	0:12	1.00			2,836		2				
Port Moller/Herendeen Bay	4/20	0:42	1.00	12		2,975		207		6,961	15	
Nelson Lagoon	4/20	0:32	1.00	400	1,200	9,969		16		10,302		
Nelson Lagoon to Izembek Lagoon	4/20	0:55	1.00		580	781		677		2,907		
Izembek Lagoons	4/21	1:57	1.00	53		27,051		195		418	15	23
Kinzerof Lagoon	4/21	0:11	1.00	6		1,067	20	10				42
Morzhovoi Bay Lagoons	4/21	0:15	1.00				2					116
Bechevin Bay	4/21	0:33	1.00			205	11	169		84	7	6
Totals				**2,325**	**251,942**	**54,888**	**128**	**17,134**	**0**	**33,108**	**362**	**278**

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 & 3.
2. Goodnews Bay 95+ percent ice-covered. 3. chagvan Bay 95+ percent ice-covered. 4. Nanvak Bay 100 percent ice-covered.

Table 1. Continued

Survey Unit	Date surveyed	Elapsed Time	Expansion Factor	Bufflehead	Mergansers	Black brant	Emperor goose
Toksook Bay to Kuskokwim R.	4/18	1:56	1.00				
Kuskokwim R. to Chagvan Bay [1]	4/19	1:49	7.35				
Goodnews Bay[2]	4/19	0:03	1.00				
Chagvan Bay[3]	4/19	0:03	1.00				
Nanvak Bay[4]	4/19	0:01	1.00				
Nanvak Bay to Togiak Village	4/19	1:00	1.00		21		
Togiak Vilage to Kulukak Bay	4/19	0:33	1.00		86		
Kulukak Bay to Cape Constantine	4/19	0:32	1.00		137		
Cape Constantine	4/19	0:13	1.00				
Kvichak Bay	4/19	1:21	1.00				
Naknek River to Port Heiden	4/20	0:59	1.00		119		8
Egegik Lagoon	4/20	0:15	1.00				16
Ugashik Lagoon	4/20	0:14	1.00				14
Cinder River Sanctuary	4/20	0:02	1.00				1,400
Port Heiden	4/20	0:27	1.00		12		45
Port Heiden to Port Moller	4/20	1:02	1.00		9		1,141
Seal Islands Lagoon	4/20	0:12	1.00				7,258
Port Moller/Herendeen Bay	4/20	0:42	1.00				6,740
Nelson Lagoon	4/20	0:32	1.00				17,107
Nelson Lagoon to Izembek Lagoon	4/20	0:55	1.00				716
Izembek Lagoons	4/21	1:57	1.00	2	72	40,846	3,643
Kinzerof Lagoon	4/21	0:11	1.00	4	65	97	178
Morzhovoi Bay Lagoons	4/21	0:15	1.00	42	43		6
Bechevin Bay	4/21	0:33	1.00	3	20	21	166
Totals				**51**	**584**	**40,964**	**38,438**

1. Estimates reported herein for this survey unit are expanded using a factor calculated as: area of survey unit/(transect length x transect width). Survey area extrapolated to is illustrated in figure 2.

2. Goodnews Bay 95+ percent ice-covered. 3. chagvan Bay 95+ percent ice-covered. 4. Nanvak Bay 100 percent ice-covered.

Table 2. Survey totals for all species, Spring Steller's eider surveys, southwest Alaska, 1992 to 2010. For survey years with replicate surveys (1992-1997, 2008), 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
Mergansers	2,103	1,176	2,766	670	1,395	214	211	648
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	4/24-29/2008	4/15-21/2009	4/18-21/2010	2000-09 avg
Birds:								
Pacific loon	7	0	0	0	12	0	0	3
Red-throated loon	2	0	1	1	4	3	8	36
Common loon	1	1	0	1	0	3	43	1
Yellow-billed loon	0	0	0	0	0	0	0	0
Unident. loon	4	10	8	57	26	9	3	31
Red-necked grebe	54	0	4	5	25	7	5	79
Horned grebe	0	0	0	3	0	0	0	1
Cormorants	217	33	1,110	966	283	252	133	484
Tundra swan	2	4	1	4	3	28	0	5
Canada goose	15	0	0	0	0	5	0	16
Brant	29,293	32,875	28,365	45,047	60,124	75,628	40,964	48,888
Gr. white-fronted goose	0	0	0	0	64	7	0	18
Emperor goose	35,288	53,614	30,681	37,501	37,794	17,394	38,438	36,628
Mallard	6	225	179	251	130	335	168	140
Gadwall	7	8	15	0	3	0	10	4
Northern pintail	1,250	1,875	3,528	2,126	4,438	1,963	470	2,010
Wigeons	10	85	25	145	15	113	95	44
Northern shoveler	0	0	0	0	2	0	0	1
Am. Green-winged teal	0	0	3	6	0	0	0	5
Canvasback	0	0	0	0	0	0	0	0
Scaups	3,557	3,310	5,618	3,832	1,749	1,865	1,750	2,716
Common eider	3,862	3,841	13,514	3,220	3332	5,934	2,325	5,674
King eider	109,627	195,841	146,512	575,376	285832	197,302	251,942	193,783
Spectacled eider	0	0	0	0	0	0	0	0
Steller's eider	**77,369**	**82,772**	**79,022**	**87,400**	**70,480**	**77,777**	**54,888**	73,904
Harlequin duck	176	381	378	1,774	341	1,230	128	671
Long-tailed duck	25,883	9,876	32,273	9,244	21,279	7,351	17,134	21,280
Surf scoter	13	8	0	52	6	25	0	28
Black scoter	42,698	16,980	48,040	49,392	41,223	27,910	33,108	38,291
White-winged scoter	818	102	10,623	995	3,787	1,847	362	3,751
Unident. scoter	4	32	1,400	0	8,000	15	0	1,490
Goldeneyes	610	1,175	1,079	848	255	29	278	524
Bufflehead	29	22	8	123	2	119	51	34
Mergansers	947	383	1793	2156	962	1022	584	926
Bald eagle	16	32	53	145	63	67	16	48
Sandhill crane	0	0	0	0	0	0	2	0
Shorebirds	770	842	2,900	4,842	10,305	10,014	13,827	5,487
Gulls	16,356	13,927	999	20,701	21,226	10,102	14,926	12,908
Black-legged kittiwake	710	200	756	168	3,600	1,502	2,606	2,320
Guillemots	0	0	0	56	0	7	5	7
Marine mammals:								
Sea otter	1,090	1,414	1,917	266	1,629	918	1,573	1,001
Pacific walrus	1	0	1	1	0	0	14	13
Seal	1,076	1,283	978	756	620	203	101	1,240
Steller's sea lion	1	0	22	9	38	40	30	19
Harbor porpoise	0	0	0	0	0	1	0	2
Belukha whale	0	2	34	0	0	0	3	11
Orca whale	0	0	0	0	0	0	0	
Humpback whale	0	0	0	0	0	11	0	
Gray whale	38	39	20	23	26	8	75	26

Table 3. Inclusive dates, flight hours, and personnel, Steller's eider spring aerial migration surveys, southwest Alaska, 1992-2010.

	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			
2009	4/15-20	44.0	**W Larned, K Bollinger,** S Savage						
2010	4/18-21	30.8	**W Larned**, K Bollinger						

* Pilot/port observer in bold print

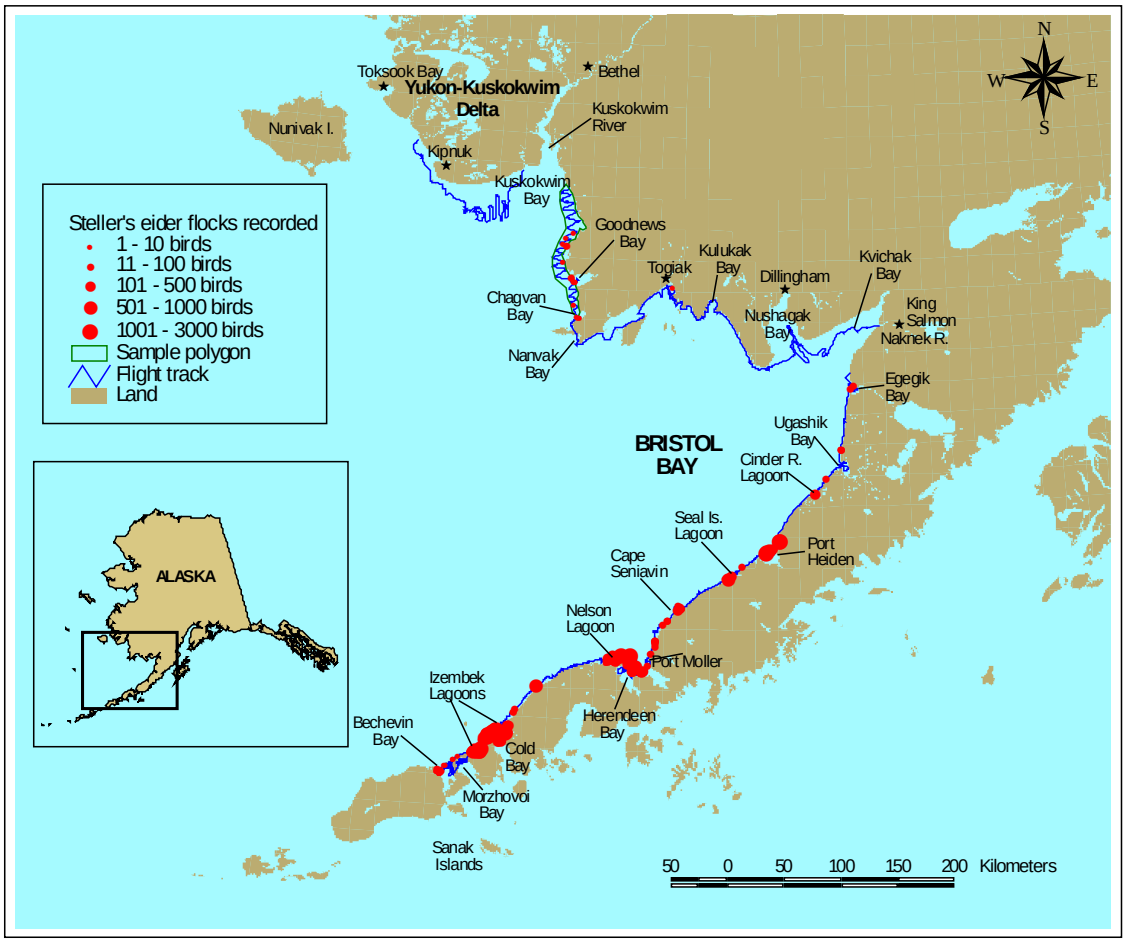

Figure 3. Survey sample areas, flight lines, and Steller's eider flock locations and relative size, Steller's eider spring migration survey, 18-21 April 2010.

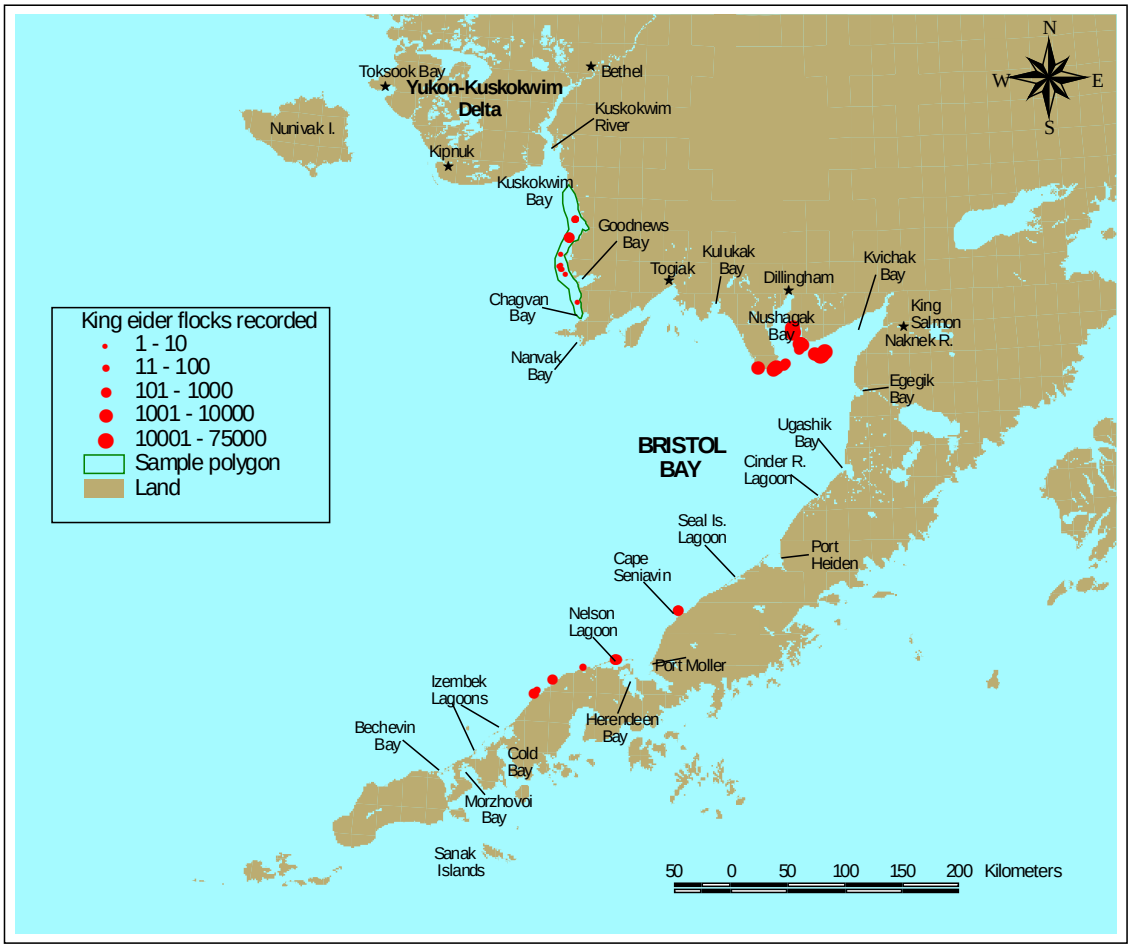

Figure 4. Location and relative size of king eider flocks recorded during Steller's eiders migration surveys, southwest Alaska, 18-21 April 2010.

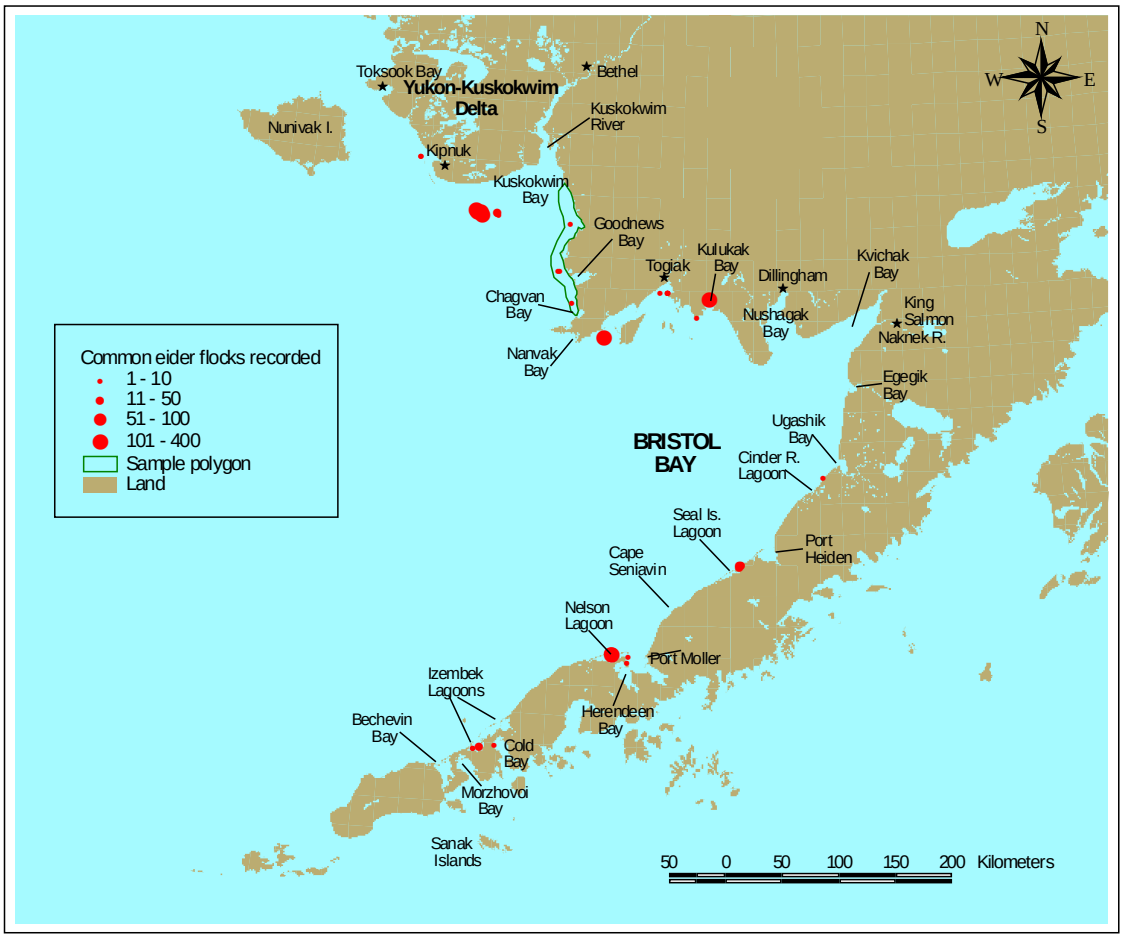

Figure 5. Location and relative size of common eider flocks recorded during Steller's eiders migration surveys, southwest Alaska, 18-21 April 2010.

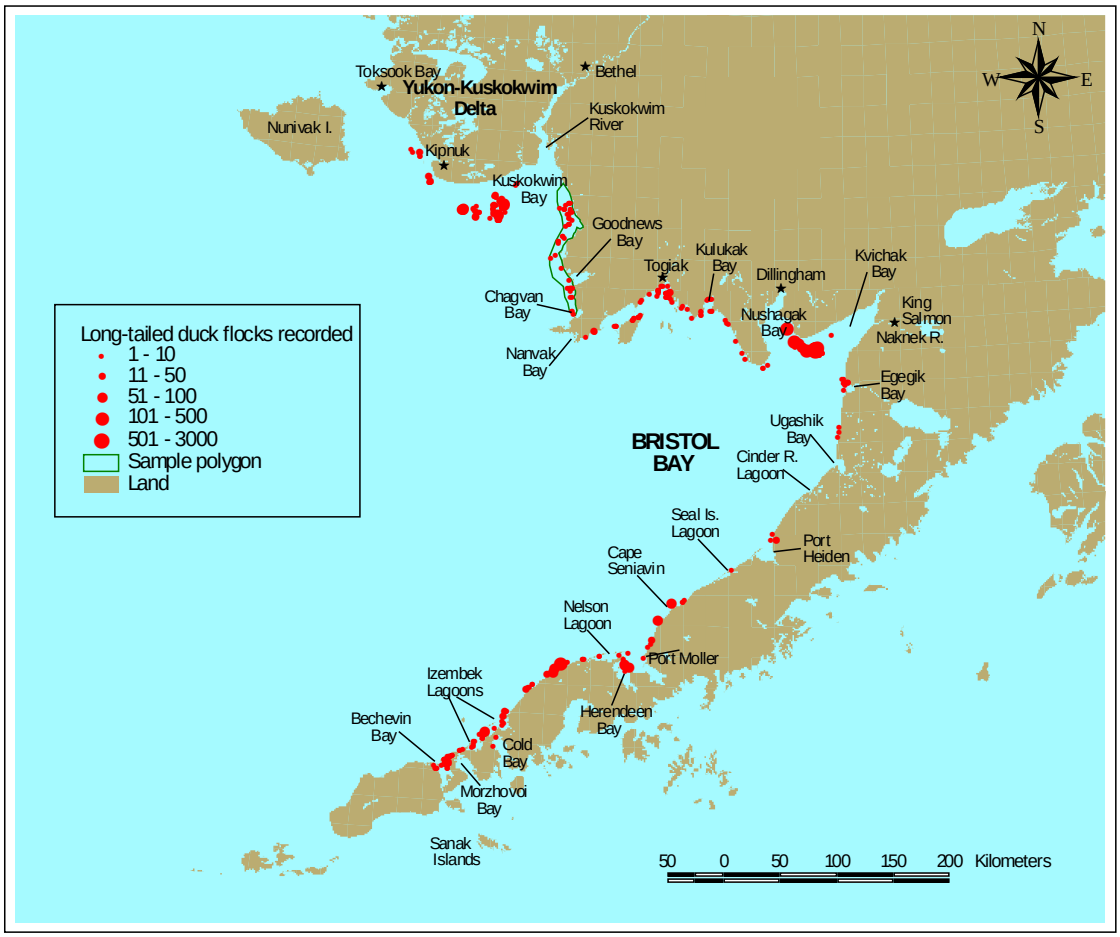

Figure 6. Location and relative size of long-tailed duck flocks recorded during Steller's eiders migration surveys, 18-21 April 2010.

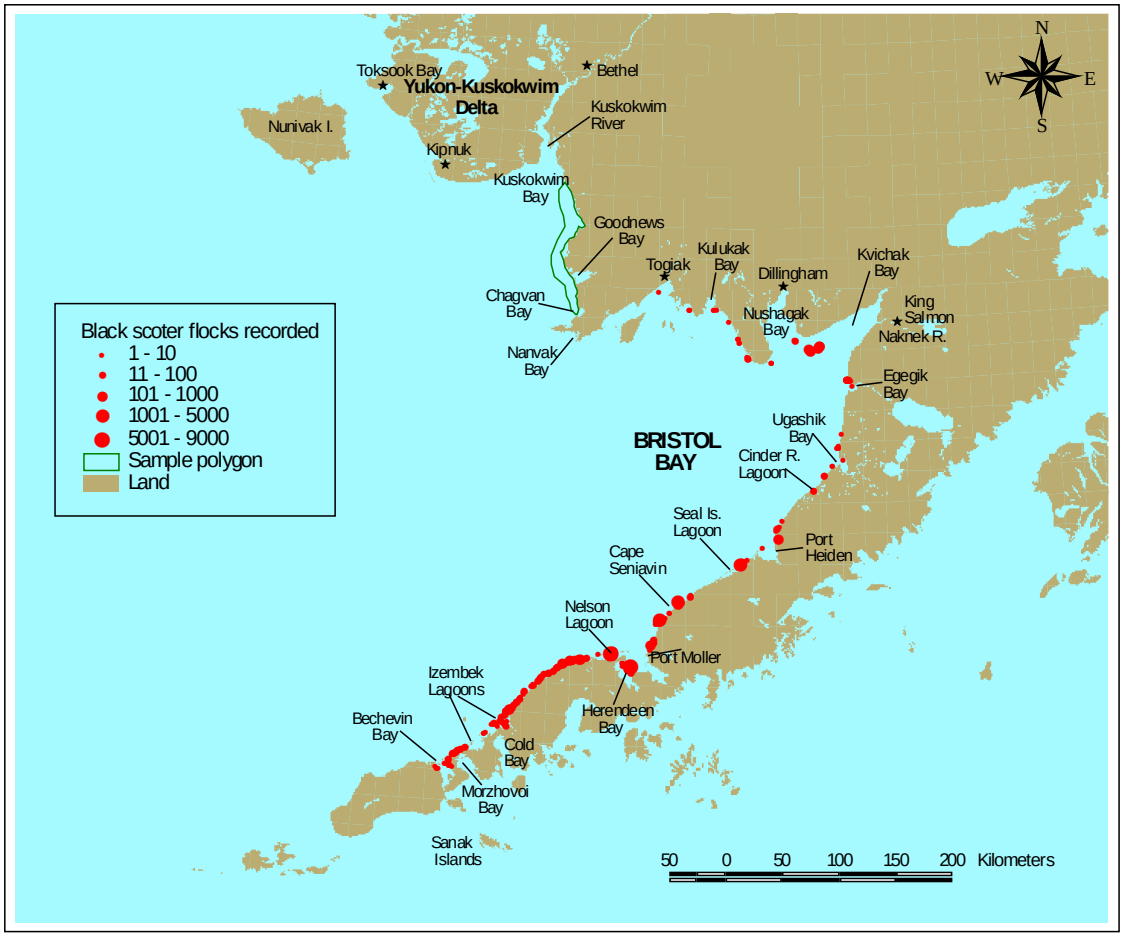

Figure 7. Location and relative size of black scoter flocks recorded during Steller's eiders migration surveys, southwest Alaska, 18-21 April 2010.

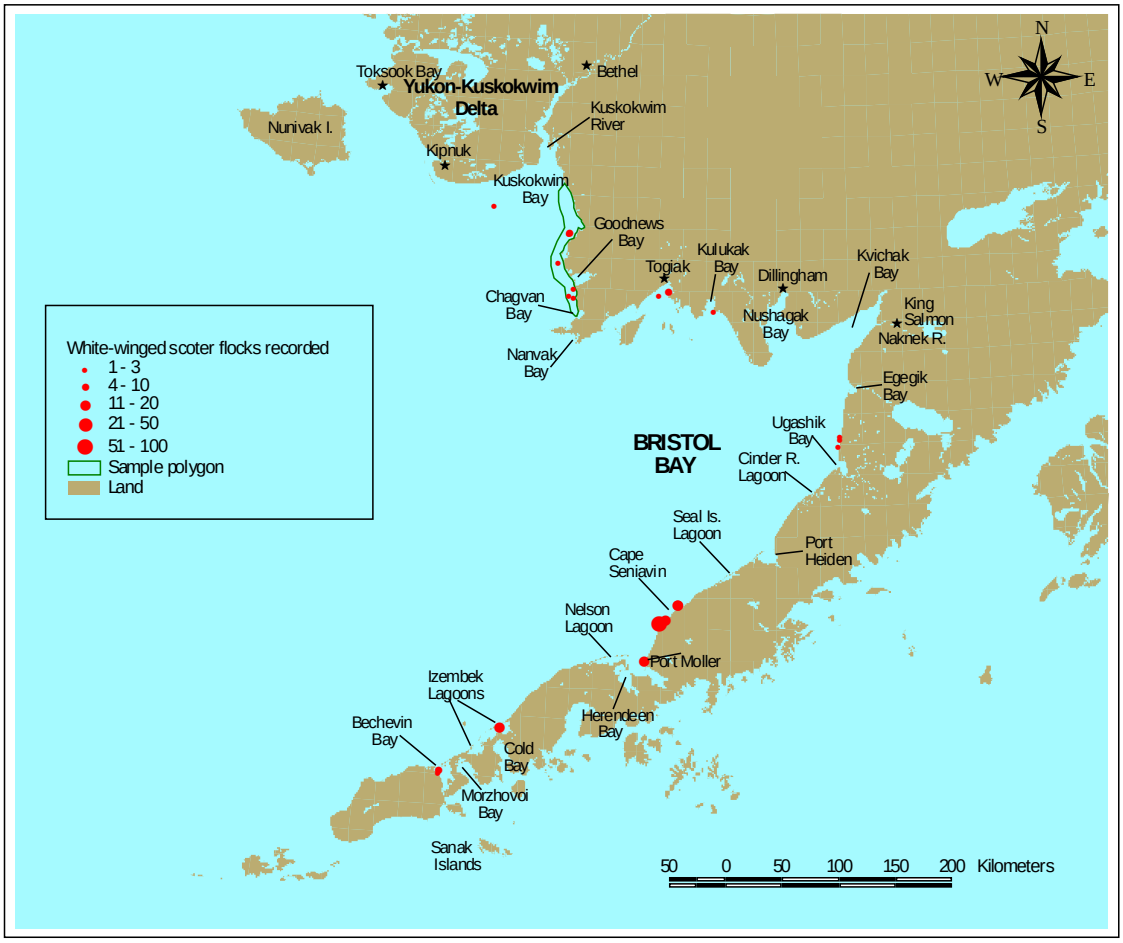

Figure 8. Location and relative size of white-winged scoter flocks recorded during Steller's eiders migration surveys, southwest Alaska, 18-21 April 2010.

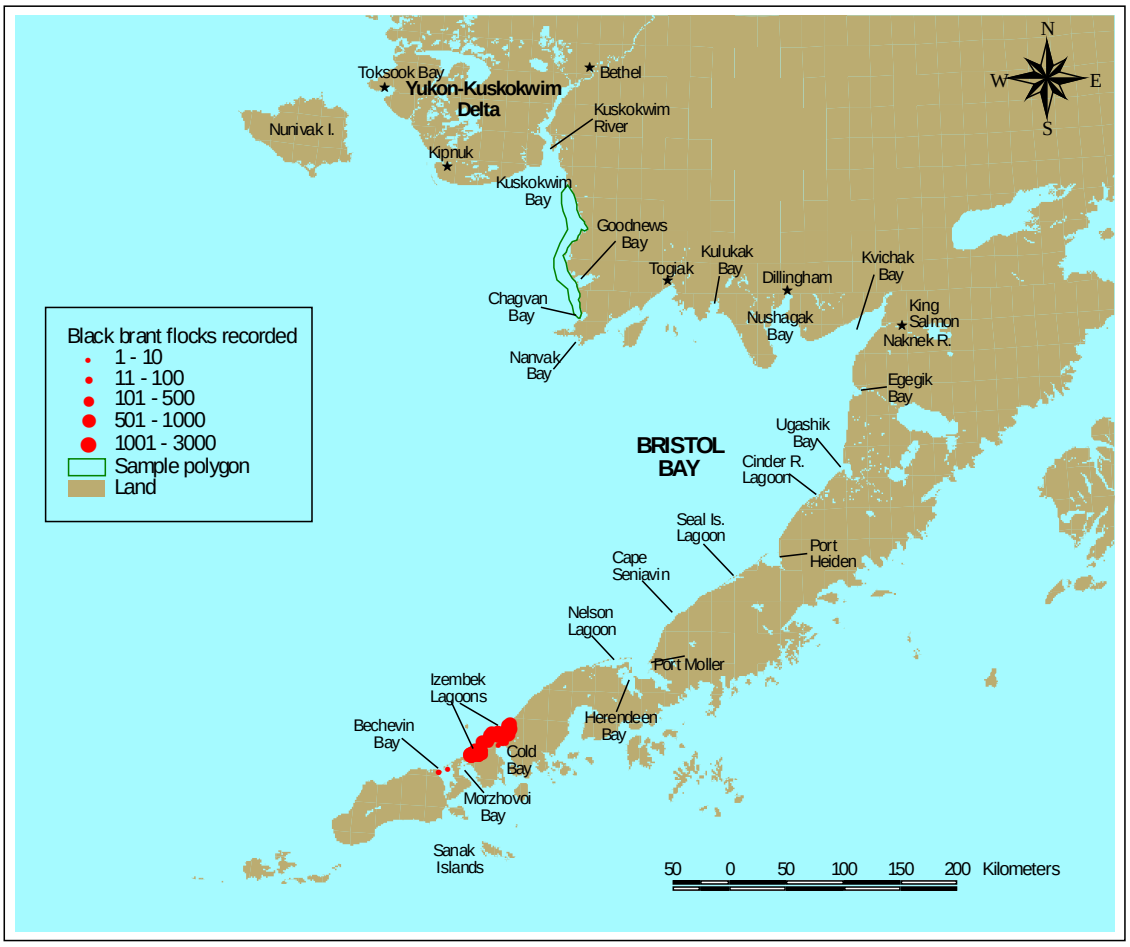

Figure 9. Location and relative size of black brant flocks recorded during Steller's eiders migration surveys, southwest Alaska, 18-21 April 2010.

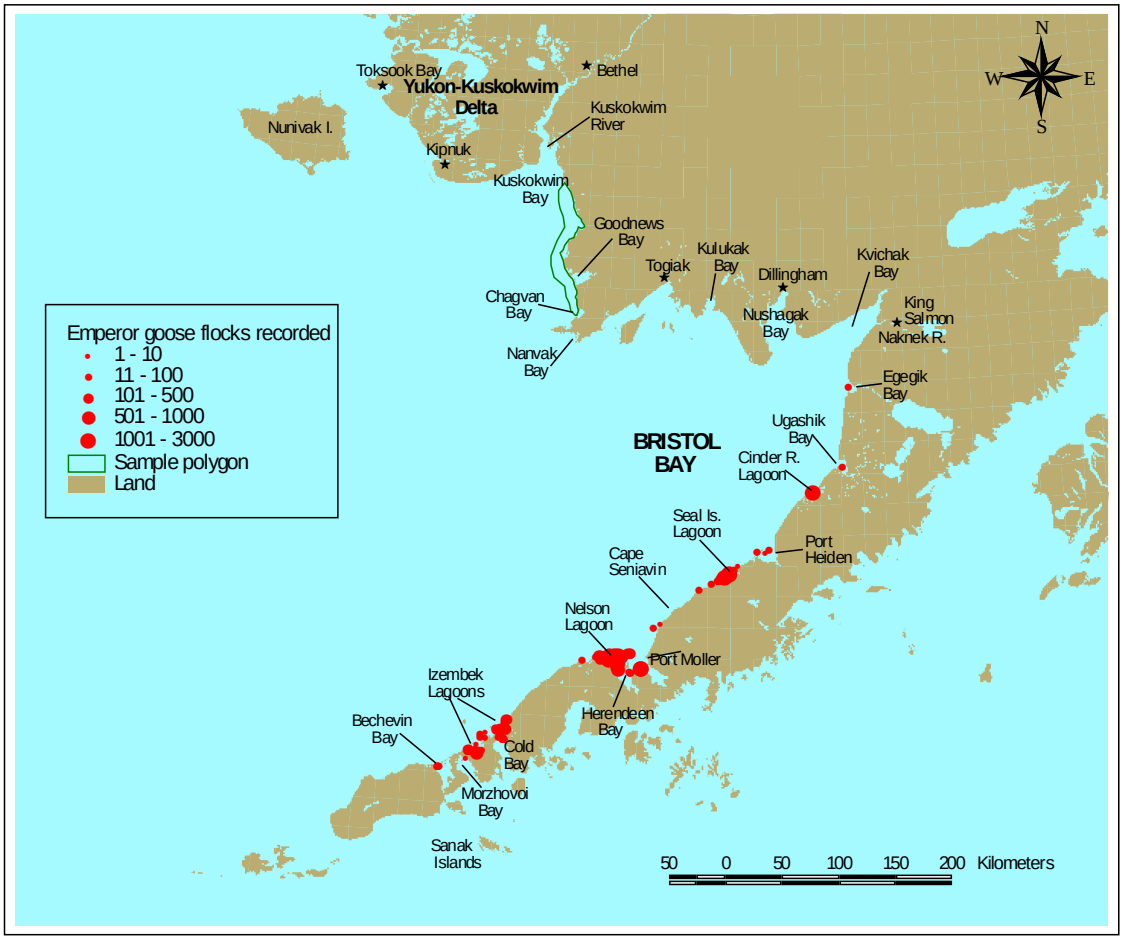

Figure 10. Location and relative size of emperor goose flocks recorded during Steller's eiders migration surveys, southwest Alaska, 18-21 April 2010

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*