LATE WINTER POPULATION AND DISTRIBUTION OF SPECTACLED EIDERS (*Somateria fischeri*) IN THE BERING SEA 1996-97

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Abstract.
We conducted aerial surveys in March of 1996 and 1997 to further refine our estimates of what we suspected was most or all of the world's population of spectacled eiders (*Somateria fischeri*), wintering together in the northern Bering Sea. We first flew an adaptive search over the wintering area, using previous survey data and recent satellite telemetry locations as a guide. Then, using the resulting reconnaissance data, we designed and flew a systematic grid to obtain visual estimates and oblique aerial photographs of all flocks of spectacled eiders and other waterbirds. We later combined hand counts from aerial photos with visual estimates to produce a population estimate. In March 1996 we located a large concentration of spectacled eiders 120 km northwest of the observed distribution from the March and April, 1995 surveys. Widely dispersed ice and birds precluded a photo census, but we made a low-confidence visual estimate of 226,810 spectacled eiders. In March 1997 we located spectacled eiders concentrated in small openings in nearly continuous sea ice overlapping the south portion of the 1996 observed distribution. We obtained complete photographic coverage of 18 of 19 flocks observed, which we felt represented all of the birds in the vicinity. The total estimate from the 18 photographed flocks was 363,030 (95%CI 333,526 to 392,532), and the visual estimate for the unphotographed flock was 900 birds. This more than doubles the previous world estimate for the species, but lack of historical perspective dictates caution in interpretation. Periodic repeats of this survey are recommended due to concern for genetically distinct Alaska breeding populations and as an indicator of the health of the Bering Sea ecosystem.

Key Words: waterfowl, spectacled, eider, *Somateria fischeri*, aerial, survey, Bering Sea, Alaska

INTRODUCTION

Prior to 1993, the location and characteristics of habitats used by spectacled eiders (*Somateria fischeri*) outside of the breeding season were largely unknown. From 1993 through 1995 we conducted aerial surveys of known or suspected molting and wintering areas, in an effort to evaluate the relative importance of these habitats(Larned and McCaffery 1993, Larned et al. 1995a, b, c, d). The systematic searches were initially based on location data from a telemetry study, in which satellite transmitters were surgically implanted into spectacled eiders on breeding grounds in Alaska and arctic Russia, and followed via ARGOS data for several months (Petersen et al. 1995). Interpretation of these survey and telemetry data led us to speculate that a major portion, if not the entire global population of this species wintered together in openings of the sea ice south of St. Lawrence Island. If we were correct, this fortuitous phenomenon provided a unique opportunity for periodic total counts of the world population of this species of concern. Therefore, having doubts that the 1995 count of 148,059 (95%CI =137,136-158,982) represented the total wintering population, we conducted additional aerial surveys in March of 1996 and 1997. This paper reports the results of the latter two efforts.

METHODS

The surveys were simple adaptive censuses, similar to those conducted in March and April of 1995 (Larned et al. 1995b). The survey crew in 1996 consisted of pilot Douglas Burts, forward right observer and photographer Bill Larned, and left rear observer Bill Eldridge. In 1997 the crew was the same except that Tim Tiplady replaced Bill Eldridge as left rear observer. We used a chartered Aero-Commander Model AC-500 high-winged twin-engine aircraft which we flew at 222 km/hr (120 kts) and 123-246 m (400-800 ft) altitude. This aircraft is equipped with a removable 60-U.S. gallon auxiliary fuel tank in the baggage compartment, for extended range on long offshore flights. Observations were made as far out from the aircraft as we could detect flocks, a distance which varied from about 2 to 10 km depending on flock densities, water surface conditions, presence of sun glare, and atmospheric conditions. During both surveys we strayed freely from the survey lines to closely examine each open lead visible from the flight path, resulting in complete coverage of open water within the systematic search grids. In 1997 we used image-stabilized 12X36 binoculars to examine distant open leads for the presence of birds. This effectively doubled our efficiency by enabling us to double the distance between search grid transects, and still see all flocks in the leads for complete coverage. When a flock was detected by either observer, the aircraft was maneuvered to put the birds on the starboard side. The photographer took photos obliquely through the open window, while the rear observer shifted over to the starboard side to make a visual estimate, which was recorded into a cassette tape recorder.

Our primary navigation instrument was an ARNAV Star 5000 GPS with a grid-plotting feature which automated laying out and navigating a search grid. We recorded the flight path using a GPS data-logging program called GPSTRAK8 (Anthony and Stehn 1994). The output file contained position coordinates logged at 3- or 4-second intervals, and the current time for each position, from the computer clock. Coordinates for each observation of eiders were obtained indirectly by recording the exact time of the observation, from a watch synchronized with the computer clock, into audio tapes. The observations were then entered into the track file by matching corresponding times. We then mapped flight paths and locations of observations using Atlas GIS software.

We photographed eider flocks using a 35 mm camera with motor drive and 28-105 mm variable focal length lens, with 200 ISO color slide film. The camera was equipped with a data imprinting system which was set to record the date and time of each photograph, allowing us to match each photograph with a location from the recorded flight path. To count birds in photographs, we projected the color transparencies onto 27 inch X 34 inch white paper ("flip charts") using a standard slide projector with zoom lens and remote control. We drew a grid of parallel lines through each flock, and counted birds between the lines using a hand tally counter. To avoid double-counting areas of overlap between slides in multi-frame sequences we either marked directly on the slides using a fine permanent marker, or projected adjacent slides simultaneously using two projectors and drew match lines on the projected images. Total birds were counted in flocks photographed in flight. However, in sitting and swimming flocks, only birds showing white (adult or subadult male) plumage were counted, because the dark plumage of females and first-year males was difficult or impossible to see against the dark water on many slides. A subsample of images that were sharp and clear enough to show all of both brown and white birds was selected and used to generate a ratio from which to correct the male-only counts to obtain an estimate of total birds. The variance of this ratio was calculated using the formula presented in Cochran (1963) for cluster sampling for proportions, with each slide as the sampling unit.

We based the survey flights in Mekoryuk in 1996 and Emmonak in 1997. Flight hours included 31.2 in 1996 and 19.0 in 1997.

NARRATIVE

1996 SURVEY This year was quite different from 1995 in two ways. First, the most recent satellite location data was from December, when there had been little or no sea ice south of St. Lawrence Island, compared to the February location we had in 1995. Secondly, the winter of 1996 was unusually mild with storms with strong, predominately southerly winds, resulting in discontinuous, mobile, fragmented sea ice, compared with the cold, relatively stable late winter conditions of 1995 with nearly continuous ice far south of St. Lawrence Island. With these differences in mind, we spent our entire first survey flight of 3/22 systematically searching the vicinity of the 1995 flock locations (Fig. 1), and finding murres and a few other sea birds, but no spectacled eiders. On 3/23 we began by searching the polynya along the south side of St. Lawrence Island (Fig. 1), where we had encountered numerous flocks of spectacled eiders in November of 1994 (Larned et al. 1995d). The polynya contained a lot of open water, but we found only scattered flocks of common and king eiders, oldsquaw, glaucous gulls, and common murres. Then, after a rest stop at Gambell, we used our remaining flight time to briefly search the vicinity of the December satellite telemetry "hits", and found several flocks of spectacled eiders spread out in large openings in fragmented sea ice. After two days of stormy weather, we conducted a systematic survey of the latter area (Fig. 2), and found numerous spectacled eiders in a loose distribution measuring 60 x 43 km. Using the survey technique described above, Eldridge estimated each flock while Larned took oblique aerial photos. Unfortunately, many of the larger eider flocks were interconnected and spread out in large expanses of open water among ice fragments, making both techniques difficult and tedious. We were not able to get enough useable photographic mosaics of the larger flocks to be able to develop a total photo estimate, so we obtained only a visual estimate in which we had little confidence. This experience convinced us of the desirability of conducting this census during periods of extensive and stable ice conditions when birds would be confined to a few small openings.

1997 Survey The winter of 1996-97 was slightly warmer than normal, but without the violent storms of 1995-96. By March the sea ice south of St. Lawrence Island was much thinner and with more abundant open leads than in 1995, but vastly more extensive and stable than that of 1996. In early March the ice extended southward well beyond St. Matthew Island and nearly to St. Paul Island in the Pribilofs. Nearly all of the Alaska Science Center's satellite transmitters failed by late November (M. Petersen, unpubl. data), and the last locations that month were clustered in two general areas: immediately south of St. Lawrence Island in a pattern similar to what we found during our survey in November of 1994 (Larned et al. 1995d), and southwest of the island centered at the south end of but overlapping considerably with the distribution of flocks from our survey of March 1996. There were also 2 "hits" from a single bird transmitter on 10 January, also at the south end of this latter distribution. We conducted a reconnaissance flight on 7 March, first looking briefly at the area closest to the island, which had few openings in the ice and no obvious flocks of spectacled eiders, then flying a loose search grid over the second area. The grid (Fig. 3) encompassed the distributions of the flocks observed during the 1996 aerial survey and the recent satellite telemetry locations. We located several flocks of eiders in the southwestern portion of the survey grid. Then on 8 March we returned to fly a second grid (Fig. 4) centered around the locations of flocks seen the day before, but continuing well beyond them to ensure that we had not missed any flocks. On both of these surveys we used the image-stabilized binoculars to remotely examine distant open leads for eider flocks, greatly enhancing our efficiency. Conditions were excellent for detecting and photographing the birds. Then the crew flew back to the staging location at Emmonak, dropping Larned at Gambell, SLI, on the way, and returned to Anchorage. On the following day Larned accompanied a BBC film crew back to the site by helicopter, to obtain film footage of the eiders and to land on the ice for fecal samples.

RESULTS AND CONCLUSIONS

Total visual estimates from the March 1996 survey were:

Spectacled eider	226,810	(n=115 observations)
King eider	311	
Common eider	3,862	
Common Murre	3,792	
Glaucous Gull	185	

The spectacled eiders were generally more scattered and less densely flocked than in 1995, which was expected due to the more open conditions (approximately 60% open water in the vicinity of the birds). Within the large flocks we noted very dense clusters of up to several hundred birds. Also, we found several flocks densely packed into small openings in the ice as close as 1 km from continuous open water, and there were many birds loafing on the ice throughout the search area.

On 8 March 1997 we observed 19 flocks of spectacled eiders (Fig. 5), and obtained complete photographic coverage for 18 of these. Our estimate of birds successfully photo-censused is 363,030 (95%CI=333,526 to 392,532), and the one flock for which we have only a visual estimate was estimated at 900 birds. Calculations for this estimate are as follows:

total birds (males and females) counted in flying flocks	13,529
total white-plumaged birds in sitting flocks	190,132
total white-plumaged birds counted in 13 selected sex ratio slides	13,084
total birds counted in 13 selected sex ratio slides	24,051
total birds per male in 13 sex ratio slides	1.838199
lower 95% CI for sex ratio (total birds per male)	1.683028
upper 95% CI for sex ratio (total birds per male)	1.99337
total birds (190,132*1.838199)+13,529	363,030
lower 95% CI (190,132*1.683028)+13,529	333,526
upper 95% CI (190,132*1.99337)+13,529	392,532

The size of this estimate in the context of our limited knowledge of breeding populations from recent surveys in Alaska and Siberia strongly suggests that most if not all of the world's population of this species regularly spends at least part of late winter together in this general area in the northern Bering Sea. Another anecdote that supports this area as a traditional favored winter habitat is the sighting of "a large number of large flocks of eiders" during a bowhead whale census conducted during March and April, 1979 (Brueggeman pers. comm.). The sightings, made from a shipboard helicopter, were made in precisely the area where we encountered the wintering spectacled eiders in 1996 and 1997. This was the only location where the investigators encountered large eider flocks. The observers were not able to positively identify the eiders to species due to the survey altitude and other priorities, but we feel it is highly likely that they were mostly or totally spectacled eiders. We also suggest that the distribution of spectacled eiders observed in 1995, 120 km southeast of the 1996 and 1997 locations, may have resulted from some or a major portion of the wintering population being displaced from their preferred winter habitat by extraordinarily severe sea ice conditions.

Individual flocks observed during the 1997 survey ranged from 800 to 150,966 birds, and the latter flock occupied 8 km of a long, narrow open lead. Many of the flocks were loafing on the ice surrounding small pools of open water that had little or no openings to the water below. The flocks flew freely between these ponds and the open holes and leads. We observed no birds obviously diving to feed during this or any of the earlier late winter surveys. This may have been due to our presence, or perhaps they prefer to feed at a different time of day. We suspect the latter because a high percentage of the flocks seemed to be settled on loafing areas without nearby diving access.

During the BBC helicopter flight we noticed that the eiders tolerated close passes (as close as 150 meters) without taking flight and showing only mild alarm and avoidance behavior (e.g. moving away a few steps). On the other hand, occasional approaches within 150 to 200 meters for photos during the fixed wing survey often elicited departure of the entire flock to another lead.

We observed no waterbird species other than spectacled eiders in 1997, primarily because we did not search the polynya adjacent to St. Lawrence Island where oldsquaw, common and king eiders are typically found. During the flight from the survey area to Gambell, as we traversed open water adjacent to the west side of the island, we observed oldsquaw, common and king eiders, but, due to fuel reserve concerns, we did not attempt counts.

RECOMMENDATIONS

We feel that the 1997 late winter spectacled eider survey reinforces our hypothesis that essentially the entire world's population of this species winters together in a predictable location in the Bering Sea. This knowledge puts us as resource managers in the enviable position of being able to periodically monitor, with a high degree of precision, the worldwide population of a species that is of interest, concern, and possibly a good indicator of large scale changes in the Bering Sea ecosystem. While the current immediate concern is focused on the Yukon-Kuskokwim Delta and the Alaska arctic slope breeding populations, which have been shown to be genetically distinct, worldwide concern for declines in boreal sea duck populations should demonstrate the prudence of capitalizing on such opportunities for obtaining precise population estimates and trend data. We recommend attempting this survey at least every second year, recognizing that conditions will not permit a successful mission for every attempt. We also recommend supporting additional studies of the wintering ecology of this species, which would help place our trend data in context. For instance, having set foot on the sea ice near the wintering birds this year, I believe that with careful planning and local logistic support it may be safe and feasible for a small research team to spend some fruitful time on the ice collecting food habits and behavioral data.

ACKNOWLEDGMENTS

Special thanks go to William Eldridge for his excellent job as observer under challenging conditions in 1996. Robert Stehn adapted the statistical methods and performed the analysis that enabled us to estimate the precision of our results. Margaret Petersen and David Douglas provided satellite telemetry data critical to planning the surveys. Dennis Marks spent many tedious hours counting birds in photographs. Our sincere thanks go to Winnie James and other people of Gambell who assisted with logistics for the helicopter flight. The Yukon Delta National Wildlife Refuge provided the use of their cabin and other equipment, and the able assistance of refuge employee Henry Ivanoff, all of which made operation out of Mekoryuk practical and enjoyable in 1995 and 1996. We would also like to thank members of the Spectacled Eider Recovery Team for their continued support of this and other aerial survey investigations.

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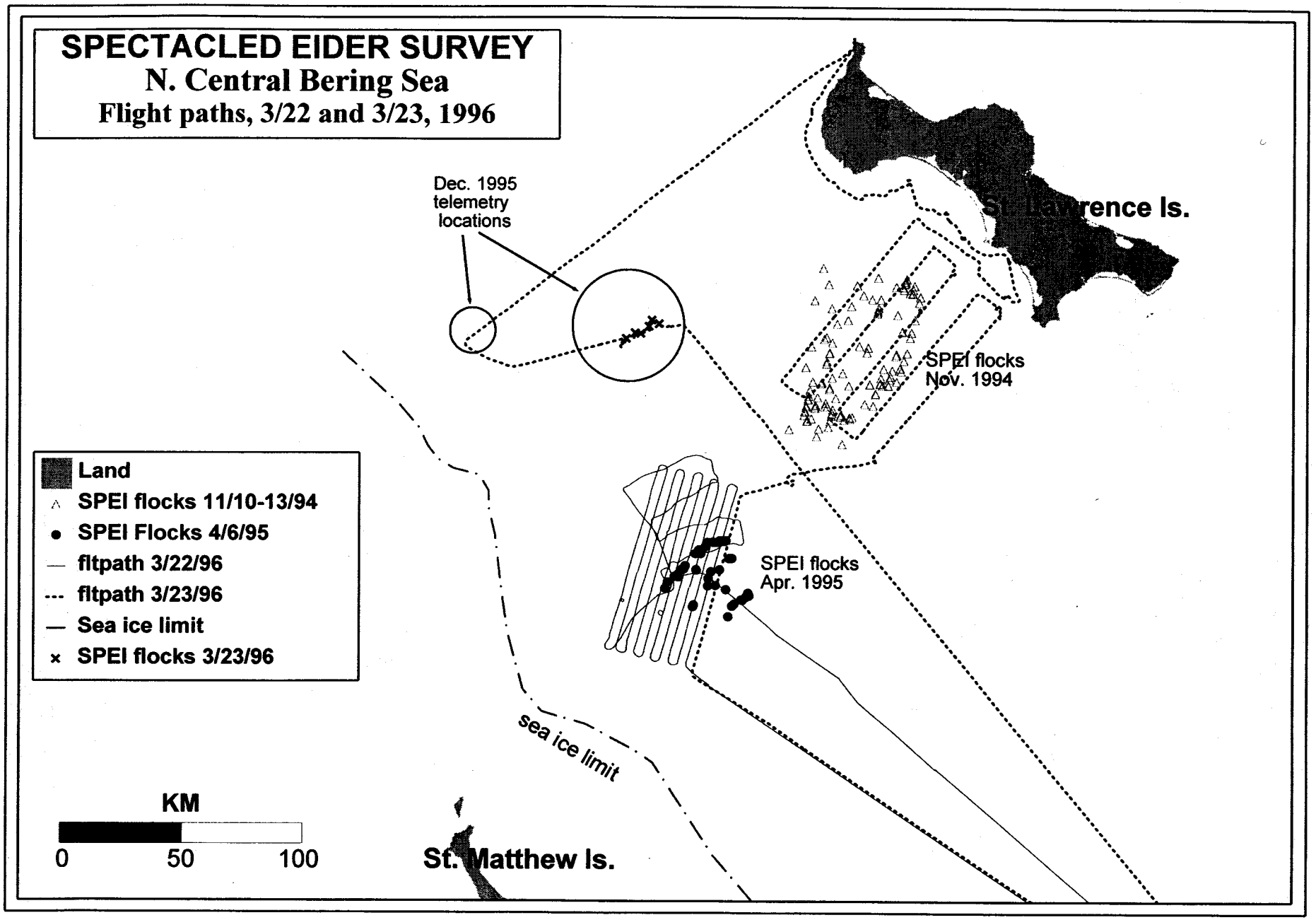

Figure 1. Recorded flight paths from aerial survey reconnaissance flights conducted in the Bering Sea, 22 and 23 March 1996, showing locations of satellite telemetry data and spectacled eider flocks from these and previous surveys.

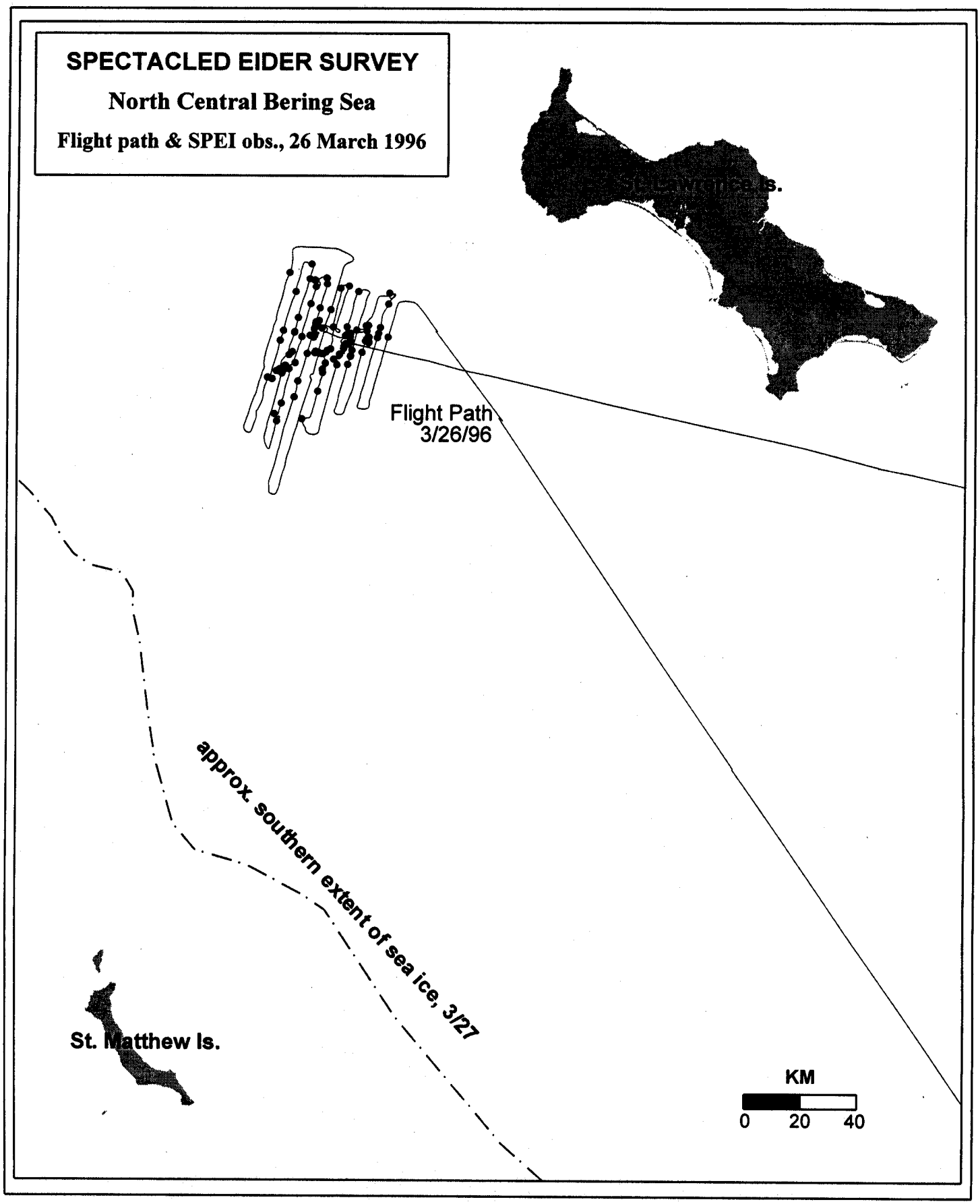

Figure 2. Recorded flight path and locations of spectacled eider flocks from an aerial survey conducted in the Bering Sea, 26 March 1996.

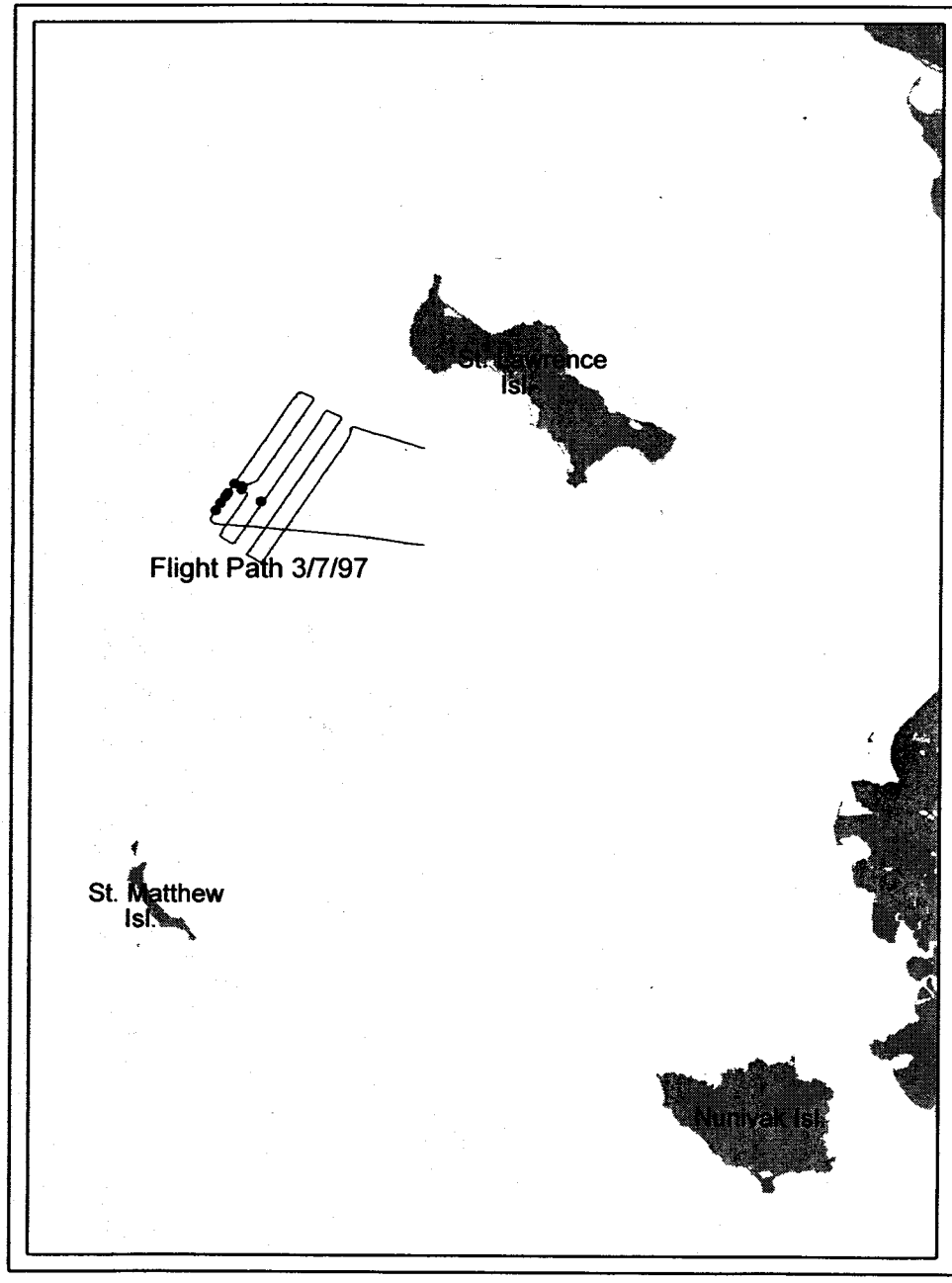

Figure 3. Flight path from an aerial survey in the Bering sea on 7 March 1997, with locations of spectacled eider flocks observed.

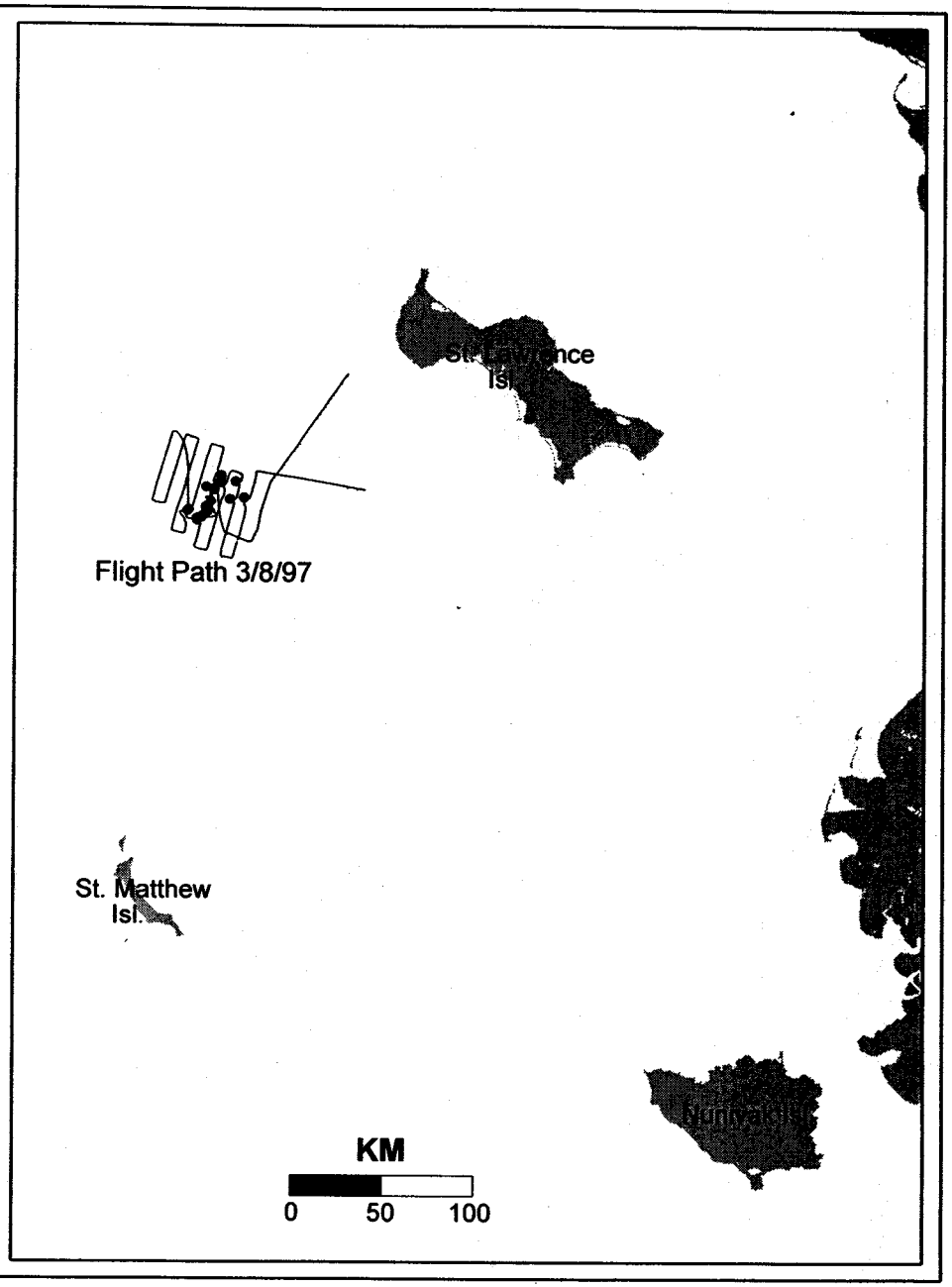

Figure 4. Flight path from an aerial survey in the Bering Sea on 8 March 1997, with locations of spectacled eider flocks observed.

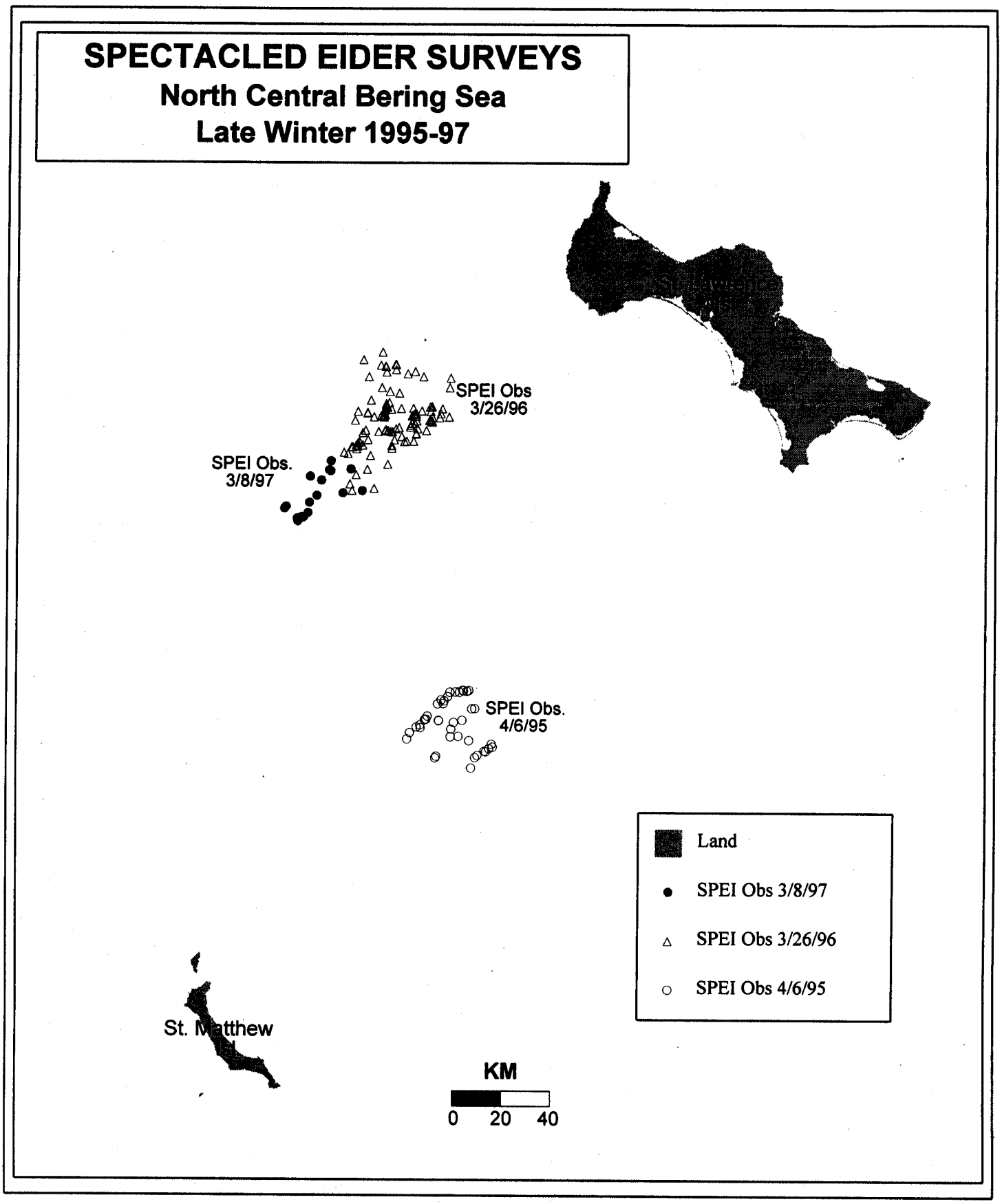

Figure 5. Locations of spectacled eider flocks observed during an aerial survey in the Bering Sea, 8 March 1997, showing spacial relationships to flock locations from earlier surveys.

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

Common Name	Scientific Name
Glaucous gull	*Larus hyperboreus*
Common murre	*Uria aalge*
Oldsquaw	*Clangula hyemalis*
Spectacled eider	*Somateria fischeri*
Common eider	*Somateria mollissima*
King eider	*Somateria spectabilis*