Evidence for Wing Molt and Breeding Site Fidelity in King Eiders

LAURA M. PHILLIPS[1] AND ABBY N. POWELL[2,3]

[1]Department of Biology and Wildlife, University of Alaska, Fairbanks, AK 99775
Internet: lphillips@yritwc.com

[2]USGS Alaska Cooperative Fish and Wildlife Research Unit, Fairbanks, AK 99775

[3]Institute of Arctic Biology, University of Alaska, Fairbanks, AK 99775

Abstract.—Fidelity of King Eiders (*Somateria spectabilis*) to breeding and wing molt sites was examined using satellite telemetry data obtained opportunistically when battery life of transmitters provided locations in a second year. Consecutive breeding locations were obtained for eleven female and 23 male King Eiders. All females exhibited breeding site fidelity by returning to sites within 15 km of first year breeding areas on the North Slope of Alaska. Breeding locations of males in a subsequent year were located on average >1000 km from their prior breeding sites and were primarily outside Alaska, on the coasts of Russia and Canada. Second-year wing molt locations were obtained for two female and six male King Eiders. Wing molt sites of males were located 6.2 ± 3.1 km apart on average in successive years, while female wing molt locations averaged almost 50 km apart. Our results demonstrate site fidelity of female King Eiders to a breeding area on the North Slope of Alaska, document the dispersal of male King Eiders between breeding seasons, and present the first evidence for wing molt site fidelity in males. *Received 27 July 2005, accepted 25 November 2005.*

Key words.—Alaska, breeding, fidelity, King Eider, satellite telemetry, *Somateria spectabilis*, wing molt.

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Many waterfowl species exhibit fidelity to use areas (e.g., winter, molt, breeding) throughout the annual cycle (Anderson *et al.* 1992; Hohman *et al.* 1992; Robertson and Cooke 1999). Fidelity to breeding areas has been well documented, and female waterfowl tend to have higher rates of site fidelity than males (Rohwer and Anderson 1988). Female-biased fidelity in waterfowl has been attributed to formation of pair bonds on wintering grounds and the tendency for males to follow females to breeding sites (Rohwer and Anderson 1988).

Fidelity of waterfowl to areas outside the breeding range has been studied less frequently, but there is evidence that some waterfowl species exhibit high interannual return rates to wing molt areas (Hohman *et al.* 1992; Bollinger and Derksen 1996; Flint *et al.* 2000). Fifty two percent of Black Ducks (*Anas rubripes*) captured at a molting area in northern Labrador returned to the same site the following year (Bowman and Brown 1992), while Black Brant (*Branta bernicla*) molting flight feathers near Teshekpuk Lake on the North Slope of Alaska had a fidelity rate of >90% (Bollinger and Derksen 1996). Steller's Eiders (*Polysticta stelleri*) showed fidelity rates of >95% to molt locations along the Alaskan Peninsula (Flint *et al.* 2000). Fidelity rates may be higher in bird species using areas with lower environmental variability, and marine environments used by many sea duck species tend to be more stable than freshwater habitats (Robertson and Cooke 1999).

Female King Eiders (*Somateria spectabilis*) have exhibited apparent return rates of 51-72% to breeding sites in Canada (Kellet 1999). Currently, there is no published information on fidelity of King Eiders to wing molt sites. In this paper, we present information on the degree of site fidelity by King Eiders to a breeding area on the North Slope of Alaska and to wing molt sites in the Bering Sea.

STUDY AREA

Capture Locations

King Eiders were trapped in early to mid-June 2002, 2003, and 2004 at Kuparuk (70°20'N, 149°45'W), between the Colville and Kuparuk rivers. This site is within the breeding range of King Eiders and characterized by numerous thaw lakes, ponds, and basins. Wetland community types include wet sedge (*Carex* spp.) meadows, moist sedge-dwarf shrub (*Salix* spp.) meadows, and emergent *Carex* spp. and *Artophila fulva* on the margins of lakes and ponds (Anderson *et al.* 1999).

Wing Molt Locations

During the post-breeding period (late June through mid-September), Alaskan-breeding King Eiders generally move into the Bering Sea (Suydam 2000; Phillips 2005). The Bering Sea is characterized by a large, shallow, gently-sloping coastal shelf that is less than 200 m deep and encompasses almost half the sea's total area. This shelf is broad in the northeast (> 500 km) along the Alaskan coast and narrow (< 100 km) in the southwest along the Siberian coast.

METHODS

King Eider locations were obtained throughout the annual cycle using implantable satellite transmitters. King Eiders were captured on breeding grounds in early to mid-June, prior to nesting, using mist net arrays and decoys. Once captured, the eiders were placed in a secure, dark kennel and transported to a nearby, indoor facility equipped for surgery. A 35-g satellite platform transmitting terminal (PTT) transmitter (Microwave Telemetry, Inc., Columbia, Maryland) was surgically implanted into the abdominal cavity of each eider following the techniques of Korschgen *et al.* (1996). Satellite transmitters were < 3% of the average body mass of birds used in this study. Eiders were fitted with a U.S. Fish and Wildlife Service band while under anesthesia. Birds were held until fully awake and recovered from anesthesia (usually about two to three hours), and then released at capture sites. Transmitters were implanted into 21 (10 female, 11 male) King Eiders in 2002, 12 (3 female, 9 male) in 2003, and 27 (12 female, 15 male) in 2004. All methods and handling of birds were approved by the University of Alaska Institutional Animal Care and Use Committee (IACUC # 02-10).

To maximize location information on wing molt and molt migration, transmitters were programmed with four duty cycles. Transmitters were on and transmitting location information to satellites for six hours every 48 h from June through September, every 84 h from October through December, every 168 h from January through March, and every 84 h from April until the end of the battery life. The expected battery life was about one year. Satellite transmitters used in this study had an average life-span of 385 ± 15 (SE) days ($n = 33$, range 99-519 days), thus we obtained two years of data on a subset of birds returning to breeding and wing molt sites. We received location data from Service Argos (2001). Error associated with satellite telemetry locations was reported by Service Argos as one of six "location classes". Service Argos (2001) estimated error to be <1 km for locations with a location class of at least 0 and <150 m for locations with a class of 3; however, a study by Britten *et al.* (1999) estimated an average error of 4 km for 0 class locations from small (30g) backpack-mounted satellite transmitters. There is no published information on the accuracy of the 35-g implantable satellite transmitters used in this study. Location data was filtered for accuracy using PC-SAS Argos Filter V6.4 (Dave Douglas, USGS, Alaska Science Center, Anchorage, AK). The filtering program removed implausible locations based on location redundancy and tracking paths. For our analyses, the best location per transmission period was used based on location class. Locations were plotted using ArcView GIS (ESRI 1998).

Breeding areas were defined as onshore locations where an individual was located after spring migration and prior to molt migration. Breeding areas for females may or may not contain a nest site. Nesting status of females were not checked after capture. Eight males appeared to be nonbreeders that staged offshore during their second summer season. For males without locations on land during the breeding season, locations where an individual was staging for more than one week after spring migration and prior to movement toward wing molt areas was used as their second year breeding location. Wing molt areas were defined as an area where an eider spent ≥ 3 weeks with lowest daily movement rates between June and December. The breeding and wing molt sites of an individual during the capture year are referred to as first year, while the following year's locations are referred to as second year.

Minimum convex polygons (MCP) were created for breeding and wing molt areas using the Animal Movement extension in ArcView (Hooge and Eichenlaub 1997). Distances between breeding and wing molt areas in consecutive years were calculated as the distance between the centriods of the MCPs created. Means are presented ± SE.

RESULTS

Breeding Areas

Second-year breeding locations were obtained for 11 female and 23 male King Eiders. All eleven females returned to the Kuparuk capture area in their second year. Two of these females were re-captured at the same trapping location in successive years. Centroids of female breeding areas in successive years averaged 3.9 ± 1.4 km (N = 11, range: 0.6 - 14.6 km) apart, while successive male breeding locations were 1361.7 ± 194.8 km (N = 23, range: 13.9 - 3175.6 km) apart on average. Two males returned to areas on the North Slope of Alaska in a subsequent breeding season. One of these males returned to a breeding site 13.9 km from the Kuparuk capture site, while the other was located south of Barrow. Of the remaining 21 males, seven were located in Russia during the second breeding season and 14 were located in Canada. Male King Eiders breeding in Russia were located on the coast of the East Siberian Sea near the Kolyma and Indigirka River Deltas, on the coast of the Laptev Sea west of the Lena River Delta, on the New Siberian Islands, and on the Taimyr Peninsula. One male that bred on the Taimyr Peninsula during the second breeding season was located 3175 km from the Kuparuk study area where he was captured the previous summer. Second-year breeding locations of males in Canada were on Banks Island, Victoria Island, Cape Bathurst, Cape Dalhousie, and offshore in the Beaufort Sea near Cape Bathurst (Fig. 1).

Wing Molt Areas

Centroids of wing molt areas of individuals were 17.1 ± 8.4 km (N = 8, range: 1.7 - 70.1 km) apart in successive years (Fig. 2). Second-year molt sites for female King Eiders were 70.1 km and 29.55 km from first-year locations, while male wing molt locations averaged 6.2 ± 3.1 km (N = 6) apart.

DISCUSSION

In this study, female King Eiders exhibited high breeding site fidelity to an area on the North Slope of Alaska; however, the distances observed between breeding sites used in successive years were slightly larger than those seen in female King Eiders returning to nesting sites at Karrak Lake in Canada (Kellet 1999). Second-year nest sites of females at Karrak Lake that successfully hatched young the previous season averaged only 0.2 km from first-year locations, while unsuccessful females dispersed 0.6 km on average and up to 2.8 km. The Karrak Lake study relied on recapturing nesting females within the study area to calculate return distances; therefore, distance estimates could be low if females returned to sites outside the search area and were not detected. The larger distances between successive breeding areas of female King Eiders in this study could also be attributed to the error associated with satellite location data or to the inclusion of location data in minimum convex polygons not associated with a nest site. It should also be noted that the nesting behavior of King Eiders is markedly different between the two study locations. King Eiders nest at Kuparuk in low densities on the mainland, while at Karrak Lake, King Eiders nest on islands at unusually high densities (Kellet and Alisauskas 1997). The benefits of colonial and island nesting at Karrak Lake may encourage female King Eiders there to dispersal shorter distances than hens nesting at Kuparuk. During the breeding season following capture

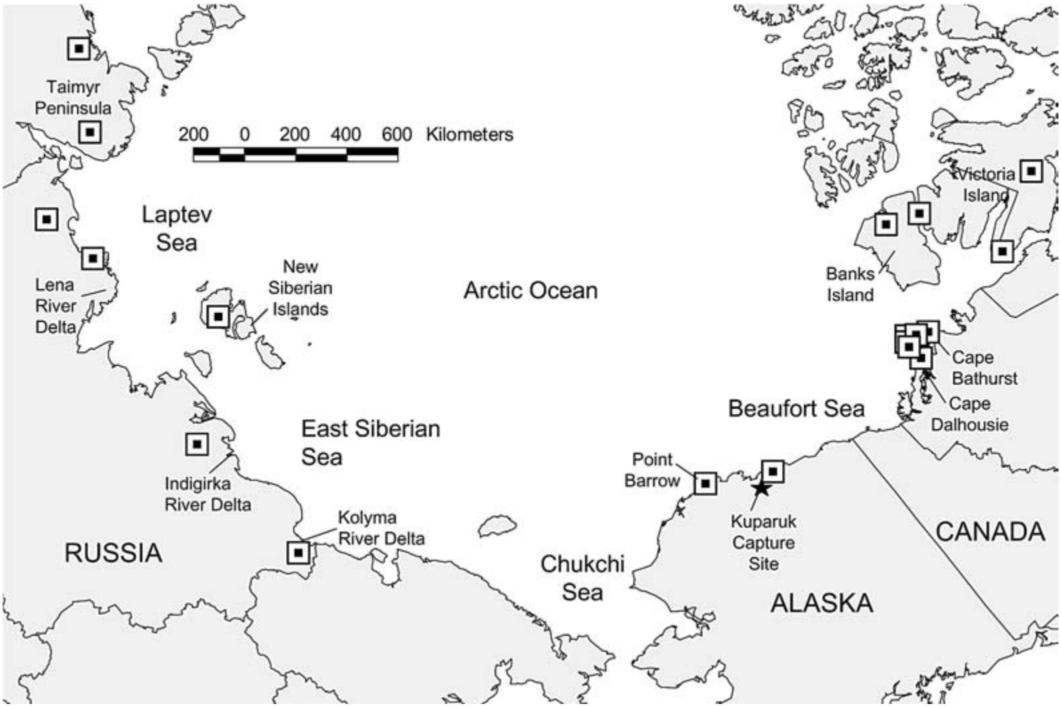

Figure 1. Second-year summer locations of male King Eiders captured on the North Slope of Alaska in 2002-2004. Centroids of breeding areas of 23 males are represented by squares with black centers.

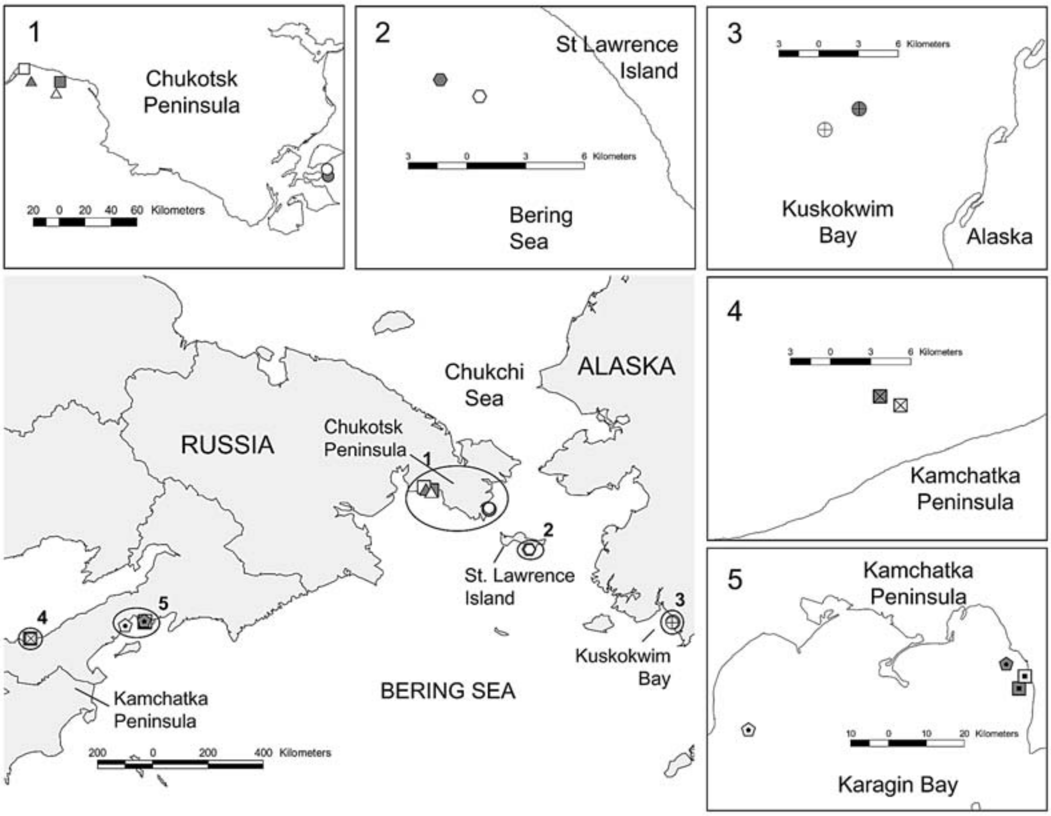

Figure 2. Consecutive wing molt locations for eight satellite-transmittered King Eiders, two females and six males, captured on the North Slope of Alaska. Centroids of wing molt locations of individual eiders are represented by the same symbol in consecutive years. First-year locations are indicated by grey-filled symbols, while second-year locations are denoted by open symbols. The two female King Eiders are represented by the square symbols and the pentagons with black centers.

and transmitter implantation, female King Eiders dispersed from breeding areas earlier than would be expected if they had successfully raised young to fledging (Phillips 2005). Some studies have shown that a failed breeding attempt during one year may promote a longer dispersal to a nesting site in the subsequent year (Hepp and Kennamer 1992; Bustnes and Erikstad 1993; Kellet 1999). However, the conclusions of this study matched that of Kellet (1999); female King Eiders exhibit high breeding site fidelity at a small geographic scale. Female waterfowl may benefit from breeding site fidelity by experiencing improved nest success, female survival, feeding efficiency, and brood-rearing success (Anderson *et al.* 1992).

Observations of paired males and females on spring migration have led to the conclusion that King Eiders, like other sea ducks (Spurr and Milne 1976; Dau and Kistchinski 1977; Robertson *et al.* 1998; Laubhan and Metzner 1999), form pair bonds in wintering areas (Suydam *et al.* 2000). In this study, the broad dispersal of males to alternate breeding sites in second-year summers supports the idea that King Eiders form pair bonds in winter and males follow females to breeding areas. The dispersal of males across the northern coasts of Russia, Alaska, and Canada during the breeding season probably would result in increased gene flow within the western population of King Eiders and is consistent with the results of Pearce *et al.* (2004) which revealed little spatial genetic structure within this population. Male Common Eiders (*Somateria mollissima*), Harlequin Ducks (*Histrionicus histrionicus*), and Long-tailed Ducks

Table 1. Distances between centroids of successive breeding areas of female King Eiders returning to Kuparuk on the North Slope of Alaska in 2003-2005.

Capture year	Distance (km)
2002	2.9
	0.6
	14.6
	1.2
	11.7
	0.7
2003	2.5
	1.3
	4.1
2004	1.6
	1.7

(*Clangula hyemalis*) were reported to show some fidelity to breeding sites by re-pairing with the same female in multiple years (Alison 1975; Spurr and Milne 1976; Smith *et al.* 2000). We observed only one male King Eider return to the capture area the following summer. This male was apparently unpaired when captured the first year, thus we have no evidence for the occurrence of re-pairing of King Eiders in consecutive years.

Our results suggest some fidelity of King Eiders to wing molt locations in consecutive years, especially males. Female King Eiders may also exhibit fidelity to wing molt areas, but our small sample size precludes making firm conclusions. It may be unlikely that female King Eiders use the same wing molt locations in each year, because location of wing molt sites for female waterfowl may be dependent on their breeding success (Hohman *et al.* 1992). Fidelity to wing molt sites has been observed in other sea ducks. More than 90% of male Harlequin Ducks molting flight feathers in coastal British Columbia returned to the same molting site in consecutive years, while two marked females were not resighted (Breault and Savard 1999). Both male and female Steller's Eiders have exhibited high return rates (>95%) to molt sites along the Alaska Peninsula (Flint *et al.* 2000). For King Eiders, fidelity to wing molt sites could be advantageous by providing them with site familiarity and prior knowledge of resources and shelter, or by maintaining social bonds with conspecifics (Hohman *et al.* 1992; Robertson and Cooke 1999).

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Literature Cited

Alison, R. M. 1975. Breeding biology of the Oldsquaw (*Clangula hyemalis*). Ornithological Monogr. No. 18.

Anderson, M. G., J. M. Rhymer and F. C. Rohwer. 1992. Philopatry, dispersal, and the genetic structure of waterfowl populations. Pages 365-395 *in* Ecology and management of breeding waterfowl (B. D. J. Batt, A. D. Afton, M. G. Anderson, C. D. Ankney, D. H. Johnson, J. A. Kadlec and G. L. Krapu, Eds.). University of Minnesota Press, Minneapolis.

Anderson, B. A., C. B. Johnson, B. A. Cooper, L. N. Smith and A. A. Stickney. 1999. Habitat associations of nesting spectacled eiders on the Arctic Coastal Plain of Alaska. Pages 27-32 *in* Behavior and ecology of sea ducks (R. I. Goudie, M. R. Peterson and G. J. Robertson, Eds.). Canadian Wildlife Service Occasional Papers No. 100. Ottawa.

Bollinger, K. S. and D. V. Derksen. 1996. Demographic characteristics of molting Black Brant near Teshekpuk Lake, Alaska. Journal of Field Ornithology 67: 141-158.

Bowman, T. D. and P. W. Brown. 1992. Site fidelity of Black Ducks to a molting area in Labrador. Journal of Field Ornithology 63: 32-34.

Breault, A. M. and J.-P. L. Savard. 1999. Philopatry of Harlequin Ducks moulting in southern British Columbia. Pages 59-64 *in* Behavior and ecology of sea ducks (R. I. Goudie, M. R. Petersen and G. J. Robertson, Eds.). Canadian Wildlife Service Occasional Papers No. 100. Ottawa.

Britten, M. W., P. L. Kennedy and S. Ambrose. 1999. Performance and accuracy evaluation of small satellite transmitters. Journal of Wildlife Management 63: 1349-1358.

Bustnes, J. O. and K. E. Erikstad. 1993. Site fidelity in breeding Common Eider *Somateria mollissima* females. Ornis Fennica 70: 11-16.

Dau, C. P. and A. Kistchinski. 1977. Seasonal movements and distribution of the Spectacled Eider. Wildfowl 28: 65-75.

ESRI. 1998. ArcView GIS Version 3.3. Environmental Research Institute, Inc., Redlands, CA.

Flint, P. L., M. R. Petersen, C. P. Dau, J. E. Hines and J. D. Nichols. 2000. Annual survival and site fidelity of Steller's Eiders molting along the Alaska Peninsula. Journal of Wildlife Management 64: 261-268.

Hepp, G. R. and R. A. Kennamer. 1992. Characteristics and consequences of nest site fidelity in Wood Ducks. Auk 109: 812-818.

Hohman, W. L., C. D. Ankney and D. H. Gordon. 1992. Ecology and management of postbreeding waterfowl. Pages 128-189 *in* Ecology and management of breeding waterfowl (B. D. J. Batt, A. D. Afton, M. G. Anderson, C. D. Ankney, D. H. Johnson, J. A. Kadlec and G. L. Krapu, Eds.). University of Minnesota Press, Minneapolis.

Hooge, P. N. and B. Eichenlaub [online]. 1997. Animal movement extension to ArcView. Ver 1.1. <http://www.absc.usgs.gov/glba/gistools/> (January 2005).

Kellet, D. K., and R. T. Alisauskas. 1997. Breeding biology of King Eiders on Karrak Lake, Northwest Territories. Arctic 50: 47-54.

Kellet, D. K. 1999. Causes and consequences of variation in nest success of King Eiders (*Somateria spectabilis*) at Karrak Lake, Northwest Territories. M.S. thesis, University of Saskatchewan, Saskatoon.

Korschgen, C. E., K. P. Kenow, A. Gendron-Fitzpatrick, W. L. Green and F. J. Dein. 1996. Implanting intra-abdominal radiotransmitters with external whip antennas in ducks. Journal of Wildlife Management 60: 132-137.

Laubhan, M. K. and K. A. Metzner. 1999. Distribution and diurnal behavior of Steller's Eiders wintering on the Alaska Peninsula. Condor 101: 694-698.

Pearce, J. M., S. L. Talbot, B. J. Pierson, M. R. Petersen, K. T. Scribner, D. L. Dickson and A. Mosbech. 2004. Lack of spatial genetic structure among nesting and wintering King Eiders. Condor 106: 229-240.

Phillips, L. M. 2005. Migration ecology of King Eiders. M.S. thesis, University of Alaska, Fairbanks.

Robertson, G. J., F. Cooke, R. I. Goudie and W. S. Boyd. 1998. The timing of pair formation in Harlequin Ducks. Condor 100: 551-555.

Robertson, G. J. and F. Cooke. 1999. Winter philopatry in migratory waterfowl. Auk 116: 20-34.

Rohwer, F. C. and M. G. Anderson. 1988. Female-biased philopatry, monogamy, and the timing of pair formation in migratory waterfowl. Current Ornithology 5: 187-221.

Service Argos [online]. 2001. Argos user's manual. Service Argos, Inc., Largo, MD. <http://www.cls.fr/manuel/> (January 2005).

Smith, C. M., F. Cooke, G. J. Robertson, R. I. Goudie and W. S. Boyd. 2000. Long-term pair bonds in Harlequin Ducks. Condor 102: 201-205.

Spurr, E. and H. Milne. 1976. Adaptive significance of autumn pair formation in the Common Eider *Somateria mollissima* (L.). Ornis Scandinavica 7: 85-89.

Suydam, R. S. 2000. King Eider (*Somateria spectabilis*). *In* The Birds of North America (A. Poole and F. Gill, Eds). The Birds of North America, Inc., Philadelphia, PA.

Suydam, R. S., D. L. Dickson, J. B. Fadely and L. T. Quakenbush. 2000. Population declines of King and Common Eiders of the Beaufort Sea. Condor 102: 219-222.