The Wilson Journal of Ornithology 121(2):430–434, 2009

Brood Rearing Ecology of King Eiders on the North Slope of Alaska

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ABSTRACT.—We examined King Eider (*Somateria spectabilis*) brood survival in the Kuparak oil field in northern Alaska in 2002 and 2003 by monitoring hens with broods using radiotelemetry. We observed complete brood loss in eight of 10 broods. Broods survived less than 2 weeks on average, and most mortality occurred within 10 days of hatch. Distance hens traveled overland did not affect brood survival. Apparent King Eider brood survival in our study area was lower than reported for eider species in other areas. We recommend future studies examine if higher densities of predators in oil fields reduces King Eider duckling survival. *Received 26 September 2008. Accepted 18 January 2009.*

Declines in the North American population of King Eiders (*Somateria spectabilis*) have increased interest in the status and ecology of this species (Dickson et al. 1997, Gratto-Trevor et al. 1998, Suydam et al. 2000). King Eiders are circumpolar breeders that nest primarily along the margins of freshwater ponds and lakes on the arctic tundra (Suydam 2000). King Eider females leave the nest after hatch with their brood and move over land among tundra ponds (Bergman et al. 1977). Some waterfowl studies hypothesize that distance traveled over land may reduce duckling survival by increasing risk of mortality due to predation or exposure (Rotella and Ratti 1992, Seymore and Jackson 1996), while other studies suggest a positive correlation (Yerkes 2000, Mehl and Alisauskas 2007) or no effect (Wayland and McNicol 1994, Dzus and Clark 1997).

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Estimates of duckling survival for waterfowl species suggest that survival rates are lower from hatching to fledging than during later life stages, and variation in survival is linked to recruitment (Mendenhall and Milne 1985, Johnson et al. 1992). Duckling mortality has been attributed to predation, adverse weather, starvation, and disease (Johnson et al. 1992). Identifying mortality at different life history stages is important for developing conservation plans for King Eiders. We examined survival of King Eider ducklings on the North Slope of Alaska and examined survival in relation to distance traveled over land.

METHODS

Study Area.—We trapped female King Eiders on nests in 2002 and 2003 at the Kuparuk oil field (70° 20′ N, 149° 45′ W) between the Colville and Kuparuk rivers on the North Slope of Alaska. The site was characterized by numerous thaw lakes, ponds, and basins (Anderson et al. 1999).

Capture and Telemetry.—We searched accessible areas in the Kuparuk oil field for nesting King Eiders during each summer, 2002 and 2003. We candled and floated eggs from nests to assess incubation stage and estimate hatch date (Weller 1956). We monitored nests at least once per week.

We captured hens on nests about 1 week prior to hatch using hand-carried mist nets (Bacon and Evrard 1990) or bow-net traps (Sayler 1962). We originally planned to trap 20 randomly selected hens each year but, due to low nest success we attempted to trap any female still on a nest 1 week prior to predicted hatch date. We captured 12 females in 2002, clipped feathers on their upper back between their wings, and attached 8-g VHF transmitters (Telonics Inc., Mesa, AZ, USA) to the area using epoxy. We attached 10-g VHF anchor transmitters using a suture technique (Pietz et al. 1995) to 12 hens in 2003 to reduce transmitter loss. We checked nests daily after

TABLE 1. King Eider radio-tracking at Kuparuk, Alaska, 2002–2003.

	2002	2003	Total
Females radio-marked	12	12	24
Radio-marked females that failed to hatch eggs	5	3	8
Radio-marked females that lost radio tag	3	0	3
Females radio-tracked	4	6	10
Radio-marked females that lost broods prior to first relocation	0	3	3

capture to document departure of broods. We did not flush hens from nests during these checks. We checked nests for number of hatched eggs when females departed the nest area following hatch. We assumed initial brood size was equal to the number of hatched shell membranes (Girard 1939). All methods and handling of birds were approved by the University of Alaska Institutional Animal Care and Use Committee (IACUC # 02-10).

We located hens after hatch every 2–5 days until ducklings were 30 days of age or until we observed a female without a brood on two consecutive tracking sessions. We tracked marked hens by vehicle, foot, and aircraft. Aerial telemetry flights were used weekly when weather permitted to locate hens not found from the ground. Transmitters had a range of at least 1 km from the ground and up to 10 km from the air. We recorded location information using Global Positioning System (GPS) units and aerial photos. We used aerial photos to record locations when we were not able to get exact GPS locations or did not want to disturb hens with broods. We later returned to these locations to obtain locations using GPS or inferred locations using ArcView. We also recorded brood size, number of hens and ducklings if broods had formed crèches, and predators observed.

Analysis.—We plotted movements of females using ArcView 3.2 Geographic Information System (GIS) (ESRI 1998). We calculated straight line distances between re-observations and mean bearing of movement paths using Animal Movement extension (Hooge and Eichenlaub 1997) in ArcView. We considered survival of a brood as at least one duckling surviving to 30 days of age when King Eider ducklings closely resemble adults in size and mortality from predation is negligible (Mehl and Alisauskas 2007). We considered a marked hen observed in a crèche to still have a brood if ducklings of the appropriate age tended to follow her rather than alternate hens when disturbed. We calculated daily survival estimates for broods using the Mayfield method and assigned exposure days for complete brood loss equal to 50% of the last observation interval (Mayfield 1961, 1975, Johnson 1979). Survival to 30 days was calculated by raising the daily survival rate to the power of 30.

We used linear regression to test whether the number of days a brood survived was affected by distances traveled over land and if distances traveled per day varied with duckling age. Data from both years were pooled in all analyses due to small sample sizes. We performed all statistical analyses using SAS software (SAS Institute 1990); means $\pm$ SE are presented. Results were considered significant at $\alpha = 0.05$.

RESULTS

Four of 12 hens captured in 2002 were successfully radio-tracked with broods, five failed to hatch eggs, and three prematurely lost their radio transmitters prior to first relocation after hatch (Table 1). Six of 12 hens captured in 2003 were successfully radio-tracked, three failed to hatch eggs, and three lost broods prior to first relocation after hatch (Table 1). We relocated marked hens with broods 5.6 $\pm$ 1.4 times ($n = 10$, range = 1–14).

Average brood size at hatch was 4.2 $\pm$ 0.4 ducklings ($n = 10$, range = 2–6). We observed complete brood loss in eight of 10 broods (80%). Broods survived an average of 13.4 $\pm$ 3.1 days ($n = 10$, range = 2–31). Most brood loss (5 of 8, 62.5%) occurred within the first 10 days after hatch (Table 2). The daily survival estimates for broods was 0.855 $\pm$ 0.026, and estimated survival over 30 days was 10.3% (95% CI: 2.0–49.3). We observed the depredation of a King Eider chick from a

TABLE 2. Number of King Eider ducklings observed in broods of radio-tracked females at Kuparuk, Alaska, 2002–2003. All females experienced complete brood loss within the first 2 weeks after hatch.

ID #	Age (days)			
	Hatch	1–5	5–10	10–15
KIEI02	4	0		
KIEI06	5	3	0	
KIEI17	3	0		
KIEI29	6	3	0	
KIEI68	4	4	1	0
KIEI70	5	5	1	0
KIEI87	3	3	0	
KIEI95	4	3	3	0

tracked brood by a Glaucous Gull (*Larus hyperboreus*) and witnessed two unsuccessful attacks on radio-tracked broods, including one by two Parasitic Jaegers (*Stercorarius parasiticus*) and another by a Glaucous Gull.

Average daily movement rate of hens with broods was 507.4 ± 68.7 m/day (n = 56; range = 0–2,376 m). Longer daily movement rates did not affect the number of days a brood survived ($F_{1,8}$ = 0.10, P = 0.76). Distance traveled per day by hens with broods did not vary with duckling age ($F_{1,54}$ = 0.90, P = 0.35). Hens did not appear to travel in a particular general direction with ducklings after hatch. Four hens moved east, three north, two south, and one west.

Crèche formation was not extensive; we rarely observed crèches of King Eiders on the study area and only observed two marked hens with broods in crèches. The hens that joined crèches were the only females in our study to successfully raise young to 30 days of age. One marked hen hatched five ducklings, but was later observed with three King and three Spectacled (*S. fischeri*) Eider chicks. We first observed her in a crèche when her chicks were 9 days of age. We later observed this hen in a crèche of up to 40 hens and 12 young. We believe some of these ducklings were still associated with the marked hen based on their behavior. We observed the second successful hen in a small crèche with one other hen when her chicks were 18 days of age; each had a brood of two ducklings. The two broods were discernable by their different ages with the marked hen having smaller, younger ducklings.

DISCUSSION

We offer the first description of survival of King Eider broods in Alaska. We observed lower apparent survival of broods (20%) than observed for King Eiders breeding at Karrak Lake in Nunavut, Canada (35%, Mehl and Alisauskas 2007). Apparent survival of King Eider broods at Kuparuk was also lower than reported for related eider species in Alaska. Half (49%) of all Spectacled Eider (Flint and Grand 1997) and 73% of all Common Eider (*S. mollissima*) females (Flint et al. 1998) on the Yukon-Kuskokwim Delta lost their broods within 30 days of hatch.

Our calculation of apparent survival of broods does not include an estimate of variation in the data. Given our small sample size and probable variation among years, we would assume this variation to be significant. Mayfield estimates of survival for King Eider broods at Kuparuk, while low, show large confidence intervals that overlap with survival estimates for broods at Karrak Lake (31%, 95% CI: 13–50%; Mehl and Alisauskas 2007).

Gull predation has been identified as a primary cause of eider duckling mortality (Mendenhall and Milne 1985, Mehl and Alisauskas 2007). Glaucous Gulls nest across Alaska's Arctic Coastal Plain; studies have indicated their populations may be more concentrated near coastal villages and areas of industrial development such as Kuparuk and Prudhoe Bay (Noel et al. 2006). Other potential predators of ducklings at Kuparuk included Parasitic Jaeger, Common Raven (*Corvus corax*), and arctic fox (*Alopex lagopus*). The population of predators in Alaskan oil fields has increased since development, most likely due to greater access to food from anthropogenic sources such as landfills and garbage dumpsters, and shelter for nesting and denning sites (National Research Council 2003).

We did not observe extensive crèche formation at Kuparuk similar to Mehl and Alisauskas (2007) at Karrak Lake; however, the only hens in our study that successfully raised ducklings joined other females with broods. Crèche formation may increase duckling survival by females jointly caring for young and by larger brood sizes diluting the risk of predation (Eadie et al. 1988).

King Eider brood survival did not improve with greater distance travelled over land in the Kuparak area in contrast to the findings of Mehl and Alisauskas (2007) at Karrak Lake. We hypothesize the contrasting results of these two studies may be partially explained by habitat composition of the study areas. The Karrak Lake site is a large lake with many islands, while Kuparuk is characterized by small ponds and wetland complexes. Mehl and Alisauskas (2007) hypothesized that movement of broods to smaller ponds from the main nesting areas at Karrak Lake improved survival by providing better foraging, lower gull densities, and more shelter from winds. Movements from nesting locations at Kuparuk would not yield the same benefits because nesting already occurs on small ponds.

We had little evidence to suggest broods not re-observed with hens were adopted, because crèche formation was limited in the study area and we did not observe hens with an unusually large number of ducklings. Our analysis of brood survival underestimated mortality by censoring broods from the analysis that were not re-observed after hatch, but our observations of King Eider broods at Kuparuk suggest that survival of broods may be low. Our findings should be useful for developing a comprehensive investigation of King Eider survival as more King Eider nesting habitat across northern Alaska is leased for resource development. We encourage additional study of King Eider survival on the North Slope of Alaska especially near areas of resource development where survival of ducklings may be depressed by artificially inflated predator populations.

ACKNOWLEDGMENTS

Financial support for this research was provided by the Coastal Marine Institute and Minerals Management Service. Additional support was provided by ConocoPhillips, Alaska Inc., the North Slope Borough, U.S. Geological Survey, Alaska Cooperative Fish and Wildlife Research Unit, University of Alaska Foundation Angus Gavin grant, and the U.S. Fish and Wildlife Service. We acknowledge the valuable suggestions and assistance provided by Chuck Monnett, Jeff Gleason, Betty Anderson, Philip Martin, Catherine Rea, Anne Lazenby, Leigh McDaniel, Justin Harth, Robert Suydam, and Declan Troy. We thank Eric Duran, Lori Guildehaus, Ben Soiseth, and Rebecca Bentzen for field assistance. Carol McIntyre, Nora Rojek, and two anonymous reviewers provided helpful reviews of earlier drafts of the manuscript. Any use of trade, product, or firm names in this publication is for descriptive purposes only and does not imply endorsement by the U.S. Government.

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The Wilson Journal of Ornithology 121(2):434–439, 2009

Diet Composition of Wintering Wilson's Snipe

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ABSTRACT.—We examined diet composition of Wilson's Snipe (*Gallinago delicata*) (n = 372) collected along the central Gulf Coast of Texas based solely on upper digestive tract contents. Food items included 11 invertebrate orders, one invertebrate class, and eight plant genera. Oligochaetes were the predominant food throughout the non-breeding period, but snipe consumed fewer (P = 0.021) earthworms in spring than in fall. Aquatic insects were frequently consumed by snipe and during spring represented approximately the same proportion of the diet as earthworms. Plant foods consisted almost entirely of seeds and comprised 9.7–26.8% of the diet throughout the non-breeding period. Wilson's Snipe consumed dipteran larvae more often during spring than fall (P = 0.056). Female snipe consumed crustaceans during spring (14.8%), while only trace amounts were found in the diet of male snipe. Differences in the diet of Wilson's Snipe between males and females were probably related to differences in habitat use as well as availability of invertebrates throughout the non-breeding period. *Received 5 March 2008. Accepted 7 September 2008.*

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Studies of Wilson's Snipe (*Gallinago delicata*) suggest that animal foods are a signifi-