COMMON EIDERS NESTING AND ARCTIC FOX PREDATION AT ICY CAPE, ALASKA

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February 1981

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Common Eiders nesting on a barrier island at Icy Cape, Alaska, suffered Arctic Fox predation early and late in incubation. Foxes had access to one barrier island via an estuarine mudflat and presumably swam to an adjacent island and eider colony. Arctic Foxes were observed swimming at Icy Cape on several occasions. Predation early in the season may have resulted in delayed nesting and smaller clutches. Late in incubation, a single fox destroyed a nesting colony, cached an estimated 498 eggs, and killed one female eider. Glaucous Gull nests were also destroyed by foxes , but Arctic Tern nests survived. Man made causeways connecting the mainland to barrier islands would provide foxes access to these systems and thus pose a serious threat to Common Eider nesting colonies along the Chukchi and Beaufort Sea coasts.

Key words: Common Eider, Arctic Fox, predation, barrier island, causeways.

Common Eiders (Somateria mollissima) have not been studied along the Chukchi Sea coast of Alaska, though breeding biology information has been collected further north along the Beaufort Sea coast (Schamel 1977), as well as on the Atlantic coasts of North America and Europe

(Milne 1963, Choate 1966, Guignion 1967, Ahlen and Andersson 1970). Along the northern Chukchi and Beaufort Sea coasts, most Common Eiders nest in colonies on barrier islands (Schamel 1977, Divoky 1978, this study). Island nesting may have developed as a form of protection from Arctic Fox (Alopex lagopus) predation (Lewis 1942, Larson 1960, Schamel 1977). Although Arctic Foxes visit barrier islands throughout the winter and may be stranded during ice break-up, most islands are free of foxes during the summer.

At Icy Cape, Alaska, in 1980, foxes reached an eider colony on a barrier island early and late in the nesting season. This paper reports our observations of Common Eider nesting biology and Arctic Fox predation.

Study Area

Icy Cape (161° 52'W, 70° 20'N) is on the northwest coast of Alaska on the Chukchi Sea (Fig. 1). Several Common Eider colonies occur in the area, including the two largest known to exist along the Chukchi and Beaufort Sea coasts of Alaska (Divoky 1978). Eider colonies on Amaulik and Tern Island (Fig. 1) were selected for study. These flat gravel barrier islands (98.6 ha and 23.5 ha, respectively) separate Kasegaluk Lagoon from the Chukchi Sea. Sparse vegetation grows only on those parts of the islands that are rarely submerged by storm tides. Major plant species include Elymus arenarius, Puccinellia langanea, Carex subspathacea, and Honckenya peploides. Tidal fluctuation is only 10-15 cm along the arctic coast.

For most of the year, Kasegaluk Lagoon is frozen and barrier islands are connected to the mainland by ice. Following breakup in May

or June, most barrier islands are separated from the mainland by 2 - 8 km of shallow lagoon (0.3-4.0 m deep). Cape Island (Fig. 1), however, is connected to the mainland in summer by a broad mudflat. Arctic Foxes have access to Cape Island except during periods of southerly winds when the mudflat is inundated by lagoon waters.

The summer of 1980 was exceptionally cold; Kasegaluk Lagoon remained partially frozen until 21 June, and Chukchi Sea ice was packed against the barrier islands into the first week of July. Summer temperatures at Point Barrow, 200 km northeast, were the coldest in 30 years (Myers and Pitelka 1979).

In addition to Artic Foxes, potential predators of eider eggs included Brown Bears (Ursus arctos), Parasitic Jaegers (Stercorarius parasiticus), and Glaucous Gulls (Larus hyperboreus). Several birds used the barrier islands for feeding and resting, but the only other nesting species were Arctic Tern (Sterna paradisaea), Brant (Branta bernicula), and Oldsquaw (Clangula hyemalis); all nested at lower densities than eiders.

Methods

During a study of bird use of the Icy Cape area from 20 May to 23 September 1980, we observed Common Eider nesting and Arctic Fox activities. Until boat travel was possible, we observed eider activity on Amaulik Island through a 20-40 x spotting scope from a camp on the mainland. We visited Amaulik Island on 28 June, 11, 16, 20, 23, 25, and 31 July, and 4, 12, and 24 August; we visited Tern Island on 16, 23, 25, and 31 July. Nests were marked by placing a numbered stake 0.5 m from each bowl. On Amaulik Island we kept records of all beach nests

on the southern half of the island and all nests in a 9.5 ha plot that encompassed about half of the main nesting colony. On Tern Island, we marked and kept records on all beach nests on the north end of the island and all those in a 0.5 ha plot encompassing half of the main colony. On each visit we recorded presence of down, and number of eggs, young, or eggshells. After checking a nest, we covered the eggs with down.

Throughout the summer we kept records of all fox sightings, noting date, time, location, and activity.

Results and Discussion

Common Eider flocks were first seen migrating by Icy Cape on 25 May. Eider pairs were first observed in melt water ponds on the mainland, and in overflow water on the lagoon on 4 June. We first observed eiders walking on Amaulik Island on 11 June, coincident with the development of an open lead in the lagoon. Schamel (1977) also noted that Common Eiders did not walk up on the nesting island until the ice sheet connected to the mainland was broken; he suggested that by thus delaying nesting, eiders avoid fox predation. At Icy Cape, however, foxes were able to reach Amaulik Island after the lagoon ice sheet melted. From Cape Island, foxes may have reached Amaulik Island via the Chukchi Sea ice, which remained packed against the barrier islands until early July, or by swimming the pass between islands (about 150 m). We observed a fox being mobbed by Arctic Terns on Amaulik Island on 19 June. On 28 June, fox tracks were found in the sand along the beach; they appeared to be 2-3 days old.

Table 1 summarizes the information on nesting chronology, clutch size, and nesting success in the two colonies. Nesting chronology at Tern Island was slightly earlier than on Amaulik Island. On Tern Island since clutches hatched 23-31 July, egg-laying occurred between 23 June and 2 July. This calcuaation is based on a 26-day incubtation period (Schamel 1977), and assumes that incubation begins after the third or fourth egg was laid (Schamel 1977; Belopol'skii 1957).

On Amaulik Island, egg-laying had begun by 28 June (our first visit). We examined 151 nest bowls on this date; 17 contained a single egg, 46 contained down, but no eggs. Since eiders do not line their nests with down until after laying the first egg and sometimes not until the clutch is complete (Cooch 1965, Schamel 1977), at least those 46 nests containing only down probably had been preyed on. Eggshells, evidence of avian predation, were found near 13 nests. Fox predation on nests had probably occurred also, as we found fresh fox tracks near the colony. On our next visit, 11 July, 84 of 244 nest bowls on Amaulik Island contained eggs. By 16 July, only 1 of 15 nests rechecked had an additional egg. Thus, egg-laying on Amaulik Island occurred between 26 June and 12 July.

Divoky (1978) reported eider egg-laying at Icy Cape occurred 18-27 June in 1976, which is about 10 days earlier than we observed. This difference may have occurred due to the cold and late spring during our study. The nesting chronology we observed is very similar to that observed by Schamel (1977) for an eider colony along the Beaufort Sea coast; his study was also conducted during a cold late summer (1972).

Mean clutch size on Tern Island, 3.8, was larger than on Amaulik Island, 2.9, but not significantly so (t-test, $p > 0.05$). Since

predation had occurred during early egg-laying on Amaulik Island, some of the clutches may have been renests. Smaller clutches are typical of eider renests (Schamel 1977). Clutch sizes on both islands in 1980 were significantly lower than 5.1 as reported by Schamel (1977). Divoky (1978) reported a mean clutch size of 3.8 in 1976 at Icy Cape.

On Tern Island young hatched from 43 of 125 nests (34%); 163 chicks were produced. On Amaulik Island, no eggs survived to hatch. Late in the nesting season, the Amaulik Island colony was destroyed by an Arctic Fox, which presumably reached the island by swimming Icy Cape Pass (Fig. 1).

We observed a fox on Amaulik Island near Icy Cape Pass at 0100, 23 July. When we approached within 300 m of the eider colony at 0300, we saw the fox in the midst of the nesting area. About 100 female eiders were gathered in a small lake at the edge of the colony, but most nests we could see through binoculars were still occupied by incubating birds. Two pairs of Arctic Terns and several Glaucous Gulls mobbed the fox. The fox occasionally jumped or ducked when a gull or tern swooped low over its back, but it continued trotting around the colony. The fox ran up each Elymus-covered sand mound looking for nests. Most incubating birds did not move off their nests until the fox approached within 2 m of their nests, then the bird flew or scrambled away. At each nest, the fox took one egg in its mouth, trotted 10-20 m away, dug a hole with its forepaws, dropped the egg in, then covered it by moving sand over the egg with its muzzle. Often the fox dug more than one hole before burying the egg. The fox buried each egg in a different place, but consistently chose sites on the southwest side of clumps of Honckenya peploides. It did not scent mark any of the spots, which

suggests that Arctic Foxes do not mark sites which contain food, similar to Red Fox (Vulpes vulpes) behavior as reported by Arehart-Freichel (1977). We were able to locate only two buried eggs later on; each was covered by about 4 cm of sand.

A female eider that did not flush until the fox was within 0.5 m of her nest was captured. When the eider finally flushed, the fox leaped in the air and snatched the bird by its tail. After a few seconds of struggling, the fox released the eider's tail and bit it around the neck. The fox ate the eider's head, then left the carcass and returned to flushing eiders and burying eggs. We saw the fox attempt (unsuccessfully) to catch two other eiders that flushed closely.

At 0600, we returned to camp due to deteriorating weather. During 3 h of observation, we saw the fox bury about 30 eggs, but it never ate one. We were unable to return for 36 h (25 July). Then, the colony was virtually deserted by eiders; but 50 females were on the beach. We checked all nests on the island; only two contained eggs. Down remained in some nest bowls, but had blown away from many. The two surviving nests were isolated on the far side of the lake adjacent to the colony. Since all other isolated beach nests were destroyed, it seems likely that the fox simply did not visit the beach on the far side of the lake. There were no eggshells to indicate avian predation, so we believe the fox was responsible for destruction of the entire eider colony. Based on the percent of active nests and mean clutch size in our plot, we estimated the fox buried 498 $\pm$ 42 (95% CI) eggs. In addition, six of seven Glaucous Gull nests were empty (15 eggs); the surviving nest was located on the same stretch of beach as the surviv-

ing eider nests. Surprisingly, the three Arctic Tern nests on the island survived, though they were in the midst of the eider colony.

Although we walked around the entire island on all visits, including four visits after the predation occurred, we only saw a fox or fox-sign on 28 June and 23 July. Divoky (1978) suggested foxes were living on some of the barrier islands, however, if the fox had been living on the island, eider nests would certainly have been destroyed before late incubation. Hence, we conclude that the fox swam to the island.

We have found only one account in published literature of swimming by Arctic Foxes. Childs (1969) reported a fox swam across a river after he startled it from a gravel bar where it was sleeping. We first observed Arctic Foxes swimming on 10 June in a saltmarsh pond adjacent to the lagoon. This fox swam a distance of about 3 m, then got out and rolled in the snow. On 12 June we saw two different foxes swimming large meltwater ponds on the lagoon ice as each crossed to the barrier islands. On 28 June, we observed a fox swim about 100 m from the mainland into the lagoon and return. The barrier island is 1.5 km from the mainland. Foxes often waded through water 10–20 cm deep and walked across the wide mudflats connecting the mainland and Cape Island. During May and June, foxes were observed crossing the mudflats almost daily. After reaching Cape Island via the mudflats, a fox would have to swim about 100–150 m across Icy Cape Pass to reach Amaulik Island.

Beetz (1916) and Gudmundsson (1932) hypothesized that the foul-smelling excreta of incubating female eiders is an adaptation to deter fox predation. When frightened from their nests, eiders eject this excreta over their eggs. This excreta has been shown to be unpalatable to rats and ferrets (Swennon 1968) and possibly deters crows (Corvus

cornone) from preying on eider nests (McDougall and Milne 1978). The fox preying on eider nests on Amaulik Island showed no obvious aversion to the fouled eggs. In a separate incident on the mainland, we observed a fox preying on a nest with heavy excrement covering. The fox picked up one egg, but quickly laid it down about 1 m from the nest. The fox then rubbed its nose on the ground and trotted around the area sniffing. It then returned to the nest, carried away and buried the remaining eggs. Despite its initial reaction, the fox then returned to the first egg, carried it away and buried it.

Conclusions

These observations suggest that colonial Common Eiders require nest site that are inaccessible to foxes. Under natural conditions, fox predation on island nesting colonies may be rare. The Icy Cape area may be unusual in that foxes are able to reach a barrier island in the summer via an exposed mudflat. Although we believe a fox swam over 100 m to reach the eider colony, it seems unlikely that a fox would swim 1-2 km of lagoon to reach a barrier island, as would be necessary in most areas. Additionally, 1980 may have been an unusual year. Due to a late break-up, foxes were able to reach the barrier island across the ice late into June after eiders began egg-laying and thus may have become aware of the potential food source on the island. Further, small mammal populations appeared to be at a low in the area, which may have forced foxes to exploit alternative food resources. Eberhardt (1976) found that the main prey items of Arctic Foxes on the north slope were Brown Lemmings (Dicrostoynx torquatus) and Collared Lemmings (Lemmus sibiricus), although birds and bird eggs were of secondary

importance in the summer. More years of observation are needed to determine whether fox predation on eider colonies at Icy Cape occurs regularly.

Our observations indicate that if foxes have summer access to any barrier island, they will be able to reach other islands by swimming. Oil and gas developers propose building access highways between the mainland and various barrier islands on the north slope. These highways will provide foxes year round access to the barrier island system (e.g., Errington 1961). Since highway access to one island may allow foxes to reach nearby islands as well, such highways pose a serious threat to Common Eider nesting colonies.

Acknowledgements

This study was funded by the U.S. Fish and Wildlife Service, Division of Ecological Services, Anchorage, Alaska. We would like to thank Dr. Dirk V. Derksen for providing us the opportunity to conduct the study and reviewing the manuscript. In addition, we thank the following people for critically reviewing drafts of the manuscript: Thomas C. Rothe, Douglas Schamel, Stephen O. MacDonald.

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Table 1. Nesting density, clutch size, and nesting success of Common Eiders on two barrier islands near Icy Cape, Alaska in 1980.

	Amaulik Island	Tern Island
Number of nest bowls on island	479	Unknown
Monitored nests		
in plot	244 (84)[1]	109 (68)
on beach	40 (18)	16 (12)
Nesting density		
island (bowls/ha)	4.9	Unknown
plot (bowls/ha)	25.8 (8.9)	218 (136)
Estimated Laying Dates	27 Je-12 Jy	23 Je-2 Jy
Hatching Dates	--	23 Jy-31 Jy
Clutch size		
mean (eggs/nest)	2.9	3.8
s	1.18	1.72
n	92	80
range	1-6	1-11
Nesting success		
chicks/nestbowl	0	1.3
average brood size		3.79 (1.50)

[1] Number of nest bowls containing eggs in parentheses.