BREEDING OF THE COMMON EIDER (*SOMATERIA MOLLISSIMA*) ON THE BEAUFORT SEA COAST OF ALASKA

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The Common Eider (*Somateria mollissima*) has a circumpolar breeding range. Throughout much of this area, these birds are confronted with mammalian and avian predators, as well as a brief nesting period. Even in the best of years in northern Alaska, habitat for nesting eiders is unavailable until mid-June. Fall freezes may trap the young from nests started after mid-July. Where arctic foxes (*Alopex lagopus*) occur on the nesting grounds, eider production can be severely reduced (Larson 1960). Glaucous Gulls (*Larus hyperboreus*) frequently steal eggs and commonly nest near eiders. This study investigates the interrelationships of eiders and gulls in a mixed colony, with emphasis on the breeding biology of the Common Eider. Adaptations to avoid fox predation are also considered.

STUDY AREA

Egg Island, Alaska is a barrier islet located at 70°26'N and 148°43'W on the Beaufort Sea coast (Fig. 1). It lies 8 km NW of Prudhoe Bay and 4 km NE of the Kuparuk River delta, an area mentioned by Anderson (1913) as supporting large colonies of breeding eiders on sandspits. During a survey of islands in this area in July 1971, I found Egg Island to have the greatest concentration of nesting eiders.

The island is relatively small (7.5 ha) and flat (max. elev. 1.7 m; Fig. 2A) and is comprised of sand and gravel. Vegetation is extremely sparse, both in species and coverage. Only four species of plants (Fig. 2B), sandbeach sandwort (*Honckenya peploides*), oysterleaf (*Mertensia maritima*), lyme grass (*Elymus arenarius*) and alkali grass (*Puccinellia phryganodes*), were found. Botanical nomenclature follows Hultén (1968). Overflow water from the break-up of ice in the Kuparuk River floods low areas of the island creating temporary ponds. These are used for loafing and drinking by eiders and other birds until July, when the ponds disappear.

From October to June the island is icebound. After spring break-up, the north shore becomes susceptible to the action of waves and ice. The instability of Egg Island was first noted by Leffingwell (1919); erosion washed away his beacon in less than three years. Although tidal fluctuations for this area average 15 cm, changes in wind direction and velocity can cause even greater variations in water level. Wind, ice, and currents constantly rework the island during summer and fall. These probably have the greatest long-range impact on the size and shape of the barrier islands. Fall storms can rapidly bring about short-term changes (Hume and Schalk 1967). As storm waters recede, scattered sticks and logs are left behind, above the high tide mark of late spring and summer, when storms are rare.

King Eiders (*Somateria spectabilis*), Arctic Terns (*Sterna paradisaea*), Glaucous Gulls and Black Brant (*Branta bernicla nigricans*) also nest on Egg Island.

METHODS

I studied the Egg Island colony for the summers of 1971–1973. In 1971 (7 July–12 August) I did not arrive there until after incubation was under way. Only during the 1972 field season (20 May–12 August) was I able to follow the nesting process from nest site selection to the departure of broods. Hence, most behavioral observations (430 of 480 man-hours for the two summers) rely upon data from a single summer. I worked alone in 1971. In 1972 I was aided by one assistant. Data from 1973 were supplied by R. Bergman, who visited the island twice during the nesting period.

Observations were made using a 20× spotting scope and 7× binoculars. A small tent was used as a blind during the first summer. To minimize disturbance to the birds, it was located 125 m NE of the growth of *Elymus* (Fig. 2B), at the center of the colony. At this distance, observations were often hampered by dense fog or heat waves. Activity within the blind immediately disrupted the birds.

In 1972, a small temporary building was erected on the island prior to the spring eider migration. It was located less than 30 m N of the center of the 1971 colony. Because I was concerned that human

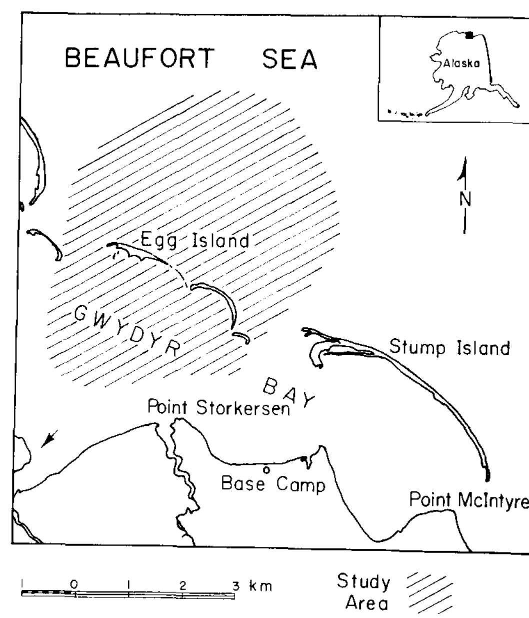

FIGURE 1. Central Beaufort Sea coast of Alaska, showing the location of the study area. The eastern tip of the Kuparuk River delta is indicated by the arrow southwest of Egg Island.

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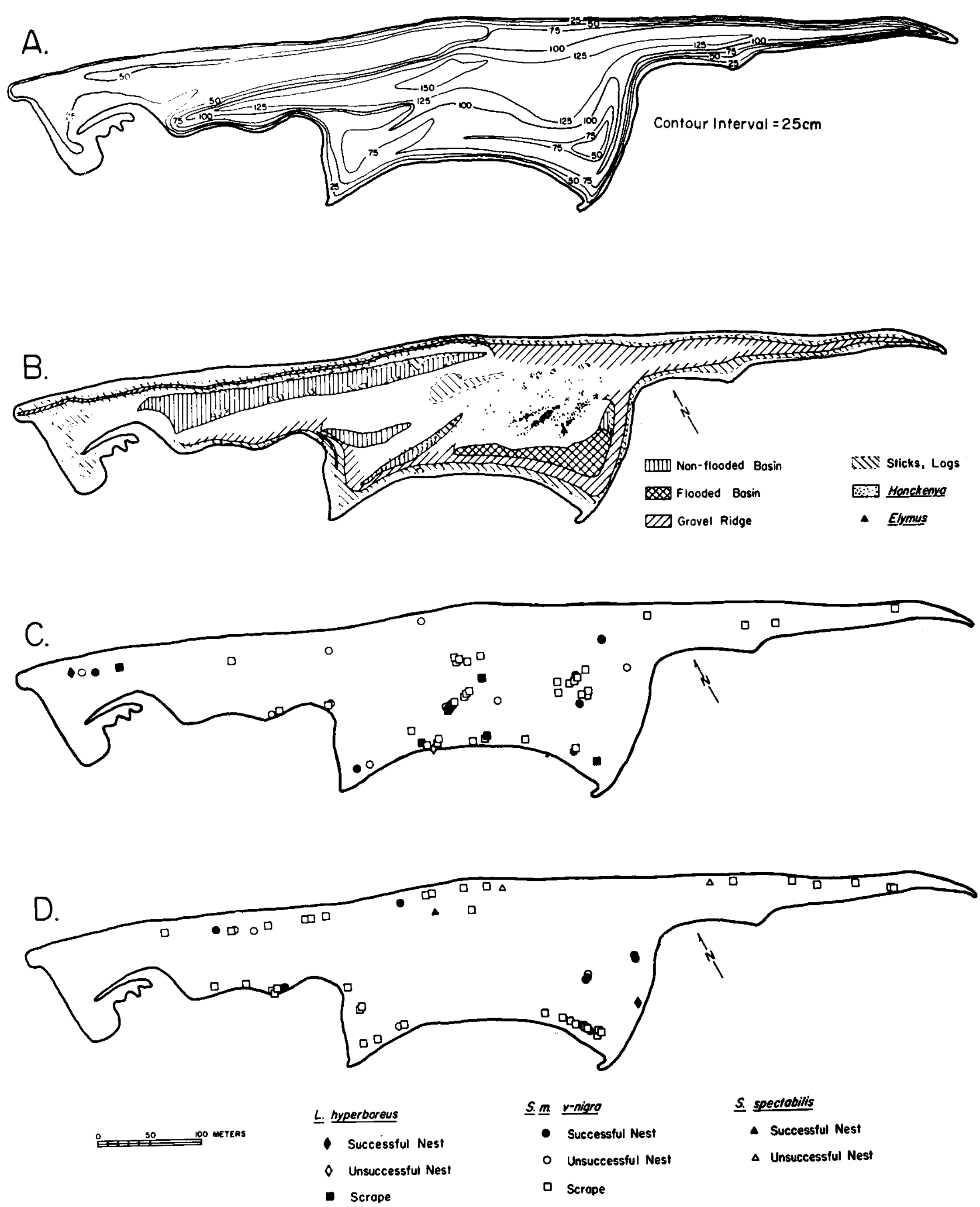

FIGURE 2. Egg Island, Alaska, showing: A. topography. B. major habitat features. C. 1972 utilization of nest sites used in 1971. D. utilization of new sites created in 1972.

presence might inhibit eider nesting attempts, I went outside the shelter as little as necessary. One eider nested within 10 m of the building. Behavioral observations were made on rotating 8-h shifts, as follows: 0800–1600, 0000–0800 and 1600–2400. Usually an observation week consisted of six days. During the first five days, six 8-h shifts were covered, while the sixth day was devoted to general observations. The two observers watched separate areas, which permitted fairly complete coverage of bird activities on the island. During the hatching period, a 24-h observation schedule was maintained in order to get as much information as possible.

In 1971, clutch size was determined by direct counts during incubation. In 1972, clutch size was estimated for all nests on the basis of the number of young leaving the nest, the number of eggs remaining in the nest, and known predation before hatching. A nest was considered successful if at least one egg hatched.

In this paper, "nests" denote sites where eggs were deposited and "scrapes" refer to nest forms in which no eggs were laid. "Depressions" is the collective term used to refer to both "nests" and "scrapes."

Common and King eiders appeared to have similar nest site selection criteria and nesting success. Therefore, data for the two species are pooled in many of my calculations and tables.

RESULTS AND DISCUSSION

ARRIVAL ON THE BREEDING GROUNDS

The single most important factor in the progress of Common Eiders toward their northern breeding grounds is apparently the availability of open water. In this study, the nearby Kuparuk River (Fig. 1) began to overflow on 1 June 1972, and the first pair of Common Eiders was observed the following day. At Wales, Alaska, Bailey (1948) noted that their first appearance coincided with the opening of leads. In northern Hudson Bay, Freeman (1970) recorded that eiders arrived within 24 h of the beginning of break-up.

The pre-laying period on the breeding ground is shortened through pair formation enroute or on the wintering grounds (Dement'ev et al. 1967, Freeman 1970, Schamel, pers. observ.). Little courtship activity was seen near Egg Island. Near the Bering Sea wintering grounds, Kenyon (1961) and McKinney (1961) noted Common Eiders pairing in early May.

NEST SITE SELECTION

Timing of nest searching and nest initiation. The timing of break-up near the breeding islands seems to govern the onset of nesting. Eiders appear to postpone nesting attempts until the islands are surrounded by open water. Although overflow dates for the Kuparuk River were essentially the same for 1971 and 1972, lower temperatures shortly afterward in 1972 retarded the melting process and postponed the break-up of ice surrounding Egg Island. The mean hatching date in 1971 was 19 July ±2 days; in 1972 it was 25 July ±2 days. This delay occurred despite the fact that the island was essentially snow-free by 14 June. Similar delays were reported that year for inland-nesting waterbirds (Bergman 1974).

Although Common Eiders had been seen in the vicinity of Egg Island since 2 June 1972, none ventured onto the island until the ice sheet connecting it to the mainland was broken. On 16 June, the southwest side of the island was ice-free. Four days later, the entire south shore was separated from the ice sheet by 5 m of open water. I saw the first pair of

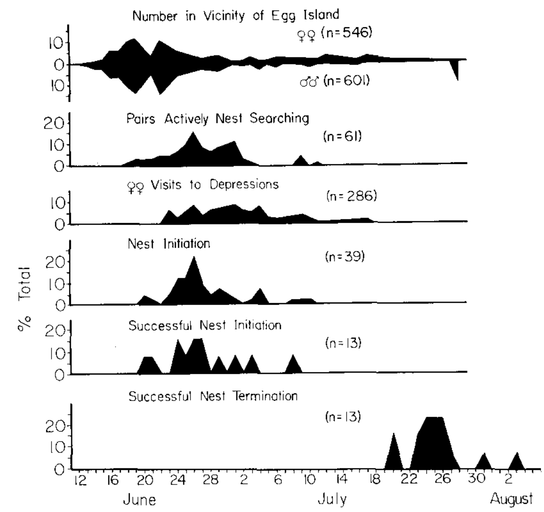

FIGURE 3. Chronology of main events of Common Eider reproduction during the summer of 1972.

Common Eiders on the island on 18 June. The first egg was laid two days later (Fig. 3).

In the Prudhoe Bay area, Common Eiders nest almost exclusively on offshore islands. They have been noted as regular breeders on such islands throughout their range (Gudmundsson 1932, Ahlén and Andersson 1970). The establishment of these nesting islands in the north has been attributed to the predatory activity of the arctic fox on the mainland (Lewis 1942, Larson 1960). Barry (1968) suggested that all waterfowl smaller than Black Brant cannot successfully defend their nests from this predator and are thus forced to breed in areas less accessible to foxes. Nest predation by arctic foxes on the mainland was significant during the years of this study (Bergman 1974), but I saw no foxes on Egg Island.

Male role. Male Common Eiders had little to do with nest site selection and defense. During nest searching, the male accompanied the female to potential nest sites. If aggressive encounters occurred at these sites, the outcome of bouts between females, not males, determined site ownership.

Early-nesting birds maintained their pair bond through the first few days of incubation, while late-nesting birds terminated theirs prior to or during nest initiation. The males of the two earliest nesting pairs remained close to their mates for five days after beginning a nest. One of these males defended a pond near the nest of his mate and a narrow corridor between it and the nest.

Male Common Eiders are showy birds, for their black crowns, flanks, breasts and bellies contrast sharply with their white heads, necks

TABLE 1. Cover types at nests with eggs incubated by Common and King eiders.

Category	% island coverage	1971 N	1971 %	1972 N	1972 %	1973 N	1973 %	Total N	Total %
Sticks, logs, old gull nests	10.0	12	70	12[b]	80[b]	14	60	38	70
Honckenya	0.0005	4	24	0	0	7	30	11	20
Elymus	0.000006	0[a]	0[a]	2	13	1	5	3	5
No cover	90.0	1	6	1	7	1	5	3	5

[a] Occupied by Black Brant prior to arrival of eiders.
[b] Includes one King Eider nest.

and backs. By abbreviating their stay near the cryptically-plumaged nesting female, males minimize the risk of attracting predators. However, birds that nest early in the season may have an opportunity to renest if their initial clutch is lost soon after incubation begins. It would therefore benefit early-nesting birds to maintain their pair bond until a second nest would no longer be feasible. Late nesters may benefit if the pair bond is brief and terminates when the female has a sufficient supply of sperm to fertilize the complete clutch of eggs.

Physical features. Eiders tended to choose sites that offered a visual barrier to predators, protection from the prevailing winds, and sufficient elevation to avoid flooding during normal shifts in water level. Sticks, logs, old gull nests and vegetation, whose locations are shown in Fig. 2B, provided both camouflage and wind protection. Little use of *Elymus* (Table 1) simply reflects the fact that only one small clump (0.5 m^2) of this grass exists on Egg Island. This was the location of the only nest site used in all 3 years. I consider *Elymus* to be the cover type most preferred by eiders. Freeman (1970) and Gudmundsson (1932) also considered this to be an important nest cover. *Honckenya*, with a total island coverage of 35 m^2, appeared to be the second most preferred nest cover. While no eiders nested here in 1972, these plants received much use in other years (Table 1). Although *Honckenya* does not provide the dense cover of *Elymus*, it may offer camouflage for nesting birds. When in their hiding posture (body flattened, neck outstretched and lowered), incubating Common Eider females superficially resemble the larger mounds of *Honckenya*. Sticks, logs, and old gull nests provided cover for the majority of nests (Table 1). However, they also comprised 10% of total island coverage. This cover type seems to be less preferred than those discussed above.

Eiders seem to prefer sites with cover affording some protection on the north side of the nest. Eighty-nine percent of the nests had protection on the north side, while protection on other sides ranged from 40% to 54% (Schamel 1974). Eiders may select for protection from the prevailing northeast wind, which could blow the down from unattended nests, leaving them exposed to predators.

Common Eiders located their nests within a 1 m range of elevation on Egg Island (Table 2). If wind protection was available, they nested fairly high (ca. 1.5 m above sea level) on the gravel ridges (Fig. 2A, B, C). At low elevations (ca. 30 cm) these birds appeared to be limited in their choice of sites, perhaps by dampness and proximity to water. Areas less than 20 cm above sea level are subject to flooding during normal summer storms. Regression analysis showed that eiders used significantly higher sites at the beginning of the season and lower sites later ($0.1 < P < 0.05$). This may be related to the moisture conditions of different elevations over time. In general, higher elevations become dry earlier.

Observations on pairs attempting to initiate a nest and on females with broods indicated that the distance to water is probably not important in nest site selection or success. Egg Island is so small that no point is more than 93 m from water.

Intraspecific aspects. Common and King eider nests were randomly dispersed ($0.05 < P < 0.10$, $N = 39$) in 1972, as shown by the

TABLE 2. Elevation above sea level of Common and King eider nests.

Nest category	N	Elevation (m) $\bar{x} \pm 95\%$ C.L.	Elevation (m) Range
1971 successful	17	1.07 ± 0.13	0.50–1.45
1972 successful[a]	15	0.78 ± 0.20	0.32–1.37
unsuccessful	17	0.70 ± 0.16	0.28–1.37

[a] Includes one deserted Common Eider and one successful King Eider nest.

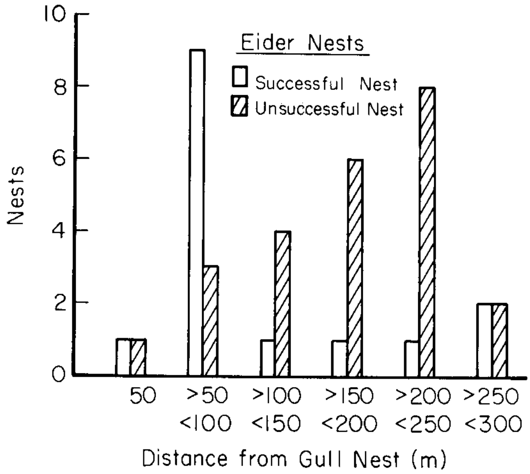

FIGURE 4. Location and fate of eider nests in relation to Glaucous Gull nests in 1972.

mean square successive difference test (Zar 1974). This test uses sequential nearest neighbor distances for nests at the time of their initiation. The nearest neighbor could be either in the laying or incubation stage. Distances also were measured from recently initiated nests to (1) the nearest incubated eider nest, (2) the next nearest incubated eider nest, (3) the nearest nest in the laying stage, and (4) the next nearest nest in the laying stage. None of these social parameters was found to be statistically significant in the ultimate success or failure of a nest. However, I did note that sites used earliest in the season received the most visits from pairs attempting to start nests. These sites also were visited regularly by nonbreeding females throughout the summer. In his Danish study area, N. E. Franzmann (pers. comm.) found that females fight for choice nesting places.

Interspecific aspects. Common Eiders and Glaucous Gulls co-exist as nesting birds. The gull is an effective predator of eider eggs, quickly learning the location of eider nests and actively hunting these areas. However, nesting gulls also defend their nests from avian predators. In doing so, they provide protection for eiders nesting within their territories by reducing the total number of potential predators. Eiders attempting to nest too close to gull nests appear to attract the resident gulls, thus losing the advantage of nesting within their territories (Fig. 4).

In 1972, gulls destroyed 67% (26) of the Common Eider nests, all during the laying stage. Sites frequently visited by eiders were routinely examined by gulls on patrol (a thorough search along a relatively regular route). During patrols, gulls sometimes flew from one depression to another without searching the area between. More often, they examined exact sites while searching generally along the high water line of debris. As this was well above the summer debris line, it was unlikely that the gulls were searching for carrion. In this area, gulls overturned mats of vegetation and small sticks and found some of the new nest sites, most of which were created in the debris (Fig. 2B, D). When a nest was located, it became one of the routinely visited sites. Unless a nest was occupied continuously or tended closely by an eider before it became part of a gull's regular patrol, its probability of success was very low. Only at one of five sites where nests were initially destroyed was there a successful subsequent nesting attempt. Milne (1974) noted similar predatory behavior in Carrion Crows (*Corvus corone*) hunting eider eggs in Scotland.

In 1972, gull territories covered areas of approximately 100 m radius surrounding their nests. The two gull nests on Egg Island that year were begun before eiders began to search for nest sites. The area just inside the gull territories (50–100 m) contained a greater density of eider nests than other sections of the island ($X^2 = 2.90$, $0.05 < P < 0.10$, N = 39). A significantly greater number of these nests was successful ($X^2 = 5.76$, $0.01 < P < 0.02$, N = 15) than expected by chance alone (Fig. 4).

Eiders apparently selected these protected sites only during the early nesting period from 20–25 June ($X^2 = 12.5$, $P < 0.005$, N = 11). After this date, site selection was random ($X^2 = 1.6$, $0.10 < P < 0.25$, N = 28). It is possible that older, more experienced birds nested earlier.

The adaptive significance of associations between gulls and waterfowl is still unclear. Some workers believe them to be advantageous for the waterfowl (Bourget 1973) while others consider these associations to be an "ecological trap" (Dwernychuk and Boag 1972), where waterfowl may produce numerous young that are subsequently eaten by neighboring gulls. My data indicate that eiders nesting within a narrow band near the territorial boundary of resident gulls benefit from the association, as suggested by Choate (1966). Similar predator-prey associations have been noted elsewhere. Common Eiders in the Aleutians have been found nesting near nests of the Peregrine Falcon (*Falco peregrinus*; Turner 1886). Snow Geese (*Chen caerulescens*) nest in association with Snowy Owls (*Nyctea scandiaca*) on Wrangell Island (Minyeev, cited in Portenko 1937).

INCUBATION PERIOD

Eider nests are most vulnerable to avian predation from the time when the first egg is laid until the beginning of incubation. During this period, the female returns to the nest only to lay additional eggs. Once incubation (continuous attendance) begins, it is virtually impossible for a gull to rob eider eggs.

Incubating females leave their nests infrequently and only for short periods. A total of 18 absences was noted for 10 different nests during the entire incubation period. This agrees well with Campbell's (1975) data. I suspect that incubating birds may leave their nests once every 4–5 days. In nine absences of known duration on Egg Island, the nest was vacated for 10 ± 5 min (R = 1–25 min). During these absences, females swam, preened, and drank at distances up to 200 m from the nest. Gull predation at such times was never seen. The female's absence may not have been noticed by gulls. Before departing, females covered their nests. Vegetation or debris near the nest also may have camouflaged the bird's absence. Significantly more absences occurred during the period 1201 to 1759 than expected by chance alone ($X^2 = 8.8$, $0.01 < P < 0.025$). This is the warmest period of the day, and females may need to replenish water lost during body temperature maintenance. Milne (1974) noted incubating females drinking on warm days. Heat loss from eggs would also be minimal at this time of day.

While on the nest, female Common Eiders are effective in defending their eggs from Glaucous Gulls. If a gull approaches within 0.5 m of the nest, an eider may actually attack the gull. Five such instances were recorded. Gulls were never observed to drive an incubating bird from its nest. In Spitsbergen, however, Campbell (1975) saw gulls driving incubating females from their nests and robbing eggs.

In this study, I have equated the continuous attendance of a female on a nest with incubation, but this is not necessarily true. If a female could attend the nest without incubating, the nest would be exposed to predators for less time. This could be accomplished by sitting either near the nest or on the eggs and postponing the development of the brood patch. The former has been noted as a protective adaptation against Carrion Crows in Scotland (Milne 1974). At one closely watched nest in this study, the female began continuous attendance after laying the third egg. This nest eventually contained seven eggs. At another nest, placement of down and continuous attendance both began after the last egg of a three-egg clutch was laid. Cooch (1965) reported considerable variability in the deposition of down, as well as in the onset of incubation. Some birds begin incubation after laying the first egg, but more commonly after three or four eggs have been laid (Milne 1963, Cooch 1965). However, incubation may not begin until after the last egg has been laid (Guignion 1967). The fact that eiders frequently begin continuous attendance at a nest several days before completing the clutch contrasts sharply with most other species of waterfowl, which usually delay such activity until after laying the last egg (Barry 1960, Erskine 1972).

Although most avian predators cannot dislodge incubating Common Eider females from their nests, most mammalian predators are able to do so (Barry 1968). When eiders are frightened from their nests, they eject foul-smelling excreta. Swennon (1968) demonstrated the unpalatability of this material to rats and ferrets. The expulsion of excreta may be an adaptation that deters predation by foxes (Beetz 1916, Gudmundsson 1932).

NEST TERMINATION AND NESTING SUCCESS

The mean date when nesting ended in 1972 was 25 July ±2 days. The first broods departed from Egg Island on 20 July; the last brood left on 4 August (Fig. 3). Ice may form in the bays in mid-September (Divoky et al. 1974), trapping non-flying young. This would affect broods that hatched after 10 August. Seven instances of nest termination were observed, and in all cases, the female led the brood to the Gwydyr Bay almost immediately. They remained in the island shallows and fed along the leeward south shore. Milne (1963) and Choate (1966) also noted that young broods fed in sheltered, shallow bays. Owing to dense fog during the hatching period, I was able to watch only three broods more than 2 h. Two broods remained near barrier islands for at least 12 h. The third brood crossed the island and swam out to sea although the pack ice was hard-pressed against the north shore. Broods were not harassed by gulls while enroute to water, which supports other studies (Dwernychuk and Boag 1972, Campbell 1975). Harassment of young eiders by gulls was never observed, although gulls probably did take some young eiders, away from the island (Campbell 1975).

In 1972, 33% of Common and King eider nesting attempts were successful, and 58% of the eggs hatched. The mean clutch size was 5.3 ± 1.3 eggs. An average of 1.5 young were produced per nesting attempt. My figures on nest success are similar to those of Paynter (1951), Gershman et al. (1964), Choate (1966) and Guignion (1967) for two islands. Hatching success on Egg Island was higher than the 39% reported by Choate (1966) and 13% by Guignion (1967) but lower than Milne's 95% success (1963). My figure on the production of young falls within the range reported by both Choate (1966) and Guignion (1967).

SUMMARY

Common Eiders breeding along the Beaufort Sea coast of Alaska have adapted well to the problems of a brief nesting period and predators. By arriving already paired at the time of break-up, they minimize the pre-laying period. These eiders appear to avoid fox predation by nesting almost exclusively on offshore islands and postponing nesting attempts until the islands are surrounded by open water. Only the earliest nesting birds maintain a pair bond through the first few days of incubation. This allows for rapid renesting in the event of predation. Females choose nest sites that offer camouflage, wind protection, and sufficient elevation to avoid flooding. Males are brightly colored, but by staying away from nests help to keep them hidden. Although eiders did not nest close together, they seemed to cluster just inside the territorial boundaries of Glaucous Gulls. These nests were more successful than those elsewhere in the colony studied.

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