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Autumn Arrival and Moult in King Eiders (*Somateria spectabilis*) at Disko, West Greenland

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ABSTRACT. Observations of King Eiders and their moult carried out at western Disko Island, West Greenland, July-October 1991 and 1992 showed two waves of immigration. The post-breeding males arrived mainly in early August in advanced body moult and undertook wing moult between mid-August and late September. Females arrived from mid-August and peaked in the second half of August. Females undertook body and wing moult from late August into October. A significant part of the females as well as males from the eastern Canadian Arctic appear to perform a moult migration to central West Greenland.

Key words: King Eider, *Somateria spectabilis*, moult migration, sex ratio, moult, West Greenland, Disko Island

RÉSUMÉ. Des observations d'eiders à tête grise et de leur mue faites de juillet à octobre 1991 et 1992, dans la partie occidentale de l'île Disko, située à l'ouest du Groenland, ont révélé deux vagues d'immigration. Les mâles ayant accompli leur tâche de reproducteurs arrivaient surtout au début d'août, dans un état de mue corporelle bien avancé, et la mue des ailes avait lieu entre mi-août et fin septembre. Les femelles arrivaient à partir de mi-août et leur nombre culminait durant la dernière quinzaine du mois. Pour les femelles, la mue du corps et des ailes commençait fin août et se poursuivait en octobre. Un grand nombre des femelles comme des mâles de l'Arctique canadien oriental semblait effectuer une migration accompagnée de mue vers le centre-ouest du Groenland.

Mots clés : eider à tête grise, *Somateria spectabilis*, migration accompagnée de mue, rapport mâles-femelles, mue, Groenland occidental, île Disko

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INTRODUCTION

In wildfowl and several other bird groups, the majority of the species shed their flight feathers simultaneously once a year, resulting in a period of flightlessness. At this critical time the birds withdraw to special areas where they are safe from predators and which have good food supplies and, for diving species, an adequate depth of water. If these requirements are not met at the breeding grounds, the birds move to areas farther away. For many bird species, particularly within wildfowl, this has resulted in mass movements of individuals towards restricted moulting areas ("the moult migration"), where the birds may gather in several thousands (Salomonsen, 1968).

In King Eiders *Somateria spectabilis*, the moult migration is highly developed. The species breeds in the high arctic regions (Cramp and Simmons, 1977), where the ice-free period is short. Thus, the birds leave the breeding grounds before they become flightless and move to low arctic regions to moult, where the risk of being "caught" by the new ice in the flightless stage is low (Salomonsen, 1968).

Central West Greenland, particularly the Disko Bay region, is one of the most important moulting areas for King Eiders in the Western Arctic. Between July and October some 100 000 post-breeding males and immatures of the eastern and central Canadian Arctic and Northwest Greenland undergo complete moult in the area (Salomonsen, 1968). The geographical position in relation to the breeding grounds, lack of ice in the moulting period, good food supplies, and a low predation rate (at least locally) appear to account for the crucial importance of central West Greenland as a moulting area for these populations (Frimer, 1994).

While the timing and major routes of the male moult migration to West Greenland are quite well documented (Abraham and Finney, 1986), the knowledge of the movements of females is incomplete and the principal moulting areas are unknown. According to Salomonsen (1968, 1979), the adult females do not participate in the moult migration to West Greenland. However, no detailed field studies have been carried out on this subject in West Greenland.

In the summers and autumns of 1991 and 1992 I spent several weeks on western Disko Island studying King Eiders. This paper describes the occurrence and progress of moult in King Eiders from July through October. The results provide new information on movements and moult of these populations.

The classification of plumages and moults follows the American terminology given in Palmer (1976), which was found more suitable than the European terminology (Ginn and Melville, 1983). Age is given in terms of calendar years.

In King Eiders, the moult from the breeding plumage (alternate plumage) into the "eclipse" plumage (basic plumage), called the prebasic moult, begins by moult of the head and neck, followed by the rest of the body, wing, and tail. The birds become flightless for about three weeks (for details see Schiøler, 1926; Palmer, 1976; Salomonsen, 1990).

King Eiders are highly gregarious birds outside the breeding areas (Cramp and Simmons, 1977). At Disko Bay the eiders spend virtually the entire day on the water (including ice floes). Foraging takes place near the coast, with peak intensity early and late in the day, while the birds usually rest some distance offshore during midday and midnight (Frimer, 1994).

STUDY AREA AND METHODS

The field work was carried out at the narrow fiords Akugdliit (Mellemfjord) and Kangersooq (Nordfjord) and

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at the bay Qasigissat, on western Disko Island (70°N, 55°W) (Fig. 1). These areas are rarely visited by humans in the ice-free period. The data were primarily collected in 1992. Some data from 1991 are included, but this season was mainly used for surveying.

In 1992 I camped 4–10 July at Qasigissat, 30 July–4 August at Kangersooq and 10–23 August, 28 August–3 September, 12–16 September and 1–2 October at Akugdliit. In addition in 1991 and 1992, several trips were made by research vessel along western Disko, with short visits to the study areas.

Most observations were made using binoculars and a telescope (20–60×) from elevated points near the coast, 100–2000 m from the eiders and up to 7000 m when counting numbers present.

King Eiders were counted around midday, when the feeding activity is minimal, in order to reduce underestimations due to birds being submerged. On 29 July 1992 the entire fiord of Akugdliit was surveyed from the vessel, while later counts here were made from the coast and covered only part of the area (Fig. 1).

Sex and age ratios and proportions of birds in body and wing moult were estimated 5–6 times regularly distributed over the period July–September 1992. Each ratio/proportion was calculated using data obtained from flocks selected at random over a period of at most three successive days.

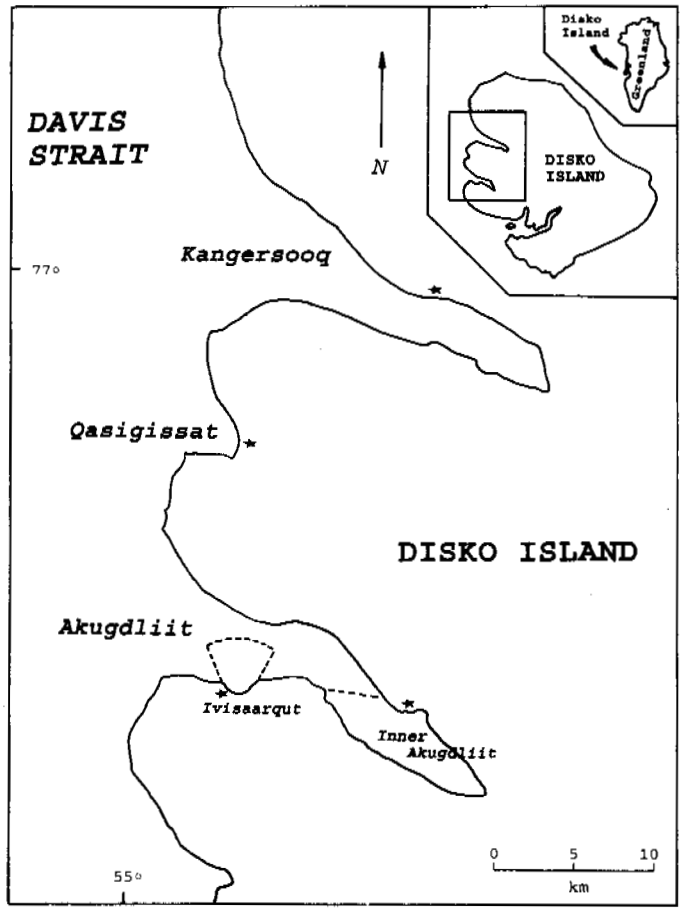

FIG. 1. Map of the study area, showing places mentioned in the text. ★ = camp site. Broken lines border the approximate areas covered when counts were made from the shore.

Observations were made over the widest range of flock size and observation distance as possible. The sample flocks ranged from 1 to 105 (mean 18) individuals.

Non-juvenile male King Eiders differ considerably from females in all plumages. Thus the birds could be sexed even at considerable distance, and all individuals in the sample flocks were sexed. Juveniles were not seen before mid-September.

Aging moulting King Eiders in the field was limited by two major problems: 1) the observers were unable to distinguish between age classes in basic plumage birds of either sex, and 2) females arrive at Disko in worn (pale) plumages, when the plumage characteristics of the age classes are reduced. Hence, only males with at least some discernible alternate plumage feathers retained were aged; second-year males were classified as immatures, and older males as adults. King Eiders may not reach maturity until their fourth year (Palmer, 1976).

Due to the considerable difference in general colouration between the alternate and basic plumages of adult males, the body moult is conspicuous. Four plumage phases were recognized: 1) adult males in alternate plumage; 2) adult males in prebasic body moult with new feathers on chest and/or head and neck, but with some discernible alternate feathers retained on these parts of the body; 3) immature males in alternate plumage, or with at least some discernible alternate feathers retained; and 4) males in basic plumage with no alternate feathers discernible, which includes adults and immatures in late and completed body moult. In the sample flocks all males were recorded, and their plumage was classified.

Observations on wing moult were primarily carried out on flocks foraging near the coast. The stage of wing moult was ascertained by observing the remiges when the birds were flapping the wings. Individuals with flight feathers just shed or with flight feathers that could be discerned as not fully developed were classified as moulting, and birds in which wing moult could not be discerned as not moulting. The latter are either non-moulting or have nearly completed flight feather growth. This method was introduced by Piersma (1987) in a study of Great Crested Grebes *Podiceps cristatus*. The sex, age of alternate plumage males, and stage of wing moult of each eider seen wing flapping were recorded.

To examine whether the estimated proportions of birds in wing moult were biased by differences in wing-flapping frequencies between moulting and non-moulting eiders, these frequencies were measured by focusing on single individuals and small subgroups (N) of eiders of known stage of moult. In each individual or group of individuals the number of wing flaps (F) was recorded within a time period (T), timed in minutes. The wing-flapping frequency, expressed per hour, was calculated by dividing the total number of recorded wing flaps by the sum of time spent observing each of the N individuals ("bird-minutes"): $60 \times \Sigma F/\Sigma(N \times T)$.

The Common Eider *Somateria mollissima* occurred in comparatively low numbers in the area and were almost exclusively males. The two eider species were distinguished by plumage and, at a distance, by profile and body size.

RESULTS

Time of Arrival

The numbers of King Eiders recorded in Akugdliit during 29 July–2 October 1992 are shown in Table 1. In late July a total of 560 birds was present in the area; all birds occurred at Ivisaarqut and in the inner parts of the fiord (Fig. 1). During August and the first half of September numbers increased considerably, and the birds became scattered over all of the area. In mid-September 1610 birds were counted in the inner parts of the fiord. Assuming that by this time at least 200 birds were present at Ivisaarqut, and that the figures given in Table 1 are somewhat too low because some birds most certainly were submerged during counts, the total number of King Eiders in these two areas may have been around 2000 individuals. Flocks occurring elsewhere in Akugdliit were not counted (except in early July), but hundreds of birds were seen here from the vessel in September. With this background, the total number of King Eiders in Akugdliit is estimated to be 2200–2400 individuals in mid-September. Considering that moulting King Eiders are extremely shy, the numbers recorded in early October may not be representative, because the birds were disturbed by a boat on the night before counts were made.

Similar buildups were recorded in other areas of western Disko: at Qasigissat, 160 King Eiders in early July 1992, 70–80 in mid-July 1991, and ~500 in the third week of September 1992; at Kangersooq, ~300 individuals on 20 July 1991, ~400 on 2 August 1992, and >1000 in the third week of September 1991 and 1992.

Between early July and mid-August the proportion of adult males increased, with the highest increase during the first half of August (Fig. 2). As the estimated age ratios are based on males in partial or full alternate plumage, and immature males on average attain basic plumage earlier than adults (see later), this increase may actually be somewhat lower than Figure 2 suggests. During the second half of August an influx of females took place, resulting in a significant shift in the male:female ratio from ~3:1 in mid-August to ~1:1 by the end of the month.

The influx was conspicuous at Ivisaarqut, where several flocks of up to 55 individuals, consisting almost exclusively of females, were seen moving into the area between 15 and 23 August 1992. A similar pattern was observed in 1991 during my stay at Ivisaarqut on 13–16 and 25–26 August. From mid-August in both years, a few females were recognized as being adults, but the age ratio in females is unknown. To obtain further evidence of the occurrence of adult females, 18 females collected in Akugdliit in September and early October 1991 and 1992 were dissected for analysis of stomach contents. Of these, 15 were adults and 1 was immature, while 2 were in full basic plumage and were not aged. Twelve (80%) of the adult females had 4–10 mm wide and somewhat convoluted oviducts, indicating that they were post-breeders. The remaining 6 females had straight and up to 4 mm wide oviducts.

Low numbers of juveniles were seen from mid-September in both years, in groups of up to four individuals.

TABLE 1. Numbers of King Eiders recorded in two areas of Akugdliit in 1992

Date	Ivisaarqut	Inner Akugdliit
29 July	70	490
11 August	220	—
17 August	200	—
29 August	—	1250
13 September	—	1610
2 October	320	1100

Time of Moult

Adult males initiated body moult from early July, with peak numbers in mid-August (Fig. 3). By the end of August the great majority had achieved basic plumage. Immature males probably initiate body moult earlier than adults because, by 20 August, all immature males had achieved basic plumage.

Estimated proportions of males in wing moult showed a peak occurring about 1 September (Fig. 4), two weeks after peak proportion in body moult. Most adult males undertook wing moult between mid-August and late September. Most immature males initiated wing moult by mid-July (Fig. 4). A similar and even more pronounced pattern was observed in females (Fig. 5). The drop in the proportion of wing-moulting females in mid-August is, to a large extent, due to the arrival of presumably adult pre-moulting females. On 2 October the majority of the males had regained flight capability, while a high proportion of the females were flightless.

As shown in Table 2, the likelihood of observing wing flapping and recording a non-moulting King Eider is an estimated 1.75 (8.4/4.8) times higher than the likelihood of observing wing flapping in a moulting eider. The adjustment figure of 1.75 should be treated with some caution, because the wing-flapping frequency may also vary with the state of

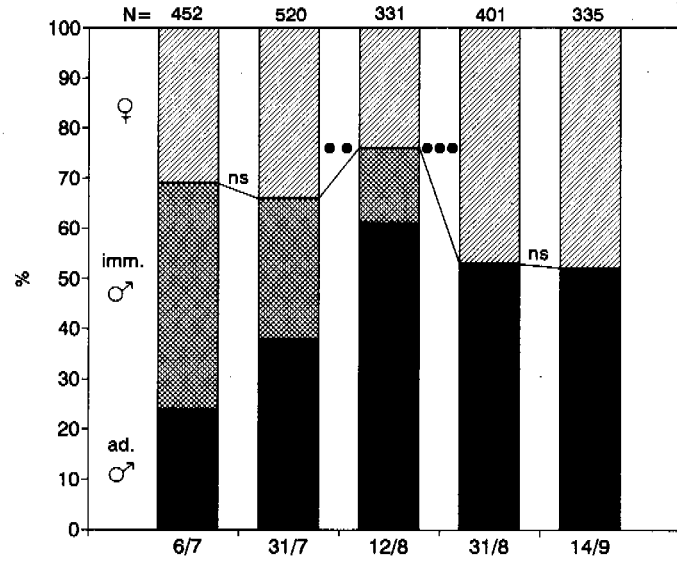

FIG. 2. Variation in estimated sex ratio in King Eiders during July–September and in age ratio in males (of those aged) during July and mid-August. Females = hatched; immature males = cross-hatched; adult males = shaded; all males (including adults and immatures) = solid. The number of recorded birds (N) is shown above each column. Sex ratios between successive observation periods were compared by means of a 2×2 contingency table: ns = not significant ($P>0.05$); •• = $P<0.01$; ••• = $P<0.001$.

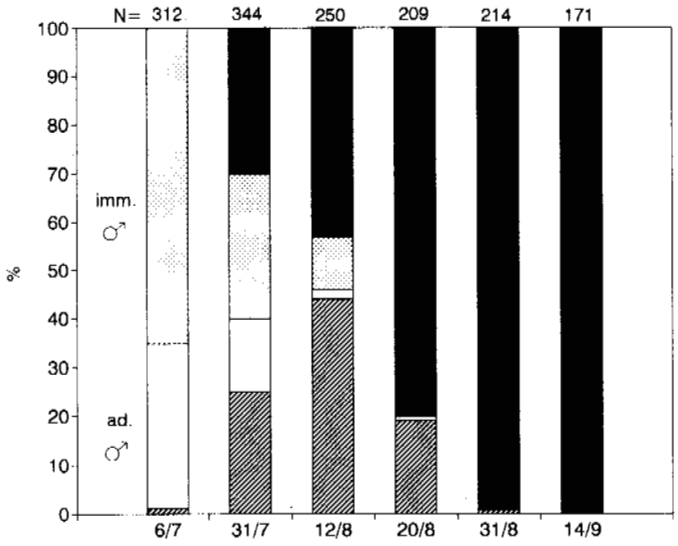

FIG. 3. Estimated proportions (%) of adult male King Eiders in alternate plumage (open) and prebasic body moult (hatched); immature males in partial or full alternate plumage (cross-hatched); and males, including adults and immatures, in basic plumage (solid), during July–September. The number of recorded birds (N) is shown above each column.

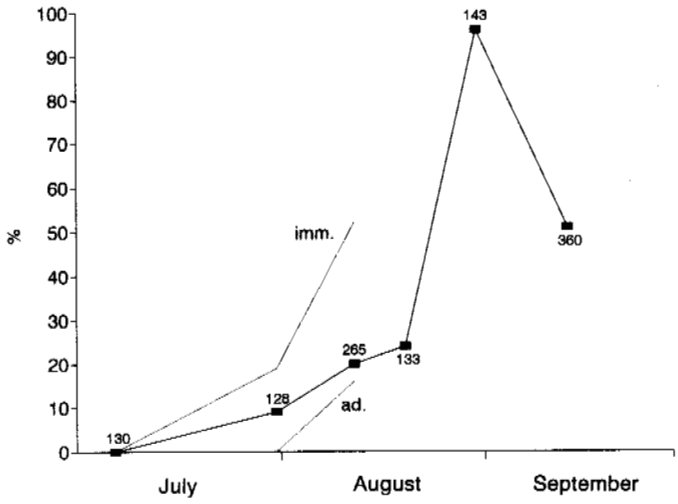

FIG. 4. Estimated proportions (%) of male King Eiders in wing moult during July–September (solid line). Broken lines show the estimated proportions of adult and immature males (of those aged) in wing moult. The number of records is shown for each data point.

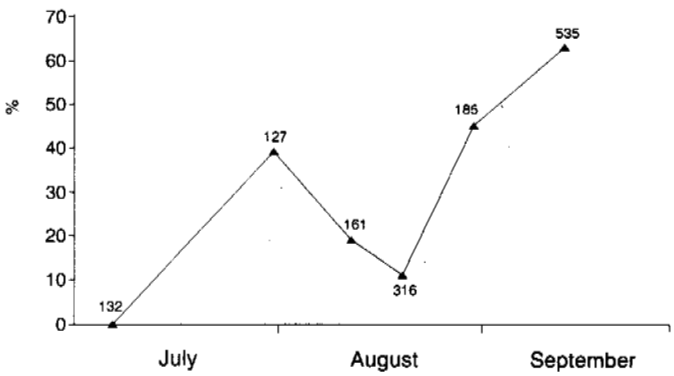

FIG. 5. Estimated proportions (%) of female King Eiders in wing moult during July–September. The number of records is shown for each data point.

TABLE 2. Wing-flapping frequencies measured as the number of wing flaps per bird hour in foraging wing moulting and non-moulting King Eiders

	N	Total observation time (min)	Wing-flapping frequency
Moulting	15	167	4.8
Non-moulting	34	218	8.4

N = the total number of birds observed. Total observation time = the sum of time spent observing each of the N individuals.

primary growth, and most moulting birds in our data had just recently shed their flight feathers. It does indicate that the proportions given in Figures 4 and 5 are probably underestimated.

DISCUSSION

In Akugdliit the number of King Eiders increased during August and peaked in mid-September following the influx of females. This timing of peak arrival is about a month later than reported by Salomonsen (1968), who did not observe adult females.

Arrival and Moult in Males

The sex and age ratios estimated in early July (Fig. 2) agree with previous records from Disko from the same period (Frimer and Nielsen, 1990). At this time of year most adult males occurring at Disko are probably non-breeders (Salomonsen, 1968). The arrival of post-breeding males began sometime in July and peaked in the first half of August, which is typical at Disko (Salomonsen, 1968) and in good accordance with records from the major moult migration routes in the eastern Canadian Arctic across central Baffin Island (Wynne-Edwards, 1952; Watson, 1957) and through Lancaster Sound (McLaren and McLaren, 1982).

The estimated proportions of males in body and wing moult (Figs. 3, 4) indicate that most post-breeding males arrive at Disko in well-advanced body moult and initiate wing moult shortly after arrival. Immature males, of which many may have spent the summer in the area (Salomonsen, 1968), initiate body and wing moult perhaps up to two weeks earlier than adults.

Arrival and Moult in Females

The proportion of females appears to have been rather stable through July. Assuming that the majority of the adult females are at the breeding grounds in this period (Palmer, 1976) and considering that the number of King Eiders in the same period increased in the study area, a regular increase of non-breeding females may have taken place. Most of these females are probably immatures that spent the summer south of their potential breeding range (Salomonsen, 1968). These birds initiated wing moult in July, perhaps even earlier than the immature males.

The influx of females in the second half of August included adult birds, as evidenced by the estimated sex ratios, the proportions of females in wing moult, and the dissection of birds. Most of these females undertook wing moult from late

August into October. The time of arrival of this cohort of females falls perfectly into the pattern of moult migration of females observed in the eastern Canadian Arctic. McLaren and McLaren (1982) reported up to 25 000 females (presumed to include both King and Common Eiders) passing eastward through Lancaster Sound and along northern Baffin Island in mid-August. Other studies have also reported large numbers of females moving through Lancaster Sound in August (Abraham and Finney, 1986). The principal moulting area(s) of these females has hitherto been a matter of speculation. Dalgety (1936) observed thousands of females along the Eglinton Fjord–Clyde Inlet coast of eastern Baffin Island in mid-August 1934. Salomonsen (1968) stated that they "probably intended" to spend the flightless period there.

The present data suggest that a significant part of the females from the eastern Canadian Arctic perform a moult migration similar to the post-breeding males of these populations; females also move across Davis Strait to undergo wing moult in central West Greenland. Whether this indicates a recent change in the migration pattern of females, or that the adult females simply have been overlooked, perhaps due to their arrival in worn alternate plumage, is a matter of speculation. More work needs to be done to obtain data on yearly variations in time of arrival and moult of females in central West Greenland.

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