OVERLAND MIGRATION BY COMMON EIDERS OF THE ST. LAWRENCE ESTUARY

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The Common Eider (*Somateria mollissima*) is an abundant summer resident on and around the islands of the St. Lawrence estuary (Fig. 1). The birds usually arrive in early April and leave by mid-November. Band recoveries indicate that the wintering grounds of this population extend from southern Nova Scotia to Massachusetts and that migration is a gradual movement through Cabot Strait and along the southeast coast of Nova Scotia (Reed 1975). Some banding data and circumstantial evidence led us to believe that a more direct overland migration route might be used by some birds. That overland route, including a 300 km stretch over dry land, represents a distance one-fifth that of the route through Cabot Strait (450 versus 2350 km, total distances from center of breeding area to winter grounds).

In this paper we examine (1) the historical evidence which indicates the presence of an overland route, (2) the numbers and status of eiders undertaking the overland trip, (3) their behavior preparatory to the overland flight and (4) the possible significance of the alternative migration routes for this sea duck.

STUDY AREA AND METHODS

From 1963 to 1973, 2200 eiders were banded with conventional aluminum-alloy leg bands on a number of islands in the St. Lawrence estuary (Fig. 1). Our banding effort was evenly spread between islands on either side of the Saguenay River. In 1972 and 1973, 1400 were color-marked (in addition to leg bands) with patagial tags and sometimes leg streamers to permit individual recognition. Of the total marked birds, 97% were adult females.

Preliminary observations in 1972 and discussions with local residents made us select Anse-à-Giles, a small locality 3 km downriver from Cap-Saint-Ignace (Fig. 1) as the best vantage point for observing migrating eiders. Intensive observations were conducted from there between 2 October and 9 November 1973. During 29 of the 37 days, uninterrupted watches were kept from dawn till dusk and any eider movement quantified. On 4 of the remaining days, associate observers noted the passage of migrants without quantifying it. Weekly aerial surveys were also conducted in the estuary in the fall of 1973.

Weather records were obtained from the meteorological station at the Quebec (Ste. Foy) airport, 64 km SW of our observation post at Anse-à-Giles. Repeated observations at the latter site indicated no appreciable differences from the data provided by the airport records.

RESULTS

Historical evidence for an overland route.—As early as 1938, flocks of eiders were recorded in the inner estuary (near Montmagny) during the fall

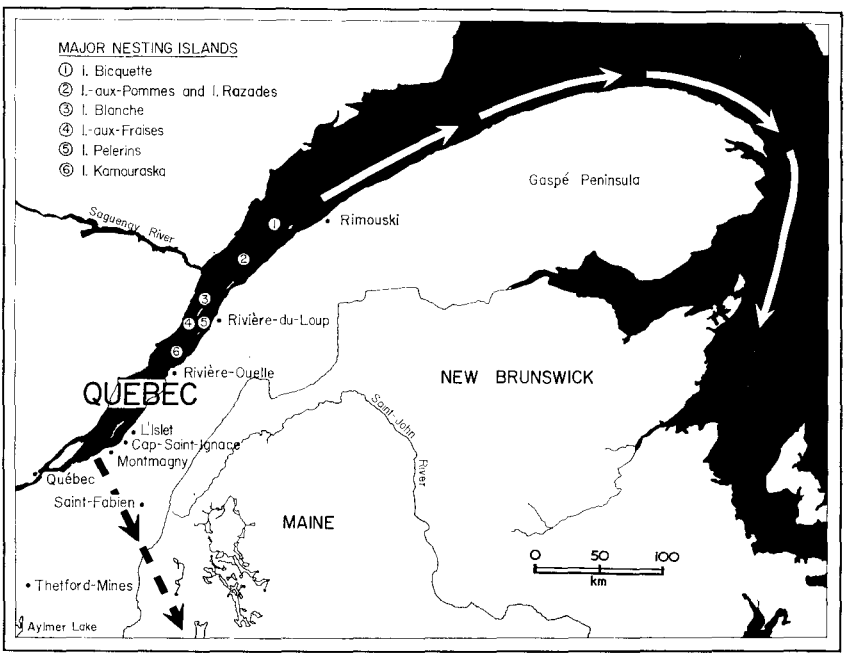

FIG. 1. The St. Lawrence estuary and the major nesting islands used by the common eider. The map shows the 2 migration routes discussed in the article. The position of either arrow is generalized and approximate.

(Lewis 1939). Only recently, band recoveries have shown that these birds belong to the breeding population of the estuary. The presence of eiders in this location, roughly 160 km upriver from the center of the breeding area would not be expected if all individuals followed the coastal route indicated by previous studies (Reed 1975).

H. Mendall of the Maine Cooperative Wildlife Research Unit speculated, on the basis of fall observations he made in Quebec during the 1950's, that an alternate overland route existed between the inner portion of the estuary and the coast of Maine. Thus, on 23 October 1958, he noted a flock of 300–400 eiders leaving the St. Lawrence river at a point about 15 km west of Montmagny and disappearing high overland in a southeasterly direction (pers. comm. to Reed).

Resident game wardens were aware of the presence of eiders in the area in the fall and of their flights inland from the St. Lawrence. Further, on 31 October 1972, A. Bourget of the Canadian Wildlife Service (pers. comm.) observed a flock of about 550 eiders flying inland in a southeasterly direction

TABLE 1

NUMBER OF COMMON EIDERS PASSING AT ANSE-À-GILES IN THE FALL OF 1973[a]

Date	Number of eiders flying				Net number of eiders flying SW
	SW		NE		
	Flocks	Birds	Flocks	Birds	
Oct. 6	8	388	1	6	382
7	9	258	1	55	203
8	4	930	2	550	380
9	4	324			324
11	1	45			45
18	6	2880	1	60	2820
19	7	3975	2	2150	1825
20			1	1000[b]	
21	1	100	4	153	
22	2	390			390
25	9	2732			2732
26	1	261			261
27	6	1599			1599
28	10	2274	1	1721	553
Nov. 4	1	72			72
5	1	178	1	27	151
TOTALS	70	16406	14	5722	11737

[a] Flocks under 100 were counted individually and presumably carry no error. For flocks larger than 100 and smaller than 200 we assume a confidence interval of 15% and above 200 a confidence interval of 30%. So, the total migrants for a day may exceed 100 or even 200 and carry no error if the total was made up of several flocks smaller than 200 that could be counted singly.

[b] These birds were counted on water during low tide.

near Montmagny. He was able to follow the flock 6.4 km inland from the shore at which point it broke up with one group (250 birds) returning to the St. Lawrence and the other (300) maintaining a SE bearing until out of sight.

On 4 November 1972, a banded eider was shot by a hunter on Lake Aylmer, 130 km south of Quebec City. When questioned on the presence of eiders in that area, the hunter reported that small numbers occurred regularly each fall. Furthermore, on 27 November 1973 a female eider color-marked by us the preceding June on Ile aux Fraises was found dead on the shore of Lake William, 25 km north of Lake Aylmer.

Evidence of the use of this route by spring migrating eiders is restricted to the following observations. H. Mendall has observed flocks following the Penobscot River northwards in the spring (pers. comm.). J.-P. Savard (pers. comm.) sighted eiders on a lake about 60 km inland south of Montmagny

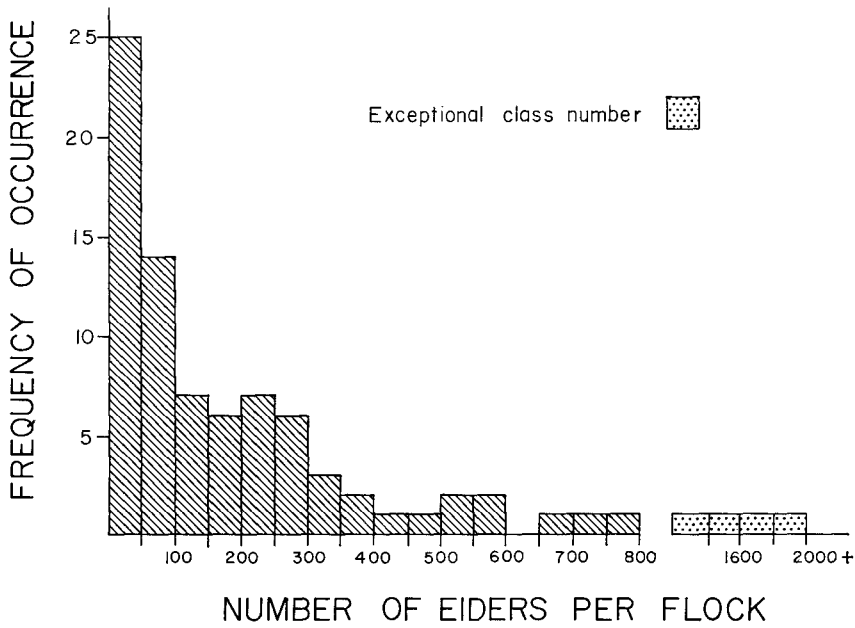

FIG. 2. Net number (only birds heading SW) of individuals in eider flocks passing at Anse-à-Giles in October and November 1973. Note change of scale on the X-axis beyond the 750–800 class.

on 22 May 1967. One male in nuptial plumage was found dead 40 km inland east of Montmagny on 31 March 1974. Finally, eiders are sighted regularly in late April on the St. Lawrence River between Montmagny and Quebec City (at this time, the maritime estuary and the southern part of the gulf are frequently ice-jammed, while the estuarine area near Montmagny is consistently ice-free).

The exact route of the inland corridor has not been determined as inland tracking of the migrating flocks was impossible. Two factors hindered observation: the absence of access roads and the occurrence of migratory activity during the twilight period.

Numbers and status.—Net numbers of eiders moving west beyond our vantage point were assumed to represent total numbers of birds about to engage in overland migration; we estimated that roughly 12,000 eiders used that migratory route over the period of observation (Table 1). Single eiders were seldom seen but modal flock size was fewer than 50 birds, while 78% of all flocks contained fewer than 300 individuals (Fig. 2).

Inspection of Table 1 reveals the existence of a seasonal peak of migration

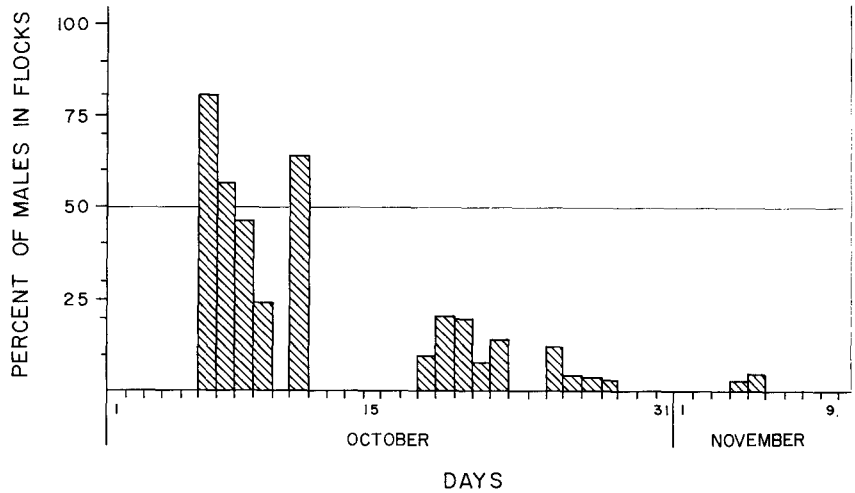

FIG. 3. Sex ratio in eider flocks seen at Anse-à-Giles during October and November 1973. Sample size as in Table 1.

between 18 and 27 October, with more than 80% of all the birds passing during that period.

The sex ratio in the flocks of migrants changed markedly as the season progressed (Fig. 3). In early October the number of males was higher than the number of females but by the last week in October and the first week in November, the number of females constituted 95% of the migrants.

The age of the birds in flocks could not be ascertained by direct observation. However, examination of eider wings received in the annual harvest surveys of the Canadian Wildlife Service in 1972 and 1973 indicated that all 8 birds killed in the vicinity of Montmagny were adults while only 24 of 88 birds killed east of Kamouraska were adults.

Seventeen sightings and recoveries of marked eiders were made in the upper St. Lawrence estuary. All but one of these birds had been marked on islands west of the Saguenay River.

All the birds seen or collected in the upper estuary in early fall were capable of flight. On the other hand, a substantial proportion of the birds seen or collected in the region east of Kamouraska during the same period had not completed the molt of the primaries: 35 of 88 eiders (40%) obtained during the 1972 and 1973 hunting seasons were not capable of flight.

Behavior.—The majority of flocks observed over the St. Lawrence at Anse-à-Giles behaved in a stereotyped manner: the birds flew low over the water in a compact group of variable formation (often comet-shaped). Eiders rest-

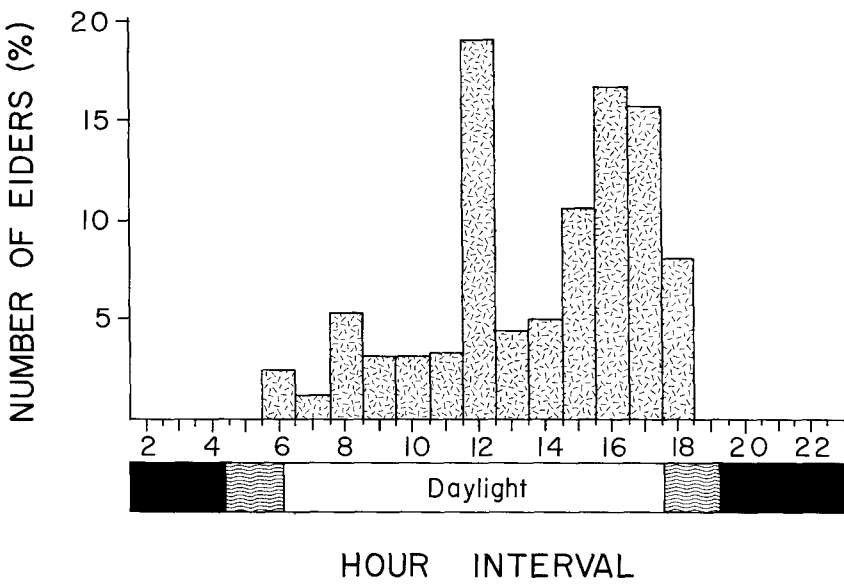

FIG. 4. Proportion of total number of eiders (21,128) involved in migration according to hourly intervals (EDT). Length of day adjusted to 6 October.

ing on the water maintained compact flocks, slowly drifting towards shore. They were never seen to feed and only rarely did they accompany other species.

On 3 occasions, we watched flocks initiating overland flights. In each instance, the flock hesitatingly circled over the shoreline while gradually gaining altitude. Once a few hundred meters high, the flock established a steady bearing (SE) which it maintained as long as it remained visible.

There was a tendency for flocks to pass along the St. Lawrence near our observation post during the afternoon. Thus, 62% of the flocks passed between 12:00 and dusk (about 18:15 in October) and 45% between 14:00 and dusk. The same tendency is also explicit when one examines the numbers of eiders involved in such flights (Fig. 4). However, all observations of departure on overland flights were made just before or during the evening twilight period. This contrasts markedly with Bourget's observation where the flight occurred at 08:30. We also observed a flock heading towards the St. Lawrence one morning, apparently returning from a night inland. This observation suggests that possibly some flocks observed initiating overland flights did not complete their migration on that same occasion.

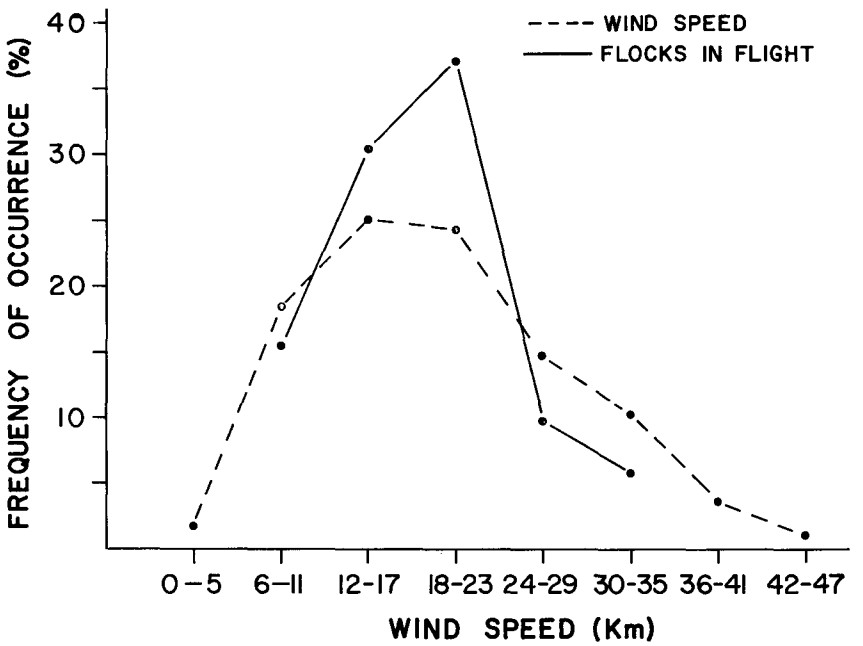

FIG. 5. Frequency of wind speed (km/h) and flight activity of eiders.

To examine the effects of weather on migratory activity we compared our data on flock behavior at Anse-à-Giles with the following weather variables: wind direction and speed, barometric pressure, cloud cover or insolation, and air temperature.

Migratory activity was observed irrespective of wind direction; yet, more than half of the flocks migrated with SW and W winds. At our observation post, birds flying in that general direction (SW, W) are heading upriver; hence, headwinds seem to be preferred by the eiders but only when relatively light to moderate (12 to 23 km per hour); headwinds above 24 km per hour seem to hinder most migration (Fig. 5).

A negative relationship clearly existed between cloud cover and eider movement; but overcast, as measured at the local weather station was expressed in a complex 4-point scale which rendered the correlation analysis rather cumbersome. Another independent variable expressing the same phenomenon, the number of hours of bright sunshine per day, produced a very strong positive relationship ($r = 0.789$, $P < 0.001$) between daily amounts of sunshine and eider movements (see Fig. 6).

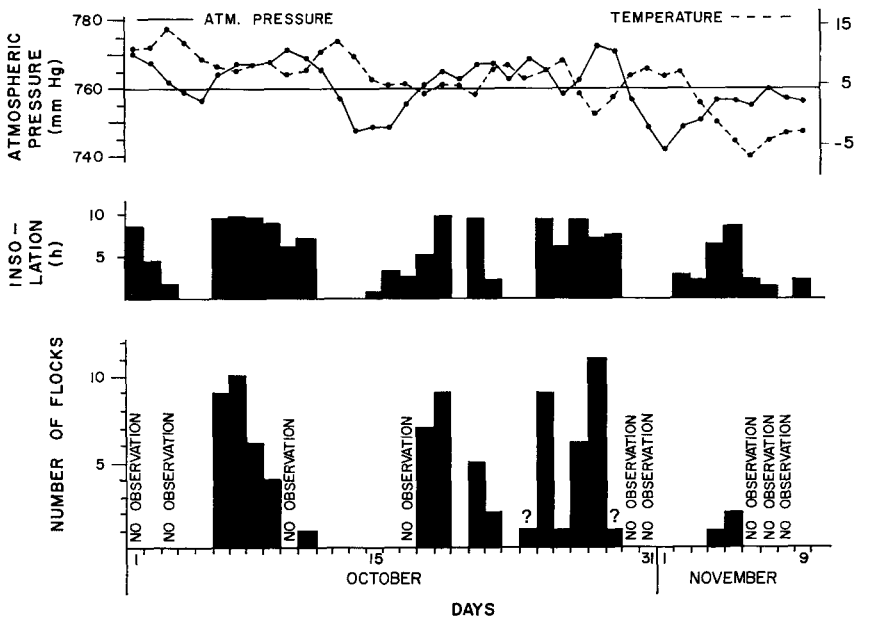

FIG. 6. Insolation (number of hours per day), temperature (daily average in °C) and barometric pressure (daily average in mm Hg) in relation to migratory activity of eiders at Anse-à-Giles. On 24 and 29 October, observations covered only a part of the day, hence the question marks.

A positive correlation was also found between absolute barometric pressure and the degree of migratory activity ($r = 0.583$, $P < 0.01$). As a rule, a rise in barometric pressure was a sure indication of recurring migratory activity while stable high pressure seemed to favor continuous movement (Fig. 6).

When considered individually, atmospheric pressure and insolation account for an important proportion of the variance in the migration data, but, obviously, the 2 are not independent, being different expressions of the same weather system. Further statistical analysis indicated that the increase in the amount of variance explained by adding the action of barometric pressure to that of insolation is not significant. Therefore, insolation is considered the best single predictor of migratory activity in eiders in the present situation.

No relationship was found between the number of flocks passing during a given day and average air temperature for that day. However, several pulses of migration occurred following periods of a few days during which the temperature had been falling (Fig. 6).

DISCUSSION

The Common Eider has been known to make inland flights for some time (Tufts 1962, Boyer 1966) but the documented cases involved short overland journeys of a few kilometers at the most, as for instance over the Isthmus of Chignecto between Nova Scotia and New Brunswick. The migration discussed in the present paper is clearly of a different nature.

Fall movements did not begin to any appreciable extent before October and reached a peak between 18 and 27 October. There was no evidence that the large numbers involved in the late October flights had accumulated in the area during the preceding weeks. Aerial surveys during September and October rather revealed the presence of numerous small scattered flocks between Montmagny and Riviere-Ouelle, all heading west.

The dominance of males among early migrants (Fig. 3) may be accounted for by their earlier postnuptial migration and molt, soon after the females begin incubation (Bent 1925). Shortly after, females that have lost their clutch or their brood early after hatching will also begin a post-breeding molt. Our observations reveal that between 80 and 90% of all females fall into this category. Finally, females with parental duties do not molt until the end of the brood rearing period in late August or early September (Cantin and Bédard, pers. obs.). Hence, males are able to migrate earlier than females. A similar progressive change in the sex ratio over the season of migration was noted in eider species near Point Barrow, Alaska (Johnson 1971, Thompson and Person 1963).

The number of birds involved in flight activity was greater after mid-day, reaching a peak in the 3-hour period before sunset (Fig. 4). A similar daily pattern has been shown by Johnson (1971) and by Nelson (1969) for eiders in Alaska. However, in Sweden, Roed (1971) observed that eiders migrated in the morning as well as in the evening. Bent (1925) quotes Hagerup's notes from Irictut, Greenland, also describing evening inland flights of Common Eiders.

Generally ducks are held back in migration by cloud cover (Hochbaum 1955, Bellrose 1967, Svardson 1953) and our observations support this. However, Roed (1971) observed that eiders migrating overland in Sweden did so only during fine weather while coastal migrants were not held back by overcast weather.

Examination of weather maps for the time period involved (U.S.D.C. 1973) revealed that the passage of a cold front was invariably followed by a pulse in migratory activity: these fronts generally move west to east in the area and are generally indicative of clear skies, dropping temperatures and rising barometric pressure. A persistent high pressure center over the area also enhanced migratory activity (Fig. 6).

We cannot explain why overland flights were initiated at dusk, but the initiation of migratory activity with clear skies may relate to the navigational means used by the eider. Ducks and geese have the ability to navigate at night and often at great heights above land (Bellrose 1967).

The total eider breeding population of the St. Lawrence estuary is estimated at 45,000 individuals (Reed 1973) and we estimate that approximately ¼ of the population uses the overland route.

The simultaneous existence of 2 distinct migration routes for this population needs to be accounted for. Eiders undertaking the long coastal migration apparently move leisurely from one bay to the next, never leaving their traditional habitat and feeding all along. Characteristically they fly low and for short distances over the water. The coastal migration likely takes several weeks. Eiders following the inland route devote a much shorter period of time to migration, with the overland leg of the trip probably lasting 4–8 hours. From the middle estuary, they move upstream to the point of overland departure in habitat unsuited for feeding; the estuarine waters near Montmagny are very poor in marine organisms (Bousfield and Filteau 1974). The 300 km overland journey covers inhospitable terrain, dense forests, fresh water lakes, and mountain ranges over 500 m.

Thus, part of the population takes a lengthy but "leisurely" migration while the remainder take a short but demanding and risky one. The status of the birds undertaking one or the other of these routes might shed some light on the factors influencing the choice.

Sightings of color-marked birds and band recoveries suggest that most overland migrants breed on the westernmost islands (west of the Saguenay River). Birds nesting closest to the entrance of the overland corridor are therefore more likely to take that route but other individuals from these same islands use the coastal route and at least one individual from the eastern group of islands was known to follow the overland route. Thus, the location of the nesting island is important, but not the sole factor involved in the choice.

There is evidence to suggest that the fall overland route is undertaken mainly by full-winged adult birds while many late-molting adults and juveniles take the coastal route. This might be interpreted as suggesting that the potential time-saving of the overland route is only practicable for birds with full flight capacities.

We have dealt only with the fall migratory activity, yet it is likely that a similar but reverse migration takes place in the spring, leading birds directly from the New England coast to the upper St. Lawrence estuary. Other than the scattered reports mentioned earlier, this spring movement has gone unnoticed. Probably these birds enter a migration corridor over a rather narrow path but arrive on a broad front, which would account for the spectacular

character of the fall movement in the estuary and the unobstrusive nature of the spring arrivals.

The advantages of a direct overland flight may be greater during spring migration. In March, April, and May the upper estuary between Quebec City and the Saguenay is consistently ice-free while the waters of the gulf are frequently ice-choked (Berenger and Michel 1972). Therefore in some years it may be advantageous to use an overland route to return to the nesting islands. This may have been the case in 1967, a year when an exceptional accumulation of ice occurred in the gulf during April; only a relatively small number of eiders (overland migrants?) showed up to breed on the nesting islands on schedule (Reed 1975). However, a higher rate of mortality may accompany those taking the overland route. We have only 2 records of birds being found dead along the overland route but, in view of the very remote chances of birds being found in that area of low human population and poor access, they can be regarded as evidence of important losses. Thus, the advantages of reaching the nesting islands to breed at the optimum time even in years of heavy ice in the gulf may be balanced in the long run by greater adult mortality. The crucial question of whether individual adult birds can exercise a choice of route or whether they are restricted through tradition or heredity to a single one cannot be answered at this time.

ACKNOWLEDGMENTS

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