

# CRÈCHE FORMATION IN THE COMMON EIDER

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**ABSTRACT.**—The formation of crèches was studied in the Common Eider (*Somateria mollissima*) nesting at high density on Bicquette Island in the St. Lawrence River estuary. Aspects of social behavior relevant to crèche formation are examined in detail. Data from 293 individually tagged females aided in elucidating the breeding history and in understanding the parental behavior of previously recognized categories of adult females ('B-Brooding,' 'A-Associate,' 'V-Visiting,' and 'N-Neutral'). Crèches resulting from the encounter between two or more broods begin to form immediately after the nest exodus and last well into the rearing period (about 10 weeks). The encounters themselves may be stimulated by alarm or predation or may sometimes result from the mutual attraction of ducklings. Our figures reveal that the rate of fixation of such encounters into permanent crèches decreases from a high of 88% in broods reaching the shore of the nesting island to a low of 0–6% in encounters between groups meeting during the latter half of the rearing period (between the 4th and the 10th weeks). Agonistic interactions among B-status females tending crèches provoke a hitherto unexplained lowering of the ratio of females to ducklings in such groups. Instead of a loose system of cooperation between females rearing crèches as was previously surmised, we found rather that the organization of these groups is based upon a hierarchical ranking of females involved in tending. The crèche is thus seen as an accidentally expanded family.—*Département de Biologie, Faculté des Sciences et de Génie, Cité Universitaire, Université Laval, Québec, Qué., Canada G1K 7P4. Accepted 17 May 1976.*

A NUMBER of Anatinae display crèching behavior (see Gorman and Milne 1972 for a recent review). Crèche was defined elsewhere as the grouping of any number of parentally unrelated adult female(s) and young (Munro 1975). In the Common Eider (*Somateria mollissima*) of the St. Lawrence estuary, amalgamation of broods into crèches sometimes resulted from accidental encounters between two or more broods and sometimes represented a spontaneous tendency to regroup in the face of larid predation. In the latter case, the behavior conferred a distinct survival advantage to the young in most cases (Munro 1975). Once formed, a crèche was very stable from the time of settling in the coastal rearing areas at about 1 week of age, to fledging, at about 10 weeks of age (Munro 1975). Even a crèche consisting of up to 35 ducklings and 2 females behaved as a cohesive family unit.

In the present paper, we seek to understand the social and ecological conditions that prevail at and shortly after hatching and lead, within a few days, to the fixation of familial bonds and thus to numerically aberrant family units (crèches). To this end, we describe in fairly minute detail various aspects of the behavior of the various categories of birds involved in crèching. We also discuss the influence of duckling age on crèche formation and the proportion of encounters resulting in permanent amalgamation.

## STUDY AREA AND METHODS

About 20,000 pairs of Common Eiders breed in the St. Lawrence estuary, 92% being found on 6 nesting islands (see Reed 1973 and Munro 1975 for details). A discrete peak of hatching occurs between 10 and 20 June and the majority of broods and/or crèches are rapidly led by adult females to mainland littoral areas for the duration of the rearing period. The length of the sea crossings involved varies between 3 and 14 km. Most ducklings are reared along the southern shore of the river between Kamouraska and Matane, with smaller numbers remaining around the largest islands or moving to the northern shore between the Saguenay River and Forestville.

Over 1,400 breeding females were marked with patagial tags during 1972 and 1973, and a few entire broods and/or crèches were marked as they were leaving nesting islands. The ducklings were marked with

colored nape tags, which did not disrupt brood unity but did cause a significant increase in predation. Therefore, the tagging of broods was discontinued after marking 140 young in 24 different groups.

Four discrete categories of female behavior were recognized. (1) *Broody* (B). Assumes the leadership of the brood/crèche. She does all or most of the vocalizations and surveillance and swims in a central or fore position in the group; does not abandon ducklings except under most extreme disturbance. Two, or rarely three, B-status birds may accompany a crèche on a permanent basis with little or no aggression between them. (2) *Associate* (A). Assumes a subordinate role to the B-female. Swims in a peripheral or rear position in a crèche. Readily leaves the ducklings in the case of moderate disturbance. Generally associates with the same crèche over several consecutive days. (3) *Visiting* (V). Has a very low and transitory broodiness. Such females are temporarily attracted to a nearby brood or crèche. Show ambiguous (care-giving and agonistic) behavior towards ducklings. May swim alongside a crèche for variable lengths of time but leave at the slightest disturbance. May visit a number of different crèches in the same day. (4) *Neutral* (N). Displays no broodiness whatsoever and is not attracted by a nearby crèche or brood. Some of the V-females may probably assume an N-status at certain times and vice versa. Generally 5 min of continuous observation are sufficient to classify a female. Further explanations of these categories are found in Munro (1975).

Most of the observations were obtained during June 1973 and 1974 on the NE coast of Bicquette Island, a 9.1-ha wooded islet 30 km SW of Rimouski and inhabited by approximately 7,500 pairs of Common Eiders.

## RESULTS

*Crèche size.*—Crèches encountered during the present study comprised between 1 and 5 females of Broody or Associate status and between 1 and 60 ducklings. The most commonly encountered assemblage contained 2 females and 7–9 ducklings. We divided the period from laying to fledging into time intervals of different lengths that corresponded to discrete stages in the life history of the young ducks. These stages are labeled A–F in Fig. 1 and are discussed further below.

### BEHAVIOR OF CRÈCHING BIRDS

*On the nest (stages A–B).*—The incubating female is normally silent. A few hours before the ducklings are either seen or heard, she emits soft low calls at variable intervals. These calls seem to mesmerize V-females. The latter often leave the shore of the inlet in groups of 2–5 individuals, loudly chorusing bisyllabic notes of increasing intensity towards the end of the phrase. These parties roam under the forest canopy or amidst the thick brush and finally converge upon a hatching clutch of eggs to settle down. The V-birds come and go, sometimes as many as 10 of them competing with one another for position, the most aggressive individuals settling as close as possible to the incubating female. The latter will not tolerate such V-birds any closer than about 1 m. Other incubating females on immediately surrounding nests show no concern whatsoever for such activities. Most of the V-females disappear towards nightfall.

A minimum average of 25 hours ( $n = 9$ , Range 9–27) elapses between hatching of the first egg and nest exodus; over this period, the ducklings acquire their full mobility and perfect their vocal abilities. The female adopts a brooding posture with partly opened wings and spread tail; in this position the energetic ducklings roaming on her back and around the female must be exposed to the two whitish wingbars. These wingbars are much less evident on neighboring V-females.

*From nest to shore (stages B–C).*—Over the average 38 m that separate the nest from the shore, the family party will pass by about 100 nests, 10 of which perhaps will be hatching. If hatching occurs towards the peak of the season, the brood will also meet with two or three more broods also on their way to the shore. The mother,

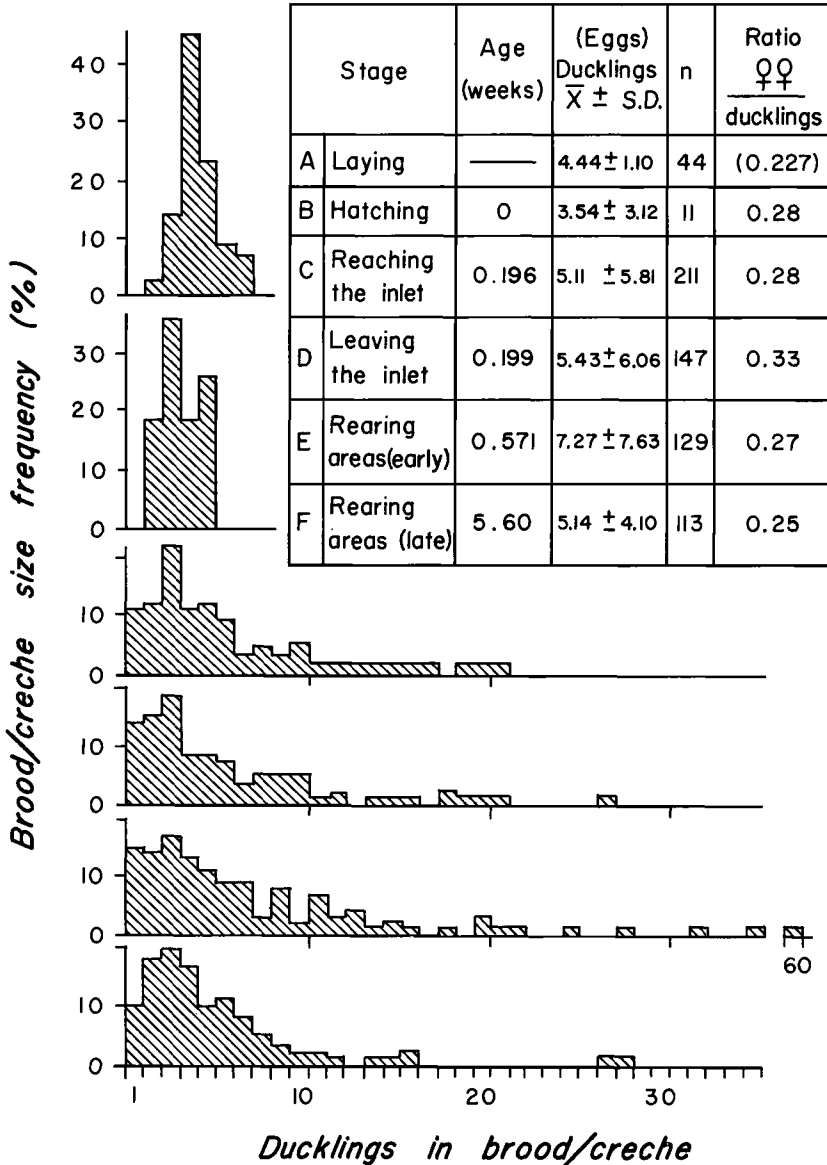


Fig. 1. Frequency of brood/creche size, females/ducklings ratio (summing only females with B- or A-status); Bicquette Island, 1973.

or B-status bird leads the brood with the same low-pitched calls that she emitted on the nest. She vocalizes to indicate departure, to maintain vocal contact with dispersed young, and to respond to a distressed duckling. The V-females often join the brood, walking alongside or slightly at the rear of the brood, all the time emitting vocalizations of the type already described. The group makes many stops, some of these lasting 10 or 15 minutes, particularly in the grassy rim that surrounds the forested core of the island. In this sparse cover, Herring Gulls (*Larus argentatus*) make predation attempts. Upon reaching the inlet, the group size has increased from  $3.54 \pm 3.12$  to  $5.11 \pm 5.81$  (Fig. 1). Although these two figures do not differ signifi-

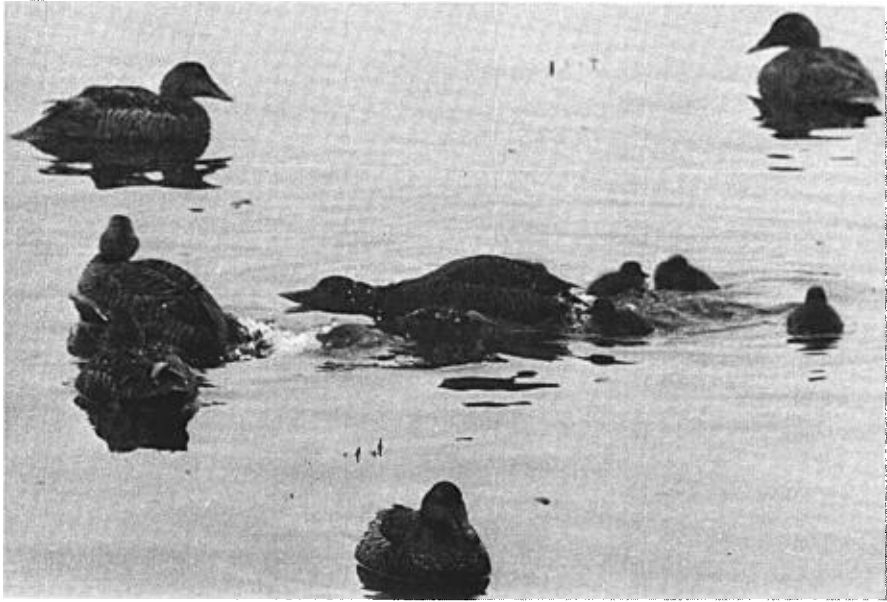


Fig. 2. Typical aggressive reaction of a "Broody" (B-status) female towards a "Visiting" (V-status) bird that came too near the ducklings.

cantly from each other ( $t = -1.64$ ,  $0.2 < P < 0.1$ ), the histograms in Fig. 1 instantly reveal that important changes in group composition have happened.

*In the inlet (stage C).*—During the next moments—traversing the inlet in its whole length requires an average of 30 min ( $n = 211$ , extremes 5 and 120)—the brood or crèche will make many costly encounters with gulls. Upon attack, only the B-females accompanying the group emit a loud, rolling alarm call. The ducklings respond by clustering under the opened wings and tail of the B-female(s). Out of the 211 groups observed, 201 had an escort of V-status birds. In most cases, the small number that came with the group from the nest is augmented by another 10–20 upon reaching the inlet. The numbers of this escort will change continuously thereafter by the constant addition and departure of individual birds. Sometimes the entire escort will detach itself and converge towards a neighboring group whose B-female is emitting alarm calls in the face of gull attacks. These V-females strive to contact the ducklings, fight among themselves to get closer, and often manage to dislocate the crèche in the process. In such a case isolated ducklings wander from one V-female to the other, emitting distress calls and eliciting at first great interest among the escort; but this interest dwindles rapidly once a given female has managed to approach the duckling(s) and often after delivering aggressive jabs at the lone young.

Visiting females might by their mere presence act as deterrents to the attacking gull(s), but their actual influence upon protection of the crèche was assessed as "slight" elsewhere (Munro and Bédard 1977).

In only 9 cases out of 211 did we notice that the female(s) leading the group adopted a tolerant attitude towards the escorting V-birds. Normally, these are greeted harshly by the leading B-bird(s), which strive to maintain a free radius around the ducklings (Fig. 2). Even in absence of gull predation and harassment by V-females, the brooding female will emit soft calls to maintain contact with the

ducklings. She also maintains a semibrooding posture, the wingbars clearly displayed.

In the event of a disruption created by the activities of V-females, the leading bird is normally able to regroup her party and to continue towards the mouth of the inlet of the island. Most of the V-females abandon the brood/crèche as it nears the sea, individual birds joining incoming crèches or simply hauling out for a rest.

*Around the island (stage D).*—A modal brood size of 3.0 among broods leaving the inlet suggests that at this time real broods still make up a substantial proportion of the groups. Although predation pressure has been very strong between stages C and D, the average size of the group has remained unchanged during this interval (Fig. 1).

From now on, predation pressure is reduced considerably (Munro and Bédard 1977), and harassment from V-females is almost over. But over the 2–24 hours that the crèche will spend around the island before launching on the 5-hour journey that will take it to the south shore of the estuary, 13 km away, it will encounter many broods and crèches and may temporarily or permanently amalgamate with some of them. Ducklings first begin feeding along the shoreline of their natal island, even though they may pass only a few hours in this region.

*Coastal rearing areas (stages E–F).*—Once in the rearing areas, the groups, either brood or crèche, have a remarkable stability as well as, in general, a strict preference for a very specific rearing site. We sighted 47 marked broods or crèches a total of 264 times throughout the summer of 1973: 91% of these successive sightings were obtained from the same sites. This phenomenon is further examined in Munro (1975). This site and social stability lasts until the ducklings are 9–10-weeks old. Towards the middle and the end of the rearing period, feeding ducklings may disperse over an area 25–30 m in diameter; yet, upon alarm and during roosting, the maintenance of family links is obvious. It is only during the 9th or 10th week that these links seem to disintegrate, at which time large groups of molting females and fully grown ducklings begin to move eastward along the south shore of the estuary.

From the above description, it appears that eider groups, broods or crèches, behave as real family units; one category of female, the B-status birds, always accompanies the group and performs protection and attraction displays that exert a strong effect upon the ducklings.

#### BREEDING HISTORY OF CRÈCHING FEMALES

*Origin of broody and associate females.*—The appearance of brooding behavior in a female eider coincides with her hatching a clutch of eggs. Three marked females followed for at least 30 days each while tending crèches and broods in the coastal rearing areas displayed broody behavior (in the sense understood for the B-category) characteristic of B-status females. These 3 marked birds were sighted a total of 11 times on and around Bicquette prior to hatching their brood and leaving the island with it. In the 5 cases when they could be assigned to a behavioral category, they fell into the N-category as is proper for incubating females.

Like B-hens, A-females have successfully hatched a clutch of eggs. But abundant circumstantial evidence suggests that the latter are more or less broody hens that have been displaced from leadership by broodier and more aggressive females. As witnessed in the records from 10 marked birds, both B- and A-status are stable at

least throughout the entire 30-min interval between the arrival in the inlet and their departure. A total of 304 females of these two categories accompanied the 211 groups reaching the shore of the inlet. Of these, 30 were catalogued as Associates and 274 as Broody. Following instances of predation and particularly during brood mixing, some of the broody females were in turn displaced by broodier birds and adopted in turn the status of Associate bird.

Out of 18 B-status females that suffered total predation on the brood they accompanied, 16 displayed a remarkable parental behavior *in vacuo*: they kept calling intensely while patrolling the area where the loss occurred. Such birds also adopted a brooding attitude with partly opened wings and lunged towards passing gulls. More interesting still, 7 of these 16 birds joined another crèche within 20 min of the loss of their young and assumed therein the previously held B-status (5 cases) or a newly acquired A-status (2 cases). The remaining 9 birds were not presented such an occasion of a group passing by, and their parental attitude decreased while they were joining V- and N-females at rest, so that they were lost among them. Thus, very clearly, these behavioral attitudes are very discrete and likely correspond to hormonal conditions and the social feedback brought about by the breeding history of the individual. The permanence of the B-status in 40 marked females followed in the rearing areas lasted an average of 36 days (Munro 1975). Thus V-females cannot, under the circumstances prevailing in our study area, become incorporated in a brood or a crèche in the manner that B- or A-birds can.

*Origin of visiting and neutral females.*—In view of the high density of nesting birds, the contingent of females resting from incubation duties in the inlet at any one time may be quite considerable. Could these simply assume V-status while off duty? Not likely, for we found that marked incubating females, either on or off the nest are oblivious of ducklings. Seven marked females in various stages of incubation were assigned the Neutral status when confronted with incoming broods while resting on the shore of the inlet between incubation bouts. Such indifference towards ducklings will also develop in birds failing to breed early during incubation, as we shall explain below.

Moreover, we found that marked incubating females left the nest for periods lasting less than 10 min at a time. Since V-females harass crèches or surround hatching nests, sometimes for hours at a time, it is unlikely then that V-birds are actively engaged in incubation.

Other workers (Lewis 1959, Robertson 1929) suggested that V-females were subadult birds, but this is untenable as in 4 years of field study, we never collected or observed more than a few dozen subadult (mostly males) Common Eiders in the St. Lawrence estuary.

Visiting females are thought to be failed nesters on the basis of the following evidence. Three marked females accorded this status in the inlet had been trapped with their mates (thus in the very first stages of breeding) on Bicquette Island 20 days earlier. V-females were also frequently seen settling into empty nest bowls for periods of up to 30 min suggesting an attraction to nest sites and perhaps a tendency to renest. Finally, we also analyzed resightings of 16 females marked in our trap that were never seen as Broody or Associate birds but were later found displaying V- or N-status. The average time interval between tagging and first resighting (both events on Bicquette Island) with V-status was  $19.8 \pm 10.11$  days ( $n = 10$ ); the remaining 6 birds when first resighted assumed N-status ( $7.83 \pm 7.24$  days). This difference ( $P < 0.025$ ) leads us to think that V-status birds were resighted much later because

TABLE 1  
OUTCOME OF ENCOUNTERS<sup>1</sup> BETWEEN COMMON EIDER BROODS AND/OR CRÈCHES<sup>2</sup>

Location	Age <sup>3</sup> hours (weeks)	Total number of en- coun- ters ob- served	Encounters resulting in amalgamation		Amalgamation transitory <sup>4</sup>		Amalgamation transitory: original groups reform	
			N	%	N	%	N	%
I Nesting grounds <sup>5</sup>	26 (0.155)	—	26	—	3	12	—	—
II Inlet, NE Bicquette	27 (0.161)	75	50	67	14	28	13	93
III Around Bicquette Is. and outer reefs	30-40 (0.208)	68	35	51	25	71	16	64
IV Around Bic Is.	41-65 (0.315)	12	4	33	3	75	2	67
V Rearing areas (groups of mixed age)	(1.5) <sup>6</sup>	49	17	35	13	76	13	100
	(6.5) <sup>7</sup>	28	2	7	2	100	2	100
		88	17	19	16 <sup>8</sup>	94	16	100

<sup>1</sup> Approaching groups are involved in an "encounter" provided they came within 8 m of each other.  
<sup>2</sup> On Bicquette Island and on the neighboring shore of the St. Lawrence estuary. Bic Island (IV) is on the normal route to the rearing areas.  
<sup>3</sup> Age 0 is the complete hatching of the first duckling of a brood.  
<sup>4</sup> Mixing results in a new group and is considered transitory when the latter separate within 30 min.  
<sup>5</sup> These cases are of groups already formed by the time they reached the shore of the inlet. Note that 211 groups reached the inlet of which 26 were mixed, implying an original cohort of about 234 broods. The number of encounters among these cannot be established.  
<sup>6</sup> Mixing involves groups of even age in their 1st, 2nd, or 3rd week after hatching.  
<sup>7</sup> Mixing involves groups of even age in their 4th-10th week after hatching.  
<sup>8</sup> One permanent mixing involved 1 group of 4 ducklings aged 9-10 weeks joining another of one B-female and 5 ducklings aged 7-8 weeks.

they were engaged in incubation longer and hence, much less likely to be observed loafing in the inlet.

Admittedly, more evidence is needed to support this interpretation, but the data would be very tedious to gather. As we have established elsewhere (Munro 1975), birds losing nests or young slowly shift over time from one behavioral category to the next, the evidence indicating that the transition is directional from B through A, then V and finally N.

BROOD MIXING

*Circumstances in which mixing occurs.*—The thickness of the vegetation kept us from witnessing directly the mixing of broods heading toward the inlet shore. We noted above (Fig. 1) that a degree of mixing took place in such circumstances, but nothing suggests that predation could account for such mixing. Departing broods are sometimes temporarily halted by obstacles in the footpath (our trapping device being one of these) and thus have an opportunity to meet another brood. In 9 such cases of two broods coming together along our trap, permanent mixing resulted in 6 and was followed by aggression among B-status birds leading the broods. In one case, a B-status bird completely expelled the other.

Once in the narrow inlet, random movements of broods also lead to contact with one another. These contacts may result in any of the following. The two groups may separate immediately or they may swim or walk alongside each other for some time without ever mixing. The two groups may amalgamate and remain together as a stable crèche. The groups may combine briefly, and then separate, perhaps with an exchange of ducklings between the groups having taken place. The relative frequency of these various instances of encounters between broods are examined in

TABLE 2  
CHANGES IN THE NUMBER OF FEMALES TENDING BROODS AND/OR CRÈCHES IN GROUPS LEAVING  
BICQUETTE ISLAND IN JUNE 1973<sup>1</sup>

	Behavioral status	
	B- Brooding	A- Associate
A. Changes in crèche structure without changes in (relative) numbers		
I. i. Gains resulting from the amalgamation of two or more broods under continuous observation	58	4
ii. Expected gain following splitting of a crèche under observation (23 cases)	24	3
II. Status change within a group under observation		
i. Brooding female becomes Associate	-7	+7
ii. Associate female becomes Brooding	+3	-3
B. Changes in crèche structure and numbers		
I. Losses		
i. Following disintegration after total predation	45	8
ii. Departure of tending females (A- or B-)		
1. Resulting from aggression by resident or newly arrived B-status female	5	13
2. Does not follow arrival in crèche of a new B-status female	2	7
3. Does not follow arrival of new B-status bird and no aggression noted among females in crèche	0	5
4. Unaccounted for	3	3
II. Gains		
i. Unknown origin but not left over after mixing or splitting	25	33
ii. Shift from neighboring brood	0	1
iii. Female freed after loss of ducklings joining a new group	6	1

<sup>1</sup> A total of 211 groups containing 303 females were followed in detail. The time interval examined covers steps C and D in Fig. 1.

Table 1 and will be further discussed below. Quite often the mixing seems to be the result of mutual attraction, but most cases of mixing coincide with harassment by larid predators. This matter is discussed, and figures on the subject are presented elsewhere (Munro and Bédard 1977).

Feeding broods or crèches often come into contact after leaving the inlet. Such contacts are enhanced by greater dispersal of the ducklings, probably as a response to reduced predation pressure. During sea crossings, we have also noticed a tendency to regroup: in 3 instances we saw 2 groups leaving the shore of Bicquette Island for the mainland simultaneously but independently, a few hundred meters apart. Upon noticing each other some distance away from the shore, both converged towards each other and swam as a single party for at least 300 m before disappearing out of sight.

Along the coast, in the rearing areas, encounters are frequent but amalgamations resulting from these are rare (Table 1). Only in cases of alarm did we observe large, but short-lived grouping taking place (sometimes as many as 150 ducklings could become involved in such grouping).

*Behavior of females and ducklings during mixing.*—In the inlet, ducklings mix spontaneously either as they naturally follow their B-female or, else, as they converge towards the most defensive bird and the one adopting the most obvious brooding posture in the case of a gull attack. On the rearing grounds and especially as they reach older age, ducklings may show aggression towards a foreigner attempting to join their brood or crèche, but usually ducklings show no resentment toward the company of other ducklings of similar age. They will, however, soon respond very specifically to the vocalizations of their B-female, which (depending upon whether or not mixing has occurred) may or may not be their mother. During mixing (or im-



mediately following predation), agonistic relations between B-females in the newly formed crèche are commonplace. These events seem to determine a hierarchy reflected in the position of the birds in the floating group. The result of this aggression may go from one extreme, that is, the expulsion of one of the broody females (Table 2, BIi1) to the mutual tolerance of two birds of nearly equivalent status in the same crèche. The latter case will usually be the outcome of a rather major clash between two evenly matched birds. Occasionally, the subordinate B-female will remain as Associate and swim either near the rear or the sides of a crèche containing perhaps some or all of her ducklings. The duration of her status as Associate is not well established.

Relations among several B-females within a crèche are coordinated by a number of minute agonistic attitudes and movements, many of which must have escaped our attention. In Table 2, the statistics on attendance of B- and A-females are pooled for the 211 cases observed in detail. Only two cases (BIi2) are interpreted as representing spontaneous departures for a B-status bird and were quite certainly not the result of agonistic activities of the other B-female. In most cases—and this also perhaps includes poorly documented cases (BIi4) and even some cases when no aggression was detected (BIi3)—the losses of B- and A-females from a crèche must be accounted for by agonistic activities from broodier and more aggressive females.

The 58 cases (AI) of females of unknown origin joining crèches very likely included both females who had recently lost their brood and thus still retained a strong maternal drive, and B-females expelled from their own group. But most are probably B-females of various tendencies that have lost their entire brood or crèche as a consequence of predation: 53 females thus freed were seen to join loafing birds on the sides of the inlet. We must remark that it is also from these groups of loafing birds that most of these 58 incomers originate. Section A in Table 2 is a straightforward compilation of all gains and losses occurring in groups followed without interruption. For all the groups involved, the result of mixing is nil as the gains of one group are created by the losses of the other. Changes in status among crèche females are thus generally the result of agonistic relations. The rate of departure of B- and A-females can be estimated by comparing the measured B- and A-females/ducklings ratio to the expected one considering duckling mortality rate and forced (by complete mortality of the group) departure rate. Duckling mortality at the end of the 6th week was estimated at 67.7% (Munro 1975). When this percentage is applied to the initial brood size of 3.54 (Fig. 1), one finds a final expected brood size of 1.14. If we ignore crèche formation and the loss of entire broods, we can predict that on the average, by the 6th week after hatching, one female would care for this reduced brood. But we know from Table 2 (BI) that the loss of entire broods frees 17.5% (53/303) of all the females (B- and A-status) while duckling mortality over the same time interval amounts to 23% (Munro 1975). Assuming that such a rate of entire brood losses is prevalent over the first 6 weeks of brood rearing, we can estimate that 51.5% of all the females would be freed from parental duties while total duckling mortality would amount to 67.7% during the same time. Thus if broods remained broods and if any female that suffered the loss of its whole brood departed, we would expect a females/ducklings ratio of 0.425 or 42.5%. The observed value is a mere 0.25 or 25% (Fig. 1), and this important decline in female involvement cannot be accounted for by our calculations. According to our behavioral observations and our earlier discussion, these departures result almost exclusively from aggressive interactions within the crèche and, secondarily, from spontaneous abandonment by weakly motivated females. An

examination of mortality data in Munro and Bédard (1977) and the data in Fig. 1 suggest that about two thirds of these departing females leave between reaching the inlet and the 5th day (first age class) of the young.

*Brood mixing frequency: changes with time.*—When one considers the already established case for group stability on the coast on the one hand and the familial character of the relations described above on the other, one is led to conclude that crèches are nothing but numerically aberrant family units. Table 1 shows the progression of group stability with time. The decreasing amalgamation rate and the increasing separation rate can be accounted for by invoking age, the only factor that changes uninterruptedly. The correlation coefficient between age on the one hand and the proportion of permanent amalgamation on the other is  $-0.843$  ( $P < 0.05$ ).

The role of predation in the process of crèche stabilization with age can be dismissed. Actually, while no predation was observed on the nesting site, crèche formation still took place there. In the inlet, newly formed crèches and those arriving already formed (on the nesting grounds) suffered the same predation pressure, yet the latter did show a greater stability. Afterwards, predation diminished in parallel with actual mixing but no longer paralleled age. Thus around Bicquette, predation pressure is low, yet encounters are still numerous. But splits leading to the *statu quo ante* are the rule (13 cases out of 14 encounters) at an age of 27 hours. Even at this early age, the ducklings are able to recognize and choose to follow a given B-female leader.

#### DISCUSSION

Crèching behavior and the environmental conditions leading to it are not found exclusively on Bicquette Island. Though nesting density is higher there than anywhere else, great densities are also encountered on at least five islands or island groups in the St. Lawrence estuary (see Reed 1973 for details). On every one of these islands, conditions of topography, vegetation, and exposure create locally and to a varied extent conditions leading to brood pile-ups or brood convergences. Distinct forest paths used by departing broods are known for every one of the nesting islands. Protected bays or inlets where broods tend to converge for minutes or hours after hatching before undertaking the sea crossing are also known for most islands and in particular Ile aux Pommés, Brandypot, and the Pèlerins.

Stonehouse (1960) established that parental links in the King Penguin (*Aptenodytes patagonica*) develop over the first week while real "crèches" form after about the youngs' 6th week of age. Crèching in that species has evolved apparently as an antipredator device. The same pattern has been found in the White Pelican (*Pelecanus erythrorhynchos*) (Schaller 1964) and the Great White Pelican (*P. onocrotalus*) (Brown and Urban 1969) except that in the latter crèches form at 20–30 days of age. Adult birds recognize their own progeny among the crèche as in the penguins, and the crèche is thought to have evolved to ease thermoregulatory problems of isolated young. In the Gentoo Penguin (*Pygoscelis papua*), Roberts (1940) described crèching behavior and ascribed to it an energy saving value. In these three species at least, crèching behavior is seen as an evolved feature of the rearing period, normal interfamily aggression being reduced so that members of the crèche can secure certain advantages against predation or heat loss.

The crèching in the Common Eider has nothing in common with what has been just described. In our opinion, the only evolved trait of this behavior is the spontaneous tendency for females to regroup their ducklings in the face of predation with

concurrent lowering of normal aggressiveness among them (Munro 1975). The contingent stabilization of groups formed following encounters (be these due to predation, chance, or alarm) seems to be a fortuitous consequence of overcrowding at the precise period when family links tend to crystallize. The two factors that correlate best with crèche formation are age and predation rate but, as discussed previously, the latter agent cannot be held responsible for the familial fixation itself. In an Anatidae, the Mallard (*Anas platyrhynchos*), Raitasuo (1964) felt that relations between members of a brood seemed to be based upon imprinting and had stabilized permanently by the 3rd day of age after which foreign ducklings were rejected. In the Anatidae (Cushing and Ramsay 1949, Collias and Collias 1956) and the Coot (*Fulica atra*) (Alley and Boyd 1950), 4–7 days are required for the formation and stabilization of family links. Our estimate of the time required in the Common Eider is nearly equivalent or perhaps slightly shorter, but our views that crèching is nothing but the aberrant hardening of oversize family links are perfectly harmonized with the views expressed by these authors. In *The King Penguin* Stonehouse (1960) also noted that prior to the fixation of family links (1 week) exchange of young and the resulting crèche formation in the sense discussed here also occurs. Koskimies (1957) also believed that in the Velvet Scoter (*Melanitta fusca*) the high density prevalent upon or soon after hatching interfered with normal family development and provoked crèche formation. Thus time is a necessary component of crèching: predation alone or alarm or chance encounters while provoking mixing of broods does not necessarily result in the formation of crèches. Birds within these groups must further develop mutual or reciprocal links between adult females and young, and perhaps later between young themselves. Presumably the circumstances in the St. Lawrence estuary, where the ducklings must all undertake lengthy sea crossings lasting several hours under the leadership of B-female(s) before reaching the rearing areas must be greatly conducive to the stabilization of links within such groups.

It is impossible to say without experimentation, whether or not the ducklings can recognize each other at age 27–35 hours. Evidence from captive birds suggests that individual recognition is not possible before several days at least and more likely before several weeks. Thus the leadership of the B-female would be the determinant factor in crèche stability at least in the early stages of crèche life. On the other hand, two femaleless groups of 8- and 9-week-old ducklings were seen repeatedly in the rearing grounds preserving great stability and going through a number of encounters with crèches and broods but always maintaining their original composition. Thus reciprocal links between the ducklings had developed at that age. Besides female leadership, these mutual links must play a role in the cohesion of the group and may account at least partly for the growing avoidance with age or even repulsion of groups in face of other groups. The marked tendency to avoid mixing is reflected in the column "Encounter resulting in amalgamation" in Table 2 where the percentage decreases steadily from 67 to 7 over the first 6 weeks of age. We have circumstantial evidence suggesting that beyond 30 ducklings, a crèche becomes increasingly unstable. Perhaps at this size, the mutual abilities of ducklings and of females to cope with so many social elements are exceeded.

Among factors playing a role in mixing and crèche formation, the polarizing effect of a superbroody female (the "mother-effect" as some workers call it) has been recognized by Bergman (1956) in the Goosander (*Mergus merganser*) and in the Red-breasted Merganser (*Mergus serrator*), by Koskimies (1957) in the Velvet Scoter (*Melanitta fusca*), by Williams (1974) in the Shelduck (*Tadorna tadorna*), and in the

Common Eider by Ahlén and Andersson (1970). This effect is also manifested in data provided by Boase (1938) in *Tadorna* as the females/ducklings ratio is much smaller in his data in large crèches than in small ones. This strongly suggests that very maternal and broody females may draw to them many more ducklings than can more modestly aggressive and less broody females. Recent work on *Tadorna* in the Ythan estuary in northeastern Scotland largely confirms these views and further documents the existence of vast differences in the aptitude of individual females to attract ducklings and to establish parental relations with them (I. J. Patterson, pers. comm.).

The latter fact has been noted in *Somateria* by Koskimies (1957) and by Ahlén and Andersson (1970) who report that the ducklings will spontaneously cluster behind the most stimulating female. Our observations lead us to similar conclusions. We further believe that this 'stimulating' character of certain females is primarily mediated through her vocalizations, secondarily through her postures, and thirdly through her vigor in chasing neighboring females.

According to Gorman and Milne (1972) crèches in the Common Eider constitute an example of a genuine cooperative system in which the care of the young is left to newly arrived breeding females thus freeing the early arrivals to move to supposedly better feeding grounds. The behavior is thus characterized by a total and rapid (3.88 days) dissolution of family links. We believe that the departure of some females is caused by the encounter itself resulting in either agonistic expulsion or loss of contact with known ducklings. Thus aggression among successfully breeding females results in a rapid loss of position of the subordinate and less broody/aggressive individuals. The latter may remove themselves entirely from the group and then rapidly lose all attachment to young, or they may attempt to regain a leadership position in another brood or crèche. Thus there appears to be no sign of "cooperation" whatsoever among females. Quite to the contrary, a marked hierarchy exists among them in the case of crèches tended by more than one bird. Over 200 resightings of 45 marked females confirmed the existence and the stability of such a hierarchical organization amongst females sharing the supervision of crèches. Once again, the only cooperation that we have established is in instances of predation when several B-females will spontaneously regroup.

McAloney (1973) felt that in crèches, no one female was totally responsible for the care of the ducklings and conversely, the ducklings did not generally appear to be imprinted on any particular female. Similar views were proposed by Milne (1963) but until experimental evidence becomes available, support for such views as "imprinting on a general female model" are entirely lacking. We have circumstantial evidence suggesting that within a crèche, some of the females may be attached only to some (perhaps in some cases their own) ducklings. Such birds usually leave the crèche if all their ducklings disappear. Similar observations have been made in Scotland by Mendenhall (pers. comm.).

Ahlén and Andersson (1970) claim that females leave the brood or crèche under the combined influences of a decrease in maternal behavior and a simultaneous increase in hunger, but they present no quantitative evidence to support their claim. We may add that the spontaneous loss of broodiness in such circumstances would be a rather stunning event, as the ducklings themselves whose presence must create a powerful stimulus to develop this broodiness are always present. Only in cases when more aggressive females persistently hold or prevent this reciprocal linkage with ducklings to develop will a female be forced to leave.

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