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NESTING BEHAVIOR OF THE ATLANTIC MURRE

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Plates 5, 6

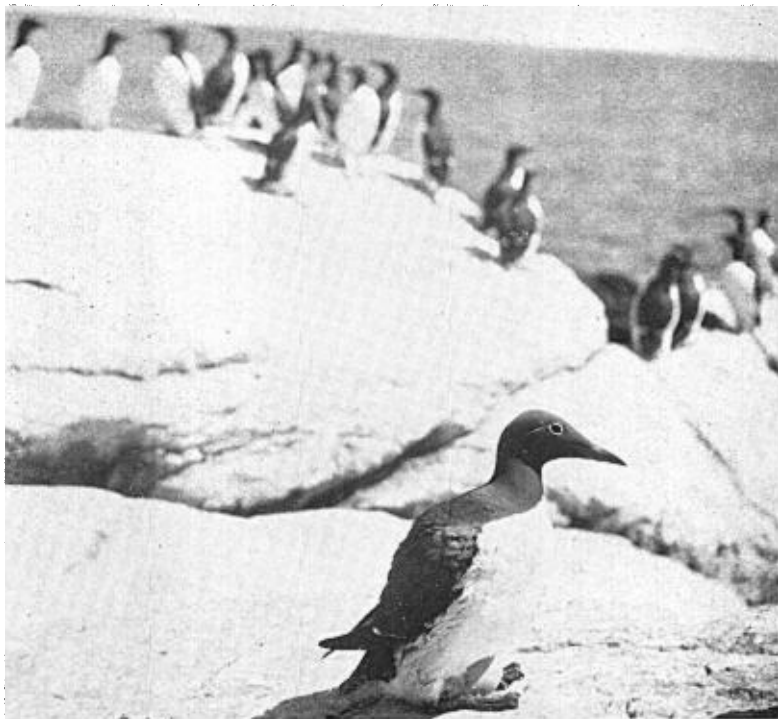
INTRODUCTION

THE vast northern seas are the natural home of the Murre; rocky islands or inaccessible cliffs are the nesting locations. Neither are elements of a dynamic environment in a comparative sense. Except for relatively recent influence of man, I believe there are few factors to cause abrupt changes in population numbers. The rate of reproduction is slow, probably not more than 1/200, as compared to Bobwhite. It therefore seems reasonable to expect that the ontogeny of the behavior pattern has developed slowly and still shows primitive relationships.

The facts that the eggs of this species exhibit great variety, that the species is said to use no nesting material and that it is often alleged to have less intelligence than most avian species, certainly less adaptability than many, are reasons why an extensive study of its behavior pattern is greatly to be desired.

The data herein presented were gathered in connection with a general study of the natural history of the species. Thus, they are limited in scope and generally associated with observations made at the nest site. All notes refer to the species *Uria aalge aalge* made between June 20 and August 10 during the summers of 1931, 1934 and 1938, in the Cape Whittle region of the Gulf of St. Lawrence.

The purpose of this paper is, first, to present the record of some data as they were obtained so that they may be evaluated in light of future findings; and, second, to venture some generalizations about the meanings which I have deduced. In another paper (Wilson Bull., 50: 164, 1938) I have listed seven general characteristics of the Murre which are significant for this study. In the same paper I have de-



ONE BIRD INCUBATES ON BREEDING AREA; OTHERS ARE ON LOITERING AREA



TWO PAIRS OF COURTING BIRDS ON NEST SITE

scribed the type of blinds used and other precautions taken to avoid disturbance and confusion between natural and conditioned behavior.

Early in this study I marked several birds with colored bands and stained areas of feathers with oil stains. This method was thought necessary to facilitate accurate identification. In every case I found the resulting disturbance of the colony was so great that I could not work with those birds again satisfactorily. Accordingly, it was necessary to confine observations largely to a few individuals in a colony; these birds could be identified by a combination of size, color, plumage condition and 'white-eyed' character. Young birds were tagged by placing a band on the tarsus, one made of soft copper wire on which were strung combinations of large colored beads.

CHARACTER OF NESTING ISLANDS

The nesting islands in the Cape Whittle region are mostly low flat granitic islands. On many of these there are wide shallow faults extending well down the slopes. Some of these are narrow at the top forming cave-like passages and some are deepened into crevasses with or without a partial fill of loose boulders. In such situations the Murres find desirable nesting places; but there are also many colonies of considerable size on the surface of the islands. Sometimes these colonies are made up of nesting birds scattered in small groups among nesting cormorants, or the groups may be found on a site where there is very little protection of any kind.

STRUCTURE OF A MURRE COLONY

A large breeding colony is made up of an indefinite confederation of groups of birds. These groups tend to show concentric formation in their laying and hatching dates. At the beginning of the hatching one can see the eggs which occupy the center position of the group beginning to hatch first, indicating that the first bird to lay established its nest site in a choice spot after which the next ones in sequence crowded about (see Plate 6). The presence of the early birds with their eggs makes the immediate surroundings much more desirable for nest sites. Where long rows of birds are found nesting in a crevasse I have seen the same distribution of hatching dates. This crowding together to form compact groups of nesting birds is attended by a great amount of activity,—fighting, social preening, crowding, and vocalizing,—a condition which seems to enhance the general state of satisfaction and welfare. In spite of intense and repeated fighting the birds show no evidence of being attracted to surrounding unlimited space. If the result of this instinct to crowd together has

survival value it certainly also results in the elimination of many eggs when the group is disturbed due to the eggs rolling down inclines and into water-holes as the birds stampede.

Once a bird settles with its egg on a nest site and starts incubation its presence becomes an important factor to its neighbor. If the outer individuals of an incubating group abandon or lose their eggs in connection with a disturbing factor, the remaining birds may progressively abandon (Johnson, 1938a).

DAILY LIFE OF INDIVIDUALS

The social relationships of a colony of breeding Murres are, I believe, very imperfectly understood. In furtherance of this phase of study it seems wise to describe the geography of the breeding bird's daily activity. By remaining in a small tent near a breeding colony for two or three days in sequence, observations have been made which lead me to make the following description of three functional areas in which the daily activities of the breeding birds transpire. These are as follows: first, the breeding-colony area where groups of breeding birds participate in activities associated with the nest site; second, the loitering ground, an area including the perching rocks where birds alight to enter the breeding-colony area and a limited space of the water area adjacent to land forming the nearest approach to the nest sites; third, the distant areas of the sea which form the feeding grounds where birds seem to scatter indiscriminately.¹ Around a large breeding colony birds are continually going out from and returning to the loitering ground. Often they return from the feeding ground directly to the nest site. Yet, I have often seen birds off duty from the nest site linger in the loitering ground for two or three hours. Among the colonies observed there have usually been a certain percentage of the population, which, having lost one or more eggs, were at the time of the study approaching another time for ovulation. These birds spend a great part of the day in rest and in ceremony, at first on the loitering ground, but as time for ovulation approaches they spend more time in courting ceremony at the proposed new nest site.

The average breeding Murre in the colony is a social bird. It requires only enough space on which to brood the egg. It desires to be very near to its neighbors, even to be crowded against them or to be up against a ledge or partly concealed in some cranny. It is probably stimulated by group activities. It responds quickly to warning from

¹ Paper read at the Wilson Ornithological Club meeting at Ann Arbor, December 1938.

one or all. It responds to group flight and contentment. It conducts social preening with its neighbors regardless of sex. It conducts frequent fights with its neighbors regardless of sex and these seem to intensify the incubation instinct rather than to vanquish the neighbor as a competitor for space. I have never seen a bird in possession of its egg or young vanquished by these fights but once these possessions are lost a bird will not long try to hold its place in a crowded group. With both sexes participating in incubation and brooding there seems to be no sex recognition apparent in these social activities among incubating and brooding birds.

EXPERIMENTS IN 1931 AND 1934

In 1931, at Wolf Bay, I conducted experiments to substantiate observations in determining the bird's ability to recognize its egg from others in the colony. The following quotation from my notes taken in the blind on July 17, 1931, gives an account of the reactions of birds to an experiment involving three eggs which were chosen for the experiment because of a somewhat similar size and coloring. The three eggs were marked, X, Y, and Z from right to left. The positions of the eggs were carefully noted and then X and Y were interchanged. The owner of X egg was a 'white-eyed' individual which aided in the identification of the birds, as after the eggs were moved the one of the 'white-eyed' bird was in line between the others. The field notes taken at the time are recorded.

10.45 a. m., in blind prepared to stay until tomorrow; windy; clouds promise to clear. 4.00 p. m., several times a Murre has approached the eggs but turned back. 4.30 p. m., 'White-eye' came into the crevice, looked at the three eggs, and directly hovered her own although I had moved it about eighteen inches and changed positions with another marked Y. She has now moved it over to the old location and is close against the one, Y, which I placed in her old location, in fact has her egg standing on end against Y. 4.50 p. m., 'White-eye' has moved her egg into its identical old position without any intentional movement of the other egg, but she has gradually crowded it out of the way (farther from its original location) and now occupies her exact old position and sits facing the same direction she did when I observed her day before yesterday. 5.15, the owner of Y egg came into the crevice, went to her old place between 'White-eye' and Z; there she squatted as to hover, just as if the egg were present. After a moment she went around behind 'White-eye' to the new location of her egg, identified it, and hovered it there for a moment. Then she left and went back to the old nest site, repeated this twice, picked a fight with 'White-eye,' preened herself, and fought again more severely. Then she returned again to the egg and after hovering for a moment began moving it a little at a time through a narrow passage between 'White-eye' and a pool of water toward the old nest site. The egg was moved after it was placed in the incubation spot among the belly feathers and held there

because of being above and between the tarsi. In this hovering position the bird slowly moved along until it was back into the old position between 'White-eye' and Z. At 5.35 p. m., all is normal and quiet with X, Y, and Z. Z came directly to its egg while Y was maneuvering.

In the summer of 1934 while working on the St. Mary Islands I twice repeated an experiment similar to the one reported above. While I did not actually observe the birds, the eggs involved in the experiment were in each case returned to their original locations. Thus, it is certain that the Murre does readily identify its egg and that it does have a definite nest site which it prefers to occupy. In colonies which have been disturbed I have seen birds return and find the eggs considerably mingled from rolling. It is not uncommon for such birds to move their eggs back to their original locations for a distance of one to five yards.

OBSERVATIONS IN 1938

On June 27, 1938, a 5 by 7 tent was placed at one side of a large Murre colony where I might remain for an extended time to make continuous observations. After considering the record of the resultant study it seems wise to present it as a whole in order that the data may be later reevaluated by students of behavior in light of their new understandings.

The tent blended well with the surroundings and was protected from wind among the large boulders of red granite which littered the broken surface of the slope. Apparently many of the Murres abandoned their eggs as a result of the disturbance, but by July 6, when I returned to record observations, the colony had settled down, accepted the tent and several pairs of birds were ready to re-nest. This condition gave me the opportunity to observe the behavior of different pairs of birds in various phases of the reproductive cycle, some beginning to hatch and others re-establishing nest sites and courting.

During the three-day observational period the birds were watched throughout the daylight hours and during most of the nights. Since they were only a few feet from my tent I could readily observe them in the semi-darkness during the inactive hours, 10.00 p. m. to 2.30 a. m. In the following record, which is presented with slight editing, numbers have been assigned to several birds in order that their activities might be recorded without confusion. Certain additional birds are occasionally referred to without numbers.

Key to Special Birds Mentioned in Notes

- (1) A 'white-eyed' bird incubating a green egg on slope near tent.
- (2) A plain-colored bird, mate to (1).
- (3) Plain-colored bird first observed incubating an egg broken at the large end with the contents partly leaked out.
- (4) Large plain-colored bird which incubated a broken egg, crushed in on the side and empty, located in the group with the other birds near the tent.
- (5) Plain-colored bird (plumage soiled) incubating a light-colored egg several feet from the tent. This bird adopted a very young bird in addition to its own egg.
- (6) Mate of (5).
- (7) Bird (very small) which produced a fresh egg.
- (8) Bird which continued for two days bringing fish to a certain site and going through the ceremony of feeding young although no egg or young was present (identified by its action and its nest site).

THE RECORD

July 6, Wednesday

4.00 p. m. I am established in a tent on Fox Island ready for an extended period of observation of this large Murre colony. Many of the eggs appear to have been lost but a few are beginning to hatch.

5.30 p. m. The birds are returning to their eggs. One bird (3) is hovering an egg with the large end broken out and the egg half empty. A 'white-eyed' bird (1) has claimed a green egg and is incubating. A stranger attempting to mount No. (1) was driven off. Another bird (4) is hovering less than half an empty shell while its mate stands by its side preening at its face, and occasionally picking at the shell.

One pair has apparently lost their egg but they still claim the nest site and there they fondle with a small piece of shell less than one-inch square. The one bird straddles the nest site, places the small shell fragment under it, then the other reaches for and fondles the fragment, preens and bills its mate, but neither is content. (Note—I later decided that this was normal courting ceremony.)

6.30 p. m. No. (4) with the half-shell moves it about over two square feet of territory. It is not satisfied with the way the shell fits its belly and the restlessness is reflected in its mate which continues to bother.

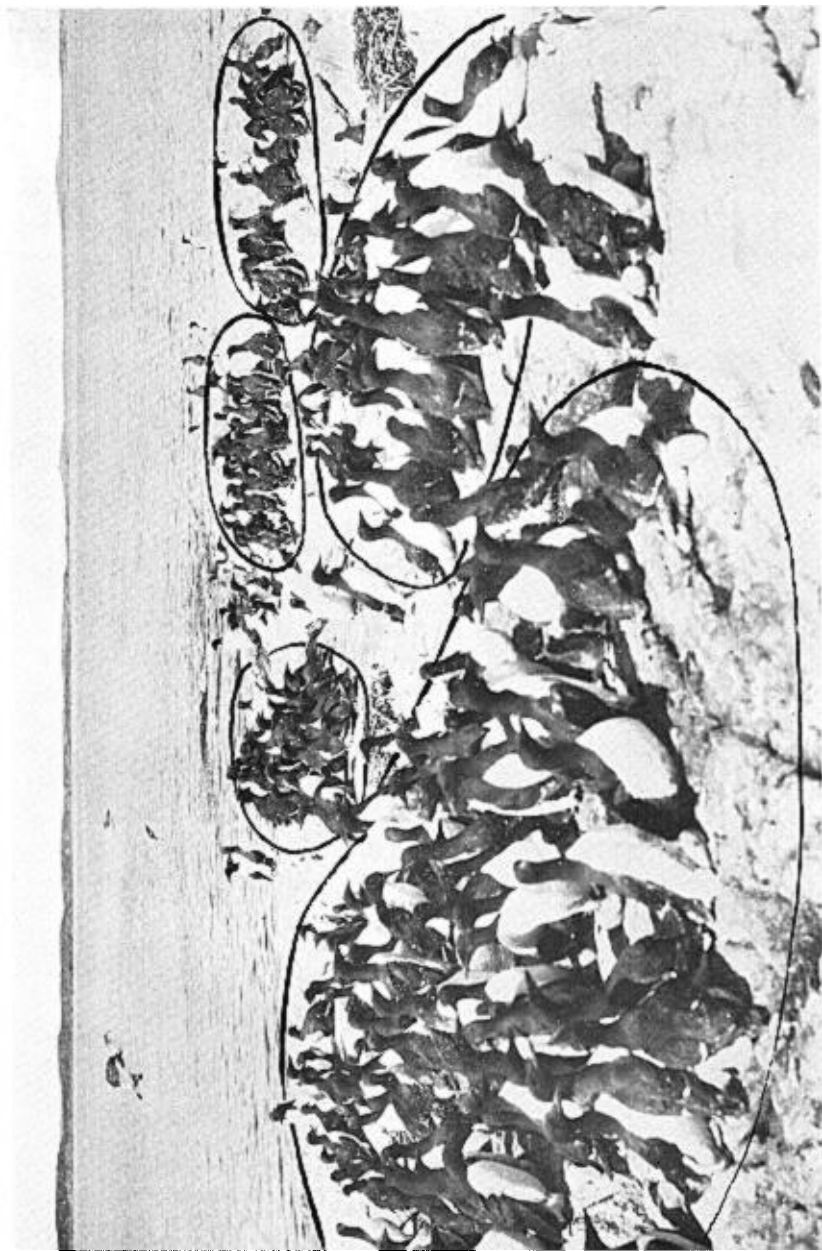
No. (3) which has an egg with the large end broken sits rather steadily only turning it occasionally. The egg appears to have lost one-half or more of its weight and the embryo has bled on the adult's feathers.

7.20 p. m. The Murres are fairly quiet. The two birds remain on their broken pieces of eggs.

9.10 p. m. Because of fog it is now dark and the birds cannot see their eggs. No. (4), with the half-shell, has just left the colony flying to sea. All unoccupied birds are gone now for the night. (This shell had become so flattened that the bird could not feel it satisfactorily and when darkness made it impossible for it to see the shell it apparently gave up and went out to roost with the unoccupied birds.)

July 7, Thursday

3.30 a. m. No. (4) is gone. Part of the shell still remains. No. (3) remains on duty. No. (2), mate of 'White-eye' is here preening its (1) face but gets little response.



GROUPS OF MURRETS IN A NESTING COLONY

6.30 a. m. No. (2) has taken over the green egg and No. (1) has gone. Birds are coming in rapidly with capelin.

9.00 a. m. The mate of No. (3) came in at 8.30 and offered to take over incubation duty but was refused. It has gone now. No. (2) has taken the flattened piece of shell formerly claimed by No. (4) and is using it for nesting material. Any object of convenient size that is available is frequently being picked up and moved about. Interest in these objects soon ceases and they are picked up by an adjacent bird.

(Note—In 1934, I noticed in certain small colonies nesting on gravel-bottom caves which at times flood to a depth of one or two inches, that sometimes an incubating bird will have built up the level of its nest site by this process of reaching for small rocks and dropping them at its breast, so that the egg is actually on a small built-up island and thus survives the temporary flood and accumulating filth about it. In this case such activity has functional value as nest building but ordinarily it seems to be only ceremony. Perhaps we have here an insight into the way nest building began in the first place among other species.)

An adult which moved its small young up the slope to a location near my tent became frightened and left the little one. It, wet and cold, soon began to cry and move about. A strange adult came near to it and when it cried, would carefully take its beak between her mandibles. The little one tried several times to push itself under the adult to hover but the old bird seemed not to understand, appeared afraid, and would not hover the youngster, yet, when it continued to cry the adult returned several times and billed it. Finally the young rolled over down the incline about four feet against another incubating adult. There it tried to get under this adult but was repulsed.

Many unattended eggs have rolled down the incline and are half buried in a pool of filth.

10.00 a. m. No. (2) took charge of the green egg at about five o'clock this morning and now has the egg upon its foot and tarsus entirely off the rocks. Birds do not always keep the eggs off the rocks. It is surprising that with so large an egg they can close the feathers entirely about it. They do this when they settle down as in the evening.

(Note—I believe the peculiar shape of the Murre egg is explained by the fact that it is thus easier for the bird to bring a larger surface area in contact with the belly during incubation. Considering the large size of the egg in relation to the bird this is important and is, I believe, of much more functional value than the advantage the shape gives the egg in keeping it from rolling to destruction.)

11.30 a. m. No. (8), a bird which has been around here before, now is standing where it appears to claim a nest site. It has been there for some time with a fish and occasionally holds the fish's tail down between the tarsi repeating the ceremony of offering food to a small young. No young or egg is present. After several minutes the bird flew with the fish, and went out to sea.

12.00 m. The adult which left its young this morning has returned, recovered the young from the mud and has it fairly well dried. No. (3), the bird with the broken egg, has just left the colony. The broken egg is well flattened now. This leaves No. (2) alone of that group of birds. When No. (3) left, No. (2) stood in an uncertain manner for a few moments, but decided to stay with the egg.

1.00 p. m. The gull flew over and called. This frightened the adult with the young. It flew, upsetting the young which rolled several feet landing against No.

(5), which seems receptive although it has been occupied with its own egg since early morning. Soon the parent returned and fought the innocent No. (5), securing the young one under its wing again. But the gull returned again whereupon the parent was frightened away the second time. After about ten minutes of crying and pushing against No. (5) the young has been accepted under the wing of No. (5) where it is being hovered beside the egg. (Note—This is the first case of adoption I have seen in three summers' observations.) We shall see what may happen when the real parent returns.

1.30 p. m. No. (3) has returned and is incubating the shell although it is less than half the thickness of the original egg.

2.15 p. m. No. (4) which had the half-shell last evening and abandoned it at dark has reclaimed another similarly colored egg from the half-buried lot in the mire and has moved it about twelve feet to the location where last evening it hovered the shell.

3.30 p. m. For the past hour this colony has seemed to be in chaos. Many birds are trying to claim new nest sites and courting. These are the birds which, no doubt, lost their eggs as a result of the disturbance when my tent was placed. The colony is sensitive to gull warning and has suffered considerable loss. The young one is still with its foster parent, No. (5). I do not believe that it has been fed today.

5.15 p. m. The great mass of unoccupied birds here, courting and struggling for nest sites, indicates that the colony is about to be renewed and supplied with many more fresh eggs. Some of the birds are now sitting quietly on their chosen locations and the few incubating birds which I have been watching since yesterday are mostly quiet throughout today.

A pair of courting birds nearby have chosen their nest site. They are typical as they stand shoulder to shoulder and change possession, again and again, of a small piece of seaweed keeping their beaks down nearly to their feet. Frequently one utters a series of notes, as, *ya, ya, ya*. Then one preens the other's face. Again they lower the heads and repeat the *ya, ya, ya*. Occasionally they lower the breast on the rocks in a manner similar to a posturing mood while they tread with the feet in a distinctly scratching motion. I can hear their toenails scratching on the rock. Each bird of the pair performs this scratching act, sometimes in succession, sometimes not.

8.45 p. m. The young Murre is still under No. (5), the bird with its own egg; it has not been relieved today. The young cries considerably the past two or three hours. Perhaps it is hungry with no food today. Four adults, I think, have not left their eggs today. No. (2) has been here since about 4 a. m., without food sixteen hours at least.

July 8, Friday

3.30 a. m. Daylight has been coming on for fifteen minutes. The gull has just been here and cleaned up every egg out of reach of the Murres. It took the contents out of the egg which No. (4) had retrieved from the mire.

4.00 a. m. A few minutes before four o'clock No. (1) returned to take a shift on the egg. After fifteen minutes of preening about the face and the throat No. (2) stood up and flapped its wings. No. (1) tried to take the egg but No. (2) was not ready to leave. A little more billing and No. (2) stood again. Then No. (1) reached under No. (2) and took the egg with its beak while No. (2) backed slowly away. After approximately twenty-four hours of duty No. (2) left the colony.

A new bird, No. (7), came in with a small fish in its beak and took up a location near No. (1) on the flat surface where I saw it sitting yesterday. For an hour it has been quiet with the fish protruding from its beak.

5.30 a. m. About 4.30 No. (6), the mate to the bird with the adopted young, came to relieve No. (5). Twenty minutes of ceremony were required to effect the exchange and now No. (6) has taken over egg and young.

7.00 a. m. No. (7) has just produced a new fresh green-colored egg. She is still holding the fish in her beak. No. (4) has returned and is hovering the empty shell of the egg from which the gull took the contents this morning. No. (7) has just now discarded the fish which she held in her beak for nearly four hours and has stayed with her egg during a gull fright when many other birds left the colony.

10.00 a. m. No. (5) is back trying to feed the adopted young a fish as large as the bird. It cannot take the fish. During a gull fright No. (7) left her fresh egg and it rolled down the slope into the mire about twelve feet away where it seems lost. Soon No. (7) came back to the empty nest site.

11.15 a. m. No. (7) is having trouble holding her empty nest site with many courting pairs crowding about.

12.00 m. The bird which was bringing fish to an empty nest site and going through feeding ceremonies yesterday is repeating the act today.

12.30 p. m. Here is a typical courting pair going through the entire ceremony (a mixed pair, one a 'white-eyed' bird mated to the plain-colored type). Their behavior is typical and may be described as follows: the two birds crowd close together, side by side, on their selected nest site surrounded by other pairs. One bird does the scratching act (described above). Occasionally they fence rapidly with the beaks partly open, the mandibles clashing together in rapid side movements while both birds squawk. Then one scratches the ground while the other presents a piece of nesting material which is ignored. Then, they crowd closer together and arch the necks in a manner to bring the heads down under the breasts. The one which I assume to be the male tries to take the other's beak in his but not to hold it, only pretending while he utters a series of calls: *auoooooo--*, *quack, quack, quack, quack*. This *quack* note may have two, three, or four repetitions and the first note is long drawn out. Following this, the female usually shakes the head. Sometimes the male does also. Often they bill repeatedly with the beaks down under the breast of the female as if concealing them. Often the (female?) has the feathers on the head and neck raised, the eyes partly closed and shows some movement of the nictitating membrane. This continues for hours.

2.00 p. m. No. (2) has just returned and made attempts to take over the egg. At the moment a gull fright gave No. (2) a chance to get on the egg. No. (1) billed for a moment and left the colony having completed ten hours' duty. Its mate did twenty-four hours' duty before that.

3.15 p. m. The egg of No. (5) is beginning to hatch. This means that her incubation cycle was about complete when she adopted the orphan.

8.00 p. m. The ranks of the courting birds have thinned out somewhat but a few are still 'going strong'. In the case of one pair I have recorded the vocal response to the call described above, thus: one bird calls *ya, ya, ya, ya, cahooooo--*; the other bird answers, *auoooo, quack, quack, quack, quack*.

8.15 p. m. No. (2) is back on the egg. She left at 2.00 o'clock. I did not see her return.

9.00 p. m. Darkness is approaching but about a dozen pairs of the courting birds are still on the nest sites which they have been holding most of the day.

July 9, Saturday

3.30 a. m. There was some movement in the colony between 2 and 3 o'clock, but now several courting pairs are back at it.

4.30 a. m. The colony is crowded with courting pairs. Several birds hold fish in their beaks but seemingly without any purpose.

5.00 a. m. No. (1) is on her egg. This pair of birds never have left their egg regardless of the movements of others. (Note—Normally a Murre egg is never left unguarded. This is, of course, the explanation for the species' being able to use relatively steep inclines for nest sites. When one bird relieves the other from duty the egg is taken over by the incoming bird in such a manner that it has no chance to get away and roll except by accident.)

6.00 a. m. A storm is approaching and I am now leaving the blind after a continuous study of over sixty hours except for five hours of darkness during the nights.

SUMMARY

1. The Murre is a social bird in its nesting colonies, easily and adversely affected by fear.

2. In the Cape Whittle region of the Gulf of St. Lawrence, the nesting islands are flat, of granite with wide faults or crevasses for nesting places. Many large colonies are located on the flat surface of islands, sometimes among nesting cormorants, sometimes completely exposed. The structure of a nesting colony consists of a confederation of groups of birds. Each group tends to show concentric formation according to laying dates.

3. The daily activities of the breeding birds take place in three functional areas: the area of the breeding sites, the loitering ground, and the feeding area.

4. A pair of courting birds practice a certain ceremonial behavior at the nest site. With some variation in the sequence and completeness of different acts, the ceremony includes vocal notes, movements of the head and body, preening, erection of head- and neck-feathers in at least one sex, scratching with both feet while the body rests on the breast, billing, crowding and exchanging possession of small stones, sticks or bits of seaweed. One bird was observed showing movements of the nictitating membrane.

5. Courting birds often carry food fish to the nest site and there hold them in the beak from one to four hours. This behavior appears to give satisfaction to the one bird only. I have never seen another bird appear to notice these fish. Courting pairs are likely to remain at the prospective nest site for many hours at a time for a few days before ovulation.

6. In a few cases where birds nested in gravel-bottom crevasses which at times flood to a depth of one or two inches and collect pools of liquid filth, I have seen nest sites built up and the eggs thus saved by being on a small island formed as a result of the incubating bird's reaching out from her nest site and securing small stones which were in turn dropped near her breast. When one observes the bird doing such nest building (if it may be called nest building) the result appears entirely accidental because the bird does not seem to retain interest in the stone long enough to place it with any purpose. Other birds, if near, are likely to disperse these stones. But the fact that there is a tendency for some birds to accumulate materials indicates that there is some direction to the birds' movements and this may be the beginning of nest building in a species.

7. Experiments show that Murres do easily identify their eggs even when they show only slight differences and when moved some distance from the nest site. Eggs out of place are returned by their owners to the old nest site, and are usually completely ignored by strange birds. Two different pairs of birds at different times incubated broken eggs and empty shell or pieces of shells. This indicates that the birds may rapidly adjust to a change in the character of their egg. One bird was observed to adopt a strange abandoned egg of similar color to the old shell formerly cared for.

8. One incubating adult adopted a small young. This foster parent was incubating a pipped egg at the time. In many other similar situations I have seen small young left to cry and chill but they have always been ignored or repulsed by surrounding adults except in a case where the adult was frightened by man and thus allowed young birds to take refuge under its wing temporarily (see *Auk*, 35: Plate 5). After about four days of age, young do not approach strange adults.

9. Definite feeding ceremony is used by adults in offering food to young; and adult birds having lost a pipped egg or small young have been observed to return to the old nest site and perform the food-offering ceremony for a period of two or three days following the loss.

10. A ceremony of social preening and crowding is used when a bird takes over the egg or young from its incubating mate. These ceremonies are not always successful. Both birds do duty with no regular interval for exchange; but 16 to 24 hours of duty is not uncommon.

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