



OXFORD JOURNALS
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Source: *The Auk*, Oct., 1950, Vol. 67, No. 4 (Oct., 1950), pp. 477-485

Published by: Oxford University Press

Stable URL: <https://www.jstor.org/stable/4081088>

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THE BLACK GUILLEMOTS OF KENT ISLAND,
BAY OF FUNDY

BY HOWARD ELLIOTT WINN

THE following study of the Black Guillemot, *Cepphus grylle* (Linnaeus), was conducted at Kent Island and neighboring Sheep Island during the summers of 1946 and 1947, upon the suggestion of Dr. Alfred O. Gross.

Kent Island, one of the group called Three Islands, is in the Grand Manan Archipelago in the Bay of Fundy, New Brunswick, Canada. Its rocky shore is excellently suited for the nesting of the Black Guillemot. The smallness of the rocks facilitates observation of the eggs and young, whereas on nearby Southern Green Island most of the nests are inaccessible because they are under huge boulders. The major portion of my work was carried out on Kent Island, but Sheep Island, uninhabited and less frequented than Kent, was used for more accurate study of mortality.

During the summer of 1947, about 50 pairs of Black Guillemots nested on Kent Island. In the first part of July, I noted the presence of about 50 extra, non-breeding guillemots in summer plumage. After about a week of disporting and feeding off Kent Island they moved onward, and another or the same non-breeding group came to the shores of Kent in the latter half of July. The birds in these groups were probably one-year-old birds that had not attained sexual maturity although they might have been older birds that had not succeeded in raising a brood. Many young guillemots have been banded at Kent Island but no returns have been reported during subsequent nesting seasons.

The guillemots became quite accustomed to the burlap blinds that I used, and my handling of the young and adults did not seem to affect their normal behavior. A single-beam trip scale was used for weighing chicks and eggs; a vernier caliper, a 30-centimeter plastic rule, and a pair of dividers were used for the various measurements.

SPRING ARRIVAL

Guillemots in breeding plumage arrive at Kent Island about the first of March and stay offshore in open water until the middle of April, when they come up on the rocks. According to Ernest Joy, warden of the island, the first guillemots appeared offshore March 3, 1937, March 12, 1938, March 9, 1940, and February 26, 1941. He noted that the first individuals came to the rocks on April 8, 1947, and on April 10, 1938.

COURTSHIP

Courtship starts about the middle of May and ends in late June. The courtship follows an intricate pattern in the water and on the rocks. Generally, the birds are in groups ranging in numbers up to 25 with a mean of about 10, even after pairing takes place. In the early stages of courtship, it is thought that the attention of a male may be directed toward several females, but later the male seems to focus his attentions on one female.

On June 10, 1947, two adults climbed to the peak of a rock that was soon to be covered by the tide. They faced each other, bowing and whistling as they slowly turned in a circle. It appeared that the male was trying to get behind the female, but the female turned in a circle, preventing him from doing so. Suddenly the female, whistling intermittently, squatted flat on the rock with her neck outstretched and tail directed upward. The male stepped on the female, placing his feet squarely on her back and pushing downward alternately with right and left feet while copulation took place. There was none of the fighting or struggling that is characteristic of many other birds. After copulation, the pair went back into the water. As they were swimming around, another adult came close to them, but the mating pair apparently paid no attention to the third adult. They faced each other, whistling, and swimming in circles. Suddenly the female dove under water, and the male quickly followed. They bobbed up some 10 feet away, where they again circled each other. Then the male swam after the female with a peculiar side to side motion caused by the rapid alternate paddling of the feet. The female then took to the air for 20 feet, the male quickly following. Slowly the female led the chase on to a projecting rock where they again followed the courtship pattern until it ended in copulation. This time they remained on the rock, sitting beside each other, whistling, looking at each other, and apparently resting. This, in general, was the usual daily courtship pattern of the Black Guillemot on Kent Island.

The copulating position is maintained from 10 seconds to a minute, during which time the male's tail is pressed down only part of the time. Copulation occurs at any time of the day, although it seems to be most frequent during mid-morning and mid-afternoon. The times of copulation that were recorded are as follows: 9:30 a. m., 10:30, 10:30, 10:30, 11:00, 12:00 noon, 1:30, 2:00, 2:00, and 2:30 p. m. An attempt to correlate the time of copulation with the condition of the tide was unsatisfactory because of the limited number of observations at low tide. Hyde (1937: 30) stated that copulation occurs both in and out of water, but in no instance, during a full month's observation of

courtship, did I see anything that could be called copulation in the water.

In three instances, a female that had a two-day-old chick was observed to assume the copulating position, but in these instances the female quickly upset the male as he attempted to mount. This type of behavior is rare. The pattern of courtship behavior in the water is carried on throughout the summer, but it does not end in copulation. Often a bird (either immature or unsuccessful in raising a brood) will carry on courtship activity with a female that has eggs or chicks. However, if this non-breeder approaches closer than about three feet to the nest, it is immediately chased away.

NESTS AND EGGS

On June 10, 1947, a pair of guillemots, after copulation, went to the rocky shore, where they searched in many nooks and corners of the rocks, apparently looking for a suitable place to build a nest. Immediately, I built a nesting cavity of large rocks in the region they were investigating. On June 19, I found one egg in the newly constructed crevice where a small cup had been shaped out of the pebbles that I had placed there. The eggs of two nests were destroyed June 8 and June 14, and eggs were relaid in them on June 24 and 29, respectively. Thus it took these birds approximately 15 days or less to replace their clutches. Eggs destroyed after the last of June were seldom, if ever, replaced.

The nests are usually placed between the high tide mark and the line of growing vegetation. However, on Sheep Island several nests were placed under rocks amongst yarrow (*Achillea borealis*), silver weed (*Potentilla anserina*), and sea parsley (*Ligusticum scoticum*). The adults bit off these plants when they grew across the entrance of the nest.

On Kent Island the eggs are regularly laid on a cup of small pebbles in a darkened crevice, although a few have been found on bare rock. Four nests were lined with seaweed, and it is interesting to note that none of the eggs in these nests hatched. I found feathers and bones of the Herring Gull, *Larus argentatus*, fish bones, sea urchin skeletons, gastropod shells, plant stalks, and small sticks in the nests on Kent and neighboring islands. Many places amongst the rocks afforded good nesting places but were never used if even a small amount of water was present in the crevice.

The eggs are laid, either during the night or more probably in the early morning, between the first of June and the early part of July. In 1947, 39 nests contained two eggs, nine had one egg, and one had three eggs. In 16 nests during the same summer, the eggs were laid

three days apart in 13 nests, two days apart in two, and four days apart in one.

The mean width and length of 77 eggs measured in 1947 were 57.7 by 38.9 millimeters. The extremes (in italics) were as follows: *63.7* by 38.3; *51.6* by *35.0*; 60.3 by 42.3.

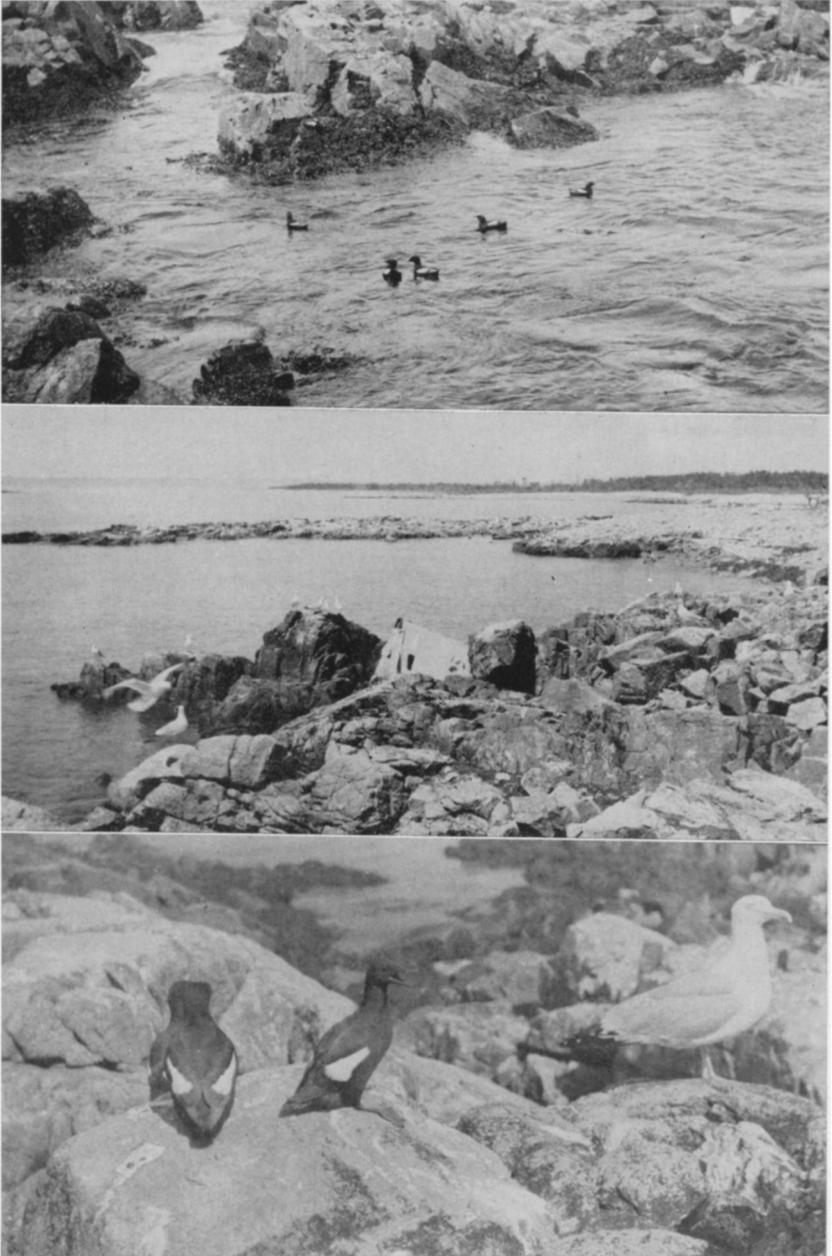
The weights of four eggs at the time of laying and on the day before hatching were: 50.35 and 41.71 grams; 50.54 and 44.41; 54.18 and 44.33; 46.13 and 38.54, representing an average 16 per cent loss in weight. The results of weighing four eggs throughout the incubation period are as follows: the eggs lost an average of 0.3 grams per day until pipped; the average weight loss was 1.5 grams per day after pipping.

It is very difficult to determine when incubation actually begins, but it seems to be between one and five days after the last egg is laid. Usually it is within one day after the laying of the second egg. Bent (1919: 159) reported the incubation period to be about 21 days, which is the time that has been generally cited throughout the literature. Incubation periods given by Witherby, *et al* (1945: 163) vary from 24 days to about four weeks. Hyde (1936: 15, and 1937: 31) reported that two eggs hatched after 28 days of incubation, two after 27 days, one after 26 or more days, and one after 23 or more days. In 1947, I checked all the nests daily until the eggs were laid. Seven eggs hatched after being incubated 28 days. These were in four nests where I had definitely established the beginning of incubation. The periods between laying and hatching of five other eggs were 29, 30, 32, 33, and 33 days. These facts would definitely place the incubation period at about 28 with a possible range of 27 to 33 days.

In several nests attended by banded birds, one adult usually was found incubating the eggs in the morning at about 10 o'clock. The other member of the pair was on the nest in the afternoon at about 2 o'clock. Hantzsch (1905: 111) stated that the males were always found on the nest at night while the females were on the nest during the day. On visits to a nest at about 10 and 3 o'clock daily I found the eggs cold at these times, on consecutive visits on from one to four days. Nevertheless, the eggs hatched.

Several eggs that were not going to hatch, which I judged by the lack of normal weight loss and by their being cold and damp for a long period, were apparently pushed out of the nests by the adults. In four such instances, I put the eggs back, only to find them pushed out again on the following days.

By moving rocks around one nest so that there was an opening just above the eggs, it was possible from the blind to watch the adult incubate. The following was observed on June 26, 1947—an adult



(Top) BLACK GUILLEMOTS IN THE WATER BELOW THEIR NESTS, BAY OF FUNDY.
(Middle) TYPICAL NESTING AREA OF BLACK GUILLEMOTS ON KENT ISLAND.
BLIND IN CENTER. (Bottom) BLACK GUILLEMOTS PERCHED ON ROCK NEAR
THEIR NESTS.

entered the nest after a cautious approach to the entrance seemingly caused by the presence of Herring Gulls. She "crawled" a few inches at a time into the crevice until finally she reached the eggs. At first she partially covered the eggs while inspecting the new opening above the nest. After a minute or two she settled down on the eggs, but immediately stood on one leg while turning the eggs over with a scratching motion of the other leg. She uttered a whistling note once in the nest; the remainder of the time she kept turning her head about, looking at the new hole. Very often one parent sits outside the nest while the other incubates.

HATCHING

The eggs of a single set usually hatch on the same day, although the eggs in one nest hatched as much as three days apart. The times between hatching of the two eggs in each of four sets, accurate within two hours, are as follows: 2, 3, 6, and 10 hours. The eggs of four other sets hatched less than 24 hours apart. It requires from three to four days for each egg to hatch. Hyde (1937: 31) described the hatching as follows: "First day: egg is cracked but not punctured. Second day: egg is pipped, opening is about 5 mm. in diameter. Third day: size of the opening is increased to 7 x 20 mm. Fourth day: at 1:00 a. m. the chick . . . emerged from its egg." In the main, my observations substantiate this description. The hatching activity is more pronounced during the last few hours. The egg tooth is used for most of the pipping until finally a wing and the bill protrude. The tarsus then emerges, and it is used as a lever to split the egg shell at the blunt end.

The egg shell is not removed from the rock crevice, although frequently the adult removes it from the small hollow of pebbles. I have found shells from previous years, apparently still in the original rock crevice.

DEVELOPMENT OF THE CHICK

At hatching: Yolk stalk scar prominent and bare; toes curled, apparently without control of voluntary muscles; young crawl well; eyes open and bulging; down dry within two or three hours; ear-opening prominent; large, white egg-tooth present; webs of feet flesh-colored with conspicuous blood vessels; skin pink; mouth lining cardinal; iris chestnut; and toes, legs, and nails black.

One day: Completely covered with black down, ventral part a little lighter; and yolk stalk scar partially covered with down.

Five days: Eyes appear normal; yolk stalk scar inconspicuous; and papillae of only scapular feathers conspicuous.

Ten days: Down thin on wings; most feather papillae present; unsheathing first of scapulars, followed by that of some wing-coverts; ventral apterium conspicuous; no tail feather papillae; and webs of feet gray.

Fifteen days: Egg tooth noticeably smaller; down thin on all parts of body; feathers of ventral tract white with dusky tips; dorsal tract with unsheathed black feathers; flanks with black feathers with white tips; occipital tract with unsheathed black feathers; wing feathers black except greater secondary coverts which are white with black tip; scapulars best developed of feathers; and greater secondary coverts longer than secondaries.

Twenty days: Primaries growing rapidly; egg tooth almost gone; and very little down left.

Twenty-five days: Egg tooth and down completely lost between twenty-fifth and thirty-fifth day; and next 15 days bring about rapid growth of body and feathers.

Thirty-nine or forty days: The young, having attained full growth and the complete juvenal plumage, leave the nest after 39 or 40 days. This statement is based on one juvenile that left the nest in 39 days, two that had not left in 37 days, one that had not left in 36 days, and Hyde's (1937: 33) statement that the young leave the nest about 40 days after hatching. This is a little longer than Seton Gordon's (1928) statement that the fledging-period of a pair of guillemots was four weeks or probably five.

TABLE 1
DEVELOPMENT OF THE GUILLEMOT CHICK*

Age in days	1	2	5	10	15	20	25	30	35	39	One adult
Weight	31	38	65	180	—	282	—	354	382	384	435
Body length	125	129	146	182	215	242	264	275	274	284	330
Wing span	108	113	138	200	270	375	404	432	450	485	560
Folded wing	18	20	24	35	57	83	101	132	134	142	202
Bill gape	21	24	26	32	35	35	39	42	45	47	46
Diameter of eye	4	4.5	5	6	6	6.5	7	8	8	8	8
Tarsal length	17	18	19	24	28	34	36	34	34	33	
Length third toe	18	19	22	28	35	34	36	36	37	37	37
Length third nail	5	5	5	6	6	7	7	8	8	8.5	9.5
Rectrices					7	16	27	36	42	47	52
Rectrices, unsheathed					3	13	24	30			
Sixth primary			1	4	20	34	50	63	75	86	89
Sixth primary, unsheathed					5	18	35	51	69		
Sixth secondary			1	5	17	32	41	50	66	62	66
Sixth secondary, unsheathed				1	6	19	35	45	63		

* Figures represent average measurements in grams and millimeters of two chicks, except the figures for 39 days which are from only one chick.

Table 1 shows the development of the chick from hatching until it leaves the nest.

CARE OF YOUNG AND BEHAVIOR OF NESTLING

For the first two to four days after hatching, both adults bring live rock eels, *Pholis gunnellus*, into the nest and dangle the live fish in front of the chicks, before feeding begins. After this they start feeding the chicks two- and three-inch rock eels which they get from shoals not visible from the island. When the chick is very young it is usually fed

dead fish, but as the chick grows older many of the fish are delivered alive and squirming vigorously. Larger eels are fed as the chicks grow older and, finally, the eels average about five inches in length. The parents feed the chicks from dawn until sunset. An average of 17 fish was brought to each of four nests between 5:00 and 9:00 a. m. In a few instances, three or four dead fish were left on the floor of the nest.

The adult will often bring the fish to the entrance of the nest and utter a whistling note. The young quickly respond by "frantic" peeping and hopping about, which they continue until fed. The chick takes the rock eel head first from the parent's bill and swallows it whole. The chick then makes a few soft squeaks as it sits, until the next feeding, in the spot where the eggs were laid.

In 1946, about 90 per cent of the food delivered to the chicks consisted of rock eels; the remainder was small red sculpins, *Myoxocephalus aeneus*. In 1947, these two species entered the diet about equally. Late in the season I saw one small herring fed to a chick.

At first the chicks remain in one spot in the nest, walking about very little, but by the time they are 20 days old, they wander considerably about the rock crevice. However, they usually return and settle down in the hollow of pebbles where the eggs were laid. A chick that was 25 days old stretched its wings and generally exercised them. In some nests, this activity is often restricted because of the small size of the nesting cavity. The chicks, while alone in the nest, often peck at bits of mollusc shells. They do not leave the original nesting crevice until ready to go to the water.

When the young are 39 or 40 days old, the adults seemingly entice them out of the nests by dangling a live rock eel in front of them. This is based on one instance I observed on August 12, 1947, at about 8:30 p. m. The young are immediately led to the water and away from the island, presumably to the feeding grounds.

MORTALITY

Of 84 eggs laid in 46 nests during 1947, 44 (52.4 per cent) hatched and only 22 of the chicks attained an age of 30 days or more. This represents a 73.8 per cent loss of eggs and young. The high tides in July, which were accompanied by extremely high waves, destroyed 25 eggs and 18 chicks. Some of the remaining 15 eggs and four chicks were probably destroyed by Crows, *Corvus brachyrhynchos*, and young Herring Gulls; some of these 15 eggs probably failed to hatch due to infertility or the death of the embryo. This seems to be an extremely high rate of loss, compared with Hyde's (1937: 33) report that Crows

destroyed six nests and the tides destroyed 16 nests, of a total of 85 nests during 1935 and 1936. Although the nests are relatively safe when the eggs are deposited in June, the extreme change in tide reaches many of the nests in July. A few of the same nests in which the eggs were destroyed by the tides in 1946 were used in 1947, only to be again destroyed by the tides. In order to escape from the mid-day heat, young Herring Gulls often take refuge under the rocks where the guillemot nests are located. They sometimes crack the eggs accidentally and/or keep the adults off the nest.

On December 1, 1943, Ernest Joy found 62 guillemots that had been killed by oil along the shore of Kent Island. Mr. Joy and Mr. Allen Moses of Grand Manan told me that raccoons introduced on the southern tip of neighboring Grand Manan Island have almost completely exterminated the formerly large guillemot colony there.

RELATIONS WITH OTHER BIRDS

The Black Guillemots nest at the southern end of Kent Island, which brings them into close relation with the large colonies of Herring Gulls and American Eiders, *Somateria mollissima*. The eiders and guillemots seem to be able to live together without any competition. However, when a group of eiders is swimming along the shore the guillemots move out of the way, usually by diving. There seems to be severe competition, on the other hand, between Herring Gulls and the less aggressive guillemots. Minimum distances from the center of Herring Gull nests to the entrance of guillemot nests are as follows: 20, 21, 28, 34, and 36 inches. This is well within the minimum range of the Herring Gull's defended nesting territory. An adult Herring Gull often took rock eels from the guillemots as they flew to their nest. One Herring Gull was almost parasitic on a pair of guillemots, robbing them of their food two out of every three times they tried to approach the nest. The guillemots are usually alert and "nervous" when Herring Gulls are nearby because the gulls try to steal their food or to chase them off the rocks.

An interesting incident from my notes of July 10, 1947, illustrates a relationship between the eider, gull, and guillemot. Several guillemots were perched on the rocks, and a few were swimming in the water. One was not more than two feet from a female eider in the water, but they seemed to be in perfect harmony. Suddenly, an aggressive Herring Gull swooped down on the guillemots sitting on the rocks, scattering them into the water. The gull continued flying out over the water and tried to land on the guillemot which was swimming near the eider. The guillemot escaped by diving, while the nearby eider

with snapping bill struck out over the water after the Herring Gull. The gull left quickly and was not seen bothering any of the guillemots while the female eider remained in the vicinity.

SUMMARY

Courtship starts about the middle of May and continues to the last of June. Copulation occurs on the rocks.

Nests are usually placed between the high tide mark and the line of growing vegetation. Nesting crevices built by man are readily utilized. A destroyed clutch is replaced in about 15 days. Most nests contain two eggs, usually laid three days apart. A few nests contain one egg and, rarely, three are present. The average loss in weight of four eggs from laying to hatching was 16 per cent. The incubation period is about 28 days with a possible range of 27 to 33 days. The eggs of one set usually hatch on the same day.

There was a 73.8 per cent loss of eggs and young. The extreme high tides caused the greatest loss of eggs and nestlings.

Rock eels and small red sculpins make up the main diet of the young in the nests. The juveniles are led to the water by the parents 39 or 40 days after hatching.

The Herring Gull is a competitor of the Black Guillemot on Kent Island. There seems to be no severe competition between the guillemots and eiders.

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