REPRODUCTIVE BEHAVIOR OF THE COMMON LOON

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THERE is comparatively little known about the behavior of the loon family, Gaviidae. The Common Loon (*Gavia immer*) is the species most extensively treated in the literature, especially in the comprehensive report by Olson and Marshall (1952), but nevertheless several important behavioral features still remain unknown, especially those pertaining to courtship and mating. As a part of a more extensive comparative study on the behavior of the Gaviidae the Common Loon was studied during the summer 1970 on Iceland, where it was possible to obtain most of this missing information.

MATERIAL AND METHODS

Between 27 May and 5 September, a total of 391 hours of observation were recorded on five pairs of *G. immer* in four different lakes. The lakes were: Selvatn on the Skagi peninsula, Holmavatn by the town Blönduos, Midfjadarvatn near the town Hvammstangi and Holtavörduvatn in the mountain pass south of Hrutarfjördur. All these pairs were followed from the arrival in spring until September. A number of additional observations were also made, on several localities spread over the whole of Iceland.

In pairs where copulation was observed and the sexes thus could be determined, the male was seen to be distinctly larger, with a heavier head and neck, and it was therefore possible to distinguish and identify these birds during later stages of reproduction.

Table 1 shows the distribution of the observations regarding different types of behavior. All the types of behavior described here have been filmed unless stated otherwise in the description, and sounds were tape-recorded using an Uher 4400 recorder. Most observations were made from the car, a Land-rover, using binoculars or from blinds.

RESULTS

Arrival.—Most authors on the subject, e.g. Bent (1919), Yeates (1950) and others, agree that *G. immer* arrives paired in spring as soon as the ice on their nesting lakes has thawed. Our observations are in accordance, since the pairs in all lakes arrived in this way, as far as could be ascertained. In one case (Selvatn) the two pairs arrived on 30 May, when the ice had left the shores, and the first egg was laid only 5 days later, on 4 June, a remarkably short time but well in accordance with data on other loons (Sjölander, 1968; Lehtonen, 1970).

Territorial behavior.—The fact that all loons are extremely territorial has been noted by most authors, as well as the fact that the Common Loon chooses a large oligotrophic lake as a nesting place. The fact that the territory is large (up to 25 ha) might be explained by its use as the main source of food, and this also leads to the well known sparse occurrence of loon pairs.

TABLE 1

THE NUMBER OF OBSERVATIONS OF SOME BEHAVIORS AND/OR THE NUMBER OF PAIRS INVOLVED IN THESE ACTIVITIES. BEHAVIORS OBSERVED MORE THAN 100 TIMES ARE GIVEN AS 100+.

Behavior observed	Number of observations	Number of pairs
Raised neck	100+	5
Bill-dipping	100+	5
Splash-dive	100+	5
Circle dance	24	5
Rush	21	2
Upright	15	1
Courtship	33	2
Copulation	6	2
Nest search		3
Nest choice		2
Nestbuilding		2
Incubating		3
Relieving	8	2
Feeding the young	100+	4
Riding on parent	30	2
Resting ashore	9	2

Perhaps the best known territorial behavior is the crying of the loon, as described by e.g. Olson and Marshall (1952). The yodeling cry was the type most clearly used as a territorial marking in all the birds we studied. It was heard only from owners of territories and occurred most frequently during the first phase of reproduction. The "wail" was observed in the same situations as the "yodel," and seemed a low-intensity form of this cry. The "tremolo call" was the cry used in all situations of agitation, i.e. disturbances by man, overflying birds, other loons directly intruding etc. Spectrograms of these calls are shown in Figure 1.

When intrusion by other loons and in some instances other species occurred, several types of defense reactions were shown. *Bill-dipping*, as illustrated in Figure 2 (15, 21, 38, etc) is the most common reaction in all situations where the birds are agitated, and might be regarded as a typical example of a displacement activity (and thus not necessarily a defense reaction). A

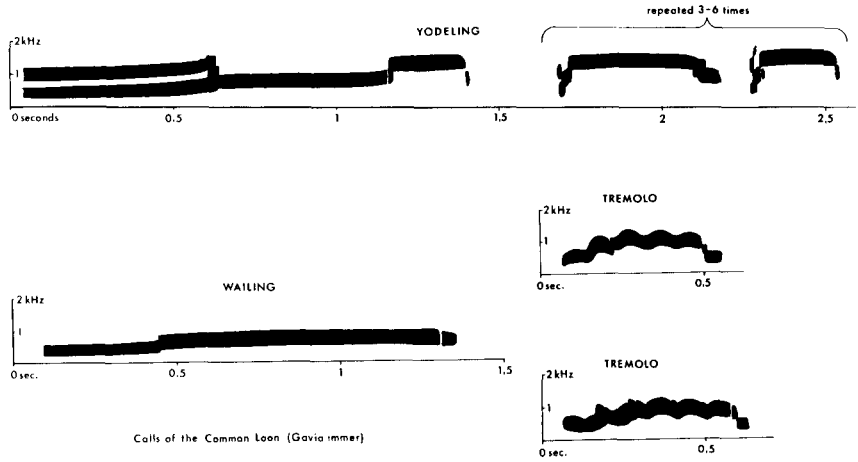

FIG. 1. Spectrographs of some calls, of the Common Loon.

raised neck position was another very common reaction, where the neck and breast are raised. At higher intensities and in aggressive situations the front plumage is lifted as well. This position is illustrated in Figure 3 (0) and in Figure 2 (26, 85, 131, etc). It is very often accompanied by the tremolo call. A *circle dance*, as illustrated in Figure 2, where the birds slowly circle around another with raised necks, bill-dipping and diving, is a common occurrence in all confrontations, especially when several birds meet. These behaviors mostly precede the *splash-dive*, where the bird gives a strong kick upwards when diving, as in Figure 4 (8). At more intense stages of territorial defense the bird raises to an *upright* position, when the body is held almost or quite vertical, with the wings folded, (Fig. 3–8), or spread (Fig. 3–54). The bird may even jump clear out of the water. This reaction is often preceded or followed by long *rushes* with flapping wings over the water (Fig. 3–121). This is not a pursuit but is mostly performed by a single bird.

Real fighting was not observed, except in one case where one bird of a pair with young attacked a floating paper bag, spearing with the bill and hitting with the folded wing, i.e. corresponding to the behavior in the vicious and occasionally deadly fights known in *G. arctica* (Sjölander, 1968). All these reactions, with the exception of the raised neck, have been reported earlier by different authors, e.g. Munro (1945), Yeates (1950), Olson and Marshall (1952) and others, though not always in connection with territoriality.

Courtship.—Since the territorial behavior of loons is so spectacular and the behavior most likely to be seen by the observer, it is easily understandable

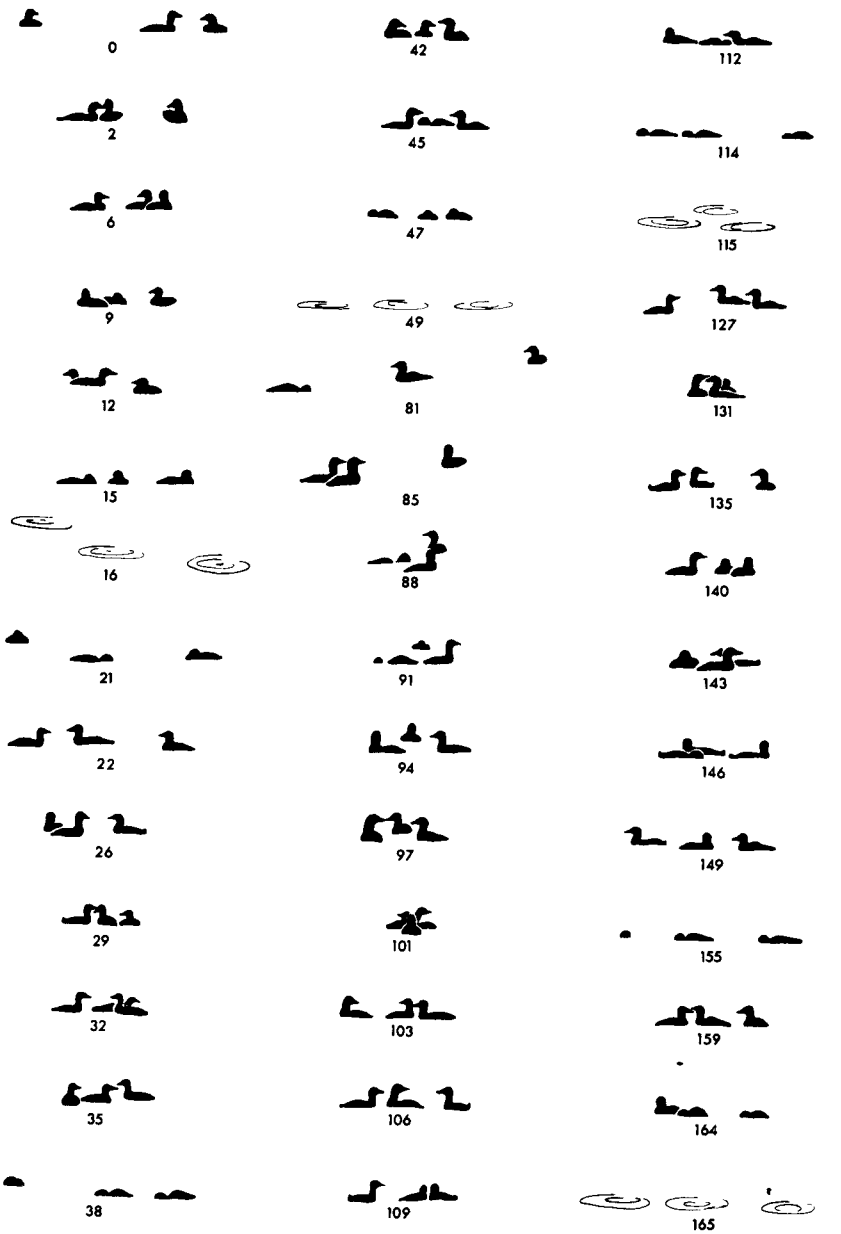

FIG. 2. Circle dance, performed by a territorial pair and an intruder. Numbers as in Fig. 3. Drawing directly from a film.

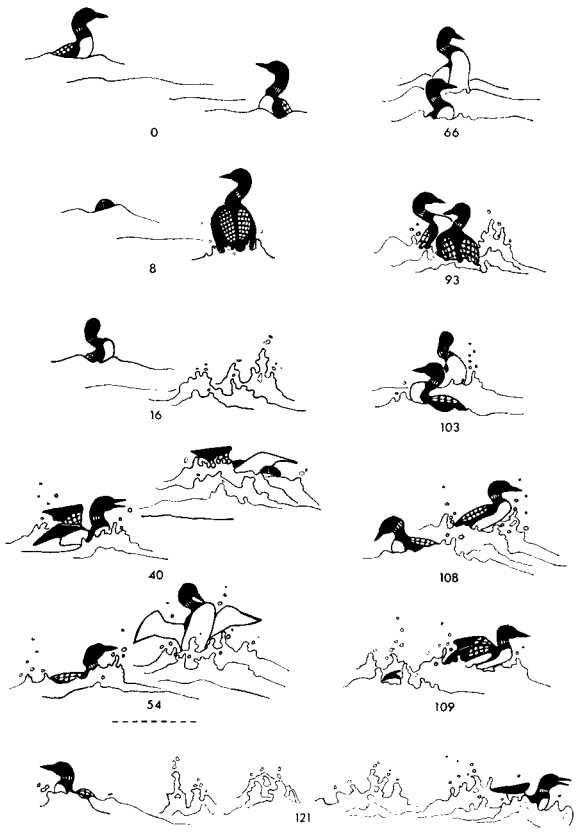

FIG. 3. Behavior towards an intruder in the territory of a pair with young. Defender to the right in 0, 8, 16, later indistinguishable from intruder. The numbers indicate frames of film at 18 frames per second, from an arbitrarily chosen zero, the drawing being made directly from a film.

that it has been interpreted as courtship by many authors (e.g. Huxley, 1923 for *G. stellata*). A number of authors, e.g. Munro (1945), Olson and Marshall (1952), Niethammer (1966), and others have described behavior regarded as courtship in *G. immer*, but all these descriptions seem to refer to territorial behavior. Our observations indicate, however, that there is very little courtship in *G. immer*, if by courtship is meant a special behavior preceding and leading to copulation. This is easily explained since the very probable life-long pairing in all loons makes the need for an elaborate courtship small. The only specialized behavior regarded as courtship in the pairs

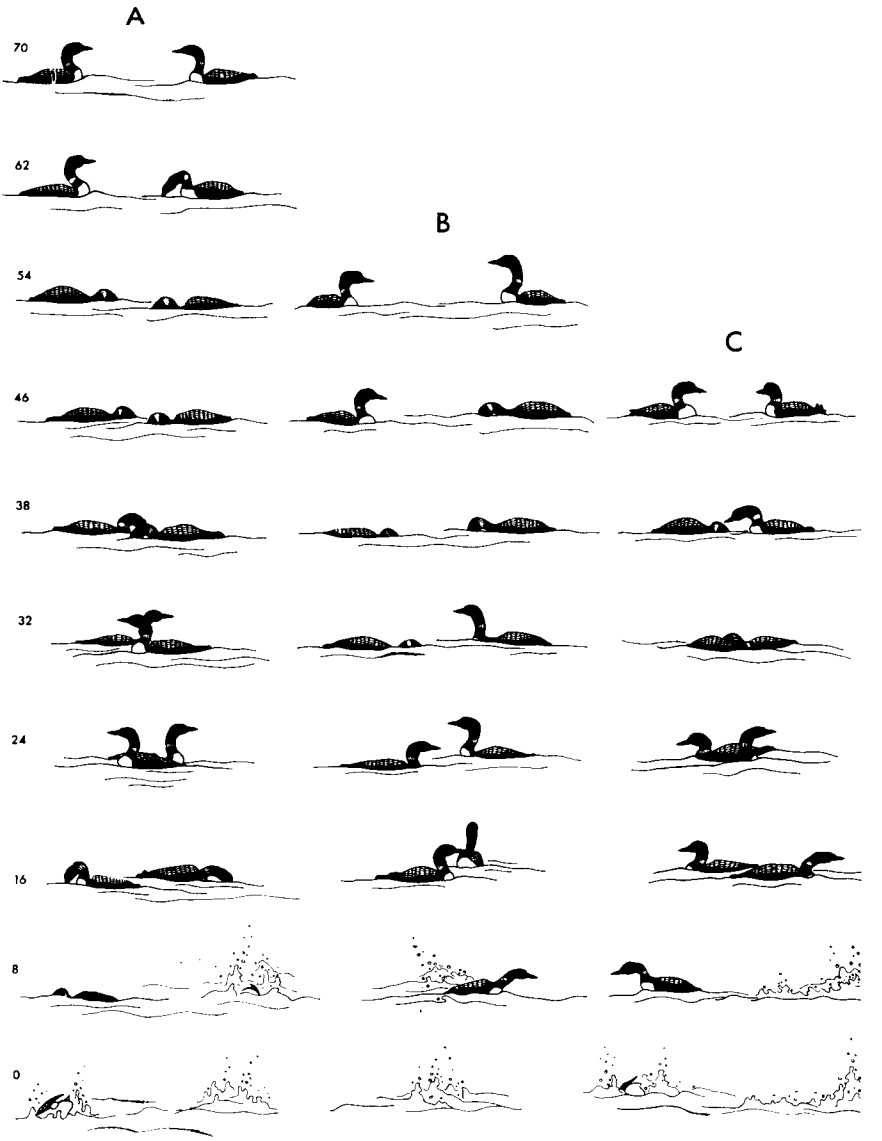

FIG. 4. Courtship, three different examples performed by the same pair. Numbers indicate frames at 18 frames per second, counted backwards from a zero chosen at the splash dive. Drawing directly from a film.

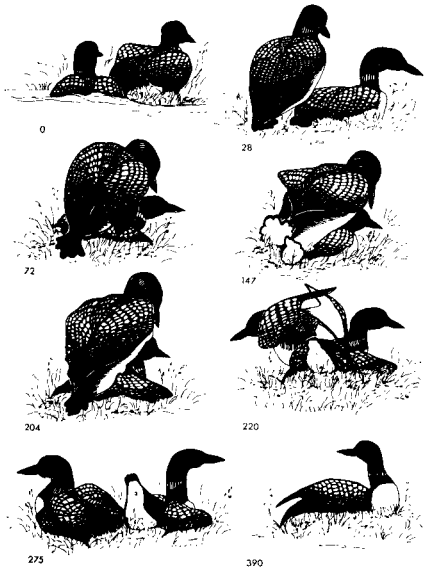

FIG. 5. Copulation. Frame numbers as in Fig. 3. Drawing directly from a film.

we studied was a formalized bill-dipping followed by a mutual splash-dive, as illustrated in Figure 4. This behavior only occurred as an immediate preliminary to copulation, or copulation attempts, and was easily distinguished from threat to intruders.

Copulation.—The copulation, which is not always preceded by any courtship, is initiated by the female who begins to seek a suitable place to go ashore anywhere in the territory. During this search-swimming both birds have very short necks. The male follows her closely. When she finds a place where she can climb up on land she goes up and awaits and male. He was in all cases very reluctant to follow, and especially in the days preceding egg-laying very often did not follow at all. If he decides to join the female he climbs up behind or next to her and immediately attempts to copulate. The copulation takes place as illustrated in Figure 5, i.e. corresponding to the same behavior in other loons.

Immediately after the copulation the male leaves the shore, whereas the female usually waits some minutes before following. The duration of the copulation is short, as can be gathered from Figure 5 (about 20 seconds from contacting the female to leaving her). Five of six copulations observed, as well as 22 out of 33 courtship displays, took place between 03:00 and 09:00.

The behavior, including attempts, was seen daily from the day of arrival until 2–4 days before egg-laying. The maximum number of copulations on one day was two.

Thus, the copulation closely resembles the same behavior in other loons as described by Huxley (1923) for *G. stellata* and Sjölander (1968) for *G. arctica*, as might well be expected. There seems to be no published description of this behavior, apart from a single observation by Tate (1969) and a report by Southern (1961). The latter report, however, describes a behavior where one bird chased another and then climbed on top of it, on the water, and thus in all probability refers to a territorial fight. It may also be noted that we found no evidence of the existence of a copulation platform, as mentioned by Tate (1969) and Tate and Tate (1970). Such platforms seem not to be used by the other loons either.

Nest choice.—In the two cases where it could be ascertained, the male chose the nest site. During the last 2 days preceding egg-laying he began to go ashore and make nest-building movements on different locations in the territory, soon settling for one of them. At the same time, the female in both pairs was still inviting; and on several occasions the two birds could be seen ashore on different places, the female inviting, the male building on the future nest. The female joined the male in nest-building on the day preceding egg-laying. In the two cases where the nest-building could be followed, the ultimate nest site was decided and the building of the real nest started on the day of the egg-laying (which as far as can be ascertained took place during the dark hours).

Nest building.—Both birds took part in the nest-building, but as soon as the female had accepted the male's choice she stayed on the nest and thus did the greater part of the building. The movements used were the same as in comparable birds, i.e. pulling material over the shoulder, drawing it near the body, scratching with the feet and wagging the body. In both observed cases the nest was built in less than 20 minutes, though added to sporadically during the incubating period. In one case these later additions combined with egg-turning moved the whole nest a distance of 1.4 m away from the first site, apparently since the place first chosen was unsatisfactory (reached by waves in strong winds).

Incubating.—Despite some reports to the contrary, several authors have noted the fact that both parents take part in the brooding, e.g. Bent (1919). In all the pairs we studied, the female took the greater part in the incubating. The periods between changing varied between less than one hour and 16 hours, with changes becoming less frequent towards the end of incubation. Especially in the beginning, there was a competition between the parents to incubate, where the incubating bird refused to leave its place to the other

parent, although the latter had already climbed up to the nest. When being relieved, the leaving bird in the majority of cases started building, i.e. picking up material and drawing it in (or making the building movements without material) and continued this behavior while leaving the nest for several minutes (in one case 42 min), even out on the water. The relieving bird usually turned the eggs before laying down, and then made some building movements after settling on the eggs. Apart from the turning of the eggs at relief, the eggs were seldom turned, and during most sessions not at all.

Hatching.—The exact incubation time could only be determined in one case, and was 28 days. In this case, the single young (the other egg was not developed) stayed on the nest 20 hours before leaving it. It was fed on the nest during this time, and made two short excursions to the water.

Parental behavior.—Altogether six pairs with young were observed of which only one had two young. The survival of only one young seems to be a very common, even normal, condition in all loons, which may at least for *G. stellata* be explained by competition between the young for the food brought by the parents, and the aggressiveness between the young (von Braun, Hessle, and Sjölander, 1968). Two of the six pairs were studied more closely, and the main bulk of observations refers to these pairs.

Most of our observations coincide well with the reports by Olson and Marshall (1952), Dunlop (1915), Wilson (1929), and others. It might be pointed out, however, that the defense of the young is very difficult to distinguish from the normal territorial defense, and so a special defense of the young might not exist. When the birds are disturbed, the young normally leave the parents and hide near the shore, while the parents show the normal behavior towards the intruder, as described by e.g. Dunlop (1915). The young and parents were thus separated for rather long times (maximum observed 85 minutes).

A behavior not previously reported in this species, but well known from *G. stellata* (von Braun, Hessle, and Sjölander, 1968), is that the birds go ashore to warm the young, not necessarily on the nest but using any suitable place. This was observed nine and two times respectively in two pairs, the time spent ashore being from 11 min to 3 hours. The initiative to go ashore came from the young in one case, but in the others from the parent.

A difference noted between the description of the feeding behavior given by Olson and Marshall (1952) and our observations was that the former authors state that the parent dips the food into the water and splashes it around before it is handed over to the young, but in the several hundred instances we observed of feeding this was not seen. The young often miss the food and drop it, and the parents then pick it up again, which might create an impression of splashing. Both parents fed the young in all observed pairs, and the

behavior described in Palmer (1962), i.e. one parent handing the food over to the other prior to feeding, was never observed.

The young were fed at approximately one hour intervals the longest pause at night being 6 hours. The number of feedings during each bout varied from one to 63, the duration of the bouts from less than one minute to 50 minutes. In practically all cases it was impossible to ascertain the type of food given, but in a few instances fishes were clearly recognized.

The young spent a considerable time riding on the back of either of the parents, up to 50 per cent of the time during the first 3–4 days, a notable difference from other loons, where riding seems less frequent (von Braun, Hessle, and Sjölander, 1968; Sjölander, 1968; Lehtonen, 1970). They were also warmed under the wing of either parent while floating. No riding was observed after the young were 16 days old.

Behavior of young.—Our observations of the behavior of the young are well in accordance with e.g. the report by Beebe (1909). The first dives were observed at four days of age, but the diving ability is not well developed until an age of about two weeks. Consequently, the young are an easy prey for such predators as the Great Black-backed Gull (*Larus marinus*), especially when the young leaves the parents during disturbances. The young bird moves easily on land, and might well be able to cover great distances in case of need, as reported for *G. stellata* (von Braun, Hessle, and Sjölander, 1968), a valuable ability if the nesting lakes freeze early.

Our observations give no clues as to the onset of independence, since all young stayed with their parents during our observation period, and were also fed (the oldest being 101 days old).

DISCUSSION

Even if a definite proof is yet lacking there are many reasons to believe that loons pair for life. The facts that they arrive in pairs immediately as the ice on the lakes thaws; that the number of pairs in a lake and even the nest sites remain the same throughout the years, as well as the lack of lengthy and spectacular courtship and the short time between arrival and egg-laying, all point to this conclusion.

We know practically nothing of the formation of these pairs, but the sparse occurrence of lone, calling birds in spring (observed in *G. arctica*) would point to the speculation that young males look for territories and then call for unpaired females, in which case the territorial cry could also be attributed a sexual significance. On the other hand, a pair formation in the spring flocks on the coasts might also be possible. Obviously, different loon species might differ in the method used, but this seems improbable in view of the many similarities in the reproductive behavior.

The courtship remains a disputable question. Very few authors on the subject have ever seen copulation, which has been described by Zedlitz (1913), Huxley (1923), and Keith (1937) for *G. stellata*, by Sjölander (1968) for *G. arctica*. There are no reports for the remaining two species except the previously mentioned report by Southern (1961) (obviously referring to a fight) and the observation by Tate (1969). In the descriptions of what has been regarded as courtship, there is therefore seldom if ever a connection stated between the reported behavior and copulation. A closer study of the territorial behavior of the loons leaves little doubt that the behavior described by different authors as courtship is really territorial, and only indirectly, if at all, connected with the mating.

The opinion given in this report, that the courtship consists of the relatively simple movements described above, gains further support from a comparision with *G. arctica* and *G. stellata* which show the same type of behavior preceding copulation, although there are notable differences in their territorial behavior (and thus in the behavior described as courtship in earlier reports).

Even if the pairs and copulations observed here are comparatively few, the fact that the behavior is about the same as in *G. stellata* and *G. arctica* strongly suggests that the observed cases were representative. Further, a copulation on the water as reported by Southern (1961) seems highly improbable since the loons lack a pseudopenis.

The significance of the building movements shown at relief by *G. immer*, in the same way as in *G. arctica* and *G. stellata*, remains uncertain, since it is the relieved parent that shows the most building, which makes a signalling interpretation difficult. A possible explanation might be that activity near the nest by the other parent stimulates an otherwise suppressed building, since inactivity on the nest is important to make the bird less conspicious, and thus a concentration of different activities from the conspicuous but necessary relieving might be advantageous.

Our observations on the behavior of parents and young do not differ from the reports by other authors except on some minor points. The warming of the young on the shore is probably a normal behavior, since it is well known especially in *G. stellata*, but since it does not seem to occur very often the fact that earlier observers have not seen it in *G. immer* is easily explained. This is also true for the differences noted in the feeding behavior, where the earlier observations are rather scanty.

On the whole, the observations in this report point to a strong similarity between *G. immer* and especially *G. arctica*, since the territorial behavior, courtship, copulation, nesting behavior, incubation, and parental behavior are very much the same. The explanation of such similarities and differences

can, however, only be had in the context of a study of the behavior of the whole family Gaviidae, which is as yet incomplete.

SUMMARY

During the summer 1970, the authors studied a number of pairs of the Common Loon (*Gavia immer*) with respect to the reproductive behavior, on Iceland. The birds were studied from spring arrival till September, and the territorial behavior, courtship, copulation, nest choice, nest-building, incubation, and parental behavior was observed and filmed. The territorial behavior was observed and filmed rather extensively, and a description of the different movements is given. Of the several vocalizations the yodel is regarded as a territorial call, the wail as a low-intensity form of the yodel, the tremolo as a warning and agitation call.

The courtship observed was very much like the behavior in *G. arctica* and *G. stellata*, but differs from earlier reports of *G. immer*. This seems to stem from the description of territorial behavior as courtship by many authors. The copulation, which took place ashore, was similar to the copulation of *G. arctica* and *G. stellata*, as might be expected.

The nest site was chosen by the male, the main nest-building done by the female. Additional nest-building was observed when the parents relieved each other on the nest. The incubation period was 28 days. The parental behavior was as described in earlier reports, but differences noted in the feeding behavior (both parents feeding, no splashing or dipping of the food). The young were sometimes warmed ashore. A number of comparisons with *G. arctica* and *G. stellata* are made.

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NEW PATRON

The latest addition to the list of Patrons of the Wilson Society is Dr. Paul A. Stewart of Oxford, North Carolina. Dr. Stewart, who is a research entomologist with the U.S. Department of Agriculture, holds three degrees from The Ohio State University. He has published about 100 papers on birds, 20 on insects, and 2 on mammals. One of his major pieces of research has been a thorough study of the life history of the Wood Duck, and his other interests in ornithology extend to the ecology of blackbird congregations, the evolution of bird migration, and the role of birds in the control of undesirable insects. He is a member of the AOU, the BOU, the Cooper Society, Ecological Society of America, Northeastern Bird-Banding Association, Inland Bird-Banding Association, and American Society of Mammalogists. Dr. Stewart is married and has two sons.