WINTERING BEHAVIOR OF COMMON LOONS

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ABSTRACT.—Common Loons wintering in Tom's Cove off Assateague Island, Virginia, defended individual feeding territories of 4–8 ha during the day and rafted together at night. The major activity, feeding, followed a daily pattern. Tidal changes, especially the onset of ebb tide, influenced feeding location and intensity. Generally considered solitary birds, loons may have a loosely cohesive social system of individuals that remain in contact throughout the year. *Received 5 November 1976, accepted 13 January 1977.*

THERE have been several studies of the breeding biology of Common Loons (*Gavia immer*) (Sims 1923, Munro 1945, Yeates 1950, Olson and Marshall 1952, Sjölander and Ågren 1972, Vermeer 1973, Barr 1973, McIntyre 1975, Ream 1976), but except for accounts of sightings and distribution little has been published on loon activity in winter (Leebody 1892, Robinson 1923, Dewar 1924). This paper presents the results of a preliminary study of the wintering biology of loons and describes Common Loon behavior in a single section on the mid-Atlantic coast.

STUDY AREA AND METHODS

The study was conducted from 2 January to 2 February and 24 February to 22 March 1972 at the southern tip of Assateague Island, Virginia, where large numbers of Common Loons are recorded annually (Christmas Bird Counts, esp. Amer. Birds, 1971, 25(2)).

Some observations were made on the ocean side of Assateague Island and some in Chincoteague Inlet, but the major portion of the study was done in two parts of Tom's Cove (Fig. 1). The cove is about 1.6 km across at the narrowest point and about 5 km long. At spring tides the maximum depth is 4.3 m (14 ft). (Water depths will be given in both m and ft to comply with both scientific and maritime conventions.) The contour line of 1.8 m (6 ft) mean tidal depth (MTD) shown in Fig. 1 is the one given by the U.S. Geological Survey in 1965. Aerial photographs made by NASA in February 1972 showed the same bottom contour configuration, justifying use of the 1965 map for plotting locations of loons.

Many species use Tom's Cove throughout the winter, primarily Horned Grebes (*Podiceps auritus*), Brant (*Branta bernicla*), Common Goldeneyes (*Bucephala clangula*), Bufflehead (*Bucephala albeola*), Oldsquaw (*Clangula hyemalis*), Scoters (*Melanitta* spp.), Ruddy Ducks (*Oxyura jamaicensis*), Red-breasted Mergansers (*Mergus serrator*), and Common Loons. Occasionally Red-throated Loons (*Gavia stellata*) appeared in the cove. No multispecies groups were seen, but single Horned Grebes frequently followed and dove behind foraging Common Loons.

Some observations were made from a commercial fishing boat about 1.6 km offshore. Several trips were also made into the bay with a small outboard boat in an attempt to locate loons from within the cove, but waves made sightings difficult. Two shore observation posts were used to secure most of the data. Elevations available from the ruins of an old factory at one point and an embankment at another provided sites from which each entire study area could be monitored on days when high waves and/or fog did not impede visibility.

Observations were made with a 40× spotting scope mounted with a compass. The focus adjustment button was divided into 32 ridges and a standard formulated by measuring the distance from the scope to a walking man at each one-ridge turn of the focus button. Map locations of observation posts were determined by triangulation with a lighthouse and an observation tower. Loon locations were recorded in the field as compass direction and focus button position. Locations of loons were then mapped on copies of a USGS map of Tom's Cove. Tidal tables used were from Wallops Island, Virginia and water depths were determined from USGS map designations of MTD.

During the second week in January the number of loons engaged in each of four activities was counted every 15 min from low to high tide for 5 days to cover the full range of daylight hours (0723 to 1700). These activities were (1) feeding—sequential diving, some culminating in fish or shellfish brought to the surface; (2) maintenance—preening, scratching, shaking the foot, and head rubbing; (3) sleeping—head laid over

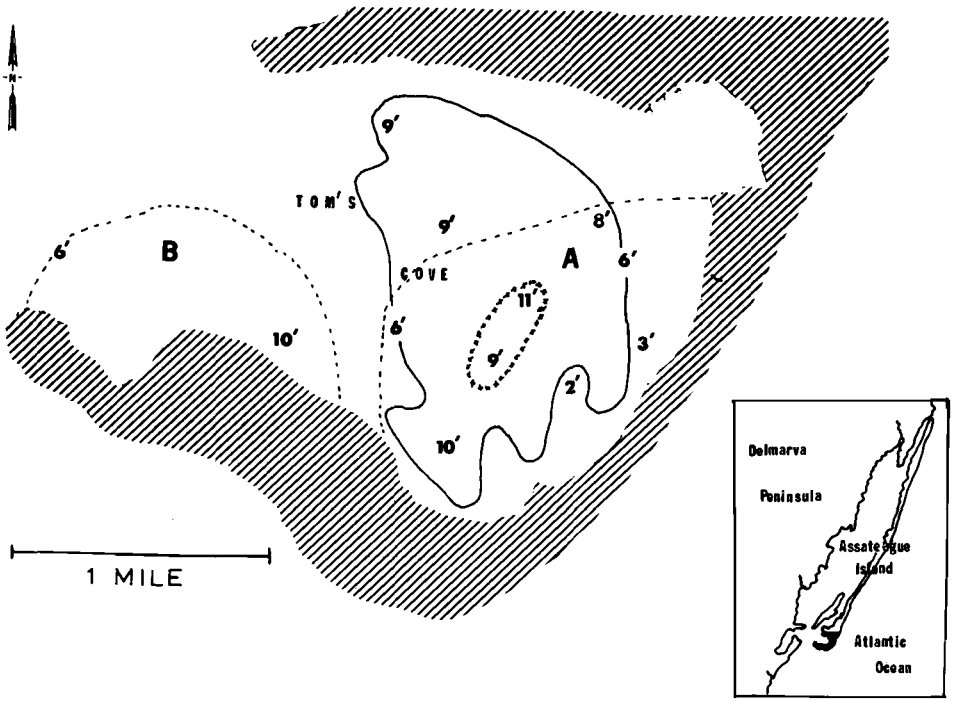

Fig. 1. Tom's Cove, Assateague Island, Virginia. Dotted lines indicate the study areas. Oval in the center of area A designates location of nightly rafts.

the back facing the tail; and (4) drifting—sitting on the water, head held low and facing forward, bird not engaged in any of the other three activities.

Results

Intraspecific associations.—Common Loons flew up and down the coast in loose aggregations throughout the winter. On 6 January from 1500 to 1530, I counted loons from a commercial fishing boat as we moved down the coast 1–1.6 km offshore. In 17.6 km we counted 161 flying loons, some singles and others in extended cluster flight flocks (terminology from Heppner 1974) composed of 2–46 individuals. Approximately 90% of the birds were heading north. On the morning of the same day large numbers were also seen flying northward. Thus, loons were flying in the same direction both morning and evening, and it did not appear they were "flying in" and "flying out" of any central location. No regular movement to and from the cove was noted at any time during the study nor did flying loons assume any consistent flight formations.

Common Loons did not form feeding assemblages as Red-throated Loons did, but spent the day spaced and feeding in separate waters defended with vocalizations and displays. The Yodel (territorial advertisement of males on breeding territories) and Tremolo (used in both inter- and intraspecific aggressive encounters during the summer) were heard and the Penguin Dance and Upright postures used as aggressive displays during the breeding season (McIntyre 1975) were given in intraspecific encounters but were not given to members of other species. Birds were noted in approximately the same locations from day to day, but individuals could not be

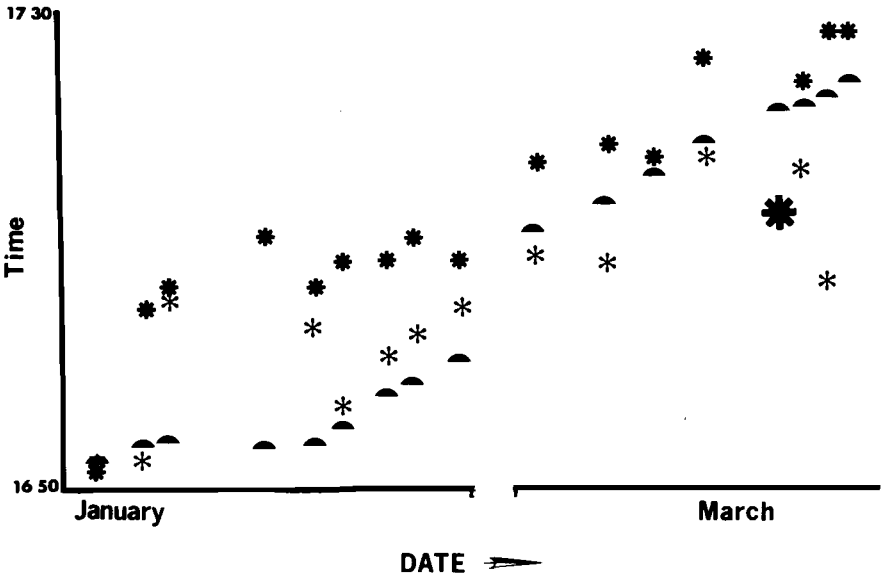

Fig. 2. Sunset time and rafting times of Common Loons. Half circles are sunset times, six-pointed symbols are times when loons first stopped feeding, asterisks are times when rafts assembled. The large asterisk is time when large raft was formed on 18 March 1972.

distinguished except for one with a malformed bill that occupied the same feeding ground daily throughout the study.

The space each loon used in the cove was calculated by three methods: (1) the two study tracts each contained about 25 individuals on most days, allowing a little less than 8.1 ha per loon; (2) locations of individuals were mapped, 65 spacings between loons measured, and an average distance determined to be 145 m—if it is assumed this represented the average radius of a feeding territory, each loon utilized 6.7 ha; and (3) movements of two loons were recorded on different January days and subsequently mapped and measured—one loon used 4.2 ha, the other 5.4 ha.

Late in the afternoon loons stopped feeding, alternately preened and slept for about half an hour, then drifted to the center of the cove to form a loose aggregation. Rafting time averaged 19.67 ± 3.38 (SD) min after sunset (Fig. 2). Although the birds did not raft in precisely the same spot each evening, they used the same general sector over the deepest part of the cove each night (Fig. 1). Loons from outside the cove did not fly in to join the assemblage and rafts were composed solely of the individuals that had occupied the cove during the day.

More loons rafted in the cove after mid-March. On 18 March the first large concentration appeared; I counted more than 75 individuals and estimated more than 100 loons in a raft within area A. Loons continued to be seen in Tom's Cove through the first week in April but none could be found there after the second week (C. Vaughn, pers. comm.). This, combined with the larger numbers and the earlier time of rafting (pre-sunset, Fig. 2) suggests they were premigratory aggregations.

Activity patterns.—Feeding activity during flood tide decreased during the period of the most rapid rate of rise (hour 3), reached its peak as the rate began to slow (hour 4) and sharply declined at high tide (Fig. 3). Sleeping patterns showed no tidal relationship. Maintenance behavior was greatest during the midperiod of tidal rise

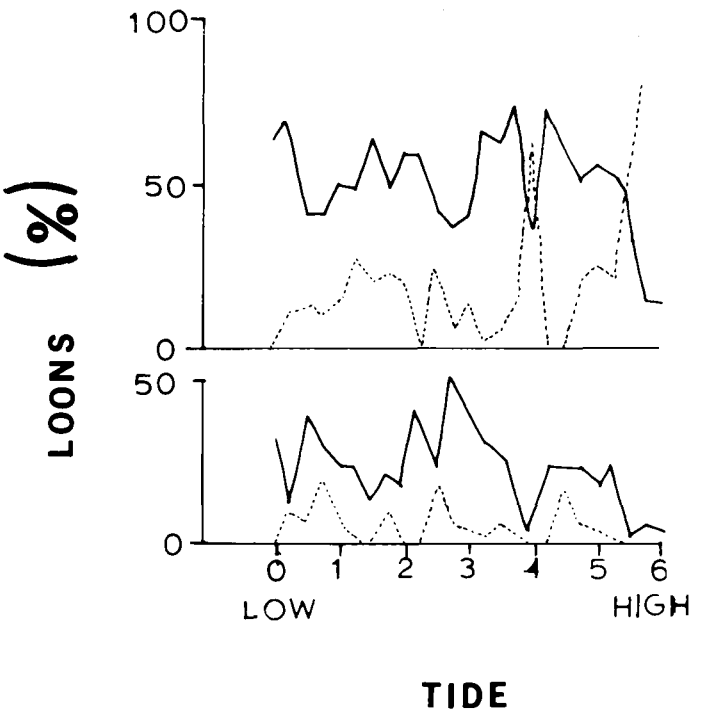

Fig. 3. Activity patterns from low to high tides for Common Loons during January as monitored every 15 min and including all daylight hours (N = 431 recordings). Tidal periods at Assateague average slightly more than 6 h. In the top graph the continuous line represents feeding, the dotted line is drifting; in the lower graph the continuous line is maintenance and the dotted line is sleeping.

when feeding decreased. The end of the tidal period saw a noticeable decrease in these three activities, and by high tide most loons were drifting.

Locations of feeding loons during ebb and flood tides were mapped as distance inshore and offshore from the 1.8 m (6 ft) contour line. I felt this gave a more accurate picture of water depth relative to loon locations than distance from shore because the bottom contour does not follow the shoreline (see Fig. 1). Correlation tests were made between water depths where loons were feeding and tidal height. No significant correlation was evident between feeding positions and changing water levels during flood tide ($r = 0.09$) but a highly significant negative correlation occurred between feeding position and water level during ebb tide ($r = 0.76$, $t(20) = 5.08$; $P < 0.001$). Loons did not swim out with the receding tide but moved into shallow water (Fig. 4); 29 loons monitored during ebb tide spent 83% of the time feeding.

Daily activity patterns are graphed in Fig. 5. All loons fed early in the morning, in midmorning and in midafternoon, and showed a final burst of feeding intensity in late afternoon. Maintenance, sleeping, and drifting showed an inverse relationship to feeding. At dusk all loons drifted.

The relative proportion of time spent in each activity was assumed to be in proportion to the cumulative number of individuals engaged in each activity at all recording periods. These were summarized for all except the first three and last two 15-min periods when nearly all birds were either feeding (AM) or drifting (PM). Time was nearly equally divided between underwater activity (feeding 55.3%) and surface activities (maintenance 25.3%, drifting 14.4%, and sleeping 5.0%).

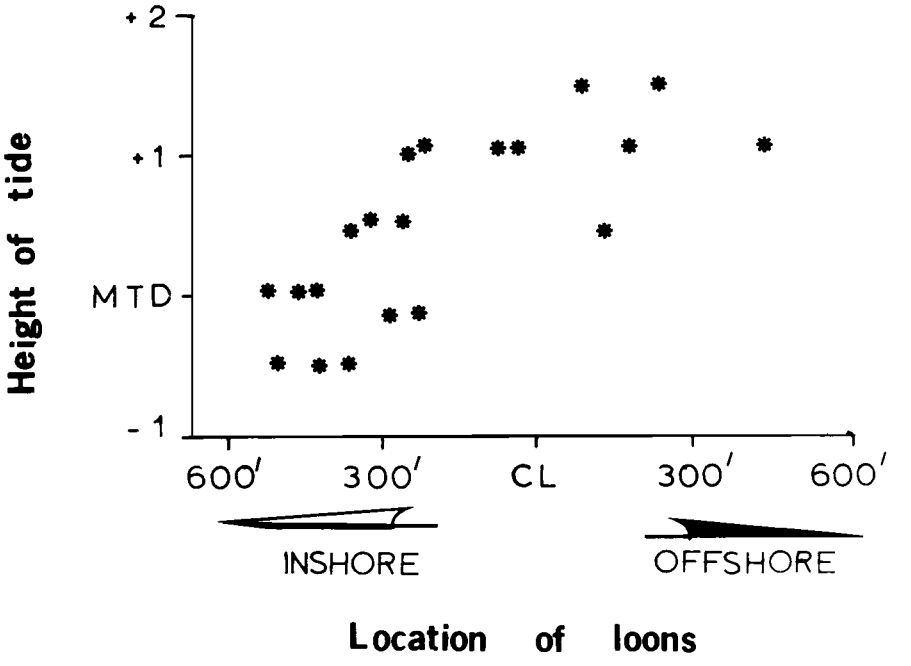

Fig. 4. Locations of feeding loons correlated with water depths during ebb tide. Numbers above and below mean tidal depth (MTD) indicate stage of tidal period when each recording was made. Rationale for using the 6 ft contour line (CL) as a reference point is explained in the text.

Feeding dives were significantly shorter (39.5 ± 1.25(SD) s) than feeding dives recorded in similar water depths in the summer on the breeding grounds (42.88 ± 0.10(SD) s; $P < 0.001$) and agreed closely with winter diving times given by Robinson (1923, 34.0 s) and Dewar (1924, 35.5 ± 0.4 s).

DISCUSSION

Loons stop feeding shortly after sunset during spring and fall migrations and throughout the summer (Barr 1973, McIntyre and Barr MS). Barr (1973) found that captive loons did not forage at night and encountered lowered capture efficiency when light levels were below 3 lux. Results of this study lend evidence that loons are visual, diurnal predators. As daylengths increased some loons stopped feeding before sunset. Birds may stop feeding before light levels reach their minimum and total feeding time varies among individuals and seasons.

Increased feeding activity at the beginning of ebb tide has several possible explanations: (1) prey items may be concentrated and slowed in their movements behind the receding tide, and loons may take advantage of this "lag effect"; (2) loons may be feeding on predatory fish moving inshore to utilize exposed food; or (3) loon feeding activity is low at high tide, so the increase in feeding as the tide starts to ebb may be a consequence of reduced feeding preceding it.

Summer territories of a pair average between 40 and 80 ha (Barr 1973, McIntyre 1975). Breeding adults need territories with food resources adequate to support two adults and a maximum of two young while each winter territory is used only by one bird. Even so, summer territories are 5–10 times larger than winter territories rather

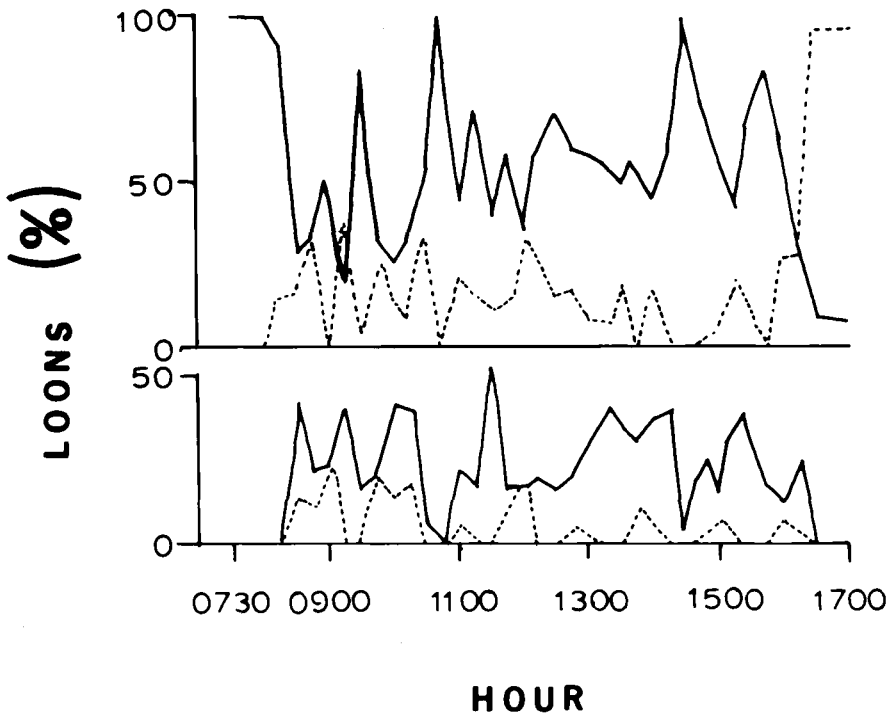

Fig. 5. Daily activity patterns of Common Loons during January as monitored every 15 min (N = 431 recordings). Graphs are arranged as in Fig. 3.

than 4 times, as might be expected if all other variables were equal. Smaller feeding territories and shorter dive times on the wintering grounds suggest that food may be of greater abundance and/or vulnerability in coastal waters than on the breeding grounds. Tidal activity may assist in causing periodic concentration and turnover of the food resource.

Although loons are territorial during the day they form rafts at night. Summaries of the functions of flocking given by Hinde (1973) and Orians (1971) emphasize feeding efficiency and safety from predators. Loons do not feed at night on freshwater lakes during the summer nor during fall migration (Barr 1973, McIntyre and Barr MS) indicating it is unlikely they feed at night during the winter. I know of no predators on adult loons on freshwater lakes and it is not known what, if anything, preys on loons in the coastal waters. However, escape from human disturbance or intraspecific aggressive attacks is underwater and it might be expected that the deeper water in the rafting area provides an advantage for escape should the need arise. Size limitation in the cove and restricted space in the deepest portion could contribute to joint utilization of the best location. Offshore sleeping might also be advantageous to minimize chances of being left stranded in receding tides or being washed ashore in storms.

A third possible pressure selecting for nightly group rafting is related to synchronous spring arrival at the breeding grounds. It is advantageous for males to arrive as early as possible, especially if territories are in short supply. The presence of nonbreeders indicates that they are; non-breeding birds of both sexes are present during the summer and were shown to be capable of replacing territorial birds when the

latter were removed (Barr, pers. comm.). Ideally, an individual should be first to arrive, but northern lakes are not available to loons when they are frozen, and there are thus limits to arrival time. If an individual's chance to be first is unfeasible, an alternative might be to see that no other males beat him, i.e. selection for synchronous arrival.

Some evidence suggests that males do arrive on the breeding grounds together. On 13 April 1976 I saw a group of eight fly into my study tract and land individually at separate adjacent lakes. I had just completed my daily check and could verify that the lakes had previously been unoccupied, but subsequent to the landing territorial males were present on them. A wintering individual that remained with males holding adjacent summer territories increases the probability that he would not be preceded to the breeding grounds by competitors. Nightly rafting could serve to maintain the unit.

I could not determine if mated pairs remained together during the winter. I did see some birds in twos from time to time but there was no way to sex them. Leebody (1892) indicated that loons remained in pairs off the coast of Ireland during the winter and held joint feeding territories. My data indicate individual territories were held. Burn and Mather (1974) and Remsen and Binford (1975) suggest that Yellow-billed Loon (*Gavia adamsii*) males and females may winter in different places. Preston (1956) concluded that spring migrants did not fly in pairs (*Gavia immer*), and McIntyre (1975) showed that male Common Loons precede females to the nesting territories in the spring. The question of whether pair members may stay together and be part of the same winter assemblage remains open. To resolve the question of the composition of winter assemblages, both as to pairs and adjacent summer territorial males, it will be necessary to secure evidence from marked birds.

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