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# Activity budgets of a marked common loon (*Gavia immer*) nesting population

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## Abstract

A newly devised nightlighting technique was used to capture breeding adult common loons (*Gavia immer*) at the Seney National Wildlife Refuge in northern Michigan in 1989. The behaviors of 6 pairs of known-sex, color-marked common loons were subsequently quantified during the breeding cycle in 1990. Collected observational data indicate that foraging, resting, locomotion, and preening were frequent throughout the breeding cycle. Time spent foraging was greatest during the pre-nesting period (53 to 57%), but declined significantly during the nesting and post-nesting periods ($p < 0.05$). Time spent foraging during the pre-nesting period was similar to that of fall and winter studies. During the pre-nesting period adult loons spent about 15% of the time in locomotion; this was significantly greater than the other time periods ($p < 0.05$) and is attributed to selecting a nest site. During the nesting cycle, almost half of each bird's time spent was nest-sitting. Sexual differences were negligible during nest-sitting. Resting and chick-rearing were the predominant behaviors during the post-nesting period and were responsible for the biggest difference in parental duties. Time spent preening declined from 8% during the pre-nesting period to 4 to 5% during the post-nesting period. Time spent by nesting pairs to produce chicks is approximately 10% during pre-nesting, 48 to 49% during nesting, and between 38 to 44% during post-nesting. By quantifying and establishing behavioral standards, subtle abnormalities or changes can be detected to better manage for viable common loon populations.

## Introduction

Numerous studies have investigated the natural history and nesting ecology of the common loon (*Gavia immer*) (e.g., Olson & Marshall, 1952; Barr, 1973; McIntyre, 1975; Strong, 1985; Titus & Van Druff, 1981). Yet, few researchers have had the opportunity to study marked individuals because of the inability to regularly capture adult loons. Only 4 people in the United States have permits to use colored leg bands on common loons (B. Howe, pers. com.). Additionally, because the adult plumage of each sex is similar and there are only minor differences in their size and shape (R. Storer, pers. com.), sexual differences in nesting ecology are unknown.

In 1989 I developed a technique to live-capture adult and juvenile common loons on their nesting territories. From 1989 to 1991 this capture technique has evolved into a time-effective, low-risk method which can be employed in a wide variety of weather and environmental conditions (Evers, 1993).

Here, I provide behavioral time-activity budget data gathered from 6 marked nesting pairs of known sex. Such behavioral observations have

been quantified for other birds (e.g., Paulus, 1984; Quinlan & Baldassarre, 1984; Collopy & Edwards, 1989) and activity patterns have been described for loons in the fall premigratory period (McIntyre & Barr, 1983) and winter (McIntyre, 1978). This is the first known study to quantify time-activity budgets for known-sex, marked loons during the breeding season.

## Study area

The study was conducted in the Seney National Wildlife Refuge, Schoolcraft Country, in the east-central portion of Michigan's Upper Peninsula. The 38630 ha refuge consists of 4 broad habitat types of which 24674 ha are emergent wetland, 10890 ha are forest, 2930 ha are open water, and 170 ha are cropland. The general topography is flat and is characterized by large emergent wetland areas interspersed with forested sandy ridges and vast expanses of forested lowlands primarily consisting of black spruce (*Picea mariana*) – leatherleaf (*Chamaedaphne calyculata*) bogs.

Twenty-one artificially controlled pools constitute the majority of open water. The pools range in size from 11 to 364 ha and are concentrated in the eastern one-third of the refuge. All 21 pools are shallow, averaging less than one m in depth and reaching a maximum depth of 2 m along the dikes. Although pools are shallow and pH levels are between 6.0 and 7.0, their sand substrate in low primary productivity.

## Materials and methods

The capture methodology for adult and juvenile loons is discussed in Evers (in press). Basically loons are captured at night using boats, one-million candlepower spotlights, and amplified playback recordings of various loon calls. Generally, adult loons can only be captured if they are accompanied by a chick less than 7 weeks of age. This represents the first time-efficient, low risk capture method. Many other capture techniques have been attempted prior to this, including other forms of nightlighting, decoy associated net-traps, scuba diver assisted underwater nets, and on-nest netting; however, none of these were considered successfull techniques (S. Sutcliffe, pers. com.).

Captured adult loons used during this study (one in 1988 and 5 in 1989) were marked with different color plastic leg bands and a United States Fish and Wildlife Service aluminum or stainless steel band. No more than 2 bands were used per leg. The color-band design was modeled after Strong *et al.* (1987). Some individuals were temporarily marked with a plastic tag wrapped around the right wing between the third and fourth secondaries.

The 6 captured adults represented 6 different pairs. Only paired adults with chicks were captured. After release, each newly marked adult had resumed normal activity by the next morning. No deleterious effect from the capture and banding process or from the bands were evident. Adults were never observed attempting to remove the leg bands.

Each of the 6 marked adults returned in late April of 1990 and established a territory with an unmarked adult. This provided an opportunity to study the time-activity budgets of known individuals and the sexual differences of these 6 marked territorial pairs (each occupying a different pool). The sex of the marked individual of each pair was determined during copulation. The sexes of each pair were also substantiated by identifying all sources of yodels from the male. Only male loons yodel (McIntyre, 1988).

The colored bands were typically visible during foot waggling, preening, resting, copulating, and nest-sitting. Maximum distances for observing bands and their colors (optimal lighting and no wave action) were approximately 1 km at the water surface (magnified 45 times) and 10 m underwater (magnified 10 times). The colored leg bands float to the water surface while the loon's legs are motionless. Banded birds were identified within 30 min of initial observation.

The breeding cycle was divided into pre-nesting, nesting, and post-nesting periods. Within each period, one-hour observation blocks were used on a rotational basis among the 6 nesting

pairs. Observations were divided into 3 time periods: (1) dawn to 4 h afterward (morning), (2) middle 4 h of the day (afternoon), and (3) final 4 h of daylight (evening). There are observational gaps in time on days with a photoperiod greater than 12 hours. For sampling purposes, each time period was further divided into 4 one-hour time blocks. Data for 2 one-hour time blocks were gathered daily for each of the 3 designated time periods (*i.e.*, 6 h of gathered observational data per day). Placement of the one-hour time blocks within the designated 3 time periods was random.

Behavioral time-activity budget data were gathered according to a continuous sampling scheme (Tacha *et al.*, 1985). Observations were made with a 20 to 45 power Bushnell Spacemaster II spotting scope from a vehicle blind at the water's edge. This non-intrusive technique minimized disturbance during observations. Minimizing visibility and discovery bias is crucial when formulating time-activity budgets (Bradley, 1985).

Behaviors were classified in 8 categories for the pre-nesting period: (1) courtship, (2) nest building, (3) foraging, (4) locomotion, (5) resting, (6) preening, (7) agonistic, and (8) interaction within pair. Nest-sitting was added during the nesting period and chick rearing for post-nesting. An additional category, out-of-sight, was used during each time period if an individual could not be located.

The results of the 4 most regularly observed behavior categories are presented and discussed in this paper: their descriptions follow. Foraging is diving and swimming underwater for less than 60 s. Resting is loafing on the water without forward movement; this includes sleeping. Individuals on nest are placed in the nest-sitting category. Locomotion is swimming on the water surface with forward movement, swimming underwater for more than 60 s, or flying. Preening is the maintenance of feathers, by means such as oiling and bathing, and includes foot waggling. Foraging was classified instead as chick-rearing behavior if the adults were (1) offering prey items and (2) frequently diving near the chick.

An activity was placed in the above categories if it was observed for greater than 30 consecutive s. The behavoir category would only be changed if it lasted for greater than 30 consecutive s. If a behavior lasted less than the 30 consecutive seconds then the behavior category remained unchanged.

A three-level nested ANOVA test (Ott, 1988) was used to determine if there were differences between the means of treatments (pools), sexes, and time periods. This test was repeated for 4 behaviors: foraging, resting, locomoting, and preening. If the ANOVA showed a significant difference within group means ($p < 0.05$) then the Student-Newman-Keuls (SNK) test was used to detect differences in mean values within behaviors between time periods.

## Results

A total of 307 h of observations was accumulated between 27 April and 21 July, 1990: 144 h pre-nesting, 111 h nesting, and 52 h post-nesting. The total number of observation h for 5 pairs ranged from 52 to 66; a sixth pair only was observed during the post-nesting period ($n = 14$ h). Of these h, 259 were used for the analysis of time-activity budgets (Table 1). The remaining 48 h could not be used due to differences in sample sizes and the statistical requirement for comparing equal samples.

Significant differences existed between sexes and among time periods ($p < 0.05$) but not among pools ($p > 0.05$). Significant differences between means of sexes were not tested with the SNK test because sample size was not sufficient.

### *Foraging*

Foraging constituted 53% and 57% of the male's and female's pre-nesting time spent, respectively. Time spent foraging in the pre-nesting period was similar to that for fall and winter as shown by McIntyre (1988). Time spent foraging by each sex was similar each time period (Table 1). Foraging declined significantly after the pre-nesting period to 34 to 36% during the nesting period ($p < 0.05$)

*Table 1.* Time-activity budgets (% time) of 6 nesting pairs of Common Lons at the Seney National Wildlife Refuge, Michigan in 1990.

| Activity | Pre-nest ($n = 105$ hrs) | | Nest ($n = 102$ hrs) | | Post-nest ($n = 52$ hrs) | |
|---|---|---|---|---|---|---|
| | Male | Female | Male | Female | Male | Female |
| Foraging | 53 | 57 | 34 | 36 | 15 | 19 |
| Resting | 16 | 14 | 5 | 4 | 32 | 22 |
| Locomotion | 16 | 15 | 5 | 4 | 7 | 7 |
| Preening | 8 | 8 | 7 | 6 | 4 | 5 |
| Courtship | 2 | 2 | – | – | – | – |
| Nest-sitting | – | – | 48 | 49 | – | – |
| Chick-rearing | – | – | – | – | 38 | 44 |
| Other | 5 | 4 | 1 | 1 | 4 | 3 |

and 15 to 19% during the post-nesting period ($p < 0.05$).

Prey items could not be quantified since adult loons swallow small fish while diving underwater (McIntyre, 1988), but some prey items were seen. Observed prey for adults was primarily brown bullhead (*Ictalurus nebulosus*), but they also fed on northern pike (*Esox lucius*), white sucker (*Catostomus commersonnii*), and common bluegill (*Lepomis macrochirus*). Crayfish were frequent prey items during the nesting period in mid-June.

Females fed chicks more often and spent more time searching for food than males. During the observed two-week chick-rearing period, food items for chicks included small fish (less than 4 cm), odonate larvae and other invertebrates, and occasionally vegetable matter.

*Resting*

Resting occupied 16% and 14% of the male and female's pre-nesting time, respectively. Time spent resting significantly increased in the post-nesting period, doubling for the male and increasing to 22% for the female ($p < 0.05$). There was a sexual difference in the time spent resting in the post-nesting period that can be attributed to the female spending less time resting and more time chick-rearing. The least amount of time spent resting was during the nesting period, 5% for males and 4% for females. These low values are attributed to time spent nest sitting, nearly 50% for each sex. There were no sexual differences in time spent nest sitting (Table 1).

*Locomotion*

Individuals from marked pairs were observed in flight only twice during pre-nesting and once during post-nesting. Foraging typically requires dives of less than 60 s underwater (McIntyre, 1988). Longer dives (greater than 60 s) can be interpreted as fleeing danger or other low frequency behaviors. Loons diving underwater for more than 60 s were not observed. Observations for locomotion consequently consist almost entirely of individuals swimming at the water surface. This was an important activity during pre-nesting (16% for males, 15% for females). During the pre-nesting period both sexes actively searched for suitable nesting sites which accounts for values significantly higher (2 to 3 times) than post-nesting and nesting periods, respectively ($p < 0.05$) (Table 1).

*Preening*

Typical preening bouts are 5 to 7 min and usually occur once every h throughout the day. The range of time spent preening per one h observation was 4 to 8% (2.4 to 4.8 min); these values are lower than the observed 5 to 7 min range since preening bouts were not always observed during the one-hour period. Time spent preening was greater

during the pre-nesting period than the post-nesting period.

*Courtship and other*

Courtship behavior is a low-frequency, short- interval activity. Three of the designated behaviors in the 'other' category (Table 1) lasted $< 1\%$ and included nest-building, agonistic (interaction between pairs, usually visually on the same pool), and interaction within pair. Much of the time assigned to the 'other' category, however, was from individuals out-of-sight, which was more likely to occur during the pre- and post-nesting periods. During nesting, the non-incubating individual was typically in the general vicinity of the nest. The other 3 behaviors were low frequency, short interval activities.

## Discussion

This study partly answers the challenge by McIntyre (1988) that 'activity patterns have not been thoroughly described for loons during the breeding season'. The major behaviors observed during each period included foraging, resting, locomotion, and preening. Over half of the time during the pre-nesting period was spent foraging, with another 14 to 16% of the time spent resting and 14 to 16% locomoting. These 3 behaviors occupied 85 to 86% of the loon's time-activity budget (Table 1). Foraging and incubating occupied 82 to 85% of the time during the nesting period (Table 1). Foraging, resting, and chick-rearing comprised 85% of the time during the post-nesting period (Table 1).

Foraging is an important activity during the pre-nesting period but is superceded during the post-nesting period by the need to rear chicks and rest. And, although there are few differences in sexual duties during the breeding cycle, females may spend more time caring for the chicks than males and more time foraging than males during the post-nesting period. In general, males and females had similar time-activity budgets during each period of the breeding cycle (Table 1).

It would be interesting to investigate the time-activity budgets for non-breeding territorial pairs using this same methodology. We already understand the direct time spent by nesting pairs to produce chicks (around 5% during pre-nesting (courtship and 'other' categories including nest building), 48 to 49% for nesting, and 38 to 44% for post-nesting), yet what is the distribution of time spent by loon pairs without nesting and chick-rearing duties? According to this study (during the pre-nesting period of the breeding cycle) and of others during the fall and winter, time spent foraging is consistently between 50 to 60%. Would this hold true during the nesting and post-nesting periods for non-breeding adult loons or does time spent resting (*i.e.*, nesting sitting during the nesting period) remain instinctive? If extensive foraging times were crucial for non-breeding pairs then there may be more pressure on accessing a time-efficient prey source (*i.e.*, multi-lake territories) instead of remaining on one pool to defend a nesting territory. At this study site, nesting pairs rarely flew to another pool, while non-breeding or unsuccessful pairs frequently visited several pools.

Eventually, the knowledge of time-activity budgets of loons during the nesting season in a variety of environmental conditions, geographic regions, and time periods will provide a reference for addressing human-related problems that loon pairs or populations face. For example, a pair of loons that are spending half of their time foraging and less than a quarter of their time chick rearing should be investigated due to abnormal parental care. Either the prey base is uncharacteristically low or high levels of human disturbance are forcing the adults to increase energy expenditure to defend their chicks. To compensate for this energy loss adults would increase their foraging rates and reduce time spent with chick-rearing.

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