Nocturnal Behavior of the Common Loon, *Gavia immer*

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Very little is known about nocturnal activity of Common Loons (*Gavia immer*). Knowledge of both diurnal and nocturnal behavior is needed to gain a complete understanding of their ecology. I used night vision light intensifiers to observe nocturnal behaviors of Common Loons. Results were consistent with the hypothesis that, as visual predators, loons would not forage at night and also that they would spend the majority of their time resting (92%). Loons, however, were just as active locomoting (patrolling) during the night as they were during the day. This suggests daily energy budgets need to be reexamined to incorporate this overlooked aspect of loon behavior. Lastly, loons on large lakes with multiple loon territories spent more time locomoting than loons on lakes that had just a single pair.

Key Words: Common Loon, *Gavia immer*, nocturnal behavior, Wisconsin.

Although there have been several diurnal time-activity budget studies of Common Loons (*Gavia immer*) (Evers 1994; Mager 1995; Gostomski and Evers 1998; Paruk 1999a), nocturnal behaviors have not been examined (McIntyre and Barr 1997). For obligate diurnal foragers, day length imposes strict limits on available foraging time (Lewis et al. 2005). Previous investigations of nocturnal foraging in sea ducks (tribe Mergini) concluded foraging dives are greatly reduced or non-existent (Nilsson 1970; McNeil et al. 1992; Guillemette et al. 1993; Lewis et al. 2005; Rizzolo et al. 2005). Barr (1973) had loons in captivity and did not observe any feeding in the dark.

During the breeding season, loons do vocalize at night, so some level of social communication is occurring during this time (McIntyre 1988; Wentz 1990). This opens up the possibility that loons may be active at night patrolling their territories. Knowledge of both diurnal and nocturnal activity is needed to gain a complete understanding of loon behavior.

The primary objective was to gain an understanding of nocturnal behavior exhibited by Common Loons through direct observation using night vision equipment. The following predictions regarding nocturnal loon behavior were examined: (a) that being visual predators of fish, loons would spend little to no time foraging at night; (b) they would spend most of the night resting or sleeping, and (c) they would sleep for longer bouts during the nocturnal hours than they do during diurnal hours. Lastly, comparisons between nocturnal and diurnal time activity budgets could be made which may potentially reveal unusual behavior.

Methods

Loons were observed in northern Wisconsin (46°N 90°W), Iron County, at several locations: Turtle Flambeau Flowage (TFF), Trude Lake, One Man Lake and Deer Lake. Descriptions of these lakes have been previously reported (Belant and Anderson 1991; Paruk 1999a). The former two lakes (TFF, Trude) are larger and each has multiple pairs of loons nesting in contrast to the latter two lakes (One Man, Deer), which are smaller and have but a single pair of loons occupying the entire lake.

Loon pairs were studied 25 June to 15 August 1996 and 1 July to 15 August 1997. I chose to study loons later in the summer so as not to disrupt nesting birds, or pairs that had young chicks (< 7 days old). Eighteen individual adults from 9 pairs of loons were studied (four and five pairs in 1996 and 1997, respectively). Each pair was observed for 5 nights for a total of 45 nocturnal observations. Observation nights were not random, but limited to suitable viewing conditions: low wind (<12 mph), clear skies, and no rain. Each loon pair was observed every 5-8 nights. A Noctron-V Model 9878 night vision light intensifier (NVLI; Varo Inc., Garland, Texas) scope was used to observe the loons. It gathered much light from the lake surface and provided 3× magnification and a substitute 300 mm lens was also used to provide 6× magnification. The observation period was restricted to the nocturnal hours (22:00-04:30, 6.5 h). Observations totaled 290.5 h. Observations were made singly, or by a team of two. Individuals or teams generally did not remain for the entire duration of the night, but were replaced by a second individual (or team) generally at 02:00 h.

Loon behavior is easily observable as they occupy lakes and often remain in the open water (McIntyre 1988; Evers 1994). Previous diurnal time activity budgets have defined and established loon behavior into the following categories: foraging, resting, preening, locomoting (patrolling) and agonistic (McIntyre 1988; Evers 1994; Mager 1995; Paruk 1999a) and were adopted for the purpose of this study. If loons responded to the observer (team) by vocalizing (wail or tremolo), observations were postponed 15 min.

Loons were viewed continuously and their behavior was recorded for the 6.5 h time block. Following Evers (1994) only changes in behavior that lasted more than 30 s were recorded. For example, if a loon was resting, then swam for 15 s and then returned to resting, the behavior category was not changed. Individuals in the head-tucked position were considered sleeping (McIntyre 1988).

For statistical comparisons, all data were tested for normality. Arc-sine transformation was used to normalize the data. To avoid problems of pseudoreplication, specific behavioral categories were analyzed using a two-way ANOVA with repeated measures, with individual and behavior as the independent variables and the amount of time spent in each behavior as the dependent variable. Experiment-wise error rate was controlled at the alpha = 0.05 level using the Bonferroni method of adjusting nominal alpha level by the number of tests performed (Sokal and Rohlf 1995).

Results

Loons did not forage at night (0%). They spent significantly more time resting (92.7%) than any other behavior, followed by locomoting (5.5%), agonistic (1.1%) and preening (0.7%), respectively ($F_{4,24} = 49.463$, $P<0.001$; Table 1). While resting, loons were in the head-tuck position 26% of the time. The majority of the sleeping bouts lasted 15-25 min (76%; $n = 212$), although there was noticeable variation (4-54 min). Loons resting with their necks in an upright position appeared alert. For example, loons responded with alarm vocalizations to both a Great-horned Owl (*Bubo virginianus*) flying overhead and a Black Bear (*Ursus americanus*) on shore.

Loons spent significantly more time locomoting than in agonistic ($F_{3,24} = 6.137$, $P<0.01$) or in preening behaviors ($F_{3,24} = 7.445$, $P<0.01$). Direct agonistic observations occurred between territorial loons twice. In each case, loons from adjacent territories were swimming the periphery of their territory when they came in contact with each other. After initial contact, each loon made several short underwater dives. This was the only occasion loons were observed diving underwater.

Summary statistics show that loons on larger lakes with multiple loon pairs ($n=14$) spent >200% more time swimming on the surface (=patrolling) compared to loons occupying smaller lakes with only a single pair of loons ($n=4$) (7.1% vs. 2.6%; Table 1).

Discussion

It was suspected that loons, being visual predators, would not forage at night. This idea was supported by my investigation (Table 1). The absence of nocturnal foraging by loons suggests they are unable to do so. However, loons have been caught in nets in the Great Lakes set at depths at 60 m (Schorger 1947) so presumably they can forage in low light levels or possibly even in complete darkness. Some deep-diving sea ducks have been observed at depths > 40 m, but it is suspected they are primarily using tactile receptors (Guillemette et al. 1993; Lovvorn et al. 2003). Thus, it remains unclear whether loons are unable to forage nocturnally or whether they choose not to forage nocturnally. My study did not test for differences between these two competing alternatives, but nonprofitable nocturnal foraging and visual constraints most likely force loons to avoid nocturnal foraging altogether. Future studies examining these alternatives would be useful to fully understanding nocturnal foraging in loons.

The second prediction also held true, that loons spent the great majority of their time resting (>92%) during nocturnal hours. This is similar to the patterns observed in sea ducks (Lewis et al. 2005; Rizzolo et al. 2005). However, compared to diurnal time activity budget studies, this is more than a 300% increase (92.7% 27.5%) (Mager 1995; Paruk 1999a). Loons with young rested in sheltered bays near shore whereas loons without young often rested farther from shore. Also, the third prediction held true in that loons spent overall more time sleeping during the nocturnal hours (96 min + 6.9 min; 6.5 hr) compared to diurnal hours (35 min + 5.8; 17. 5hr; J. Paruk, unpublished data). Also, the average sleeping bouts were longer during the night compared to the day. For example, the average sleeping duration during nocturnal hours was 24 min compared to 14 min during diurnal hours (J. Paruk, unpublished data).

After resting, the next most common behavior noted was locomoting, or swimming on the surface (5.5%). During the diurnal hours loons will move from one side of the territory to the other to investigate a disturbance (e.g., a sound, a camper, another loon) or simply to patrol the periphery of the territory (Evers 1994; Mager 1995; Paruk 1999a). During the nocturnal hours, a similar pattern was observed. For example, Paruk (1999a) showed loons patrol their territories about 8% of the time during diurnal hours and this study showed loons moved around their territories at night 5.5% of the time. This raises the question why are loons actively swimming at night? Several loon investigators have noted that loons lose their territory, in part, to intruders through usurpation (Paruk 1999b; Piper et al. 2000; Evers 2001; Paruk 2006). Turnover is higher on larger lakes with multiple loon territories (Evers 2001) which suggests there is more pressure there from conspecifics to defend and maintain territories. Although territorial disputes are often between or among neighboring loons, floaters or non-breeders are often involved in territorial skirmishes (Piper et al. 1997; Paruk 1999b; Evers 2001; Paruk 2006). In addition, it has been found that large lakes (>5 loon territories) generally contain many non-breeders or floaters (Evers 2001; Taylor and Vogel 2003*) and that some of these individuals eventually obtain a territory on these larger lakes (Piper et al. 1997; Paruk 1999a; Evers 2001). Further evidence to support this overall pattern is that agonistic behaviors were observed only on larger lakes with multiple loon pairs nesting.

Further research investigating nocturnal behavior between loons on large lakes with multiple loon pairs could prove useful in better understanding loon population dynamics.

TABLE 1. Summary of Common Loon nocturnal behavior (*n*=18 individuals; 9 pairs), Iron County, Wisconsin, 1996-1997.

Behavior	Overall (%, SE)	P-value	Large Lake* (%, SE)	Small Lake* (%, SE)
Resting	92.7, 1.0	<0.001	90.6, 0.8	95.8, 0.6
Locomoting	5.5, 0.9	<0.05	7.1, 0.6	2.6, 0.4
Agonistic	1.1, 0.8	>0.05	1.6, 0.9	0.7, 0.3
Preening	0.7, 0.6	>0.05	0.7, 0.5	0.9, 0.3

*n=14 for large lake and n=4 for small lake

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