

Nesting Biology of Pacific Loons, *Gavia pacifica*, on the Yukon-Kuskokwim Delta, Alaska

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The nesting biology of Pacific Loons, *Gavia pacifica*, was studied from 1973 to 1975 on the Yukon-Kuskokwim Delta, Alaska. Loons maintained territories on ponds throughout the pre-nesting period. Both adults incubated eggs and raised the young. Males incubated more than females during early incubation, and females more than males during late incubation. The female assumes much of the early brood rearing, with the male assisting more when food demands of young increase later in brood rearing.

Key Words: Pacific Loons, *Gavia pacifica*, nesting biology, brood rearing, Alaska.

The Pacific Loon, *Gavia pacifica*, commonly nests on the Yukon-Kuskokwim Delta, Alaska. As part of a study on the nesting ecology of Pacific Loons (Petersen 1979), I collected additional information on parental behavior in relation to feeding behavior of adults and young, as well as egg size within clutch in relation to laying sequence.

Study Area

A 12.3 km² study area (61°26'N, 165°26'W) was established on the Clarence Rhode National Wildlife Range (now the Yukon Delta National Wildlife Refuge) about 25 km from the Bering Sea coast. Habitats on the study area were predominantly wet marsh tundra and heath tundra similar to those described by Holmes and Black (1973). The study area contained 266 lacustrine ponds 0.2 to 100 ha (\bar{X} = 1.5 ha) in size and averaged 1.5 m in depth (Petersen 1979). All ponds used by loons contained fishes. Ninespine Stickleback, *Pungitius pungitius*, was the only species found. Shore vegetation was primarily Burr Reed, *Sparganium* spp., Marsh Fivefinger, *Potentilla palustris*, Sedges, *Carex aquatilis* and *C. lyngbyei*, and Mare's Tail, *Hippuris vulgaris* and *H. tetraphylea*. Submergent plants in most ponds were Pondweeds, *Potamogeton filiformis* and *P. perfoliatus*.

Methods

I observed loons throughout the nesting season from three 5-m tall towers, from canvas blinds on the ground, and while walking through the area. Observation periods ranged from one to four hours and were concentrated on two pairs in spring 1975 (16 periods totalling 59.9 hours), three pairs during incubation in 1975 (7 periods totalling 26.4 hours), and three pairs during brood-rearing in

1973 and 1975 (30 sessions totalling 83.1 hours). No observation periods were conducted in 1974 as no eggs survived until hatch (Peterson 1979). Observations occurred during all daylight hours, but fog and rain precluded an equal distribution of observation times. I identified individual adults by differences in plumage (Lehtonen 1974) and determined the sex within pairs by copulation position.

During these observation periods, I recorded the amount of time adults foraged, the amount of time adults fed young, and the number of food items fed to young per feeding bout. A feeding bout was defined as a continuous period of foraging and feeding uninterrupted by other activities. The type of foods fed to young and eaten by adults was determined by observing where adults were obtaining food and by estimating the size and shape of prey in the bills of adults.

I measured the length, breadth, and weight of the eggs of 25 clutches of known laying sequence. To estimate the fresh weight of eggs not weighed before day 2 of incubation, I multiplied the volume, as calculated following Anderson et al. (1970), by the average specific gravity (\bar{X} = 1.08, SE = 0.01, N = 26) that I measured for fresh Pacific Loon eggs.

Results

Role of adults

Pairs remained together on their nesting ponds during daylight hours from their arrival in spring through hatch (Table 1). At dusk, pairs flew toward the coast where there were believed to be open leads. The female began incubation immediately after laying the first egg and was the only bird observed on the nest during daylight hours until day 3. Thereafter, the male was

TABLE 1. Summary of presence and general activity of territorial pairs of Pacific Loons.

	No. hrs.	No. sessions	Percent of time present	Percent of total time when on territories spent:					
				Foraging	Sleep swim ?	Aggressive encounters (intra- and inter- specific)	Mutual displays	Other ¹	Incubating or brooding
Prenesting	59.9	20							
Male			100.0	40.2	48.5	8.2	3.2	-	NA
Female			100.0	58.2	30.4	8.2	3.2	-	NA
Early Incubation (day 1-14)	24.1	6							
Male			84.8	3.3	-	0.9	0.7	3.4	91.7
Female			49.8	85.8	7.4	-	0.1	3.1	3.6
Late Incubation (day 15-28)	2.3	1							
Male			-	-	-	-	-	-	-
Female			100.0	0	0	0	0	0	100.0
Early broodrearing (day 4-12)	13.0	4							
Male			30.5	0.4	99.6	0	0	0	0
Female			100.0	45.4	5.1	0.8	0	0	38.7
Late broodrearing (day 17-63)	71.1	26							
Male	0	0	84.9	20.0	76.2	3.2	0	0.6	0
Female	0	0	97.7	53.7	43.0	2.8	0	0.5	0

¹Includes disturbance by airplane, disturbance by foxes, unknown disturbances and present but out of sight in pond.

predominantly on the nest during the day until about day 14. During the second half of incubation, only the female was on the nest during one observation period at that stage. After hatch, females primarily cared for the young until the young were about 18 days of age, after which both adults cared for the young.

Foods and feeding

Prior to egg-laying, the number of daylight hours spent feeding varied from day to day but totalled 40% for males and 58% for females (Table 1). During incubation, the non-incubating member

of each pair was frequently on the pond during the daylight hours and foraged almost continuously. Immediately after the eggs hatched, females ate less frequently than during early incubation. Males ate infrequently when with the young (Table 1).

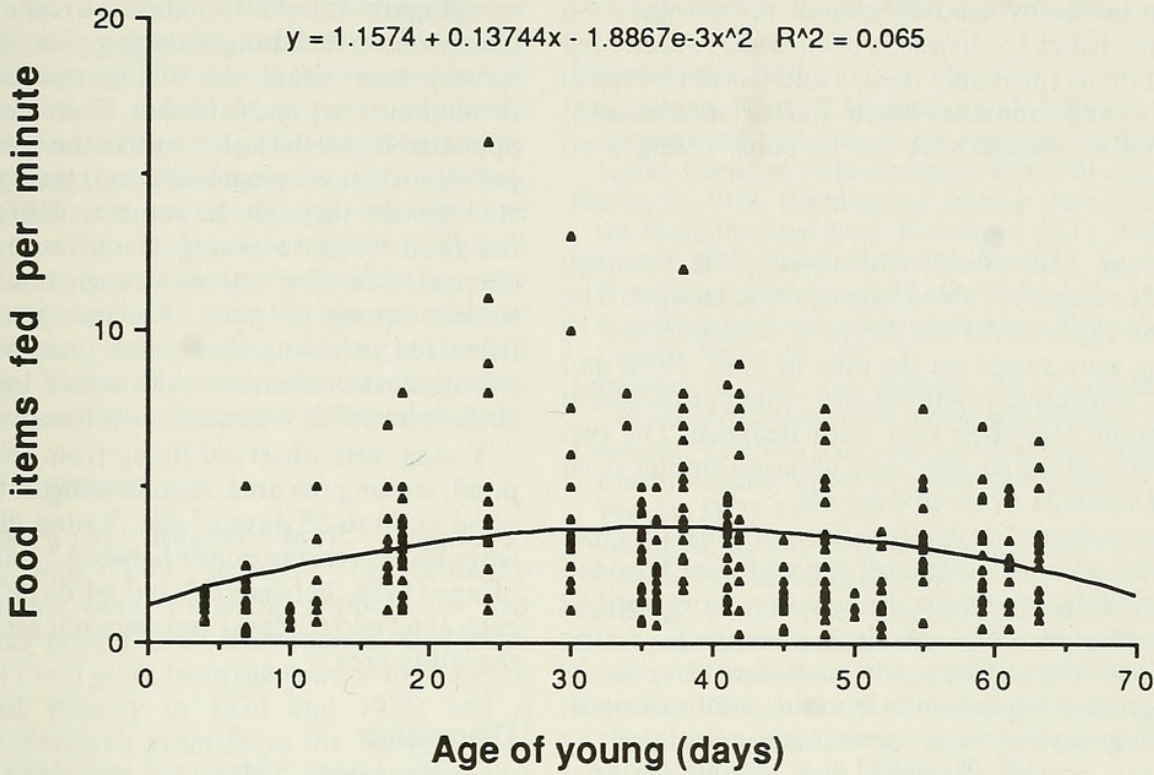
In spring, large numbers of dead Ninespine Sticklebacks were frozen in the ice of the ponds and were eaten by loons as they became available as the ice melted. Loons were observed eating sticklebacks from 12 to 72 mm in length. Fishes were occasionally seen in the bills of adults throughout the nesting season, but most items

TABLE 2. Egg sizes for 25 clutches of Pacific Loons from the Yukon-Kuskokwim Delta, Alaska.

	Length (mm) $\bar{x} \pm \text{S.E.}$ (Range)	Breadth (mm) $\bar{x} \pm \text{S.E.}$ (Range)	Volume (ml) $\bar{x} \pm \text{S.E.}$ (Range)	Weight (g) $\bar{x} \pm \text{S.E.}$ (Range)
First egg	77.1 \pm 1.7 (69.9 - 83.9)	48.5 \pm 0.3 (46.4 - 51.5)	91 \pm 1 (80 - 103)	98 \pm 1 (86 - 111)
Second egg	76.2 \pm 85.0) (70.0 - 85.0)	47.7 \pm 0.3 (44.5 - 51.0)	87 \pm 1 (74 - 104)	94 \pm 1 (80 - 112)
P value ¹	N.S.	P < 0.01	P < 0.001	P < 0.001

¹Paired *t*-tests between first and second eggs.

a.



b.

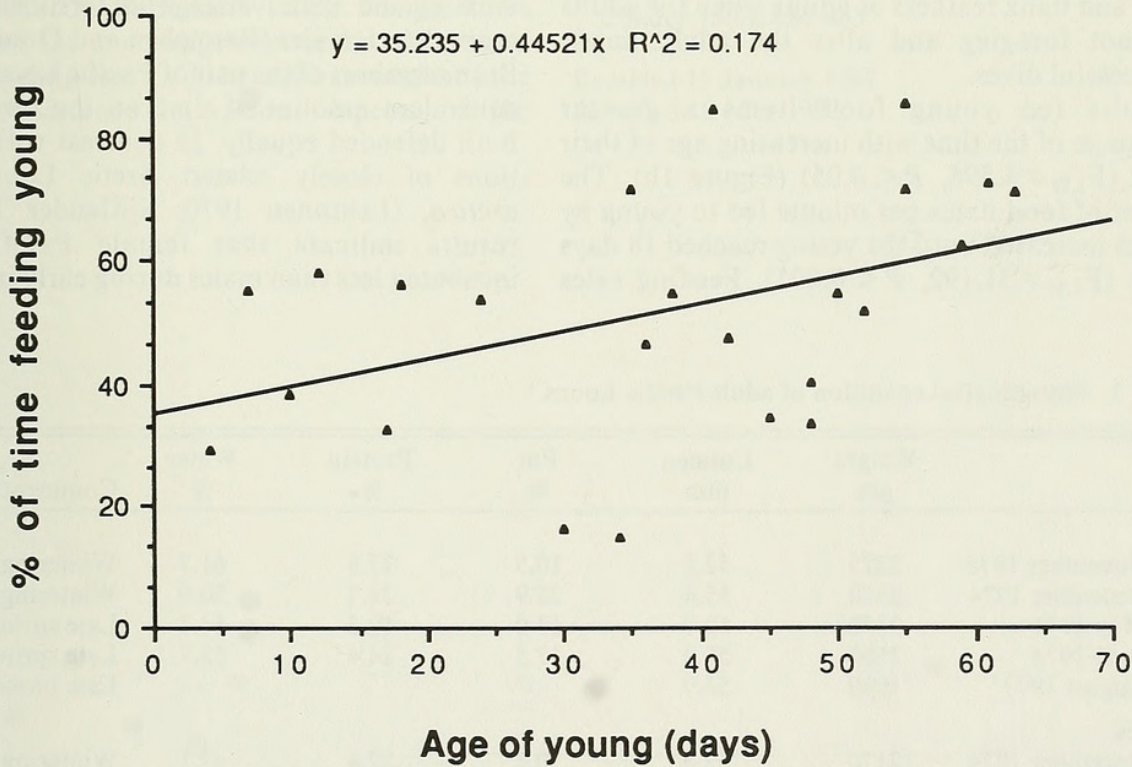


FIGURE 1. Average number of food items fed to young Pacific Loons per minute per feeding bout (a.) and the percent of time during daylight hours adults fed young (b.). Data points represent means for each pair for each day or for each feeding bout.

were unidentified. Adults foraged for insects and insect larvae by head-dipping in shore vegetation and for fishes by diving in open water. Adults fed small items (probably insects and insect larvae) to their young soon after hatch. Fishes (sticklebacks) as well as insects were fed to older young until fledging.

Broods

Young hatched asynchronously; the first egg laid (the larger) (Table 2) always hatched first. The second egg hatched one day later. Ten, one, and 10 young were raised on the area in 1973, 1974, and 1975, respectively. All but two young remained in the pond near their nest until fledging. The two that moved did so only to an adjacent similar sized pond when 21 or more days old.

Young were first led from the nest when they had reached one or two days of age and were brooded occasionally at various locations on shore until 12 days of age (39% of time observed). Young followed adults closely, when less than three weeks of age and especially when the adult foraged. Feeding activity was occasionally initiated by begging young. Begging was similar to that described for young Black-throated Loons, *Gavia arctica*, (Bundy 1979) and young Yellow-billed Loons, *G. adamsii*, (Sjölander and Ågren 1976). Young Pacific Loons begged by "nibbling" at the breast and flank feathers of adults when the adults were not foraging and after the adults made unsuccessful dives.

Adults fed young food items a greater percentage of the time with increasing age of their young ($F_{1,22} = 4.596$, $P < 0.05$) (Figure 1b). The number of food items per minute fed to young by females increased until the young reached 18 days of age ($F_{1,64} = 31.192$, $P < 0.001$). Feeding rates

decreased slowly after the young were 24 days of age (Figure 1a). This change corresponded to a change from head-dip foraging (for insects and larvae) near shore, to diving near shore and throughout the pond for fishes. Fishes fed to young appeared larger the last month of the brood rearing period; this corresponded to the growth of sticklebacks through the summer. Different pairs fed food items to young at different rates; the change of feeding rate as young grew older was similar among all pairs. The increase in size of fishes fed to young loons with increasing age of young is also common with other loon species (Lehtonen 1970; Reimchen and Douglas 1984).

Young were observed flying from their nesting pond, circling the area, then landing in the nesting pond at 50 to 55 days of age. Young disappeared from brood rearing ponds between 57 and 64 days of age (1974, between 57 and 64 days; 1975, one each at 62 and 63 days) and were not seen again on the study area.

Discussion

Pacific Loons maintained territories on ponds throughout the pre-nesting period, both adults incubated eggs, and both adults raised young. In other loon species the male Red-throated Loons, *Gavia stellata*, spend less time feeding young than females and males engage in territorial activity more than females (Reimchen and Douglas 1985). Both members of the pair of Pacific Loons spent an equivalent amount of time on the territory and both defended equally. In contrast with observations of closely related Arctic Loons, *Gavia arctica*, (Lehtonen 1970; Sjölander 1968), my results indicate that female Pacific Loons incubated less than males during early incubation.

TABLE 3. Physiological condition of adult Pacific Loons.¹

Date	Weight gm	Culmen mm	Fat %	Protein %	Water %	Comments
Males						
11 November 1975	2275	52.5	10.5	27.8	61.7	Wintering area ²
31 December 1974	2320	55.4	25.9	24.1	50.0	Wintering area ²
30 May 1974	2350	62.0	17.0	19.3	54.7	Late spring
01 June 1974	2500	56.0	17.5	24.4	55.7	Late spring
31 August 1973	1990	56.9	- ³	-	-	Late brood rearing
Females						
10 December 1974	2170	52.0	30.5	22.4	47.1	Wintering area ²
25 May 1974	2320	51.5	-	-	-	Mid-spring
12 June 1975	1670	52.1	5.5	30.4	64.1	Day 3 of incubation
30 June 1974	1810	50.8	8.5	28.2	63.3	Hatching
10 August 1973	1840	55.0	-	-	-	Mid-brood rearing

¹See Raveling (1979) for a complete description of proximate analysis technique and calculations.

²Monterey Bay, California.

³Data not collected.

Since females lay two relatively large eggs (about 10% of their weight at the beginning of incubation), they expend significantly more energy (both fat and protein, Table 3) than males before incubation. Males should be in better condition than females at the beginning of incubation, and by males assuming the bulk of early incubation duties, they allow the females to rebuild their reserves. The female assumes much of the late incubation (based on only one observation period) and the early brood rearing, while the male has the opportunity to rebuild fat reserves lost during extended incubation. The male assists with feeding when demands of young increase later in brood rearing.

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