

Drizzle Lake

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Male and female contribution to the young during the
pre-fledging period in a pair of Red-throated Loons

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While the extent of parental investment by each sex is relevant to analyses of mating systems (Kleiman 1977, Ralls 1977, Searcy 1979, Yasukawa 1979, 1981), empirical data on time budgets and energetic investment is limited for bird species exhibiting little sexual dimorphism in plumage. In loons (Gaviidae), males and females have similar plumage, are slightly dimorphic in size (females being smaller), appear to be monogamous and would be expected, from general theory (Trivers 1972) to have a similar investment in raising young. Larger size in males may be advantageous for territorial defense or may allow niche partitioning with the female (Selander 1966). Field studies of loons (Olson and Marshal 1952, Hall and Arnold 1966, Sjolander and Agren 1972, 1976, Sjolander pers. comm.) indicate that both sexes contribute to incubation, brooding and diet of the young, yet the relative investment has not been determined for any of the 4 species. We describe here the contribution of each sex to brooding, attending, feeding and territorial defense in a pair of Red-throated Loons (Cavia stellata).

At 3 nesting sites on the Drizzle Lake Ecological Reserve, Queen Charlotte Islands, British Columbia, Red-throated Loons fed their young whole marine fish, making an average of 11 flights per day from the freshwater nesting territory to the ocean (3 km distance) to obtain the prey (Reimchen and Douglas 1983). At one of the nest sites (1982), located on the shore of the 112 ha bog lake, we identified general taxa and calculated weight of fish (from video-tape recordings), estimating the daily food consumption of the

young over the 49 day pre-fledging period. For the majority of the observation days at this nest site, we were able to distinguish the sexes by a dimorphism in the number of vertical lines on the back of the neck (Figure 1). Initial differentiation was made according to body size, since female Red-throated Loons are 10 - 15% smaller than males (Cramp and Simmons 1977), but this trait is not useful when the pair were separated by more than a few meters. During the 5 days prior to fledging, the adults entered moult, which obscured the neck patterns and sex could not be determined. We examined 12 study skins of this species (Zoology Museum, University of Alberta; Vertebrate Museum, British Columbia Provincial Museum), but the usually distinct striping on live birds was not apparent on the skins and we were unable to determine whether the sexually dimorphic pattern we observed is a general trait in the species.

For the 19 days of observation (300 h) during the pre-fledging period, we have documented, for each sex, the number, taxa and weight of fish brought to the young, the number of feeding failures and the time budget for foraging flights, brooding, attending and territorial defense.

The female brought significantly more fish to the young than did the male (female, N=140 fish; male, N=88; paired t-test $t=4.31$, $P<0.001$); during the first 6 days after hatching, numbers were similar for the 2 sexes but thereafter the contribution of the male progressively decreased (Figure 2). Reduced contribution of the male to total fish numbers was partially offset by the larger size of fish brought (female, $\bar{x} = 10.7$ g; male, $\bar{x} = 13.2$ g; paired t-test, $t = 2.09$, $P = 0.05$). This represented both a difference in fish weight within taxa as well as a difference in the proportion of taxa brought to the young. Of the 6 groups identified (Ammodytidae, mean weight 1.5 g, Pholidae

4.1 g, Stichaeidae 7.0 g, Clupeidae 10.5 g, Gadidae 8.0 g and Embiotocidae 22.5 g), the male brought proportionately more Gadidae, Stichaeidae and Embiotocidae and the female more Ammodytidae and Clupeidae (chi-square = 23.4, $P < 0.001$). The contribution to actual food consumed by the young was, however, considerably greater for the female (70.9% of the total weight) than for the male (29.1%) since the chick was unsuccessful at eating 6.4% of the fish brought by the female yet 39.8% of those brought by the male (chi-square = 4.33, $P < 0.05$) (Figure 3). The two principal reasons for failure were the inability of young to swallow very large fish (usually Embiotocidae) and disturbances in the territory at the time of feeding that generally resulted in the adult (usually the male) swallowing the fish before offering it to the young. Most of these unsuccessful feedings occurred within the first 2 weeks after hatching.

There were no significant differences between the sexes in the duration of foraging flights (female, \bar{x} =54.0 min; male, \bar{x} =56.9 min; paired t-test, $t=0.33$, $P > 0.5$). The male showed a tendency (chi-square = 8.76, $DF = 3$, $P < 0.05$) to make more flights in the morning (prior to 1000 h) than later in the day, while the female's flights were distributed evenly throughout the day. The total time spent brooding and attending (female, 164.0 h; male, 170.2 h) during the daylight hours was not significantly different for the sexes (paired t-test, $t=1.96$, $P > 0.05$), although Sjolander (pers. comm.) found that females brooded the young slightly more often (66% of observed time) than did males at 2 nest sites in Sweden. The male spent more time (15.4 h) than did the female (11.1 h) in territorial disputes with Common Loons and other Red-throated Loons. Both sexes responded to conspecifics with displays,

vocalizations and occasional attacks yet the male maintained the major territorial defense against Common Loons (G. immer), by underwater attack, lunging and occasional displays.

Approximate energy requirements were calculated for body weights of 1600 g (female) and 1800 g (male) (Cramp and Simmons 1977 for mean weights) at 15 degrees C using equations for existence energy from Kendeigh (1970) and assuming that demands for foraging, flight and territorial defense were 40% above existence energy (Wiens and Scott 1975). Total energy expenditure of the sexes was similar for the 19 days (female, 3789.8 kcal; male, 3910.9 kcal); this represents a 12.9% and 8.4% increase above existence energy requirements for the female and male respectively. In summary, while the female contributed considerably more food to the diet of the young, total energetic investment by the 2 sexes was roughly equal.

Acknowledgements

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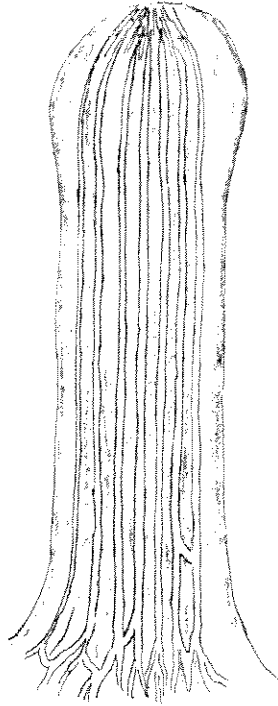
Figure Captions

Figure 1. Neck pattern on female and male Red-throated Loons observed at Drizzle Lake, Queen Charlotte Islands. Drawn from stop-action frames of video tapes.

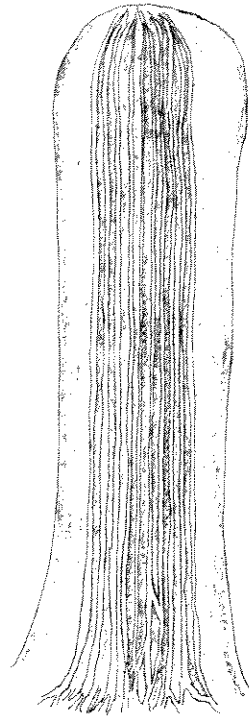
Figure 2. Daily number of fish brought by female (circle) and male (square) Red-throated Loons to young over the pre-fledging period.

Figure 3. Frequency of feeding failures for fish brought to the young by female (circle) and male (square) Red-throated Loons over the pre-fledging period.

Approximate



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Figure 1

Figure 2

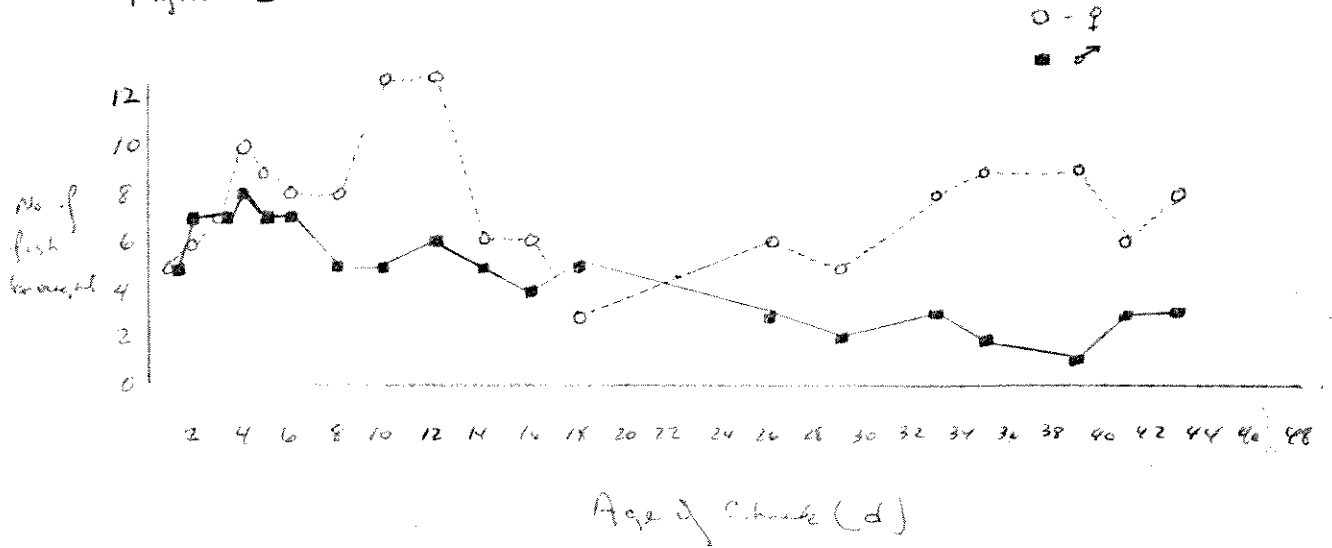


Figure 3

