Foraging Flights of Pacific, *Gavia pacifica*, and Red-throated, *G. stellata*, Loons on Alaska's Coastal Plain

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Breeding Red-throated Loons, *Gavia stellata*, are generally thought to make foraging flights to nearshore marine sites whereas breeding Pacific Loons, *G. pacifica*, are thought to feed near their nest sites. Observed marine foraging flights were essentially equivalent between Red-throated Loons (51%) and Pacific Loons (49%) on the Colville River Delta, Alaska. Equal nesting populations of the two loon species indicated that use of nearshore marine feeding flights was indeed equivalent for both species. This provides further evidence that the marine/freshwater dichotomy between Red-throated Loons and Pacific Loons varies with locality and local foraging behavior of Pacific Loons will need to be determined if the Pacific Loon is to be an effective indicator of environmental change.

Key Words: Red-throated Loon, *Gavia stellata*, Pacific Loon, *Gavia pacifica*, foraging, feeding, breeding, Arctic, Alaska.

Bergman and Derksen (1977) proposed the Red-throated Loon (*Gavia stellata*) as an indicator of nearshore marine habitat change and the Pacific Loon (*G. pacifica*) as a barometer of freshwater habitat change. They based these recommendations on nest site observations of adult loons feeding young. On the Coastal Plain of Alaska, Red-throated Loons nested on small ponds and flew several kilometers to the ocean to secure fish to feed their young. Pacific Loons foraged for invertebrates in ponds or lakes adjacent to their nest sites. Although distant marine-foraging flights by Red-throated Loons have been routinely reported by others (e.g., Reimchen and Douglas 1984), distant foraging flights by Pacific Loons depend on the location of the nest site and the proximate food supply (Davis 1972). Palmer (1962) described the foraging behavior of Pacific Loons as going "as far as necessary to fish"; the periodic absence of territorial male Pacific Loons during brood-rearing in western Alaska (Petersen 1989) might be attributed to remote feeding forays. Male Arctic Loons (*G. arctica*, a sibling species of *G. pacifica*) brought fish to chicks and mates from remote sources (Palmer 1962). Bergman and Derksen (1977) also noted seaward flights of Pacific Loons. This paper presents further quantitative evidence that Pacific Loons regularly engage in flights to nearshore marine waters.

Study Area and Methods

While surveying coastal areas of the Colville River delta for shorebirds, I had the opportunity to document the feeding flights of Pacific and Red-throated loons. The Colville River Delta lies 70 km west of Prudhoe Bay (70°30'N, 150°35'W) at the mouth of the largest river on the North Slope of Alaska. Saltmarshes, vegetated with *Carex*, *Dupontia* and *Puccinellia* spp., and dotted with brackish ponds, lie immediately inland from expansive silt barrens at the shore of Harrison Bay. The extent of nearshore environment varies (1–15 km) with the movement of the pack ice and is influenced by the freshwater discharge of the river. The study period extended from 1 July to 31 August in 1987 and 1988. All surveys were conducted between 0800 hrs and 1800 hrs. Observations of inflight loons were made in coastal habitats to ensure that birds were going to or returning from the nearshore waters of Harrison Bay. On these flights, loons tended to follow the river channels, usually in a north-south direction except in the extreme eastern delta where orientation was northeast-southwest. When a flying loon was detected (either visually or aurally), I recorded the date, time, weather conditions, species, and heading. Experience gained in 1986 was used to identify loon species by bill shape, plummage pattern, inflight posture and voice. This combination of features, coupled with favorable environmental conditions, occasionally allowed for identification of individuals at relatively long distances (≤1 km). A loon was considered engaged in a seaward (or returning) foraging flight if its heading was ± 45° of either side of the direction of the ocean-flowing channel closest to where it was observed. This procedure excluded east-west flying migrants. The proportion of all oceanward and returning loon flights represented by each species was averaged across years.

I used nest information from the U.S. Fish and Wildlife Service's North Slope Bird Habitat Study (J. R. Nickles, R. Field, J. Parker, R. Lipkin and J.

Bart, Bird-habitat associations on the North Slope, Alaska – progress report 1986, Unpublished report, U.S. Fish and Wildlife Service, Anchorage, Alaska, 1987; R. Field, F. Gerhardt, J. Tande, G. Balogh, R. McAvinchey, J. Bart, Bird-habitat associations on the North Slope, Alaska – progress report 1987, Unpublished report, U.S. Fish and Wildlife Service, Anchorage, Alaska, 1988) and from my own observations (1987, 1988) to determine the proportion of the total nesting loon population that was represented by each species in the delta. Although I lacked complete delta coverage for the 1988 breeding season, information was available for coastal sites. The proportion of nesting Pacific Loons found in the coastal zone was relatively constant from 1987 (2 of 5) to 1988 (3 of 9). Therefore, I felt that delta-wide data from 1986 and 1987 were representative of the proportional populations of Red-throated Loons and Pacific Loons nesting in the delta. Additionally, Bergman and Derksen (1977) reported that Coastal Plain nesting densities of Red-throated and Pacific loons were relatively stable over their five-year study period, as did Dickson (1992) for Red-throated Loons on Canada's arctic coast.

To control for differences in the numbers of individuals of each species in the breeding population, I used *t*-tests to compare the average proportion of nesting loons to the average proportion of oceanward flying loons for the two species. Degrees of freedom for *t*-tests were calculated with Satterthwaite's approximation (Snedecor and Cochran 1980) and were based on the average number of flights (or nests) in a given year. Using the yearly average to compute degrees of freedom reduces the falsely inflated power that results from treating the combined years' flights (or nests) as the independent sampling unit. Yearly flight sample sizes were well below my estimate of the delta's loon populations, and, therefore, seemed realistic. Following Bergman and Derksen (1977), I expected to find a greater proportion of Red-throated Loons making nearshore marine flights than was represented by the proportion of nesting birds.

Results

A yearly average of 119 oceanward loon flights was recorded during 1987-1988. Few birds were engaged in east-west flights (Pacific – 9%; Red-throated – 11%). Individuals were occasionally (Pacific – 8%, Red-throated – 18%, $n = 69$) observed returning with fish in their bills. All observed fish were at least as long as the loon's bill. Transport of smaller items and long detection distances make this a conservative estimate of prey delivery rate. Significantly more flights ($t \geq 3.8$, df = 57, $P \leq 0.001$) were made during the brood-rearing period in August by Pacific Loons (72%) and Red-throated Loons (73%) than during the incubation period of July (28%, 27%). Nesting chronology on the Colville River delta was essentially the same for both species (F. Gerhardt, R. Field, J. Parker, Bird and habitat associations on the North Slope, Alaska – chronological species summaries, Unpublished report, U.S. Fish and Wildlife Service, Anchorage, Alaska, 1988). Increased flights in August circumstantially indicated that nearshore marine foraging flights were to secure and deliver prey items to young. A difference in survey effort (Σ = 39 hrs) between July (45%) and August (55%) did not account for the greater number of foraging flights in August for either species (χ^2 = 16.0 for Red-throated, χ^2 = 14.3 for Pacific, df = 1, $P < 0.005$). Daily timing of surveys during the two periods was also similar.

On average, 31 nests of Red-throated and Pacific Loons were located in each year on the 104 km^2 study area of the delta (Nickles et al. 1987; Field et al. 1988). Contrary to my expectation, no difference between the proportion of nests and the proportion of marine flights was detected for either loon species (Table 1). Because delta breeding populations of Red-throated and Pacific loons were equivalent, differences in the proportion of each species undertaking marine foraging flights could be directly compared. From this analysis, no difference in the number of foraging flights made by loons was detected (t-test [one sample] = 0.228, df = 118, p > 0.40). Small intraspecific differences between nesting and foraging flight proportions, small interspecific difference in foraging flight proportions and adequate sample sizes indicated that Red-throated Loons and Pacific Loons did not differ in their nearshore marine foraging flight behavior on the Colville River Delta.

Discussion

My results imply that on the Colville River Delta, both the Red-throated and Pacific Loon for-

TABLE 1. Numbers and proportions of nearshore flights and nests of Pacific and Red-throated loons on the Colville River Delta, Alaska.

Species	Average no. of flights	Proportion of flights	Average no. of nests	Proportion of nests	*t*	*P*
Pacific Loon	58.5	0.49	15.5	0.50	-0.104	>>0.3
Red-throated Loon	61.0	0.51	15.5	0.50	0.104	>>0.3

age in marine waters with equal intensity. With equivalent nesting populations of both species, the number of foraging trips taken from inland nest sites to Harrison Bay did not differ between the two species. Pairs nesting near Hudson Bay used nearshore marine resources to provision themselves and their hatchlings (Davis 1972) and pairs nesting on lakes in Alaska used nearby rivers for foraging (Sjölander 1978). Whether feeding themselves or their young, Pacific Loons are relying on food resources of the nearshore waters of Harrison Bay to the same degree as are Red-throated Loons.

If Red-throated Loons and Pacific Loons are to be used dichotomously in assessing habitat impacts, the local foraging behavior of Pacific Loons must be determined. Although the uncontentious nearshore foraging behavior of the Red-throated Loon makes it a valuable indicator, the Pacific Loon might be replaced by a less variant model. Alternatively, intraspecific variation in foraging behavior of Pacific Loons could be used to monitor differences between populations that forage at inland sites and those that forage at nearshore sites. If local populations of Pacific Loons were found to make nearshore foraging flights, monitoring these individuals along with Red-throated Loons could greatly increase local sample sizes for relatively little additional cost. Because coastal oil development pressures continue in arctic Alaska and Canada (Dickson 1992), consideration of the overlap of nearshore foraging strategies in coastal breeding Pacific and Red-throated Loons is important if these species are to be effective environmental indicators.

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