Changes in Loon (*Gavia* spp.) and Red-necked Grebe (*Podiceps grisegena*) Populations in the Lower Matanuska-Susitna Valley, Alaska

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More than two-thirds of the human population of Alaska resides in the south-central portion of the state, where its continued growth is likely to affect some wildlife populations negatively. To assess changes in waterbird populations in this region, we compared counts of Common Loons (*Gavia immer*), Pacific Loons (*G. pacifica*), and Red-necked Grebes (*Podiceps grisegena*) made on Matanuska-Susitina Valley lakes. In general, the number of lakes occupied by loon or grebe pairs decreased between 1987 and 1999. Decreases in the number of lakes occupied by Common Loons were less drastic in the northwest region of the study area than in the southeast region; human development is greater in the southeastern portion of our study area. Contrary to lake occupancy, the percentage of lakes that fledged Common Loon chicks remained stable between years. Because the human population is expected to continue to grow, proactive management of lake use and lakeshore development, coupled with monitoring of loon and grebe occupancy and productivity, is needed to ensure the persistence of these waterbird populations in the lower Matanuska-Susitna Valley.

Key Words: Common Loon, *Gavia immer*, Pacific Loon, *Gavia pacifica,* Red-necked Grebe, *Podiceps grisegena*, breeding occupancy, productivity, south-central Alaska.

The stability of many bird populations mainly depends on the stability of the environments they inhabit (Newton 1998). Nesting loons (*Gavia* spp.) and grebes (*Aechmophorus* spp., *Podiceps* spp.) are often negatively affected by habitat degradation and increased levels of human-related disturbances (Riske 1976; McIntyre 1978; Evers 2003). Common Loons (*Gavia immer*), Pacific Loons (*G. pacifica*), and Red-necked Grebes (*Podiceps grisegena*) breeding on lakes in the Matanuska-Susitna Valley (Mat-Su Valley), Alaska, are encountering many changes to their local environment. The area's human population has tripled in the last two decades, and the current annual growth rate is 3.3% (McKibben and Nelson 1999*). Within the Mat-Su Valley, population growth has been greatest in the southeast, the area closest to Alaska's largest city (Anchorage; McKibben and Nelson 1998*, 1999*). The growing human population in the Mat-Su Valley has begun to encroach upon the freshwater habitat favored by breeding loons and grebes. Development of lake shorelines for houses and increased recreational use of lakes are suspected of having detrimental effects on loon and grebe populations in the Mat-Su Valley (Tankersley 1987*, Fair 1998*).

Concern over the susceptibility of local loon populations to anthropogenic pressures prompted the formation of a volunteer program, the Alaska Loon Watch, in 1985. Under the direction of the Alaska Department of Fish and Game (ADF&G), volunteers collected data on loon and grebe presence and breeding activity on lakes throughout the Mat-Su Valley (see Fair 1998*). Using data collected through the Alaska Loon Watch program and our own observations, we assessed changes in lake occupancy, distribution, and productivity of loons and grebes breeding in the Mat-Su Valley between 1987 and 1999. Based on the significant growth of the human population in the region, we predicted that lake occupancy and productivity by loons and grebes would have decreased over time. Furthermore, we predicted that the distribution of loons and grebes would shift spatially from southeast to northwest in response to corresponding changes in intensity of shoreline development and lake recreation.

Study Area

The Mat-Su Valley of south-central Alaska lies between the Matanuska and Susitna rivers and borders upper Cook Inlet. Over 1000 lakes, ponds, and wetlands of glacial origin occupy kettles in moraines and ice-stagnation complexes in this 500 km^2 region (Colazzi et al. 1986*). Lakes are classified as oligotrophic or mesotrophic with pH levels conducive to support fish species preyed on by loons and grebes (Ruggles 1991). The elevation of the valley floor ranges from tide level to 400 m, but local relief of the area is generally not more than 50 to 300 m (Dale 1956).

Uplands are dominated by White Spruce (*Picea glauca*), Paper Birch (*Betula papyrifera*), and Quaking Aspen (*Populus tremuloides*); Black Cottonwood (*Populus trichocarpa*) and willows (*Salix* spp.) are common along waterways and on alluvial plains. Maritime influences moderate the climate in the Mat-Su Valley with average mid-summer temperatures of 14°C, annual snowfall of 150 cm, and annual precipitation of about 48 cm. We concentrated our survey effort within the lower Mat-Su Valley, an area bounded by the communities of Palmer to the southeast, Willow to the northwest, Sutton to the east, and the Susitna River to the west (Figure 1).

Methods

We surveyed lakes in late May and late August of 1999 to determine occupancy by loons and grebes and productivity of loons. Because of their smaller size and tendency to linger in aquatic vegetation, productivity of Red-necked Grebes was not recorded. Of

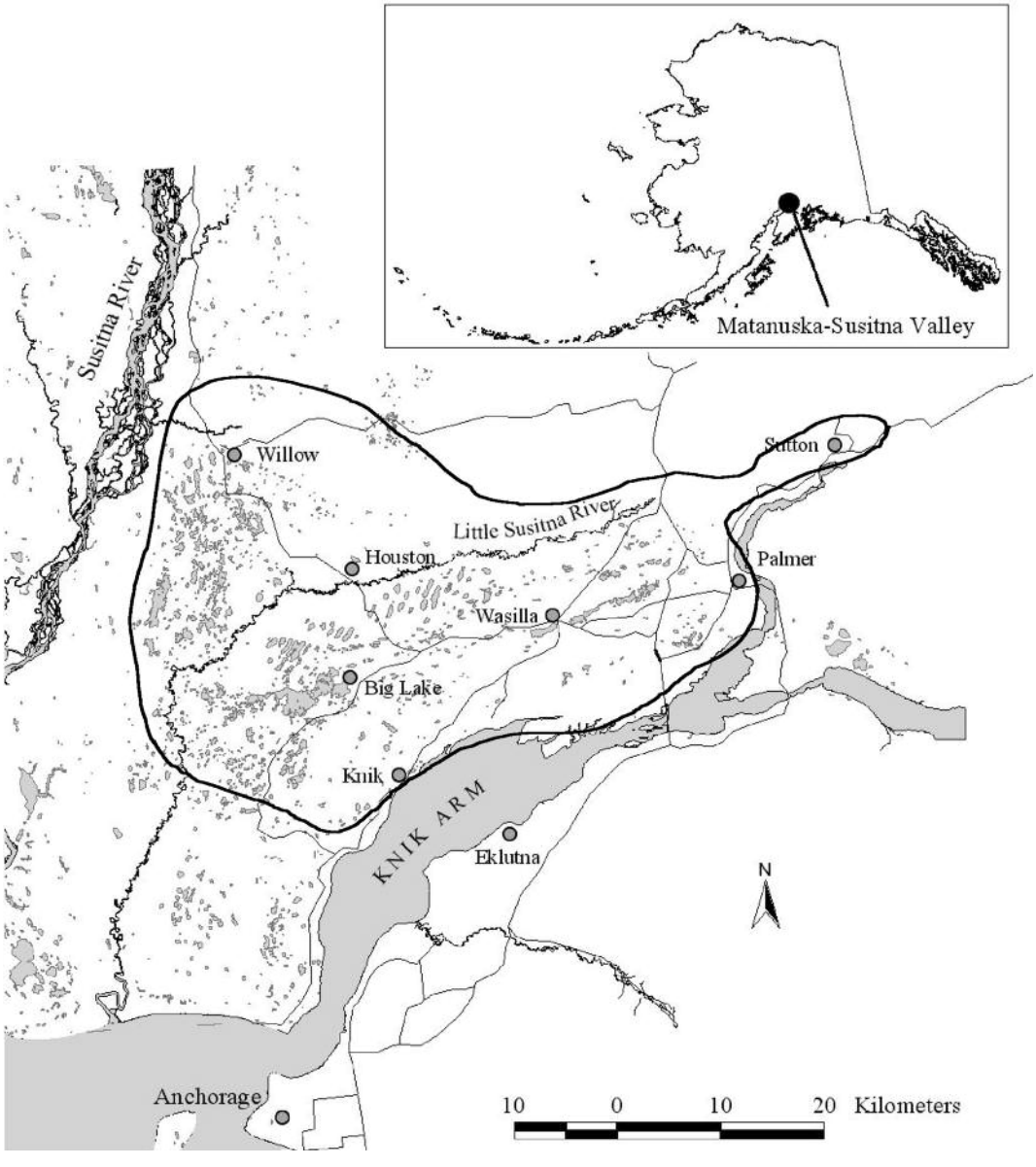

FIGURE 1. Location of the lower Matanuska-Susitna Valley, Alaska, where lake occupancy and productivity of loons and grebes were assessed, in the delineated area, in 1987 and 1999.

219 lakes surveyed in 1987 by biologist Nancy Tankersley (ADF&G) and volunteers of the Alaska Loon Watch program, we determined that 139 lakes had adequate coverage in both years to allow a meaningful comparison. In 1999, observers scanned each lake with binoculars from several vantage points along the lakeshore to ensure complete lake coverage. Lakes were scored for the presence or absence of single loons or loon pairs during late May and for the presence or absence of loon chicks during late August. Field methods were similar in 1987. A lake was considered occupied if a loon pair was found on a lake surveyed on or before 5 July, or if chicks were discovered on the lake. Only lakes surveyed after 25 June were used to determine productivity.

To detect changes in the spatial distribution of loons over the 12-year period. We divided the study area was divided into two regions of differing human population densities. The Little Susitna River runs east to west and divides the study area into southeastern (Wasilla, high human population) and northwestern portions (Willow, low human population). Lake physiographic features are comparable between regions, and lakes vary similarly in size, food availability, and shoreline topography (Ruggles 1991).

We used McNemar's symmetry test for matched pairs to compare temporal and geographic differences in lake occupancy and productivity (Agresti 1996 pages 226-229). Alternative hypotheses were constructed to indicate a decline in parameter estimates between 1987 and 1999; no statistical analysis was conducted when $n \leq 3$ lakes. We used P-values to examine strength of differences between years and regions. Standardized normal standard errors of differences were also calculated (Agresti 1996 page 228).

Results

The number of lakes occupied by any loon or grebe species decreased significantly between 1987 and 1999 across the entire study area (Table 1). Decreases in lake occupancy between years were consistent among Common Loons, Pacific Loons, and Red-necked Grebes (Table 1). Differences in occupancy of lakes by loon or grebe pairs, however, were not uniform among regions of the Mat-Su Valley. Decreases in the number of lakes occupied by any loon or grebe pair and by Common Loons were less drastic in the northwest region of the study area (Willow) than in the southeast region (Wasilla; Table 1), where development is greater. Decreases in lake occupancy by Pacific Loons tended to be greater in the northwest section ($P = 0.1094$), but conclusiveness of results was hampered by small sample sizes (Table 1). Point estimates of decreases in occupancy by Red-necked Grebe pairs were similar between regions, but variability was much higher in the northwest region (Table 1).

Contrary to lake occupancy, the percentage of lakes that fledged Common Loon chicks remained stable between 1987 and 1999. Information on productivity of Red-necked Grebes was not collected in 1987, and sample sizes were too small to permit analysis of changes in productivity for Pacific Loons. Productivity of Common Loons was similar on lakes in both regions of the study area.

Discussion

Temporal and spatial changes in the population distribution of loons and grebes in the Mat-Su Valley from 1987 to 1999 are likely attributable to the concurrent rise and spatial settlement of the human population. Significant declines in lake occupancy by Common and Pacific loons and Red-necked Grebes indicated that fewer birds are establishing breeding territories at area lakes. Most of the lakes that are no longer used by breeding loons and grebes (65%) were located in the southeastern portion of the study area – an area that has also experienced the greatest human population growth. Common Loons have been extirpated from lakes within the nearby Municipality of Anchorage, and Pacific Loon populations are decreasing there (Fair 1998*). Such changes in lake occupancy may be indicative of declining loon and grebe populations or may reflect large-scale emigration due to the loss of suitable nesting habitat. Common Loons inhabiting boreal regions of Alaska, however, appear to be stable (Groves et al. 1996).

Population declines of Common Loons and Red-necked Grebes throughout North America have occurred most frequently at the southern boundaries of their breeding ranges where habitat quality has become marginal owing to development (De Smet 1987; McIntyre 1988). In the Mat-Su Valley, a spatial shift in lake occupancy from southeast to northwest may be linked to habitat quality decreases in the same spatial direction. Habitat in the southeastern portion of the study area is likely poorer in quality compared to the northwest, where fewer people live and more lakes remain undeveloped. The stability of lake occupancy to the northwest implies that habitat quality is optimal, a fact supported by the rapid reoccupation of vacant territories (sensu Newton 1998).

The negative trends in lake occupancy may also reflect changes in the demographics of the Mat-Su Valley loon and grebe populations. Loons and grebes are long-lived species known to return to breed on the same lake territories year after year (McIntyre 1988; Stout and Neuchterlein 1999). The combination of a long lifespan and strong site-fidelity may have caused individuals to occupy lakes that had deteriorated in quality over several years. When existing occupants died or left, the vacancies were not filled, and lake occupancy declined over time. Thus, lakes may have lost loons and grebes not suddenly through abandonment by resident breeders, but by failure of new birds to replace them after the death of residents.

Although habitat in the southeastern region may be less suitable during selection of a territory, loons may remain productive if they choose to nest there. Greater

TABLE 1. Occupancy and productivity of breeding pairs of loons and grebes on lakes in high (Wasilla) and low (Willow) human population regions of the lower Matanuska-Susitna Valley, Alaska, in 1987 and 1999.

Species – stage area	Percentages of lakes occupied			Difference (SE)	
	both years	1987 only	1999 only	1999 – 1987	*P*-value[1]
Any loon or grebe - occupancy					
entire area (n = 86)	67	27	6	-21 (6)	0.0005
Wasilla (n = 52)	71	29	0	-29 (6)	<0.0001
Willow (n = 34)	62	23	15	-8 (10)	0.2905
Common Loon - occupancy					
entire area (n = 63)	59	33	8	-25 (7)	0.0012
Wasilla (n = 36)	58	42	0	-42 (8)	<0.0001
Willow (n = 27)	59	22	19	-4 (12)	0.5000
Pacific Loon - occupancy					
entire area (n = 17)	41	47	12	-35 (17)	0.0547
Wasilla (n = 10)	40	50	10	-40 (21)	0.1094
Willow (n = 7)	43	43	14	-29 (26)	0.3125
Red-necked Grebe - occupancy					
entire area (n = 33)	76	24	0	-24 (7)	0.0039
Wasilla (n = 25)	76	24	0	-24 (9)	0.0156
Willow (n = 8)	75	25	0	-25 (15)	0.2500
Common Loon - productivity					
entire area (n = 34)	24	38	38	0 (15)	0.5775
Wasilla (n = 21)	29	33	38	5 (18)	0.5000
Willow (n = 13)	15	46	38	-8 (25)	0.5000
Pacific Loon - productivity					
entire area (n = 10)	80	0	20	–[2]	–
Wasilla (n = 7)	86	0	14	–	–
Willow (n = 3)	67	0	33	–	–

[1] one-sided test, 1987 > 1999.
[2] small sample sizes precluded reasonable statistical testing.

breeding success for Common Loons in the southeastern region may reflect differences in the age structure of the population. Across numerous species, nonbreeders and non-territory holders consist mainly of sub-adult birds (Smith 1976; Birkhead et al. 1986). Because replacements for vacant territories in the northwest are likely drawn from the non-territorial cohorts (Ruggles 1991), these loons would be expected to have lower productivity than experienced territorial loons on southeast region lakes.

Tolerance of human activity by experienced territory holders may also explain the differences in Common Loon breeding success between the regions. Common Loons are known to be relatively flexible in behavior and may acclimate themselves to low-level human disturbance (Titus and VanDruff 1981; Heimberger et al. 1983; McIntyre 1988). Years of breeding experience and gradual habituation to the subtle progression of human disturbance would likely result in higher breeding success for loons that established territories years ago.

Loons may also benefit by nesting in areas where humans are moderately active. Recreational activities and residents who watch over loons may deter predators from taking young or eggs. Reports from Alaska Loon Watch volunteers often include stories of residents protecting adults and chicks by discouraging Bald Eagles and other predators (Tankersley 1987*, Mills, personal observation). This interference, combined with the defensive behavior of an adult loon, may be intense enough to dissuade additional predation attempts.

Changes in the distribution of loons and grebes warrant concern about the future of these populations within the region. The human population is expected to continue to increase in the Mat-Su Valley (Alaska Department of Natural Resources 1998), which could result in further changes to the lake habitat used by loons and grebes. Although degradation of lake habitats are likely widespread across south-central Alaska, only a small portion of North America's populations of Common Loon, Pacific Loons, or Red-necked Grebes occur in south-central Alaska. People residing in south-central Alaska, however, value living with wildlife and believe it makes their community "interesting and special" (Alaska Department of Fish and Game 2000). Therefore, proactive management of lake use and lakeshore development, coupled with continued monitoring of loon and grebe populations, is needed to improve the stability of the freshwater habitats and ensure the continued persistence of loons and grebes in the Mat-Su Valley of Alaska.

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