

and

## Avian Community Changes Following Lower Granite Dam Construction on the Snake River, Washington

### Abstract

The reservoir behind the Lower Granite Dam on the Snake River inundated 210 ha of riparian habitat and 1109 ha of flood plain habitat. Loss of these habitats was associated with the change from free-flowing river to reservoir. Our objective was to evaluate responses of the avian community to habitat change. We compared numbers of birds and species observed during monthly road counts in 1973 (preimpoundment) and 1981 (postimpoundment). More individual birds and species per survey were observed in 1981. Of 37 species classified as riparian, 18 had a larger number of individuals observed in 1981. Our data suggest that some riparian species shifted habitat-use patterns after impoundment, and/or that nonriparian upland habitats were not adequately surveyed prior to impoundment. Riparian passerines decreased after impoundment in number of individuals and species per survey, and may not have been dependent on riparian habitat. More individuals and eight new species of aquatic birds were recorded in 1981. Migrant ducks during spring contributed heavily to the increase in aquatic birds. The proportion of total birds observed increased for aquatic and upland birds and decreased for riparian birds. These changes paralleled changes in habitat behind the dam. This study may aid in evaluating environmental impacts caused by impoundments.

### Introduction

Lower Granite Dam (LGD) on the Snake River in southeastern Washington was completed in 1975, and inundated 210 ha of riparian and 1109 ha of flood plain habitat (Lewke and Buss 1977). Riparian habitat is important to many bird species (Walcheck 1970, Thomas 1979). Because of changes in habitat behind LGD, Lewke and Buss (1977) predicted that bird species dependent on riparian habitat would decrease.

Associated with loss of riparian habitat was the change from free-flowing river to a 63 km long reservoir. Weber and Larrison (1977) observed that reservoirs along the Snake River were attracting certain marine birds uncommon in the area before impoundments. Thus, species that use aquatic habitat were expected to increase after impoundment.

Our objective was to evaluate avian community changes behind LGD. We compared numbers of individuals and species observed during monthly road counts in 1973 (preimpoundment) (Lewke 1975) with data collected in 1981 (postimpoundment).

### Study Area

We collected data between Steptoe and Wawawi canyons, along the lower Granite Reservoir in

southeastern Washington during 1973 and 1981. In 1981, riparian habitat was limited to draws and small isolated areas along the reservoir. The canyon walls are steep and lined with basalt cliffs. A road follows the north side of the reservoir. Most upland habitat is grassland; dominated by cheat grass (*Bromus tectorum*) and bluebunch wheatgrass (*Agropyron spicatum*). An overstory of rabbit-brush (*Chrysothamnus nauseosus*) occurs in some places. Dominant riparian vegetation is poison oak (*Rhus radicans*), blackberry (*Rubus discolor*), snowberry (*Symphoricarpos albus*), hackberry (*Celtis reticulata*), and white alder (*Alnus rhombifolia*). For a preimpoundment description of the study area see Lewke and Buss (1977).

### Methods

Road count methods followed Lewke (1975) and were conducted between the twelfth and seventeenth of each month. Surveys were initiated within 30 minutes of sunrise. Counts were conducted between Steptoe and Wawawi canyons and direction of travel alternated each month. In 1973, the route was along the river and bordered riparian vegetation and flood plain; this road was inundated by the reservoir. The road used in 1981 was along the reservoir where it passed through grasslands and often was adjacent to basalt cliffs. In both years, the road was along the north side of the reservoir. Thirty-three

<sup>1</sup>Present address: Division of Fish and Wildlife, Saipan, CM 96950.

stations were located along the route at 0.8 km (0.5 mile) intervals. All birds heard or seen within a 0.4 km (0.25 mile) radius (ocular estimation) at each station were recorded during a three-minute observation period. Only birds north of the reservoir's south shore were recorded (including flying and swimming ducks and soaring hawks [Lewke 1975]). Observations were made with 10x binoculars or 15-60x spotting scope.

Bird species were placed into habitat and residency categories. Habitat categories included: riparian species (those that used riparian habitat proportionally more than it was available on the study area [Lewke and Buss 1977]) (e.g., black-capped chickadees [*Parus atricapillus*], warblers, and dark-eyed juncos [*Junco hyemalis*]); aquatic species (those that use predominately aquatic habitat (e.g., grebes, ducks, and gulls); upland species (those not classified as riparian or aquatic) (e.g., swallows, common raven [*Corvus corax*], and western meadowlark [*Sturnella neglecta*]). Weber and Larrison (1977) was consulted to aid in classification of birds into the following residency categories: permanent resident, summer resident, winter resident, and

migrant. Avian nomenclature follows American Ornithologists' Union (1983).

We used the Wilcoxon paired-sample test (Zar 1984) to compare number of individuals and species richness (number of species) observed per survey (12 surveys per year) between 1973 and 1981. Hypotheses for these tests were that values in 1973 are  $\geq$ ,  $\leq$ , or  $=$  to values in 1981.

We used Chi-square contingency table analysis (Zar 1984) to test if the proportion of individuals and species observed in each residency and habitat category changed between years. A separate test was made within each category.

## Results

Mean monthly temperatures were similar between 1973 and 1981 (N.O.A.A. 1973, 1981). Annual rainfall was slightly higher in 1981 (36.09 cm) than 1973 (31.42 cm). Precipitation levels were similar in all seasons except summer, which was drier in 1973 (0.69 cm) than in 1981 (7.30 cm).

Numbers of individuals per survey were greater in 1981 ( $P = 0.10$ ) (Figure 1). More individuals were observed during every month in

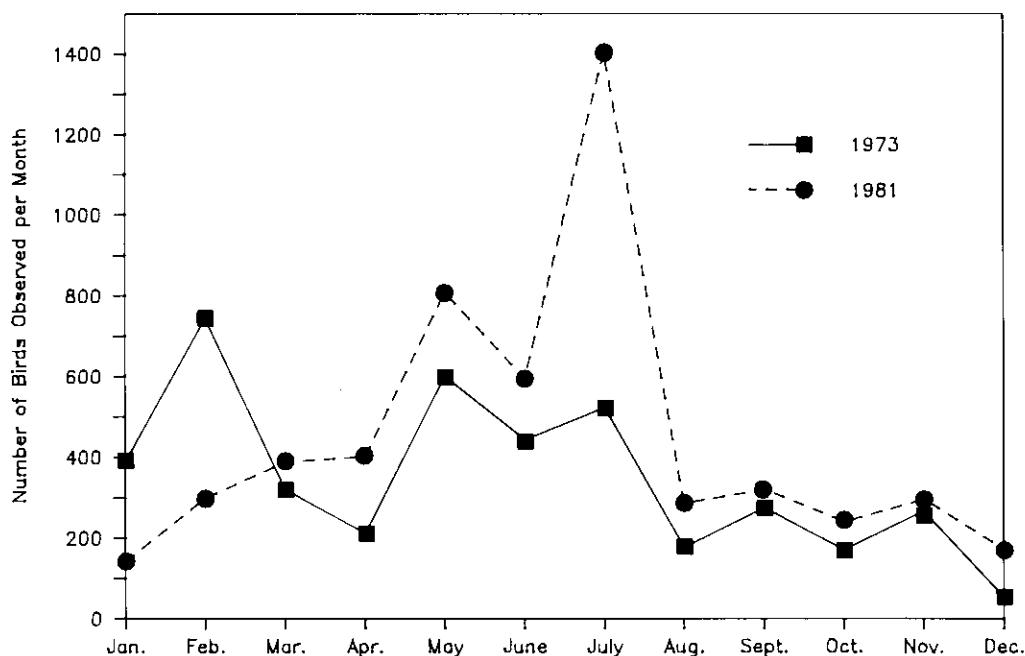


Figure 1. The number of avian individuals observed for all species during monthly road counts, behind the Lower Granite Dam along the Snake River in southeastern Washington, 1973 (preimpoundment) and 1981 (postimpoundment).

1981, except January and February (Figure 1). Numbers of species per survey also were greater in 1981 ( $P = 0.03$ ). Differences in species/month between years were somewhat erratic, but changes were small in months where species richness was greater in 1973 (Figure 2).

### Habitat Categories

In the aquatic habitat category, numbers of individuals per survey were greater in 1981 ( $P = 0.05$ ). Differences between years were relatively minor in most months, except in April and May when large numbers of aquatic birds were observed in 1981. The numbers of aquatic species per survey were larger in 1981 ( $P = 0.001$ ), differences were largest during April and May. Only in August, when aquatic birds were uncommon on the study area, was a larger number of aquatic species observed in 1973.

Differences did not occur for birds in the riparian category for number of individuals ( $P = 0.32$ ) or species ( $P = 0.40$ ) per survey. However, division of riparian birds into passerines and nonpasserines revealed important dif-

ferences. Riparian passerines decreased in 1981 for individuals ( $P = 0.08$ ) and species ( $P = 0.02$ ) per survey. The largest monthly decreases in riparian passerine birds occurred in January and February. These were the only two months where the total number of individuals of all birds observed was larger in 1973 (Figure 1). The numbers of individuals and species in riparian passerines also were much smaller during the summer. Nonpasserine riparian birds per count increased for both individuals ( $P = 0.08$ ) and species ( $P = 0.01$ ) per survey.

Upland birds increased in both the number of individuals ( $P = 0.08$ ) and species ( $P = 0.02$ ) per survey. Cliff swallows (*Hirundo pyrrhonta*) in June and July increased notably (419 vs. 1442). Increases in this species caused July of 1981 to have the largest number of individuals observed for any month for both years. (Figure 1).

### Residency Categories

Permanent residents increased from 1973 to 1981 in both numbers of individuals ( $P = 0.05$ ) and

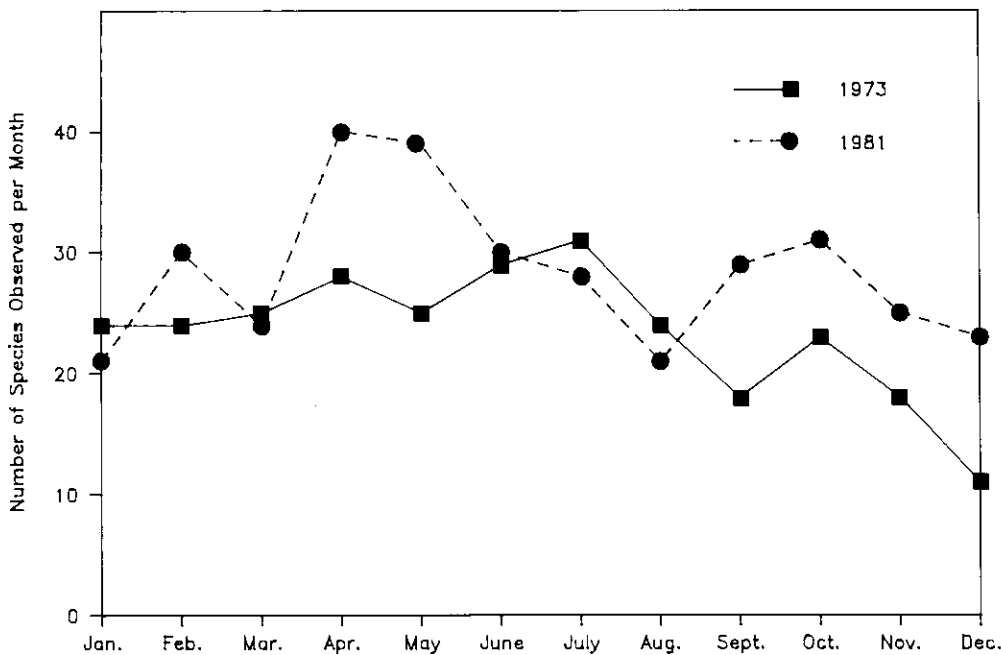


Figure 2. The number of avian species observed during monthly road counts, behind the Lower Granite Dam along the Snake River in southeastern Washington, 1973 (preimpoundment) and 1981 (postimpoundment).

species ( $P = 0.002$ ) per survey. No month had more permanent resident species in 1973 and only in January and February were less individuals observed in 1981.

Paralleling the decrease in permanent residents during winter was a decrease in winter resident individuals per survey ( $P = 0.06$ ). However, the numbers of winter resident species per survey were not different between years ( $P = 0.38$ ).

More migrant species per survey were observed in 1981 ( $P = 0.02$ ), but individuals per survey were not different between years ( $P = 0.25$ ). The increase in migrant species richness was predominately due to waterfowl, particularly in spring. Unlike the other resident categories, we did not detect a significant difference for summer residents in number of individuals/month ( $P = 0.28$ ) or species/month ( $P = 0.34$ ).

#### Proportion of Each Category to Yearly Totals

Proportion of species in each habitat and residency category, relative to total species observed in each year, remained constant for each category ( $P > 0.10$ ) (Table 1). Proportion of individuals observed (Table 1) changed in every category ( $P < 0.001$ ) except permanent residents ( $P = 0.42$ ). Proportion of individuals observed increased for aquatic birds, upland birds, summer residents, and migrants. Proportion of individuals observed for riparian birds and winter residents decreased.

#### Discussion

Lewke and Buss (1977) estimated that the LGD reservoir inundated 210 ha of tree-shrub riparian habitat. Little riparian habitat was present in 1981, relative to what was present in 1973. Lewke (1975) classified species as riparian dependent, based on a species being observed in riparian habitat proportionally more often than that habitat was available. Use and availability data are commonly used to detect habitat selection or preference by bird species (e.g., Holbrook *et al.* 1987, Wilson and Crawford 1987, Thompson and Baldassarre 1988). Of 37 species classified as riparian in this study, 18 had a larger number of individuals observed in 1981. Increases were particularly large for five of these species: American kestrel (*Falco sparverius*) (16 in 1973 to 59 in 1981), chukar (*Alectoris chukar*) (165 in 1973 to 401 in 1981), rock dove (*Columba livia*)

TABLE 1. Yearly totals for species richness and number of individuals by habitat and residency categories, from road counts along the Snake River in southeastern Washington, 1973 (preimpoundment) and 1981 (postimpoundment).

Categories	Species		Individuals	
	1973	1981	1973	1981
<b>Habitat categories</b>				
Aquatic	14	22	292	593 <sup>a</sup>
Riparian	32	30	2364	2114 <sup>b</sup>
Upland	17	22	1505	2655 <sup>a</sup>
Annual Total	63	74	4161	5362
<b>Residency categories</b>				
Permanent residents	29	33	2327	2986
Summer residents	19	19	1250	2111 <sup>a</sup>
Winter residents	8	9	536	91 <sup>b</sup>
Migrants	7	13	48	174 <sup>a</sup>
Annual Total	63	74	4161	5362

<sup>a</sup>The proportion of the category to the annual total in 1973 < 1981 ( $P < 0.001$ ).

<sup>b</sup>The proportion of the category to the annual total in 1973 > 1981 ( $P < 0.001$ ).

(62 in 1973 to 275 in 1981), black-billed magpie (*Pica pica*) (168 in 1973 to 279 in 1981), and European starling (*Sturnus vulgaris*) (201 in 1973 to 397 in 1981). These species use talus slopes and cliffs extensively (Thomas 1979, Brown 1985), which were common along the study route in 1981. We suggest three possible causes for the increases: 1) species increased after impoundment, 2) species shifted habitat use patterns after impoundment causing an increased detection and/or 3) talus slope and cliff habitats were not adequately surveyed prior to impoundment. These species may have selected or preferred riparian habitat prior to impoundment, but their dependency on it is questionable.

The road used in 1973 bordered riparian habitat along the river. In 1981 the relocated road was adjacent to talus slopes, basalt cliffs, and grassland along the reservoir. Changes in the habitat surveyed may have contributed to apparent increases in the following upland species: gray partridge (*Perdix perdix*) (0 in 1973 and 26 in 1981), rock wren (*Salpinctes obsoletus*) (126 in 1973 and 266 in 1981), and western meadowlark (196 in 1973 and 278 in 1981). These species

were associated with upland habitat (Thomas 1979, Brown 1985) along the survey route in 1981.

Riparian passerines may have been dependent on riparian habitat, as reflected by decreases in number of individuals and species per month. Riparian passerines that contributed largely to this decrease were the lazuli bunting (*Passerina amoena*) (52 in 1973 to 2 in 1981), white-crowned sparrow (*Zonotrichia leucophrys*) (320 in 1973 to 14 in 1981), dark-eyed junco (132 in 1973 to 19 in 1981), house finch (*Carpodacus mexicanus*) (153 in 1973 to 28 in 1981), and American goldfinch (*Carduelis tristis*) (441 in 1973 to 76 in 1981).

Many aquatic birds increased and eight new aquatic species were observed in 1981. Migrant ducks contributed to the annual increase in aquatic species and individuals. These ducks may have been attracted to the reservoir for rest stops during migration.

Aquatic birds were not common during summer months before or after impoundment. However, the number of individuals observed decreased between years for July and August. These data indicate that this area received limited use by aquatic species for nesting and raising young, both before and after impoundment. Water level fluctuations associated with dam operation may inhibit waterfowl nesting (McCabe 1979, Books 1985). Other than the increase in cliff swallows, only small differences were observed for the summer months in species richness and number of individuals (Figure 1 and Figure 2), indicating that the impoundment had little effect on total avian breeding community along the river. However, it is clear that riparian passerines were fewer in species and less common during the breeding months.

The only aquatic species to suffer a large decline was the common goldeneye (*Bucephala clangula*) (79 in 1973 to 27 in 1981). Goldeneyes

may prefer river over reservoir habitat, because they were frequently observed on the river above the reservoir where the current was more swift. The decrease in goldeneyes indicates that increased water-surface-area and slowing of the flow-rate may not have benefited all aquatic species.

The reservoir appears to benefit aerial insectivores, possibly because of an increase in invertebrates associated with the larger water surface area. The following swallow species were observed only in 1981: tree swallow (*Tachycineta bicolor*), violet-green swallow (*T. thalassina*), northern rough-winged swallow (*Stelgidopteryx serripennis*), and barn swallow (*Hirundo rustica*). Numbers of Say's phoebe (*Sayornis saya*), eastern kingbirds (*Tyrannus tyrannus*), and cliff swallows were all larger in 1981.

Road-counts do not yield density estimates, but they are an index to relative changes in species abundance (Rotenberry 1982). This study represents only two years of data and to perceive these years as typical for preimpoundment and postimpoundment bird populations may not be prudent. The increase in the proportion of aquatic and upland birds, and the decrease in the proportion of riparian birds paralleled the changes in habitat available.

### Acknowledgments

C. J. Herlugson and S. A. Jackson are thanked for their interest and encouragement toward this project. D. A. Budeau, R. E. Lewke, D. D. Musil, J. J. Rotella, and J. M. Scott reviewed early versions of this paper and are thanked for their constructive comments. J. T. Ratti enhanced this manuscript through stimulating discussion and a thorough review. K. P. Reese is thanked for his helpful suggestions. C. A. Monda, L. A. Monda, and N. Nork are acknowledged for their constant encouragement. Two anonymous reviewers are thanked for their comments.

### Literature Cited

- American Ornithologists' Union. 1983. Check-list of North American Birds. Sixth ed. Amer. Ornithol. Union, Baltimore, Md.
- Books, G. G. 1985. Avian interactions with Mid-Columbia River water level fluctuations. *Northw. Sci.* 59:304-312.
- Brown, E. R. 1985. Management of wildlife and fish habitats in forests of western Oregon and Washington. USDA For. Serv., Pac. Northwest Reg., Portland, Oreg.
- Holbrook, H. T., M. R. Vaughan, and P. T. Bromley. 1987. Wild turkey habitat preferences and recruitment in intensively managed piedmont forests. *J. Wildl. Manage.* 51:182-187.
- Lewke, R. E. 1975. Preimpoundment study of vertebrate populations and riparian habitat behind Lower Granite Dam on the Snake River in southeastern Washington. Washington State Univ., Pullman. Ph.D. Dissertation.

- Lewke, R. E., and I. O. Buss. 1977. Impacts of impoundment to vertebrate animals and their habitats in the Snake River Canyon, Washington. *Northw. Sci.* 51:219-270.
- McCabe, T. R. 1979. Productivity and nesting habitat of great basin Canada geese, Umatilla, Washington. *In* R. L. Jarvis and J. C. Bartonek (eds.) *Management and Biology of Pacific Flyway Geese*. Oregon State Univ. Book Stores, Inc., Portland, Pp. 117-129.
- National Oceanic and Atmospheric Administration. 1973, 1981. *Climatological data: Idaho*, Lewiston.
- Rotenberry, J. T. 1982. Birds in shrubsteppe habitat. *In* D. E. Davis (ed.) *CRC Handbook of Census Methods for Terrestrial Vertebrates*. CRC Press, Boca Raton, Fla. Pp. 307-309.
- Thomas, J. W. 1979. *Wildlife habitats in managed forests in the Blue Mountains of Oregon and Washington*. USDA For. Serv. Pac. Northwest For. and Range Exp. Station, Portland, Oreg.
- Thompson, J. D., and C. A. Baldassarre. 1988. Postbreeding habitat preference of wood ducks in Northern Alabama. *J. Wildl. Manage.* 52:80-85.
- Walcheck, K. C. 1970. Nesting bird ecology of four plant communities in the Missouri River breaks, Montana. *Wilson Bull.* 82:370-382.
- Weber, J. W., and E. J. Larrison. 1977. *Birds of Southeastern Washington*. Univ. of Idaho Press, Moscow.
- Wilson, M. H., and J. A. Crawford. 1987. Habitat selection by Texas bobwhites and chestnut-bellied scaled quail in south Texas. *J. Wildl. Manage.* 51:575-582.
- Zar, J. H. 1984. *Biostatistical Analysis*, 2nd ed. Prentice-Hall, Inc. Englewood Cliffs, N.J.

*Received 7 August 1987*

*Accepted for publication 14 September 1988*