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Avian and Amphibian Use of Fenced and Unfenced Stock Ponds in Northeastern Oregon Forests

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Abstract

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The abundance of birds and amphibian larvae was compared between fenced and unfenced stock ponds in 1993 to determine if fencing improved the habitat for these species in northeastern Oregon. Stock ponds that were fenced had significantly higher densities of bird species, guilds, and taxonomic groups than stock ponds that were unfenced. No differences in the relative abundance of larvae of Pacific treefrogs (*Pseudacris regilla*) or long-toed salamanders (*Ambystoma macrodactylum*) were found between fenced and unfenced ponds. Fencing at least a portion of stock ponds in forested areas provides habitat for a greater diversity and abundance of birds.

Keywords: Amphibians, birds, livestock grazing, northeastern Oregon, stock ponds.

Summary

Development of water sources in the form of stock ponds has benefited wildlife, as well as livestock. Fenced stock ponds provided a greater diversity and density of birds in forested habitats than unfenced ponds; this was likely because of the difference in vegetation surrounding the ponds. Amphibian larvae did not detectably benefit from the fenced ponds. These findings may suggest that livestock grazing did not have a negative effect on reproduction in the amphibian species considered, although survival and recruitment were not determined. These findings suggest that fencing at least a portion of the periphery of ponds with livestock grazing may be justified if avian abundance and diversity are considerations.

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Introduction

Livestock grazing is the most widespread influence on native ecosystems of the Western United States and occurs on most of the federal lands in the West (Fleischner 1994). Grazing greatly impacts some vertebrate populations, primarily through indirect effects on the habitat structure and prey availability, although there also can be direct effects such as trampling. On many federal lands, water sources have been developed in the last 30 years in the form of stock ponds or troughs for more efficient use by livestock and to encourage dispersal of animals.

These stock ponds are an important source of water and habitat for wildlife on many rangelands and forest lands. In the 1980s and 1990s, many ponds on national forest lands were partially fenced to protect the banks, enhance vegetation, and improve water quality. Fencing is done both to protect the resources and to provide habitat for wildlife, but it has not been determined if fencing actually benefits wildlife in these forested habitats. Our objective was to compare the density of avifauna and relative abundance of amphibians at fenced and unfenced ponds on forest lands.

Methods

Study Area

We surveyed 25 fenced and 25 unfenced stock ponds for birds and amphibians in the Wallowa Valley Ranger District on the Wallowa-Whitman National Forest in northeastern Oregon in spring and summer 1993. All ponds selected had permanent water, were 0.1 to 1.2 ha in size and less than 2 m deep, and were in conifer forests. Sixteen of the fenced ponds had more than half the pond fenced, and nine had less than half the pond fenced. Ponds had been fenced for 6 to 11 years before the study. The 25 fenced ponds were selected from a potential of 30 ponds on the district; we used those ponds closest to roads because of accessibility. The unfenced ponds also were selected based on accessibility and for being more than 0.5 km from other ponds that were selected. Continuous grazing by cattle occurred at or around the ponds from mid-June until late September.

Bird Surveys

We surveyed birds at ponds by using variable circular plots (Reynolds and others 1980) and placed one station at each pond. Each station was visited three times, once during each of the three periods: 1-15 May, 16-30 May, and 1-25 June. During a survey, we quietly sat near the pond for 15 minutes and recorded all birds seen or heard. For each bird, we recorded species and distance from the station. Surveys occurred between sunrise and 1100 hours; no surveys were done during adverse weather conditions (heavy rain or strong winds).

Density and effective area for each species detected more than once were calculated with the variable circular plot (VCP) program (Garton 1992) by using the ordered distance method (Patil and others 1982). Species were assigned to a guild category (Ehrlich and others 1988, Thomas 1979) based on a nesting and feeding location matrix approach found in Verner (1984) (table 1). We also created taxonomic groups, which placed more closely related species into common categories (table 2).

Density estimates and detection distances for fenced and unfenced ponds were tabulated by species, guild, and taxonomic group. To avoid describing density of less abundant bird species in small decimal units, estimates were scaled by a factor of 10^3 and expressed as density of birds per 1000 ha. For each set of density estimates and detection distances, we performed a Wilcoxon signed-ranks test (Snedecor and Cochran 1980) on data between fenced and unfenced plots. The Wilcoxon signed-ranks test was chosen over a paired-sample t-test because the probability plots of the differences in detectability distance appeared to be nonnormal.

Table 1—Descriptions of guilds used in grouping bird species in northeastern Oregon, 1993

Guild	Nesting location	Feeding location
GRGR	Ground, includes cliffs	Ground, air above
GRSH	Ground	Shrubs
GRWA	Ground	Water: in, on, or near
SHGR	Shrubs	Ground
SHSH	Shrubs	Shrubs
TRGR	Tree boles, large branches	Ground
TRSH	Tree boles, large branches	Shrubs
TRTR	Tree boles, large branches	Tree boles, large branches
CAGR	Tree canopy	Ground
CACA	Tree canopy	Tree canopy, air nearby
SNGR	Snags	Ground and air above
SNTR	Snags	Tree boles, large branches

Table 2—Description of taxonomic groups used to classify bird species in northeastern Oregon, 1993

Taxon	Description
ANAT	Geese and ducks
BLBR	Blackbirds and orioles
CHAR	Shore and marsh birds
CORV	Corvids
FLYC	Flycatchers
FNCH	Finches
GAME	Grouse and doves
HAWK	Hawks, falcons, accipiters
KING	Belted kingfisher
OWLS	Owls
PCNH	Chickadees, creepers, nuthatches
SPAR	Sparrows and grosbeaks
STAR	European starling
SWFT	Swifts and hummingbirds
SWLO	Swallows
THRS	Thrushes (including kinglets and bluebirds)
VREO	Vireos
WOOD	Woodpeckers and sapsuckers
WRBL	Warblers
WREN	House wren

Density estimates in the VCP program are a function of the number of birds detected and the effective area of the variable circular plot. The plot radius used to estimate effective area is derived from the same data as the detection distance. Therefore, the estimates of density and detection distance for birds within a given plot or group of plots are not independent. To ensure that any differences found in relative abundance were not simply a function of different detection distances due to variation in vegetation structure between fenced and unfenced ponds, we also compared the mean number of birds detected in fenced and unfenced plots by using Wilcoxon signed-ranks tests. A significance level of 0.05 was used.

Amphibian Surveys

We determined amphibian use of the ponds by sampling the larvae of the long-toed salamander (*Ambystoma macrodactylum*), Pacific treefrog (*Pseudacris regilla*), and western toad (*Bufo boreas*) with dip nets (Shaffer and others 1994) between 7 and 15 June 1993. This time interval was selected because larvae of all three species were present and large enough to be captured. We did not sample adults of the species because they are typically found in aquatic habitats only during breeding (Nussbaum and others 1983).

Relative abundance of larvae was determined by using eight sweeps with a dip net (rectangular frame 34 by 18 cm with 3 mm mesh) at each pond. Each sweep was 1.5 m long, ran perpendicular to the shore, and ended at the edge of the water. The locations of the sweeps were at 45^{o} intervals around the periphery of the pond. The total number of larvae caught per pond was recorded by species. We compared the relative abundance of the larvae of each species between fenced and unfenced ponds with a paired-sample t-test.

Results

Bird Survey

The fenced plots had significantly higher densities for bird species ($Z = -3.05$, $P < 0.01$), guilds ($Z = -3.06$, $P < 0.01$), and taxonomic groups ($Z = -2.15$, $P = 0.02$) (table 3). Detection distances were greater in the unfenced plots than in the fenced plots for species ($Z = 2.97$, $P < 0.01$), guilds ($Z = 2.82$, $P = 0.01$), and taxonomic group ($Z = 2.5$, $P = 0.01$). However, significantly more birds were detected in the fenced plots in all three classification methods (species: $Z = -2.81$, $P < 0.01$; guilds: $Z = -2.67$, $P = 0.01$; taxonomic groups: $Z = -3.22$, $P < 0.01$). So the differences in densities were not because of the differences in detection distances but rather a result of more birds occurring in the fenced plots.

The densities in fenced plots was more than double those in unfenced plots in the guilds of birds that nested on the ground (GRGR, GRSH, GRWA), fed on the ground and nested on tree boles and large branches (TRGR), and nested in snags and fed on tree boles and large branches (SNTR) (fig. 1). The taxonomic groups with more than double the densities in fenced plots compared to unfenced plots included hawks, thrushes, wrens, blackbirds, finches, swallows, shore and marsh birds, and starlings (fig. 2).

Amphibian Survey

There were no significant differences in the relative abundance of long-toed salamanders and Pacific treefrogs between fenced and unfenced ponds. Sample size was inadequate for a comparison of western toads. Larvae of Pacific treefrogs were detected at 92 percent ($\bar{x} = 60.8$ larvae captured in sweeps per pond containing this species; SD = 93.05) of the unfenced and 88 percent ($\bar{x} = 47.2$ larvae per pond; SD = 38.87) of the fenced ponds containing them. Larvae of long-toed salamanders

Table 3—The guild, taxon, and density (number per 1000 ha) of each bird species detected at fenced and unfenced ponds in northeastern Oregon, 1993

Species	Guild	Taxon	Relative density	
			Fenced	Unfenced
American kestrel (*Falco sparverius*)	TRGR	HAWK	219	12
American robin (*Turdus migratorius*)	SHGR	THRS	2,236	1,572
Black-headed grosbeak (*Pheucticus melanocephalus*)	CACA	SPAR	191	9
Black-backed woodpecker (*Picoides arcticus*)	SNTR	WOOD	17	17
Brewer's blackbird (*Euphagus cyanocephalus*)	CAGR	BLBR	89	426
Brown-headed cowbird (*Molothrus ater*)	SHGR	BLBR	1,951	1,536
Brown creeper (*Certhia americana*)	TRTR	PCNH	1,150	419
Cassin's finch (*Carpodacus cassinii*)	CAGR	FNCH	2,193	1,350
Chipping sparrow (*Spizella passerina*)	SHGR	SPAR	5,264	5,581
Clark's nutcracker (*Nucifraga columbiana*)	CACA	CORV	6	33
Cliff swallow (*Hirundo pyrrhonota*)	GRGR	SWLO	448	0
Common raven (*Corvus corax*)	GRGR	CORV	37	43
Common snipe (*Gallinago gallinago*)	GRWA	CHAR	11	1
Dark-eyed junco (*Junco hyemalis*)	GRGR	SPAR	4,333	9,099
European starling (*Sturnus vulgaris*)	TRGR	STAR	486	134
Evening grosbeak (*Coccothraustes vespertina*)	CAGR	FNCH	452	26
Golden-crowned kinglet (*Regulus satrapa*)	CACA	THRS	2,159	1,082
Gray jay (*Perisoreus canadensis*)	TRGR	CORV	245	47
Great horned owl (*Bubo virginianus*)	CAGR	OWLS	0	26
Green-winged teal (*Anas crecca*)	GRWA	ANAT	0	236
Hairy woodpecker (*Picoides villosus*)	TRTR	WOOD	51	91
Hammond's flycatcher (*Empidonax hammondii*)	CACA	FLYC	797	944
Hermit thrush (*Catharus guttatus*)	GRGR	THRS	83	51
House wren (*Troglodytes aedon*)	TRGR	WREN	1,536	257
MacGillivray's warbler (*Oporornis tolmiei*)	SHSH	WRBL	0	89
Mallard (*Anas platyrhynchos*)	GRWA	ANAT	822	199
Mountain bluebird (*Sialia currucoides*)	SNGR	THRS	235	85
Mountain chickadee (*Parus gambeli*)	TRCH	PCNH	1,456	962
Northern flicker (*Colaptes auratus*)	SNGR	WOOD	126	150
Olive-sided flycatcher (*Contopus borealis*)	CACA	FLYC	0	28
Orange-crowned warbler (*Vermivora celata*)	GRSH	WRBL	209	0
Pileated woodpecker (*Dryocopus pileatus*)	SNTR	WOOD	15	14

Table 3—The guild, taxon, and density (number per 1000 ha) of each bird species detected at fenced and unfenced ponds in northeastern Oregon, 1993 (continued)

			Relative density	
Species	**Guild**	**Taxon**	**Fenced**	**Unfenced**
Pine siskin (*Carduelis pinus*)	CACA	FNCH	1,776	290
Red-winged blackbird (*Agelaius phoeniceus*)	SHGR	BLBR	1,597	9
Red-tailed hawk (*Buteo jamaicensis*)	CAGR	HAWK	72	5
Red-breasted nuthatch (*Sitta canadensis*)	TRTR	PCNH	1,339	1,247
Red-naped sapsucker (*Sphyrapicus nuchalis*)	TRTR	WOOD	131	38
Ruby-crowned kinglet (*Regulus calendula*)	CACA	THRS	210	144
Ruffed grouse (*Bonasa umbellus*)	GRSH	GAME	6	3
Solitary vireo (*Vireo solitarius*)	CACA	VREO	165	22
Stellar's jay (*Cyanocitta stelleri*)	CAGR	CORV	85	115
Swainson's thrush (*Catharus ustulatus*)	SHSH	THRS	170	8
Townsend's warbler (*Dendroica townsendi*)	CACA	WRBL	452	163
Tree swallow (*Tachycineta bicolor*)	SNGR	SWLO	578	0
Unidentified bird	—	—	110	134
Unidentified bluebird	—	THRS	50	205
Unidentified finch	—	FNCH	1,150	151
Unidentified flycatcher	—	FLYC	205	50
Unidentified sapsucker	—	WOOD	37	26
Unidentified sparrow	—	SPAR	77	26
Unidentified warbler	—	WRBL	544	456
Unidentified woodpecker	—	WOOD	14	13
Vesper sparrow (*Pooecetes gramineus*)	GRGR	SPAR	12	0
Warbling vireo (*Vireo gilvus*)	CACA	VREO	0	77
Western bluebird (*Sialia mexicana*)	SNTR	THRS	2,618	240
Western flycatcher (*Empidonax* spp.)	CACA	FLYC	0	38
Western meadowlark (*Sturnella neglecta*)	GRGR	BLBR	27	116
Western tanager (*Piranga ludoviciana*)	CACA	BLBR	695	451
Western wood-pewee (*Contopus sordidulus*)	CACA	FLYC	265	226
Williamson's sapsucker (*Sphyrapicus thyroideus*)	TRTR	WOOD	41	28
Yellow-rumped warbler (*Dendroica coronata*)	SHSH	WRBL	1,067	1,884

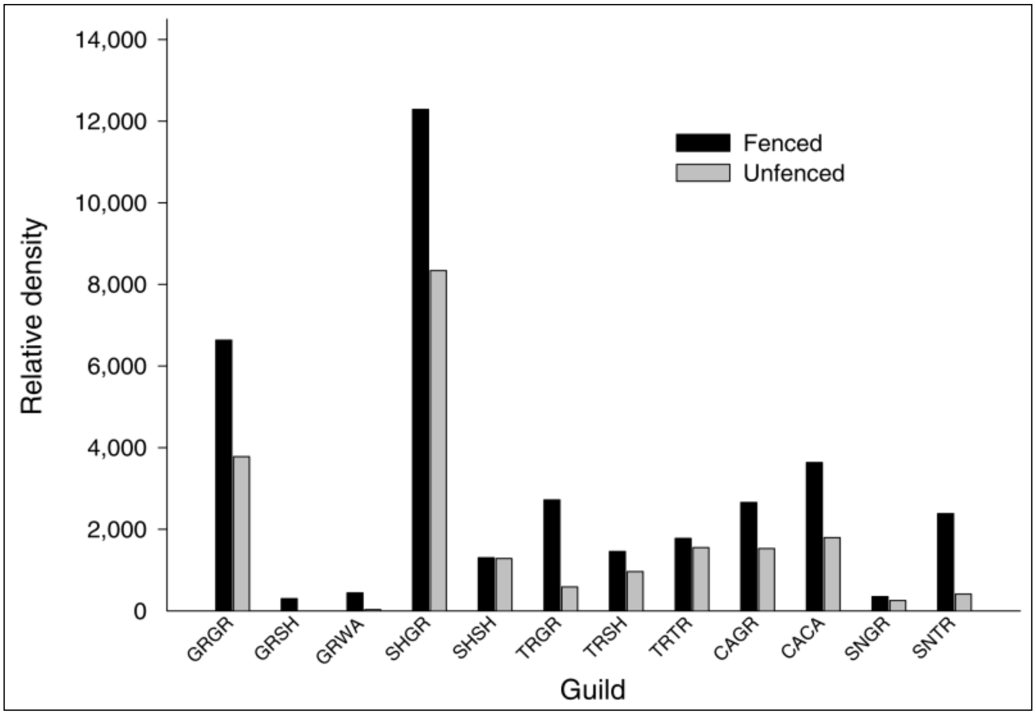

Figure 1—Density (number per 1000 ha) of bird guilds using fenced and unfenced ponds in northeastern Oregon, 1993.

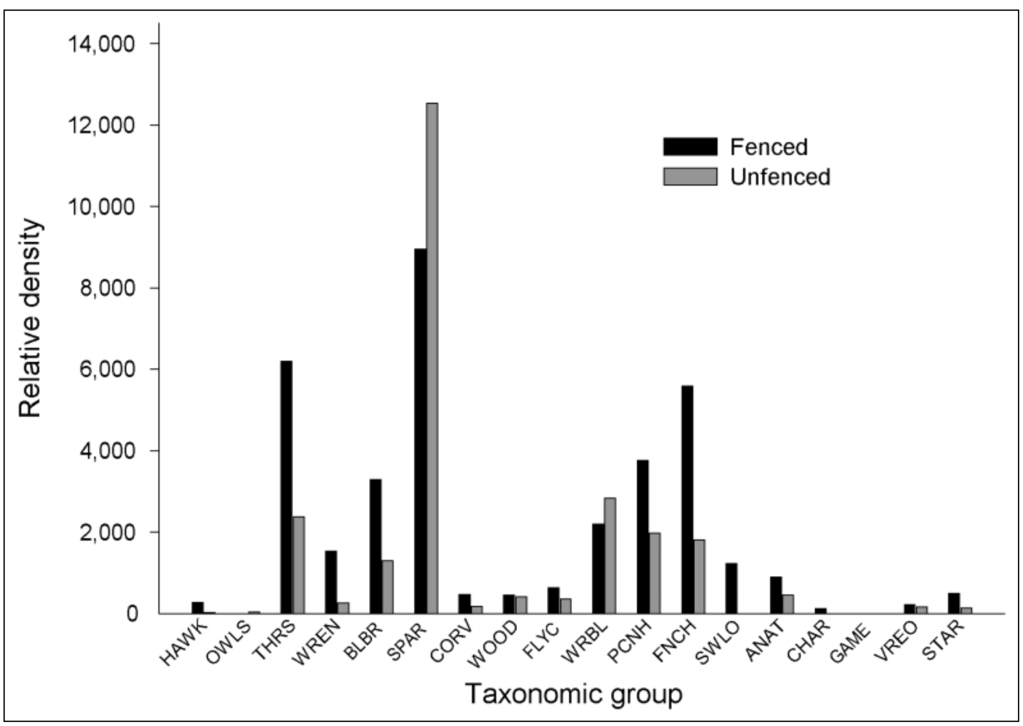

Figure 2—Density (number per 1000 ha) of taxonomic groups of birds using fenced and unfenced ponds in northeastern Oregon, 1993.

were detected at 92 percent ($\bar{x}$ = 27.9 larvae per pond; SD = 35.84) of the unfenced and 84 percent ($\bar{x}$ = 20.7 larvae per pond; SD = 18.94) of the fenced ponds. Larvae of western toads were less common with only 24 percent ($\bar{x}$ = 11.5 larvae per pond; SD = 4.97) of the unfenced and 20 percent ($\bar{x}$ = 32.8 larvae per pond; SD = 61.1) of the fenced ponds containing them.

Discussion

The guilds and taxonomic groups of birds with higher densities in the fenced ponds compared to the unfenced ponds included birds that nested or foraged on the ground, thrushes, wrens, blackbirds, chickadees, creepers, nuthatches, finches, and swallows (figs. 1 and 2). The greater abundance of many of these birds is explained by the more abundant vegetative ground cover in the areas protected from livestock grazing. The denser ground cover and vegetation would provide more material for nesting, more concealed nest sites, and more habitat diversity for terrestrial and aerial invertebrates on which most of these birds forage. Reduction in vegetation from grazing around unfenced ponds may reduce nest substrate for birds, alter availability of prey, alter the predator assemblage, and increase nest detectibility.

An interesting observation is the greater abundance of brown-headed cowbirds at fenced ponds. There is considerable concern regarding this species because it is a brood parasite and seems to be spreading throughout the West (Rothstein 1994). Young and Hutto (1999) reported that the best predictor of cowbird presence was the abundance of potential hosts in the Northern Rockies. The higher numbers we observed at fenced ponds may have been a function of the higher diversity of birds (and potential hosts) that also occurred at the fenced ponds.

Although we found no references to studies comparing avifauna using fenced and unfenced ponds in forest lands, there have been studies comparing bird use in ponds in rangelands. Grazing in stock ponds reduced pair numbers, nesting densities, and nest success of waterfowl in North Dakota (Kirsch 1969). Grazing on small pond shorelines in Texas resulted in a severe reduction of foliar cover and vegetation height; fencing at least half the shore line was recommended to protect waterfowl habitat (Whyte and Cain 1981).

Many studies comparing avian use of grazed and ungrazed riparian habitats have been conducted with varying results. Saab and others (1995) cited nine studies that describe the impacts of grazing by comparing avian populations on adjacent grazed and ungrazed sites in western riparian habitats for which abundance data were reported on 68 species of Neotropical migrant landbirds; they reported that "in a qualitative assessment of all studies combined, nearly half (46 percent) of these species decreased in abundance with cattle grazing, 29 percent increased with grazing, and 25 percent showed no clear response." No differences were found in avian communities between grazed and ungrazed riparian habitats in forested lands in northeastern Oregon (Kauffman and others 1982) and in rangelands in Nevada (Medin and Clary 1991). Taylor (1986) reported that bird species richness decreased with grazing in riparian areas in Oregon, and bird counts were 5 to 13 times higher in ungrazed areas than in grazed areas. Avian species richness and relative abundance were greater in exclosure plots than in plots with past grazing (Dobkin and others 1998). Predation on real and on artificial bird nests was higher in grazed versus ungrazed sites (Ammon and Stacey 1997).

There has been considerable speculation on the influence of livestock on amphibians (Horusp and others 1993, Jennings and Hayes 1994), but few studies have actually investigated the impacts of grazing. Bull and Hayes (2000) found no differences in the number of egg masses or recently transformed Columbia spotted frogs (*Rana luteiventris*) between grazed and ungrazed ponds in eastern Oregon. In Nevada, adult Columbia spotted frogs were associated with sites with significantly less grazing pressure than sites without frogs, although there were no differences in a subsequent year (Munger and others 1996). In our study, relative abundance of amphibian larvae did not differ between fenced and unfenced ponds, although we did not determine recruitment into the adult population. Trampling of egg masses did not occur in our study area because livestock were not present until June, and by then, the eggs had already hatched. Trampling of recently metamorphosed individuals may occur at unfenced ponds in August and September.

Fenced stock ponds provided a greater diversity and density of birds in forested habitats than unfenced ponds; this was likely because of the difference in vegetation surrounding the ponds. Amphibian larvae did not detectably benefit from the fenced ponds. These findings may suggest that livestock grazing did not have a negative effect on reproduction in the amphibian species considered, although survival and recruitment were not determined. These findings suggest that fencing at least a portion of the periphery of ponds with livestock grazing may be justified if avian abundance and diversity are considerations.

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Cover art work drawn by Susan Lindstedt.

When you know:	Multiply by:	To find:
Millimeters (mm)	0.039	Inches
Meters (m)	3.28	Feet
Kilometers	0.625	Miles
Hectares (ha)	2.47	Acres

Literature Cited

Ammon, E.M.; Stacey, P.B. 1997. Avian nest success in relation to past grazing regimes in a montane riparian system. Condor. 99: 7-13.

Bull, E.L.; Hayes, M.P. 2000. Livestock effects on reproduction of the Columbia spotted frog. Journal of Range Management. 53: 291-294.

Dobkin, D.S.; Rich, A.C.; Pyle, W.H. 1998. Habitat and avifaunal recovery from livestock grazing in a riparian meadow system of the northwestern Great Basin. Conservation Biology. 12(1): 209-221.

Ehrlich, P.R.; Dobkin, D.S.; Wheye, D. 1988. The birder's handbook: a field guide to the natural history of North American birds. New York: Simon and Schuster. 785 p.

Fleischner, T.L. 1994. Ecological costs of livestock grazing in western North America. Conservation Biology. 8(3): 629-644.

Garton, E.O. 1992. Program variable circular plot. Moscow, ID: University of Idaho.

Horusp, A.C.; James, C.; Porter, G. 1993. Vertebrates of dry rainforest of south and mideastern Queensland. Memoirs of the Queenland Museum. 34: 215-228.

Jennings, M.R.; Hayes, M.P. 1994. Amphibian and reptile species of special concern in California. Rancho Cordova, CA: [Publisher unknown]; final report. Submitted to: California Department of Fish and Game. 255 p.

Kauffman, J.B.; Krueger, W.C.; Vavra, M. 1982. Impacts of a late season grazing scheme on nongame wildlife in a Wallowa mountain riparian ecosystem. In: Proceedings of a symposium on wildlife-livestock relationships. Moscow, ID: University of Idaho: 208-222.

Kirsh, L.M. 1969. Waterfowl production in relation to grazing. Journal of Wildlife Management. 33: 821-828.

Medin, D.E.; Clary, W.P. 1991. Breeding bird populations in a grazed and ungrazed riparian habitat in Nevada. Res. Pap. RP-INT-441. Ogden, UT: U.S. Department of Agriculture, Forest Service, Intermountain Research Station. 7 p.

Munger, J.C.; Gerber, M.; Carroll, M. [and others]. 1996. Status and habitat associations of the spotted frog *Rana pretiosa* in southwestern Idaho. Tech. Bull. 96-1. Boise, ID: Idaho Bureau of Land Management. 11 p.

Nussbaum, R.A.; Brodie, E.D., Jr.; Storm, R.M. 1983. Amphibians and reptiles of the Pacific Northwest. Moscow, ID: University of Idaho Press. 332 p.

Patil, S.A.; Kovner, J.L.; Burnham, K.P. 1982. Optimum nonparametric estimation of population density based on ordered distances. Biometrics. 38: 243-248.

Reynolds, R.T.; Scott, J.M.; Nussbaum, R.A. 1980. A variable circular-plot method for estimating bird numbers. Condor. 82: 309-313.

Rothstein, S.I. 1994. The cowbird's invasion of the Far West, causes and consequences experienced by host species. Studies in Avian Biology. 15: 301-315.

Saab, V.A.; Bock, C.E.; Rich, T.D.; Dobkin, D.S. 1995. Livestock grazing effects in western North American. In: Martin, T.E.; Finch, D.M., eds. Ecology and management of Neotropical migratory birds. Oxford, England: Oxford University Press: 311-353.

Shaffer, H.B.; Alford, R.A.; Woodward, B.D. [and others]. 1994. Quantitative sampling of amphibian larvae. In: Heyers, W.R.; Donnelly, M.A.; McDiarmid, R.W. [and others], eds. Measuring and monitoring biological diversity: standard methods for amphibians. Washington, DC: Smithsonian Institution Press: 130-141.

Snedecor, G.W.; Cochran, W.G. 1980. Statistical methods. 7th ed. Ames, IA: Iowa State University. 534 p.

Taylor, D.M. 1986. Effects of cattle grazing on passerine birds nesting in riparian habitat. Journal of Range Management. 39(3): 254-258.

Thomas, J.W. 1979. Wildlife habitats in managed forests of the Blue Mountains of Oregon and Washington. Agric. Handb. 553. Washington, DC: U.S. Department of Agriculture, Forest Service. 512 p.

Verner, J. 1984. The guild concept applied to management of bird populations. Environmental Management. 8: 1-14.

Whyte, R.J.; Cain, B.W. 1981. Wildlife habitat on grazed and ungrazed small pond shorelines in south Texas. Journal of Range Management. 34(1): 64-68.

Young, J.S.; Hutto, R.L. 1999. Habitat and landscape factors affecting cowbird distribution in the Northern Rockies. Studies in Avian Biology. 18: 41-51.

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