Response of Birds to Fire in the American Southwest[1]

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Abstract

Fire was a common prehistoric disturbance in most southwestern grasslands, oak savannas, and coniferous forests, but not in Sonoran and Mojave desertscrub, or in riparian ecosystems. Prescribed burning should be applied, but under experimental conditions that facilitate studying its impacts on birds and other components of biodiversity. Fire plays a critical role in maintaining a balance between desert grassland and Chihuahuan desertscrub, but unburned areas also are important for birds dependent upon woody vegetation and/or heavy grass cover. Understory fire probably once played a critical role in maintaining relatively open oak (*Quercus* spp.), pinyon-juniper (*Pinus- Juniperus*), and ponderosa pine (*Pinus ponderosa*) woodlands and their bird assemblages, while stand replacement fires sustained aspen groves (*Populus tremuloides*) at higher elevations. Carefully controlled prescribed burning, thinning, and grazing management will be needed to return fire to its prehistoric role in these habitats. There is an urgent need for cooperative effort between managers and researchers to implement replicated burns to quantify avian responses in appropriate habitats.

Key words: birds, desert, fire, grassland, mixed-conifer, pine-oak, prescribed burning, riparian, savanna, Southwest.

The ecological importance of fire in the American Southwest has long been recognized (Leopold 1924), but the nature of these fires has been altered drastically by disturbances such as logging, livestock grazing, and suppression efforts (Moir et al. 1997, McPherson and Weltzin 2000). Southwestern ecosystems range from low desert to high montane, and fire ecology and management issues differ greatly among them (Krammes 1990).

The Sonoran and Mojave Deserts consist of structurally complex vegetation (Turner et al. 1995), and they have correspondingly rich avifaunas dependent upon trees and large succulents (Mills et al. 1991). The spread of exotic grasses such as red brome (*Bromus rubens*) and buffelgrass (*Pennisetum ciliare*) have increased the frequency and intensity of fire in these deserts, killing much of the native vegetation (Miller et al. 1995). Fire effects on birds in these deserts therefore are almost entirely negative.

Most southwestern grasslands were invaded by woody plants from the Chihuahuan Desert, beginning especially in the late 1800s, largely because of decreased frequencies and intensities of fire (Archer et al. 1995, McPherson 1995). Birds associated with grasslands have declined more than other avian groups, both nationally and in the Southwest (Brown and Davis 1998, Vickery and Herkert 2001), at least in part because of the conversions of former grassland to desertscrub. Fire has the short term effect in southwestern grasslands of reducing grass cover while stimulating forb cover and seed production for two or three post-fire growing seasons. Such burning favors grassland birds associated with relatively open ground, such as Mourning Dove (*Zenaida macroura*), Horned Lark (*Eremophila alpestris*), and Lark Sparrow (*Chondestes grammacus*), over those requiring heavy grass cover, such as Grasshopper Sparrow (*Ammodramus savannarum*), Botteri's Sparrow (*Aimophila botterii*), and Cassin's Sparrow (*Aimophila cassinii*; *fig. 1*). Prescription fire should be applied in these ecosystems, especially in relatively mesic sites, to restore open grasslands and retard woody encroachment (Bock and Bock 1992, Gordon 2000). However, a balanced approach is called-for, since other species prefer or require woody cover in Chihuahuan shrub/grasslands (Whitford 1997, Pidgeon et al. 2001).

Interior chaparral occurs from northwestern Arizona to southwest Texas and northern Mexico, and supports a variety of shrubland birds (Szaro 1981, Pase and Brown 1982). Drought, livestock grazing, and fire suppression have increased shrub cover and reduced cover of perennial grasses and forbs in Arizona chaparral (Brejda 1997). Virtually nothing is known about avian

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responses to fire in this ecosystem (but see Szaro 1981), and experiments with prescribed fire are strongly recommended.

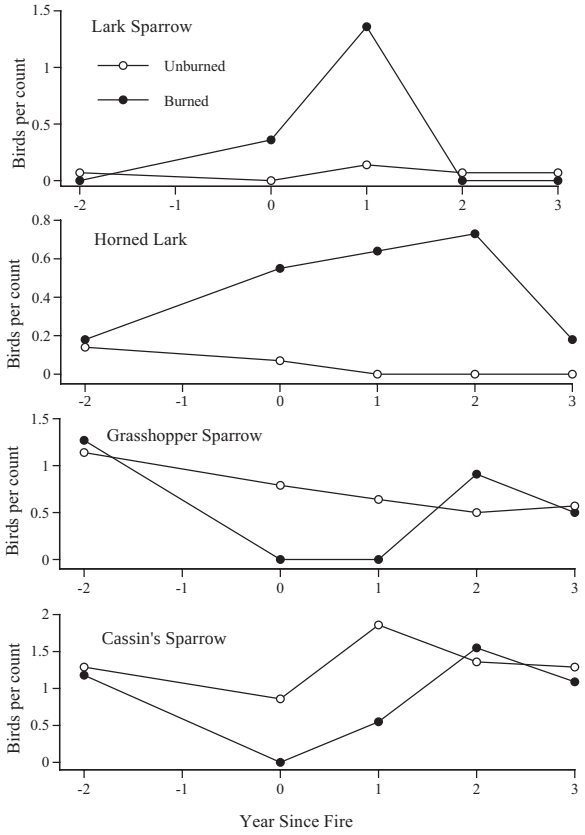

Figure 1— Relative abundances of four grassland birds two years before, just following, and for three summers after fire in a semi-arid grassland in southeastern Arizona (data from Bock and Bock 1992).

Fire once maintained oak (*Quercus* spp.) savannas in the Mexican borderlands in an open condition, by frequently killing smaller trees and shrubs (McPherson 1997). These ecosystems became more densely wooded when livestock grazing and fire suppression reduced fine fuels (McPherson and Weltzin 2000). Typical birds of southwestern oak savannas include species specializing on acorns, insect hawkers, foliage gleaners, and species dependent on the grassy understory (Brown 1982). Responses of these birds to prescribed or wildfire in southwestern oak woodlands are largely unknown, but studies in Midwestern savannas suggest that fire would favor insect hawkers and understory species over foliage gleaners (Davis et al. 2000).

Southwestern riparian woodlands support an abundance and variety of breeding birds vastly greater than adjacent ecosystems (Carothers et al. 1974), but many of these woodlands have been damaged or completely eliminated by anthropogenic forces such as alteration of natural flooding regimes and the spread of exotic vegetation (Ellis et al. 1998). The result has been a substantial decline in abundance and variety of birds in these ecosystems (Rosenburg et al. 1991), although remnant patches continue to support high avian biodiversity (Strong and Bock 1990, Skagen et al. 1998). There is little evidence that fire was a common historical event in southwestern riparian woodlands, perhaps because of moisture. Recent fires have been highly destructive of native riparian vegetation, most particularly the large trees such as cottonwood (*Populus* spp.) and sycamore (*Platanus* spp.) that are especially important to birds (Bock and Bock 1984, Busch 1995). Therefore, prescribed fire is not recommended for these ecosystems.

Pinyon-juniper (*Pinus-Juniperus* spp) woodland is widespread throughout the Southwest, but little is known about fire effects in this ecosystem (Balda and Masters 1980, Severson and Rinne 1990). We found no studies related to birds and fire in pinyon juniper woodlands. Fire likely would favor species associated with more open habitats, while negatively impacting species that depend on trees for foraging or nesting, but this tenuous conclusion is based on responses of birds to mechanical clearing of dense stands rather than to fire itself (Sedgwick and Ryder 1987).

Fire is perhaps the most important natural disturbance in southwestern ponderosa pine (*Pinus ponderosa*) forests, and frequent low-intensity fires were part of their evolutionary history (Pyne 1996, Moir et al. 1997). Suppression efforts, livestock grazing, and logging have altered natural fire regimes, resulting in dense forests and increased risk of unnatural stand replacement fires. Most studies of fire effects on birds in these forests have focused on stand replacement burns, where woodpeckers and ground foragers are the main short-term beneficiaries (Dwyer and Block 2000). Species likely to benefit from cooler understory fires are those requiring relatively open habitats, such as flycatchers, swallows, and bluebirds (Marshall 1963, Horton and Mannan 1988).

Bird numbers and species richness seemed to respond positively shortly after the 1996 Horseshoe and Hochderffer fires on the Coconino National Forest Arizona (*table 1*). During the breeding season three years post-fire, more species were detected in areas where fires were severe (stand-replacement) and moderate (understory) than in adjacent unburned forests (45, 41, and 31 species, respectively). A similar trend was found during the nonbreeding season with 33, 35, and 26 species detected in severe, moderate, and unburned forests. Major species groups that increased in response to fire included woodpeckers, flycatchers, and thrushes. In contrast, many foliage-gleaning birds (Mountain Chickadees, Plumbeous Vireo, Pygmy Nuthatch, Yellow-rumped Warbler, and Grace's Warbler) were detected less frequently within severe fire areas.

Table 1— *Simple counts of birds detected during point counts conducted within ponderosa pine forests burned during the 1996 Horseshoe and Hochderffer fires, Coconino National Forest, Arizona (Block, unpubl. data). Counts were conducted in the breeding season of 1999 and nonbreeding season 1999-2000, approximately three years after the fires.*

		Breeding			Nonbreeding		
Species		**Severe**	**Moderate**	**Unburned**	**Severe**	**Moderate**	**Unburned**
Golden Eagle	*Aquila chrysaetos*				1		
Bald Eagle	*Haliaeetus leucocephalus*				1	1	
Sharp-Shinned hawk	*Accipiter striatus*	1			7	1	
Cooper's Hawk	*Accipiter cooperii*		1				
Northern Goshawk	*Accipiter gentilis*						2
Red-tailed Hawk	*Buteo jamaicensis*	1	3		3	1	
American Kestrel	*Falco sparverius*	1	3		3		
Merlin	*Falco columbarius*					1	
Wild Turkey	*Meleagris gallopavo*				2		
Mourning Dove	*Zenaida macroura*	37	32	30	1	5	
Long-eared Owl	*Asio otus*					1	
Northern Pygmy Owl	*Glaucidium gnoma*				6		
Common Nighthawk	*Chordeiles minor*		2				
Broad-tailed Hummingbird	*Selasphorus platycercus*	20	34	5			
Rufous Hummingbird	*Selasphorus rufus*		1				
Northern Flicker	*Colaptes auratus*	32	28	17	103	83	42
Acorn Woodpecker	*Melanerpes formicivorus*	6					
Lewis's Woodpecker	*Melanerpes lewis*	9					
Williamson's Sapsucker	*Sphyrapicus thyroideus*				1	12	4
Yellow-bellied Sapsucker	*Sphyrapicus varius*					1	
Hairy Woodpecker	*Picoides villosus*	88	28	10	149	46	29
Three-toed Woodpecker	*Picoides tridactylus*	1			11		
Red-naped Sapsucker	*Sphyrapicus varius nuchalis*						3
Cordilleran Flycatcher	*Empidonax difficilis*	1		1		1	
Olive-sided Flycatcher	*Contopus borealis*	12	1				
Western Wood-pewee	*Contopus sordidulus*	51	93	11			
Horned Lark	*Eremophila alpestris*	1					
Violet-green Swallow	*Tachycineta thalassina*		3	10			
Pinyon Jay	*Gymnorhinus cyanocephalus*	4	36	17	22	23	2
Steller's Jay	*Cyanocitta stelleri*	33	94	88	152	189	114

Table 1— *contd.*

Species		Breeding			Nonbreeding		
		Severe	Moderate	Unburned	Severe	Moderate	Unburned
Clark's Nutcracker	*Nucifraga columbiana*	3	4		39	44	22
American Crow	*Corvus brachyrhynchos*	5		3	15	16	20
Common Raven	*Corvus corax*	11	5	8	96	87	83
Mountain Chickadee	*Poecile gambeli*	2	74	111	11	117	104
Bushtit	*Psaltriparus minimus*				4	7	6
Brown Creeper	*Certhia americana*	8	10	6	3	25	23
White-breasted Nuthatch	*Sitta carolinensis*	43	65	76	63	121	95
Red-breasted Nuthatch	*Sitta canadensis*				2	1	
Pygmy Nuthatch	*Sitta pygmaea*	1	26	26	17	130	116
House Wren	*Troglodytes aedon*	2	1				
Rock Wren	*Salpinctes obsoletus*		1				
Golden-crowned Kinglet	*Regulus satrapa*					3	1
Ruby-crowned Kinglet	*Regulus calendula*					1	
Western Bluebird	*Sialia mexicana*	144	136	77	116	106	74
Mountain Bluebird	*Sialia currucoides*	6			4	3	1
Townsend's Solitaire	*Myadestes townsendi*	1	5	17	1	6	4
Hermit Thrush	*Catharus guttatus*	3					
American Robin	*Turdus migratorius*	53	46	17	35	43	13
Plumbeous Vireo	*Vireo plumbeus*	10	36	24		1	
Warbling Vireo	*Vireo gilvus*		1				
Virginia's Warbler	*Vermivora virginiae*			3			
Yellow-rumped Warbler	*Dendroica coronata*	10	69	78	1		
Grace's Warbler	*Dendroica graciae*		31	32			1
Olive Warbler	*Peucedramus taeniatus*			2			2
Black-headed Grosbeak	*Pheucticus melanocephalus*	3	5				
Vesper Sparrow	*Pooecetes gramineus*	2					
Lark Sparrow	*Chondestes grammacus*	6	4	4			
Chipping Sparrow	*Spizella passerina*	19	51	9	1	4	
Dark-eyed Junco	*Junco hyemalis*	31	89	60	71	94	46
Western Meadowlark	*Sturnella neglecta*	35	14		1	2	
Brown-headed Cowbird	*Molothrus ater*	1	13	2			
Western Tanager	*Piranga ludoviciana*	24	103	20			
Summer Tanager	*Piranga rubra*		3				

Table 1— *contd.*

Species		**Breeding**			**Nonbreeding**	
	Severe	**Moderate**	**Unburned**	**Severe**	**Moderate**	**Unburned**
Hepatic Tanager *Piranga flava*	1					
Pine Siskin *Carduelis pinus*	3	3	3	11	2	5
Lesser Goldfinch *Carduelis psaltria*	1	1				
Red Crossbill *Loxia curvirostra*	4	4	7	14	30	54
House Finch *Carpodacus mexicanus*	2	1				
Evening Grosbeak *Coccothraustes vespertinus*	2		5		1	1
Total number of species	45	41	31	33	35	26
Total number of detections	734	1160	779	967	1209	867

[a] N = 49 counting stations within severe, moderate, and unburned areas. Counting stations were sampled three times during the breeding season and four times during the nonbreeding season.

Mixed conifer forests of the Southwest are dominated by Douglas-fir (*Pseudotsuga menziesii*), white fir (*Abies concolor*), Engelmann spruce (*Picea engelmanni*), and aspen (*Populus tremuloides*; Brown 1982). Many fires that occur at higher elevations in these forests are stand replacing, providing opportunities for establishment of aspen (Moir 1993), and the variety of birds associated with it (Finch and Reynolds 1987, Hutto 1995). However, a variety of other birds, including the threatened Mexican Spotted Owl (*Strix occidentalis lucida*), depend on substantial conifer forests (Smith 1980, U.S. Department of Interior 1995). More field research specific to Southwestern conditions needs to be conducted to understand fire effects on birds in mixed-conifer forests.

Both deliberately-set prescribed fire and prescribed natural fire (natural ignition, allowed to burn within pre-set limits) are essential approaches in reducing fuels and returning southwestern grass/shrublands, oak savannas, and conifer forests to their prehistoric conditions. Given the historical importance of fire in these ecosystems, there have been surprisingly few studies of the effects of either wildfire or prescribed burning on southwestern bird populations and communities. We call for managers and researchers to cooperate in the design and implementation of replicated, large-scale, properly controlled field experiments to examine avian responses to prescription burning.

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