

# Fire in the

## Finding the Right

*Conservation means harmony between men and land. When land does well for its owner, and the owner does well by his land; when both end up better by reason of their partnership, we have conservation. When one or the other grows poorer, we do not.*

— Aldo Leopold

Land owners and even wildlife biologists have traditionally favored fire suppression in the tallgrass prairie and in other grassland biomes, but there has been a more-recent emphasis on managing grassland habitats with fire. *Central Minnesota*; April 2003. © Stan Tekiela.

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Dan L. Reinking

George Miksch Sutton Avian Research Center

P. O. Box 2007

Bartlesville, Oklahoma 74005

dreinking@ou.edu

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# Tallgrass Prairie

## Balance of Burning for Birds

Rising smoke crosses the descending sun in the western sky, while orange flames advance through the prairie grasses and forbs, leaving charred black ground in their wake. Kestrels pounce on fleeing grasshoppers and scan for rodents emerging to a world without cover. It is a time of plenty for some and hardship for others, but in the dynamic ecosystem of the tallgrass prairie, nothing stays the same for long. Within a few short weeks, the ground has been transformed from smoldering ashes to a lush green carpet dominated by grasses attractive to herds of large herbivores. Within a few short years, forbs will increase in prevalence, and the occasional tree seedling will become established in low-lying moist areas. An increasing number of dead stems and an accumulating layer of litter make the prairie once again vulnerable to fire, whether due to a bolt of lightning from the sky, a glowing ember from a native American's handmade wooden fire drill, or a flaming blob of refined petroleum fuel oozing from a rancher's aluminum drip torch.

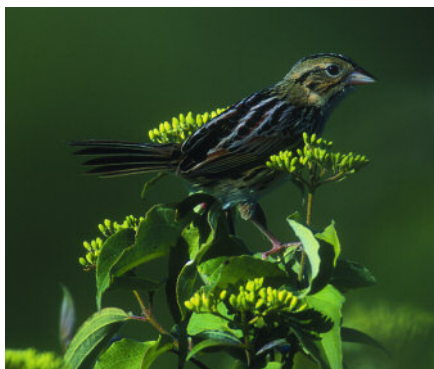
While this scene of recurring fire has played out countless times in the tallgrass prairie of North America, the cause, intensity, seasonality, and scale of each fire is different, and each factor has tended to change over time, as have human knowledge and attitudes regarding this process (Reinking 2005). The birds of the tallgrass prairie are affected by and can adapt in various ways to these changing but cyclic patterns of vegetation, although the unprecedented impacts of contemporary humankind have significant implications for the future of grassland birds, as we shall see.



Early nesters, such as the **Greater Prairie-Chicken**, may lose their nests to spring fires. Clay County, Minnesota; May 2001. © Stan Tekiela.

Grasslands once covered some 17% of the North American landscape (Knopf 1988), with the Great Plains comprising the largest portion. These grasslands are classified as tallgrass, mixed-grass, or shortgrass prairies, based on the dominant grasses present in each, and they generally follow an east-to-west gradient of increasing aridity and shorter grasses. The wettest and most productive of these grassland types, the tallgrass prairie (photographs, p. 36), is characterized by annual precipitation of 60–100 centimeters, occurring mostly during the growing season, and dramatically variable seasonal temperatures ranging from  $-35^{\circ}$  to  $45^{\circ}$  C. Although it once covered 577,500 km<sup>2</sup>, the level, fertile soils of the tallgrass prairie proved ideal for cereal grain production, and an estimated 88–99% of native prairie has been lost (table, p. 37). This decline is greater than that reported for any other North American ecosystem (Vickery et al. 2000). These landscape changes are reflected in grassland bird populations, which have shown steeper and more widespread declines than any other guild of North American species (Knopf 1994). Greater Prairie-Chicken, Upland Sandpiper, Eastern Meadowlark, Dickcissel, Grasshopper Sparrow, and Henslow's Sparrow are some characteristic tallgrass prairie species among those defined by Vickery et al. (1999) as obligate grassland species, and all of these except Upland Sandpiper have shown substantial population declines since Breeding Bird Survey monitoring efforts were established in 1966 (Sauer et al. 2005).

While loss of habitat has undoubtedly been the major contributor to bird declines in the tallgrass prairie, it is not the only factor affecting bird populations. Grasslands are dynamic ecosystems, shaped by the forces of fire, drought, and grazing. In the years following a prairie fire, forbs and woody plants begin to increase, along with standing dead vegetation



Fire has diverse and contrasting effects on the various bird species that inhabit the tallgrass prairie. Some species flourish in recently burned areas, but others, like the **Henslow's Sparrow**, require several years to recolonize. Konza Prairie, Kansas; June 2001. © Bob Gress.

and litter. This increasing fuel load sets the scene for the next fire to take place. Forbs and woody plants are killed by burning, unlike the fire-adapted prairie grasses whose growing tissues are at the bottom rather than the top of the plants. The time interval over which this shifting dominance of vegetation takes place varies based on soils, weather, and grazing patterns. Wetter years favor thirsty woody vegetation, while droughts favor hardy grasses. Grazers are attracted to recently burned areas for the lush regrowth of their preferred grasses. Contemporary fire regimes are often very different from those that occurred historically, and the resulting changes in vegetation, as well as the presence of large herbivores, impact grassland birds in a variety of ways.

A thorough understanding of historical (i.e., pre-European settlement) fire regimes in the tallgrass prairie is elusive. Scant biological evidence is available, as the largely treeless plains offer few fire-scarred tree rings for examination and little extensive, long-lived woody vegetation from which to evaluate age structures of vegetation over wide areas (Higgins 1986). A study of tree-scarring in gallery forests within Kansas tallgrass prairie resulted in an estimated fire return interval of 11–20 years, although the author suspected that the actual interval was shorter (Abrams 1985). Charcoal concentrations from core samples in northern Great Plains lakes were lower in the years following European settlement, suggesting a decrease in post-settlement fire activity (Umbanhowar 1996).

The limited biological evidence aside, much of what we understand about historical fire regimes in the tallgrass prairie is based on accounts of early explorers, making the record geographically spotty and biased toward the routes that were traveled most often. Following an extensive review of available documents, Higgins (1986) concluded that for the northern Great Plains, fires started by Native Americans appeared in the written record much more often than lightning-set fires. Fires set by Native Americans occurred in nearly all months of the year, but were most common in spring and fall, while lightning-set fires were most common in late summer. Indians used relatively small fires to influence movements of bison, the native nomadic grazers which favored recently burned areas. Most of the really large fires were likely caused by lightning.

Attitudes toward fire and the resulting management practices in tallgrass prairie have evolved over time. Early ecological studies in the 1930s coincided with drought years, giving rise to the conclusion that fire was harmful (Collins 1990).

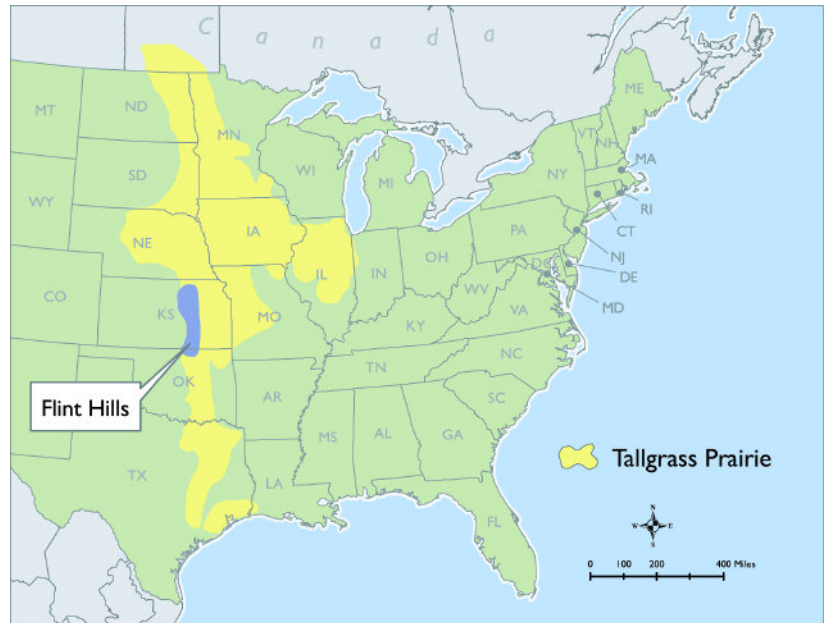
Subsequent studies began to demonstrate the importance of fire in maintaining the prairie, with one study in Kansas showing a 34% increase in tree and shrub cover in unburned prairie from 1937–1969, but only a 1% increase in burned sites (Bragg and Hulbert 1976). Another Kansas study showed a 60% increase in the number of trees in just five years without fire (Briggs and Gibson 1992). The rate of increase in woody vegetation in unburned tallgrass prairie depends upon topography, soil type, and precipitation, but such encroachment is typical in the prolonged absence of fire.

The large-scale conversion of tallgrass prairie to row-crop agriculture has all but eliminated tallgrass prairie as an intact landscape in much of the Midwest and Great Plains (table, p. 37). One exception is the Flint Hills region of Kansas and northern Oklahoma, an area of nearly two million hectares of native tallgrass prairie (map, above). This region's hills and shallow, rocky soils have made cultivation impractical, leaving livestock grazing as the primary economic use of the land. It is here that the remaining but threatened stronghold of the Greater Prairie-Chicken exists, as well as significant numbers of other declining grassland bird species such as the Henslow's Sparrow, generally rare throughout its range but locally common in portions of the Flint Hills where suitable habitat is present. Effective management of the Flint Hills and other remaining parcels of native prairie is vital for the long-term survival of the suite of characteristic bird species found there.

Several studies of the effects of fire on vegetation, especially the beneficial impact fire has on grass production, led to the development of a grazing regime known as Intensive Early Stocking (hereafter, IES; Launchbaugh and Owensby 1978, Smith and Owensby 1978, Vermeire and Bidwell 1998). Under this grazing regime, prairie is burned annually or near-annually in the spring. The resulting lush regrowth of grasses enables ranchers to graze two to three times as many cattle per unit area as they would during a year-round, continuous graz-

ing system. Cattle at this high density are left to graze for only about 100 days, and are then removed to feedlots for fattening before going to market. The short duration of grazing allows the grasses to rebuild a fuel load (for next year's fire) and go to seed before winter. This system is profitable for ranchers, provided that adequate rainfall comes after the spring fires.

Birds of the tallgrass prairie are adapted to the changing conditions in this dynamic habitat, provided that the entire range of habitat from recently burned to long unburned is present in the landscape. No location is the same from one year to the next, whether due to the slow yearly encroachment of forbs and woody vegetation, or to the rapid removal of vegetation caused by fire. Some species, such as the Dickcissel, can be found in a variety of habitat conditions. Others, such as the Grasshopper Sparrow, are noticeably more abundant in recently burned areas with sparser vegetation, while Henslow's Sparrows are found only in areas that have not been burned for several years (Reinking et al. 2000, Reinking 2002, Herkert 2003). Any management practice (such as IES) that involves significant and frequent vegetation removal, including annual or biennial burning or heavy grazing, will likely exclude Henslow's Sparrow. Because of this rigid habitat preference and the dynamic nature of tallgrass prairie, Henslow's



This map shows the original extent of tallgrass prairie in North America, plus the location of the Flint Hills. Adapted from Steinauer and Collins (1996) and Reichman (1987). Map by © Kei Sochi.

Historically, fires—frequent in occurrence and generally small in extent—were a characteristic feature of the central North American tallgrass prairie. The birds and other organisms that inhabit the tallgrass prairie still depend on regular fires, and wildlife biologists and many landowners routinely incorporate prescribed burns into their management plans. *Flint Hills, Kansas; April 1994.* © Bob Gress.





This lush, never-plowed grassland retains its native plants and birds, and is maintained by regular fires. *Flint Hills, Kansas; October 2001.* © Bob Gress.

Sparrows can readily colonize new areas of appropriate habitat as fires render breeding areas unavailable from one year to the next. Widespread and consistent application of IES in much of the Flint Hills keeps appropriate habitat for Henslow's Sparrow in short supply, although large numbers of birds are present where suitable habitat exists at Konza Prairie in Kansas and the Tallgrass Prairie Preserve in Oklahoma, at the northern and southern portions of the Flint Hills, respectively. Avian diversity is lower in annually burned Kansas prairie, in part because woody vegetation used by some species is removed, leaving behind a structurally simpler habitat capable of supporting fewer species (Zimmerman 1997). In Illinois grasslands, Northern Harriers prefer unmanaged (by fire, grazing, or mowing) grasslands in which to nest, whereas Short-eared Owls nest only in managed grasslands (Herkert et al. 1999). This is further evidence of the need for a variety of successional stages within the tallgrass prairie if it is to support the full complement of grassland bird species.

Bird abundance within differing habitats is relatively easy to measure, although it alone is not the best measure of a habitat's value (Van Horne 1983, Vickery et al. 1992). Reproductive success can also be affected in various ways by habitat management. While birds are highly mobile and suffer little direct mortality from fires, early nesting species such as Greater Prairie-Chickens may lose nests to spring fires (Zimmerman 1997, Robbins and Ortega-Huerta 2002). Fires affect insect abundance (Swengel 2001), with both grasshoppers and beetles becoming more abundant after a fire, although Zimmerman (1997) noted no increase in reproductive success for Dickcissels, Eastern Meadowlarks, Red-winged Blackbirds, or Mourning Doves in burned Kansas tallgrass prairie. He concluded that food was not a limiting

resource for birds nesting in tallgrass prairie.

Studies in Kansas (Zimmerman 1997) and Oklahoma (Rohrbaugh et al. 1999) noted reduced nest success for Dickcissels in burned and grazed tallgrass prairie. A related Oklahoma study examined 2,603 nests of 26 species, and again noted reduced nest success in burned and grazed areas (Shochat et al. 2005). Interestingly, both the Kansas and Oklahoma studies indicated that grazing alone, in the absence of fire, did not reduce nest success. Therefore, the major effect seems to be from burning, even though grazing nearly always follows after a fire takes place, except on preserves which exclude grazers in selected years or areas.

Shochat et al.'s study provides evidence of an ecological trap in burned and grazed tallgrass prairie. Such a trap occurs when the cues birds use for selecting a habitat are decoupled from the reproductive success they actually achieve in that habitat. For example, if Dickcissels preferentially select burned prairie for nesting (and this study shows that they do), perhaps due to the

increased insect abundance providing a cue suggesting high-quality nesting habitat, but they subsequently suffer high nest failure rates because nest predators are also more common there, then burned prairie ultimately acts as an ecological trap for Dickcissels. Stated simply, burned prairie is perceived by Dickcissels as higher quality habitat than it really is, and as a result has a high density of breeding individuals that ultimately have low nest-success rates, while adjacent areas of unburned prairie have lower densities of breeding Dickcissels even though the birds there actually experience higher reproductive success. This imbalance means that the Dickcissel population is not reproducing at its full potential in areas where a disproportionate amount of habitat is burned in a given year. Evidence of this type of trap also exists for Eastern



Natural tallgrass prairie fire regimes are variable in time and space, creating a mosaic of habitats, although current management practices frequently overemphasize or de-emphasize fire. *Konza Prairie; April 1994.* © Bob Gress.

Kingbirds, Scissor-tailed Flycatchers, Grasshopper Sparrows, and Eastern Meadowlarks. Given the widespread use of annual fire in the Flint Hills, and the resulting unnaturally large percentage (in a historical context) of burned prairie available to birds each year, there are clearly implications for the long-term viability of grassland bird populations.

Overuse of fire is not the only management issue of importance to tallgrass prairie birds. Paradoxically, the suppression of fire is also a serious problem. Particularly in tallgrass prairie areas outside of the Flint Hills, not all landowners are active managers, or are informed or convinced of the important role fire plays in maintaining grasslands. The gradual shift toward dominance of woody vegetation in unburned tallgrass prairie can be seen in many places. Eastern redcedar and ashe juniper are invasive woody species that have greatly increased in abundance in recent decades. A Kansas study indicated that tallgrass prairie can be converted to closed-canopy, redcedar forest in as little as 40 years (Briggs et al. 2002). One report regarding Oklahoma, which also included areas of grasslands west of the tallgrass prairie, showed that cedars and junipers had invaded 607,000 hectares by 1950, 1,500,000 hectares by 1985, and 2,500,000 hectares by 1994 (Engle et al. 1996). These cedar forests are of little use to most grassland birds, and as cedars become taller, fire becomes less effective at killing them. Grazing can further complicate matters by removing fuel and diminishing the effectiveness of fire on tree mortality. Regular application of fire, on something approaching a 3–7-year interval, probably best mimics the historically occurring pattern of fire, and would maintain grasslands by providing sufficient fuel loads to periodically knock back invasive woody plants.



*There are two ways to apply conservation to land. One is to superimpose some particular practice upon the pre-existing system of land-use, without regard to how it fits or what it does to or for other interests involved. The other is to reorganize and gear up the farming, forestry, game cropping, erosion control, scenery, or whatever values may be involved so that they collectively comprise a harmonious balanced system of land use.*

— Aldo Leopold

Tallgrass prairie habitat continues to be lost to the plow in some parts of the country, while expanding cities and suburbs claim additional acres each year. In-

**Table. Estimated original and current area and percent of original area of tallgrass prairie. Adapted from Samson and Knopf (1994) and Steinauer and Collins (1996).**

State or Province	Historic area (hectares)	Current area (hectares)	Decline (percent)
Illinois	8,900,000	930	99.9
Indiana	2,800,000	404	99.9
Iowa	12,500,000	12,140	99.9
Kansas	6,900,000	1,200,000	82.6
Manitoba	600,000	300	99.9
Minnesota	7,300,000	30,350	99.6
Missouri	5,700,000	30,350	99.5
Nebraska	6,100,000	123,000	98.0
North Dakota	1,200,000	1,200	99.9
Oklahoma	5,200,000	unknown	unknown
South Dakota	3,000,000	449,000	85.0
Texas	7,200,000	720,000	90.0
Wisconsin	971,000	4,000	99.6

deed, land development in the U. S. is outpacing population growth, and exurban development (that which takes place beyond the suburban fringe) is projected to grow 14% by 2020 (Theobald 2005). Not only is habitat still being lost, but in those remnants of what was once a vast ecosystem, grassland birds are frequently faced with habitat that is less than ideal. The habitat may be too homogenous due to widespread, annual fire, and therefore excludes some species and decreases the nest success of others, or it may be changing from

grassland to forest in the absence of fire, and no longer meets the requirements of most grassland birds. Effective management of the remaining grasslands will be vital if we are to sustain bird populations. What, then, can be done to manage for grassland birds, considering that most of the remaining tracts of native tallgrass prairie are privately owned? Outreach efforts by extension agents and neighboring landowners promoting the use of regular fire for restraining woody invasives are needed in some areas where fire is underutilized. At the other management extreme, recent research suggests a potential replacement for IES as a way to profitably manage tallgrass prairie for cattle production, while providing needed habitat diversity for birds. Called patch burning, this technique involves burning roughly one-third of a given area each year, rather than an entire pasture (Fuhlendorf and Engle 2001). The burned areas serve as intense focal points for grazing, and early indications are that herbivores may show weight gains



Although significant political and logistical hurdles lie ahead, there is reason to be hopeful about the future of the tallgrass prairie and its avian inhabitants. The **Upland Sandpiper** is an example of a species that has persisted in the agricultural landscape and whose population in the tallgrass prairie is not in decline. North Dakota; July 2003. © Maslowski Photo.

similar to those achieved under IES management. The three-year fire rotation within a given ranch or pasture means that woody vegetation is kept in check, but also that older, structurally and vegetatively richer grasslands exist for Henslow's Sparrows and other species that require them. A mosaic of burned and unburned grasslands across the landscape is needed if the diversity of tallgrass prairie birds is to be maintained. Fortunately, grazing is one of the most potentially compatible of economic land uses for sustaining grassland birds, and most landowners do have an interest in wildlife. If further study bears out the promise of patch burning, the long process of educating landowners and attempting to change ingrained management practices can begin. The dawn chorus of Dickcissels and Northern Bobwhites, the staccato chattering of kingbirds, the overhead buzz of a Common Nighthawk's courtship dive, and the distant reverberations of prairie-chickens booming over the next rise may depend on it.

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