It's Not Easy Being Green: Wind Energy and a Declining Grassland Bird

CHRISTIN L. PRUETT, MICHAEL A. PATTEN, AND DONALD H. WOLFE

*The lesser prairie-chicken (*Tympanuchus pallidicinctus*) is an umbrella species for the short- and mixed-grass prairie ecosystem of the south-central United States. This species has suffered large population declines over the last century that mirror the loss of prairie. Populations have become increasingly fragmented, and habitat connections between populations are being severed. A possible new threat to lesser prairie-chickens is the rapid development of wind-energy facilities throughout their habitat. In addition to contributing to the loss of prairie, these facilities could serve as barriers to movement if birds avoid wind turbines and their associated power transmission lines. We summarize evidence for avoidance behavior in birds, propose connectivity areas between distributional cores, propose strategies for conservation of lesser prairie-chickens, and encourage lawmakers to adopt state and federal regulations on wind-farm placement. Without a concerted effort, lesser prairie-chickens and similar species are likely to disappear, as will the southern prairie on which they depend.*

Keywords: lesser prairie-chicken, wind farm, habitat loss, connectivity, conservation

Grassland birds are among the most threatened in North America, primarily as a result of changes in land practices (grazing regimes and fire cycles) and the loss and fragmentation of native prairies (Knopf and Samson 1997, Rich et al. 2004). To preserve the remaining habitat, regional models for conservation planning based on umbrella species have been proposed to benefit nontarget taxa that spend at least a portion of their life cycle where umbrella species are found year-round. One such species, the lesser prairie-chicken (*Tympanuchus pallidicinctus*), is restricted to short- and mixed-grass, sand-sagebrush, and shinnery-oak prairies of the southern Great Plains of the United States (Rich et al. 2004, Hagen and Giesen 2005). These habitats were far more widespread a century ago. This species has since suffered large population declines throughout its range, which has contracted by at least 78 percent since the 1960s (Taylor and Guthery 1980, Hagen and Giesen 2005). The world population is unknown, but estimates range from 10,000 to 30,000 individuals (Johnsgard 2002); the number is most likely closer to, and may even be below, the low figure. Currently, the lesser prairie-chicken is listed as vulnerable on the IUCN Red List of Threatened Species and is a candidate for listing under the Federal Endangered Species Act (BirdLife International 2004, Hagen and Giesen 2005). Because of its imperiled status and habitat requirement of large tracts of unfragmented prairie, the lesser prairie-chicken is an ideal umbrella taxon for other prairie-dependent species (Hagen and Giesen 2005). Like most species, however, the major threat to its conservation continues to be the loss and fragmentation of the prairie ecosystem on which it depends, with concurrent loss of connectivity among populations.

With the advent of federal tax credits for wind energy facilities, wind farm development has more than doubled over the past five years (*www.awea.org/legislative/#PTC*), leading to a wind energy boom in the Great Plains that has been likened to the oil boom of the 1920s, complete with speculators and little or no regulation on development (Krauss 2008). Studies of the possible environmental impacts of wind farms on grassland species cannot keep pace with development: wind turbines are often erected in less than six months (personal observations) and without formal environmental impact assessment. We thus feel that a review of the potential negative effects of wind facilities on the lesser prairie-chicken is both timely and important, lest we exacerbate

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an already dire situation for this rare and declining prairie endemic.

We discuss the need for conservation of remaining short- and mixed-grass prairie and restoration of habitat between extant populations of lesser prairie-chickens in relation to unregulated wind energy development in historically and currently occupied areas. We offer suggestions on stemming the decline of lesser prairie-chickens and a plea to state and federal wildlife agencies to recognize the growing threat of extinction to this umbrella species. It would be ironic if development of green energy proved to be the final nail in this species' coffin.

Population connectivity and the lesser prairie-chicken

As recently as a century ago, lesser prairie-chickens occupied a large expanse of shortgrass-shrub prairie that encompassed much of western Texas, eastern New Mexico, western Oklahoma, southwestern Kansas, and southeastern Colorado (figure 1), an area approximately the size of California (Peterson and Boyd 1998, Hagen and Giesen 2005). It is likely that there was connectivity among populations: there is no known geographic variation in morphology (Hagen and Giesen 2005), and mitochondrial sequence data suggest historic gene flow among extant populations with isolation by distance (Van Den Bussche et al. 2003, Johnson 2008). Since 1900, populations have become increasingly disconnected because of habitat fragmentation, and it is highly unlikely that there is individual movement among regionally isolated locations. For example, the longest movements detected for lesser prairie-chickens in Oklahoma are 20 to 30 kilometers (km) (Wolfe et al. 2003, Hagen and Giesen 2005), but populations in New Mexico are more than 200 km distant (figure 2).

Movement corridors among populations are important for a variety of reasons: to maintain genetic diversity, retain ecological processes, save populations from extirpation, and possibly provide habitat for the movement of organisms affected by climate change (Chetkiewicz et al. 2006). The restoration of connections among populations will most

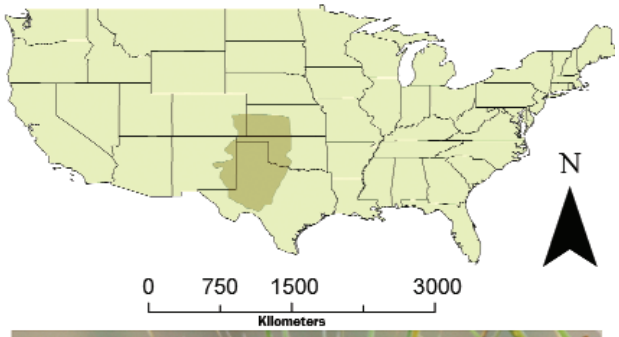

Figure 1. Upper panel: historical distribution of lesser prairie-chickens, shaded brown. Photograph, courtesy of Nappadol Paothong, of a male lesser prairie-chicken displaying on lek in New Mexico.

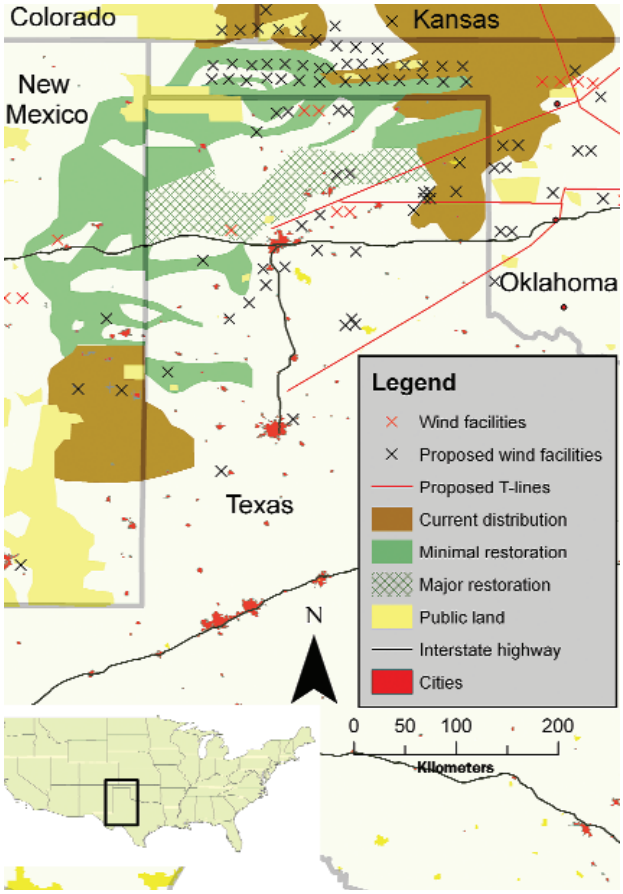

Figure 2. Potential connectivity areas between northern and southern distributions of lesser prairie-chickens at a regional scale based on habitat availability and suitability. Connectivity areas were determined by visual observations; areas south of connectivity areas are irrigated cropland and would require more intensive restoration efforts. Minimal restoration areas would require less habitat manipulation than major restoration areas. Major restoration areas have thick mesquite or red cedar forests. The proposed power transmission line (T-line) will facilitate expansion of wind development in lesser prairie-chicken habitat. Location of current distribution is on the basis of maps generated by the Lesser Prairie-Chicken Interstate Working Group. Proposed wind-energy facility locations are based on data from the Southwest Power Pool (www.spp.org). Wind facility size is variable, and we represent only a rough estimate of the area affected by these structures.

likely reduce the chances of extinction due to small population size (Saccheri et al. 1998), a very real threat to lesser prairie-chicken populations, given that inbreeding depression and local extinction have been reported in other prairie grouse (Westemeier et al. 1998, Johnson and Dunn 2006). Even so, providing only a narrow strip of habitat for dispersal may fail to rescue lesser prairie-chicken populations from extinction because this species' movement behavior is limited. Strips of habitat large enough to support the nesting and foraging of at least a small population are needed, so that a matrix of suitable areas could provide stepping-stones between distant populations. Ideally, connectivity areas would be large enough to provide suitable habitat for several display sites (leks). Research shows that at least 25 to 60 square km are needed to support a single lek (Hagen and Giesen 2005) and that habitat continuity is important for the maintenance of populations (Woodward et al. 2001). However, if movement into restored areas does not occur naturally, translocations may be necessary to facilitate connectivity (Bouzat et al. 2009).

Potential habitat connections do exist between even the most isolated locations. For illustrative purposes, we assume that there are two disconnected lesser prairie-chicken areas, one that includes populations in Oklahoma, the northeastern Texas panhandle, Kansas, and Colorado, and another that includes birds found in New Mexico and adjoining Texas locations. Several areas that probably could support populations of lesser prairie-chickens are found between these locations (figure 2), but almost all of this area is privately owned and would require habitat restoration. These restorative actions include the removal of honey mesquite (*Prosopis glandulosa*) and eastern red cedar (*Juniperus virginiana*), which have encroached into native prairie because of land practices such as overgrazing, planting of wind breaks, and fire suppression (Brennan and Kuvlesky 2005). In addition, the removal of unnecessary fences—for example, those in disrepair or not in use—or the marking of standing fences would be necessary to reduce collision risks, which now take a large (and probably additive) toll on the species (Patten et al. 2005, Wolfe et al. 2007).

Avoidance behavior and wind development

Habitat restoration in areas where lesser prairie-chickens previously lived is feasible, but the effects on lesser prairie-chickens of permanent structures such as buildings, oil and gas wells, electrical transmission lines, and, more recently, wind turbines cannot be addressed easily. Once the structures are in place, little can be done to mitigate their presence, except for the possibility of mitigation through conservation easements or mitigation banks.

Prairie-chickens will readily move across flat land with minor habitat alterations such as roads and barbed-wire fences; however, they nest farther away from, and seldom approach, large structures (e.g., buildings, natural gas compressor stations, transmission lines) even when suitable habitat appears to exist near structures (Robel et al. 2004, Pitman et al. 2005). Preliminary data on greater prairie-chickens (*Tympanuchus cupido*) in eastern Oklahoma show that individuals appear to stay at least 0.5 km away from power transmission lines (figure 3), and there is evidence that greater sage-grouse (*Centrocercus urophasianus*) also avoid power lines, perhaps because of predation pressure from perching raptors (Graul 1980, Lammers and Collopy 2007). These avoidance buffers greatly decrease the amount of usable habitat for prairie grouse (Robel et al. 2004).

Unfortunately, there is little research on the effects of wind energy development on lesser prairie-chickens, which the wind industry and oversight agencies could interpret as a lack of adverse effects on the species. The collision risk to migratory birds and bats caused by wind turbines (Drewitt and Langston 2006, Kunz et al. 2007, Cohn 2008, *cf.* Stewart et al. 2007) is well documented, but there is probably little risk of collision for lesser prairie-chickens because they rarely, if ever, fly higher than 6 meters (m) and seldom move at night (personal observations). Even so, wind turbines and associated transmission lines are likely to be a barrier to movement because the species avoids tall structures and human activity

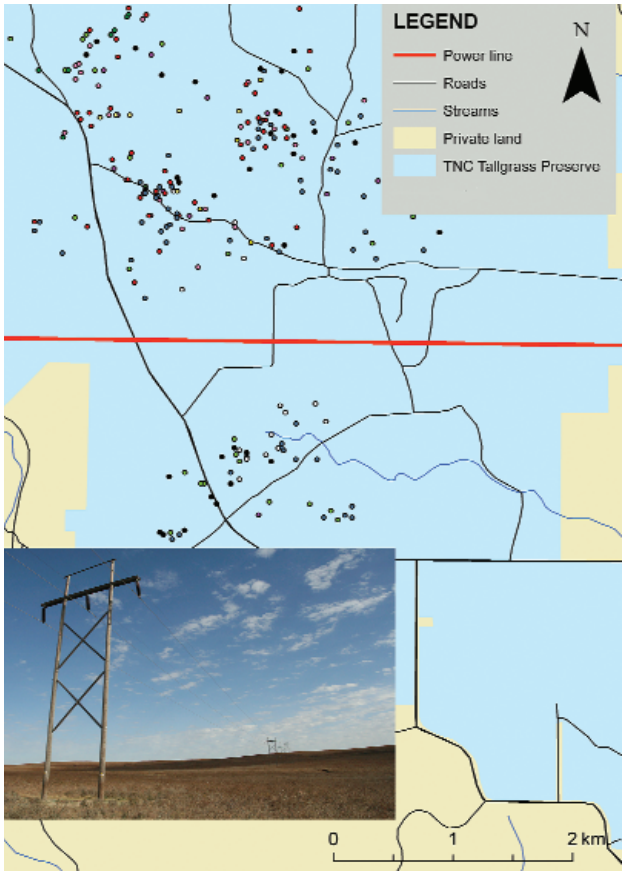

Figure 3. Apparent transmission power line avoidance by greater prairie-chickens on the Nature Conservancy Tallgrass Prairie Preserve, Oklahoma. Colored circles are different individuals (n = 9) that we tracked using radiotelemetry in 1999. Inset photo is of the power line that is being avoided (note suitable habitat beneath and adjacent to the line). Photograph: Courtesy of Daniel Reinking.

(Robel et al. 2004). Avoidance of wind turbines has been documented in other grassland birds (Leddy et al. 1999) and in European migratory birds (Desholm and Kahlert 2005). In Europe, black grouse (*Tetrao tetrix*) numbers declined in areas where wind turbines were located (Zeiler and Berger 2005). However, because of the rapidity of wind farm development and the lack of information provided by developers on wind-farm placement in advance, similar studies have not been conducted in the United States. But judging from studies of other taxa, wind turbines will most likely form a substantial barrier to movement of individual birds and could pose a threat to population connectivity (Risser et al. 2007). The US Fish and Wildlife Service (USFWS) has recommended that wind turbines be erected no closer to prairie grouse leks than 5 miles (8 km) (Manville 2004), but wind developers strongly oppose these guidelines (AWEA 2003).

How real a threat to connectivity is wind energy development? Lesser prairie-chickens are found in states with some of the highest potential for wind energy development: Texas is ranked number 2 among the states for development potential; Kansas is number 3; Oklahoma, 8; Colorado, 11; and New Mexico, 12 (*www.awea.org/projects/index.html*). Much of the new and proposed wind development is within the historic distribution of lesser-prairie-chickens, and often within currently occupied areas (figure 2). In Oklahoma, there are approximately 250 turbines in lesser prairie-chicken range, and at least 1300 more turbines have been proposed (*https://studies.spp.org/SPPGeneration/GI_ActiveRequests.cfm*). Areas considered to have the highest energy potential are ridgelines where the wind is strongest. These areas represent much of the remaining native southern prairie in these states. Thus, wind farms are being placed in locations with a high proportion of the remaining prairie-chicken habitat, including possible connectivity areas (figure 2).

Strategies for conservation of an umbrella species

Although the USFWS has issued recommendations for reducing the ecological impacts of wind energy on birds (Manville 2004), there are few regulations on wind development in the states where lesser prairie-chickens are distributed (Risser et al. 2007). If connectivity is to be achieved among populations, immediate action is needed to preserve remaining movement areas. Our map of possible connections is a start toward identifying the best areas for preservation and for restoration of southern prairies. We hope this map will educate conservationists, biologists, and land managers about the threat that unregulated wind development poses by causing complete isolation and greater fragmentation among populations. We recognize that wind development is a useful step toward limiting greenhouse gas emissions, but this development should be balanced against the potential negative effects on sensitive species of wildlife. Potential impacts on prairie organisms must be evaluated and mitigated, particularly for umbrella species. We recommend taking commonsense steps to avoid conflicts between wind developers and those who wish to conserve lesser prairie-chickens. Examples include placing wind turbines in areas that are already heavily disturbed (e.g., cultivated fields), avoiding undisturbed native prairie where lesser prairie-chickens lek, and placing turbines in configurations (e.g., blocks) that minimize their fencelike effect. At present, a linear configuration is common in the five-state region where remaining short- and mixed-grass prairie ecosystems occur (figure 4).

We propose a three-part strategy to stem the decline of lesser prairie-chickens, to increase connectivity among populations, and thus to preserve and restore the native southern prairie available to grassland obligates such as the dickcissel (*Spiza americana*; Temple 2002), the black-tailed prairie dog (*Cynomys ludovicianus*; USFWS 2000), and the Texas horned lizard (*Phrynosoma cornutum*; Donaldson et al. 1994).

First, we need to protect the remaining prairie where lesser prairie-chickens are currently found, as well as areas of possible connectivity between these prairie remnants. Protection will require a shared commitment between local landowners and state and federal agencies. Some progress toward conserving prairie-chicken areas has been accomplished through conservation agreements between landowners and the USFWS, although these agreements must state explicitly that wind energy development be excluded. In addition, federal fuel-tax credits for wind development must include specific mandates—not just guidelines—on the placement of facilities in relation to prairie-chicken habitat.

Second, habitat restoration in connectivity areas is needed, which will require a greater emphasis on prescribed fire, removal of invasive trees, and removal or marking of fences. This should include linking small subpopulations of prairie-chickens within focal areas (Oklahoma and Kansas, and New Mexico and Texas) and working toward connecting isolated regional populations. Federal and state cost-share programs

Figure 4. Wind farm in Harper County, western Oklahoma, in prairie habitat within the lesser prairie-chicken range.

(e.g., Wildlife Habitat Improvement Programs) have had some success in restoring prairie-chicken habitat in western Oklahoma (Stephanie A. Manes, USFWS, Tulsa, Oklahoma, personal communication, May 2007), and could be successful in establishing connectivity areas. The field of restoration ecology has grown considerably in the past decade. Acquired knowledge in that field should be applied in the southern prairie ecosystem.

Third, a pattern of reintroductions into previously occupied areas (connectivity areas) is needed. A series of stepping-stone translocations between Oklahoma and Kansas locations and New Mexico and Texas locations is possible. Recent reintroductions of the greater prairie-chicken have been successful (Toepfer 2007), and the methodologies used in these efforts could be adapted readily to the lesser prairie-chicken. Translocations are expensive and risky. However, we cannot be afraid to take risks, given the precipitous and unabated decline of lesser prairie-chicken populations.

As an umbrella species, the lesser prairie-chicken's conservation should be given the highest priority. Nontarget plants and animals will also benefit from efforts to preserve and restore the lesser prairie-chicken's habitat. The rush toward green energy development—a rush fueled in part by federal tax credits for wind development—must be slowed to evaluate the risks to prairie species. As the lesser prairie-chicken goes, so goes what little remains of the southern grassland ecosystem in North America.

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Christin L. Pruett (e-mail: cpruett@fit.edu), a postdoctoral research associate interested in avian ecology and genetics, is beginning a faculty position in the Department of Biological Sciences at the Florida Institute of Technology. Michael A. Patten is an assistant professor at the Oklahoma Biological Survey, University of Oklahoma, and director of research at the Sutton Avian Research Center in Bartlesville; he is interested in the evolutionary ecology and biogeography of birds. Donald H. Wolfe is a senior biologist with the Sutton Avian Research Center; his research interest is grouse biology.