National Wind Coordinating Collaborative

Facilitated by: American Wind Wildlife Institute

RESEARCH BRIEF

Effects of Wind Power Development on the Population Biology of Greater Prairie-Chickens in Kansas

May 2013

Greater Prairie-Chicken populations have declined, primarily from loss of their prairie habitat to agriculture and other human development. As wind energy projects are proposed in Kansas and other states where Greater Prairie-Chickens and other grassland birds are now of conservation concern, conservationists, wildlife agencies, and wind energy companies are collaborating to study possible impacts from such development. Results from a comprehensive seven-year research project in Kansas suggest that wind power does not strongly affect Greater Prairie-Chickens. While weak negative effects were observed in male attendance of leks (communal display sites), female survival showed a positive trend. Little to no impacts were observed on most of the demographic parameters studied. The strongest correlates of population performance were the availability of native prairie and vegetative cover at the nest site. Efforts to improve rangeland management and to reduce predation would aid in the recovery of Greater Prairie-Chicken populations.

Background

Are sensitive species of grassland birds negatively affected by wind energy development? A study led by researchers at Kansas State University explores that question by focusing on the Greater Prairie-Chicken in north central Kansas.

Wind energy has expanded rapidly, becoming the top source of new electricity generation in the U.S. in 2012. Along with the development of new wind energy have come commitments to understand the impacts of wind energy on wildlife and promote conservation.

Once abundant across the central plains, the Greater Prairie-Chicken (*Tympanuchus cupido*) is now listed by the International Union for Conservation of Nature (IUCN) as a vulnerable species because its breeding range and populations have been greatly reduced, mainly as a result of widespread loss of its native prairie habitat to agriculture and other human development. The core of the prairie chicken's remaining range is located in Kansas, Nebraska, and South Dakota, states that have considerable potential for wind energy development.

Greater Prairie-Chickens are a type of prairie grouse known for mating ritual displays during which males gather in open communal courtship areas called "leks" and make booming calls that can be heard over a mile away. Females visit the leks to mate and then hide their nests in tall, dense grass. Prairie chickens are thought to be sensitive to anthropogenic disturbance because they have large home ranges, and females may move up to 30 km (20 miles) from lek sites to nest. Previous studies suggest that female prairie chickens may avoid disturbance from oil and gas development and power lines. Declining population numbers and genetic isolation are of particular concern for Greater Prairie-Chickens because they are one of the few wildlife species where inbreeding has been documented in wild populations.

Credit: Dave Menke, USFWS

Study Design

The study objectives were to test for a broad range of potential impacts on population viability, including male attendance of leks, mating behavior, use of breeding habitat and patterns of nest site selection, fecundity rates and nest survival, natal dispersal (a process by which young permanently depart from their natal area in search of new sites) and genetic diversity, survival rates, and population numbers.

The seven-year field project was designed as a replicated experiment with three independent study sites to control for spatial and temporal variations. Investigators collected pre-construction data over three years (2006-2009) at the three sites identified for potential wind power development:

- Smoky Hills in north central Kansas,
- Northern Flint Hills in northeastern Kansas, and
- Southern Flint Hills in southern Kansas.

Post-construction demographic data were gathered over three years (2009-2011) after construction in 2008 of the 201-megawatt (MW) Meridian Way Wind Power Facility at the Smoky Hills site. Data collection included a final year of lek surveys in 2012.

Key Findings

Greater Prairie-Chickens were not strongly affected by wind power development. The study found no impacts on nest site selection, female reproductive effort or nesting success, or population numbers. Negative impacts included a trend for reductions in lek site persistence near turbines. Positive impacts of wind power development included an increase in female survival rates. The strongest correlates of female reproductive success were the availability of native prairie and vegetative cover at the nest site.

***Lek attendance*: Overall, wind power development had a weak effect on lek attendance and the annual probability of lek persistence.**

The annual probability of lek persistence decreased at distances less than three miles from turbines. Independent of turbine proximity, leks had a higher probability of persistence if they supported a large number of males (>10), and if the leks were located in grasslands rather than agricultural fields.

***Mating behavior:* Comparisons of the pre- and post-construction periods showed that wind energy development did not affect the mating behaviors of Greater Prairie-Chickens.**

In fact, the study shed new light on a little-known aspect of these birds' behavior. The prevailing view for lek-mating grouse such as Greater Prairie-Chickens is that females mate once and that nest parasitism is rare. The study found evidence that females mate multiple times to fertilize their eggs and some females lay eggs in the nests of other females (about 17% of nests).

***Breeding habitats*: Wind power development appeared to affect movements of breeding females but not nest site selection by females during the breeding season.**

In a mix of native prairie and agricultural habitats, females preferred to nest in prairie grasslands. Nests tended to be closer to turbines during the post-construction period and there was no evidence of avoidance of turbines by females during nest site selection. Females not attending nests or broods crossed the wind project site at higher rates during the pre-construction period (20%) than the post-construction period (11%).

***Female fecundity*: Wind power development had no impact on reproductive effort or nesting success, and fecundity was not affected by project development or distance to turbine.**

Nest survival was the main factor limiting female reproductive output and most losses were due to predation by coyotes, badgers, skunks, and gopher snakes. Daily nest survival was strongly related to height of vegetative cover at the nest.

***Natal dispersal*: Wind energy development had a weak effect on spatial genetic structure.**

High rates of nest failure limited the number of young that could be sampled and survival of newly hatched chicks was low. Direct observations of natal movements were limited and were inadequate to make conclusions. Measures of genetic distance among males at leks were a more sensitive measure of population structure and indicated a weak effect of wind energy development.

***Survival rates:* Unexpectedly, female survival rates increased after the wind turbines were installed.**

Contrary to predictions of negative impacts of wind power development, the annual probability of female survival increased significantly (from 0.274 during pre-construction period to 0.543 during the post-construction period). Distance to turbine and the interaction of distance and project development treatment period had no effect on female survival.

***Population numbers*: The study found no impact of wind power development on population numbers.**

Lek counts indicated that wind power development did not affect population size. Peak counts of males at leks were recorded the first year after construction was completed and the highest rates of population change were observed during the interval when the wind power facility was constructed. Estimates of relatedness among males at the same and different leks suggested that wind power development either reduced dispersal rates or changed settlement patterns, leading to higher rates of relatedness among males displaying at the same lek site. Estimates of population viability based on genetic diversity, effective population size, and rates of population exchange did not show annual changes and were unaffected by wind development during the study.

Recommendations

Based on the results of this study, the recovery of the Greater-Prairie Chicken could be aided by improvements in agricultural and conservation management practices. Reproductive performance of prairie chickens is low in managed rangelands in northcentral Kansas and efforts to improve range conditions and reduce predator activity would help increase prairie chicken populations. To encourage lek attendance, large leks in native grasslands should be a higher priority for conservation.

Assessing pasture conditions with Robel pole and sampling quadrats.

Capturing broods at night with spotlights.

Measuring body mass for a bird trapped at a lek site.

Acknowledgments

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Oversight Committee

The Grassland Community Collaborative (GCC) Oversight Committee (formerly the Grassland/Shrub Steppe Species Subgroup) of the National Wind Coordinating Collaborative (NWCC) oversaw the research from the inception of the project. The Oversight Committee included representatives from EDP Renewables; Grouse Inc.; Idaho Department of Fish and Game; Kansas Department of Wildlife, Parks and Tourism; Kansas State University; National Renewable Energy Laboratory; The Nature Conservancy; Next Era Energy; U.S. Department of Energy; U.S. Fish and Wildlife Service; and U.S. Geological Survey.

In Memoriam

Dr. Robert Robel (1933 – 2013) was a key founding member of the GCC and his expertise was instrumental in developing and overseeing this research project.

Special Thank You

The NWCC gives special thanks to Prof. Brett Sandercock for his exceptional leadership of this project and to EDP Renewables for granting the researchers access to the wind site.

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Publications

Publications available at http://www.k-state.edu/bsanderc/.

Peer-reviewed Publications

McNew, L.B., A.J. Gregory, and B.K. Sandercock. 2013. Spatial heterogeneity in habitat selection: nest site selection by Greater Prairie-Chickens. *Journal of Wildlife Management*, 77:791-801. DOI: 10.1002/jwmg.493

McNew, L.B., A.J. Gregory, S.M. Wisely, and B.K. Sandercock. 2012. Demography of Greater Prairie-Chickens: regional variation in vital rates, sensitivity values, and population dynamics. *Journal of Wildlife Management,* 76:987-1000. DOI: 10.1002/jwmg.369

Gregory, A.J., L.B. McNew, T.J. Prebyl, B.K. Sandercock, and S.M. Wisely. 2011. Hierarchical modeling of lek habitats of Greater Prairie-Chickens. *Studies in Avian Biology,* 39:21-32.

McNew, L.B., A.J. Gregory, S.M. Wisely, and B.K. Sandercock. 2011*a*. Reproductive biology of a southern population of Greater Prairie-Chickens. *Studies in Avian Biology,* 39:209-221.

McNew, L.B., A.J. Gregory, S.M. Wisely, and B.K. Sandercock. 2011*b*. Human-mediated selection on life-history traits of Greater Prairie-Chickens. *Studies in Avian Biology,* 39:255-266.

Completed Dissertations

Gregory, A.J. 2011. Landscape genetics and behavioral ecology of Greater Prairie-Chickens (*Tympanuchus cupido*). Ph.D. dissertation, Kansas State University, 159 pages.

McNew, L.B. 2010. An analysis of Greater Prairie-Chicken demography in Kansas: the effects of human land use on the population ecology of an obligate grassland species. Ph.D. dissertation, Kansas State University, 149 pages.

Manuscripts in Progress

Blanco-Fontao, B., J.R. Obeso, M. Quevedo, L.B. McNew, and B.K. Sandercock. Effects of sexual dimorphism and habitat composition on the trophic behavior of Greater Prairie-Chickens revealed through analysis of stable isotopes. *PLoS One*, submitted December 2012.

Gregory, A.J., L.B. McNew, B.K. Sandercock and S.M. Wisely. Genetic prospecting and bet-hedging: breeding behavior of female Greater Prairie-Chickens (*Tympanuchus cupido*) across a gradient of anthropogenic landscape disturbance. *Evolutionary Ecology*, submitted February 2012.

Gregory, A.J., L.B. McNew, B.K. Sandercock and S.M. Wisely. Optimizing landscape resistance surfaces to understand gene flow: a case study of Greater Prairie-Chickens. *Molecular Ecology*, submitted March 2012.

McNew, L.B., L.M. Hunt, A.J. Gregory, S.M. Wisely, and B.K. Sandercock. Wind energy development does not impact the nesting ecology of an obligate grassland bird in a fragmented landscape. *Conservation Biology*, submitted April 2013.

Winder, V.L., L.B. McNew, A.J. Gregory, L.M. Hunt, S.M. Wisely, and B.K. Sandercock. Effects of wind energy development on the survival of Greater Prairie-Chickens. *Journal of Applied Ecology*, submitted January 2013.

About the American Wind Wildlife Institute:

The American Wind Wildlife Institute combines the power of science with the voice of collaboration to facilitate development of wind energy while protecting wildlife and reducing environmental impacts. AWWI was founded in 2008 by the wind industry, conservation agencies, and science/environmental organizations as a forum to solve the most challenging wind wildlife issues. For more information visit www.awwi.org

About the National Wind Coordinating Collaborative:

The mission of the National Wind Coordinating Collaborative Wildlife Workgroup is to identify, define, discuss, and through broad stakeholder involvement and collaboration address wind-wildlife and wind-habitat interaction issues to promote the shared objective of developing commercial markets for wind power in the United States. The NWCC is co-funded by the U.S. Department of Energy's Wind and Water Technologies Program through the National Renewable Energy Laboratory and the American Wind Wildlife Institute, which facilitates the NWCC. For more information on the NWCC, visit www.nationalwind.org.