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Laura Navarrete
Texas Tech University, lmnavarrete@fs.fed.us

Kerry L. Griffis-Kyle
Texas Tech University

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LAURA NAVARRETE,[1,2] Department of Natural Resource Management, Texas Tech, University, Lubbock, TX 79407, USA; and USDA Forest Service, La Grande, OR 97824, USA

KERRY L. GRIFFIS-KYLE, Department of Natural Resource Management, Texas Tech University, Lubbock, TX 79407, USA

The High Plains of the United States have been experiencing a large increase in wind energy generation sites with the American Wind Energy Association reporting an increase across America from 10 total installed gigawatts in 2006 to 60 total installed gigawatts in 2012. (American Wind Energy Association 2012). The High Plains also coincides with the Central Flyway in North America which is used by numerous bird species during migration, some with large bodies and high wing loading including the sandhill cranes (*Grus canandensis*), whooping cranes (*G. americana*), and waterfowl. Species such as these tend to be more vulnerable to mortality from strikes with structures due to reduced maneuverability (Bevenger 1998). Texas is currently 1 of the top 5 producers of wind power generation, and installation of wind power is expected to increase due to its high wind capabilities (American Wind Energy Association 2012).

Eighty percent of the midcontinent sandhill crane population migrates to northwestern Texas every winter (Iverson et al. 1985), and the entire wild North American whooping crane population migrates through northern Texas to winter along the coast of the Gulf of Mexico (Stehn 2010). More wind turbines on the landscape may put these populations of cranes at risk for increased turbine collisions.

Previous research shows that sandhill cranes and whooping cranes use their migratory staging habitat in a similar manner (Kauffeld 1981, Armbruster 1990). Sandhill cranes may be an appropriate surrogate to study for the potential impacts of wind energy on whooping cranes during migration, and possibly during the winter. Cranes will increasingly come into contact with this infrastructure as the number of wind turbines and associated structures expands across the landscape. Cranes are susceptible to mortality from colliding with power lines and other large obstacles (Windingstad 1988, Brown and Drewien 1995, Bevanger 1998). As part of a larger study evaluating crane behavior in response to wind turbines, we documented sandhill crane mortality from contact with wind turbines in the southern High Plains of Texas. We recorded weather conditions and time of day. This information can be used as a basis for further study of crane mortality risk around wind energy infrastructure.

We recorded sandhill crane presence and behavior in Carson, Floyd, Crosby, and Dickens counties during winters (Oct-Feb) 2009-10 and 2010-11. This area is flat (elevation range 1,000 to 1,500 m) with scattered playa wetlands in a large agricultural region producing corn, milo (sorghum), cotton, and winter wheat. Cranes use this area during migration and part of winter, foraging in agricultural areas and roosting at night in playas.

We surveyed the area using 174 km of road transects. The Texas panhandle is extremely flat with few visual obstructions, and flocks of cranes could often be spotted from more than a kilometer away. Transect surveys were designed for detection of crane flocks and to sample behavior. We recorded time and weather conditions including air temperature, wind speed, relative humidity with a handheld Kestrel 3000 wind and weather meter (Nielson-Kellerman Kestrel Meters, Champlain, NY), cloud cover, and precipitation.

We documented a sandhill crane strike at the Llano Estacado wind farm (UTM zone 14S, 297542E, 3924893N; 35° 26′ 48.9″N, 101° 13′ 50.5″W) on 23 November 2009 at 1000 hours (DST, CTZ). The observer was approximately 350 m away from the impact when it occurred. It was 12.8°C, relative humidity 80%, and foggy with 90% cloud cover. Visibility was limited (<200 m). Winds averaged 13.2 km/hr, gusting to 19.9 km/hr.

The second strike occurred at the Pantex Wind Farm (UTM zone 14S, 268556E, 3919797N; 35° 26′ 40.9″N, 101° 32 ′ 54.1″W) on 24 November 2010 at 0930 hours. The observer was approximately 700 m away from the impact. The impact occurred approximately 800 m from a consistently used roosting playa for cranes and geese (Oct and Nov 2010). It was 9.4°C, relative humidity 64%, with 40% cloud cover. Visibility was limited (<200 m). Winds averaged 10.9 km/hr, gusting to 21.6 km/hr. Both impacts were directly witnessed by the surveyor.

These impacts occurred in foraging and roosting areas of sandhill cranes during their migration and

[1] USDA Forest Service, La Grande, OR 97850, USA
[2] E-mail: lmnavarrete@fs.fed.us

wintering. There are a number of factors besides body mass and wing loading (Bevanger 1998) that may increase crane susceptibility to mortality from wind turbine strike. Good turbine locations and migratory corridors tend to occur in the same areas because of favorable wind conditions (Sugimoto and Matsuda 2011). Wind farms in areas that are used regularly by large numbers of species for feeding and roosting on migratory routes, or local flight routes between foraging and roosting areas, present a greater risk to the species that occupy the area (Drewitt and Langston 2008, Everaert and Stienen 2006). Gregarious species, such as the sandhill crane, seem to be more prone to collisions, due to greater concentrations of birds and lower levels of attention shown when following a lead bird (Pettersson 2005). Birds which make local movements between roosting and foraging sites tend to fly at a lower altitude than migrating birds, which also increases the susceptibility of collisions (Drewitt and Langston 2008).

Visibility likely had a role in the crane strikes we witnessed. Birds which habitually fly at dawn and dusk between foraging and roosting sites, such as the sandhill crane, are less likely to detect the wind turbines (Larsen and Clausen 2002). Some suggest that crane flight speed is so slow that they may be able to detect and avoid turbines (Cooper 2006, McCarthy 2009). Our observations suggest this may not be the case during poor weather conditions. Inclement weather patterns that reduce visibility may increase the frequency of turbine strikes (Drewitt and Langstron 2008, Martin 2011). Furthermore, many birds do not have a high visual acuity directly in front of them (Martin 2011), likely further exacerbating the problem.

Time of year may have been a factor in the mortalities we recorded as well (Bevanger 1998). Others have documented larger numbers of bird strikes during fall migration as compared to other times of the year (Faanes 1987, Crawford and Engstrom 2001). During this time of year, migratory birds may be more unfamiliar with their environment, increasing the risk of mortality from obstacles (Drewitt and Langstron 2008).

These are observations that occurred during sampling for other objectives and therefore underrepresented the potential for cranes striking turbines. Intensive sampling for mortalities was not conducted, so we cannot calculate the mortality on a per-turbine or per-wind farm approach. Consulting documents state that turbines are not a large risk for cranes. Our observations suggest that turbine mortality surveys for cranes in the migratory and wintering habitat should be conducted, and we recommend further research assessing the frequency of collisions for both sandhill cranes and whooping cranes which use habitat during migration in a similar manner (Kauffeld 1981, Armbruster 1990).

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