Briefing Paper

Prairie Grouse Leks and Wind Turbines: U.S. Fish and Wildlife Service Justification for a 5-Mile Buffer from Leks; Additional Grassland Songbird Recommendations

Date: July 30, 2004 [Prairie Grouse Lek 5 Mile Public.doc]

Issue: The U.S. Fish and Wildlife Service (FWS, Service, or we) recommended "... avoiding placing wind turbines within 5 miles [8 km] of known leks (communal pair formation grounds[a]) in known prairie grouse habitat" (see p. 4, item 7, Site Development Recommendations) in our *Interim Guidelines to Avoid and Minimize Wildlife Impacts from Wind Turbines*, a notice of its availability published July 10, 2003 in the *Federal Register*. Some have questioned the validity of this recommendation, specifically the distance metric. While many grouse biologists consider 3 distinct groups of grouse in North America, including forest grouse (*e.g.*, Ruffed, Blue, and Spruce), prairie grouse (*e.g.*, Greater and Lesser Prairie-chickens and Sharp-tailed Grouse), and Sage-grouse (F. Hall 2004 personal communication [hereafter pers. comm.]), the Service's guidance included prairie and sage grouse within the same general "prairie grouse" category. This briefing paper provides justification for the Service's recommendation for a 5-mile buffer from occupied prairie grouse leks.

The Service reiterates that our wind siting guidelines are voluntary; we are not restricting installation of wind turbines or wind facilities within a 5-mile radius of active leks. Prior to any site selection, we recommend that the wind consultant/company/contractor assess the complete habitat requirements and habitat use and needs of whatever species of prairie and sage grouse is involved (*e.g.*, Greater and Lesser Prairie-chickens, and Gunnison and Greater Sage-grouse, and Columbia Sharp-tailed Grouse) at the site. All habitat requirements of prairie grouse should be considered, *i.e.*, habitats for courting and breeding (leks), nesting, brooding, resting, feeding, migrating, and wintering. Given continuing uncertainties about structural impacts on prairie grouse, especially the lack of data regarding impacts from wind facilities, and the clearly declining trends in prairie grouse populations (see below), we urge a precautionary approach by industry and recommend a 5-mile buffer where feasible. The public comment period on our voluntary guidance will continue to be open through July 10, 2005. We strongly encourage all interested parties to provide suggestions and recommendations on our voluntary guidance that will help improve its reliability and update its usability. Comments on the distance metric, especially those derived from ongoing scientific studies, will be important.

It also was recommended that we include a brief discussion on the declining populations of grassland and sage-steppe obligate songbirds and the need to protect their habitats. This briefing statement will review their habitat needs and will briefly discuss disturbance and habitat fragmentation.

[a] Leks are technically not "communal pair formation grounds." Sage-grouse, for example, are not "pair forming" on leks and only a few males complete most of the breeding (F. Hall 2004 pers. comm.). Leks may best be described as traditional display areas normally located on very open sites in or immediately adjacent to breeding (nesting and early brood-rearing) habitats (J. Connelly 2004 pers. comm.).

Prairie Grouse Status:

All species of prairie grouse are declining, some severely. The range and population of the Lesser Prairie-chicken (LPCH) have declined > 90% since European settlement of the great plains 100 years ago (Giesen 1998). The Attwater's Greater Prairie-chicken has been Federally listed as endangered in its entire range -- now Texas -- since 1967. The LPCH is currently listed as a candidate species under ESA in CO, KS, NM, OK, and TX. A "candidate species" is a plant or animal for which FWS has sufficient information on their biological status and threats to propose listing under ESA, but for which development of a listing regulation is precluded by other higher priority listing activities. It is a formal ESA designation, although candidate species do not receive legal protections under the Act.

The Gunnison Sage-grouse, found in the Gunnison Basin (CO and UT) was candidate-designated under ESA in 2000. Their listing priority has recently been elevated. Populations of the Greater Sage-grouse have declined 66-92% during the past 30 years in western Canada where they are listed as endangered (Aldridge and Brigham 2002). Throughout North America, Sage-grouse distribution has been reduced by at least 50% since the early 1900s, with extirpation in 5 of 16 States and 1 of 3 Canadian Provinces. Breeding populations of Sage-grouse have declined 45-80% from numbers estimated in the 1950s (Connelly and Braun 1997, Braun 1998, Connelly *et al.* 2004). The Greater Sage-grouse in the Columbia Basin (WA and OR) was also designated as a candidate species. In April 2004, FWS published a 90-day finding in the *Federal Register* (69 FR 21484) with regard to range-wide listing petitions for the Greater Sage-grouse. The FWS found that the petitions and additional information available in our files present substantial information indicating that listing may be warranted. This positive 90-day finding triggered a FWS status review of the species which will result in a 12-month finding that is to be available in December 2004 (K. Kritz 2004 pers. comm.). In June 2004, the Western Association of Fish and Wildlife Agencies published a comprehensive, science-based assessment of the Greater Sage-grouse and its habitat, reviewing landscape information for the past 100 years, population data for the past 60 years, and the available literature (Connelly *et al.* 2004; see beyond).

While wind turbines and wind facilities are new additions to prairie grouse habitats in the Midwest and West, their impacts to grouse populations could add to the cumulative effects of human development and exploitation from other sources in grouse and songbird habitats. With these continuing uncertainties, we recommend that the industry take a cautious approach. Prairie grouse did not evolve with tall vertical structures present so the addition of wind turbines and their supporting infrastructure represents a significant change in the species' environment (J. Connelly 2004 pers. comm.). Given the declining or precarious status of grouse populations, the impacts of wind development on prairie grouse must be evaluated with great care and considerable detail. Prairie grouse are "indicator organisms," showing us the health of their environments, and sage grouse are "sensitive keystone species," representing critical components of their habitats (Lyon and

Anderson 2003, S. Harmon 2004 pers. comm.). Grassland and sage-steppe-obligate songbirds (*e.g.*, Sage Sparrow, Brewer's Sparrow, Sage Thrasher, and Black-chinned Sparrow) are also showing serious population declines. Grassland songbirds are the fastest declining suite of birds in North America (Johnson *et al.* 2004).

Justification for Our Distance Recommendation:

While we acknowledge that much research continues on prairie grouse and the impacts of tall structures, including wind turbines – and thus much of the data have yet to be peer reviewed and published – several studies and their recommendations have been published and are used as the basis for our 5-mile recommendation. Most compelling was the recommendation by Connelly *et al.* (2000:978) calling for protection of breeding habitats within 11.2 mi (18 km) of the leks of migratory populations of Sage-grouse (see discussion beyond). See also Giesen and Connelly (1993) beyond for a discussion of management guidelines for Columbian Sharp-tailed grouse.

Extensive personal communications with many grouse specialists were also important in helping us make our determination. The published reviews (some of which were in press at the time of our recommendation) are included below.

We believe it is important to clarify that avoidance of vertical structures by grassland and sage-steppe-obligate wildlife is not a new issue, and the Service's recommendations are not merely reactive to current recommendations promoting wind power development nationwide. Concerns were brought to the Division of Migratory Bird Management as early as 2000 regarding the possible impacts of wind turbines on prairie grouse, including noise, habitat disruption, disturbance, fragmentation, and increased predator access (R. Reynolds and N. Niemuth, FWS Habitat and Population Evaluation Team, Bismark, ND 2000 pers. comm.). Much research has also been conducted on the impacts of high tension power transmission and electric distribution lines on prairie grouse, providing a detailed body of literature on a related structural issue (*e.g.*, Connelly *et al.* 2000, Braun *et al.* 2002, Hagen 2003, Wolfe *et al.* 2003a and 2003b, Pitman 2003, Hagen *et al.* 2004, Patten *et al.* 2004, and Connelly *et al.* 2004).

***Lesser Prairie-chicken*s**

Mote *et al.* (1998:18) reported the findings of the Lesser Prairie-Chicken Interstate Working Group (represented by CO Division of Wildlife, KS Department of Wildlife and Parks, NM Department of Game & Fish, OK Department of Wildlife Conservation, and TX Department of Parks & Wildlife). This State-led team of species experts, with input and review by researchers and academics, identified the need for a contiguous block of 20 mi^2 (52 km^2) of high quality rangeland habitat to successfully maintain a local population of LPCH. If this area represented a hypothetical square home range (Figure 1), its boundaries would be approximately 4.5 x 4.5 mi (7.2 km) and a lek located in its center would be 2.25 mi (3.6 km) from the nearest side. If the hypothetical contiguous block were a circle (Figure 2), its radius would be 2.5 mi (4.1 km) in length from a lek

located in its center. In Figure 2, we incorporated an additional 1.25-mi (2 km) minimum protection buffer zone beyond this hypothetical home range as recommended by Hagen *et al.* (2004:79), discussed below. Because range wide, the majority of remaining LPCH populations are fragmented and isolated into "islands" of unfragmented, open prairie, thus we assert that a 5-mile buffer from a lek is recommended to protect the wind power industry from later determinations that construction activities could significantly impact important LPCH populations and habitat corridors needed for future recovery.

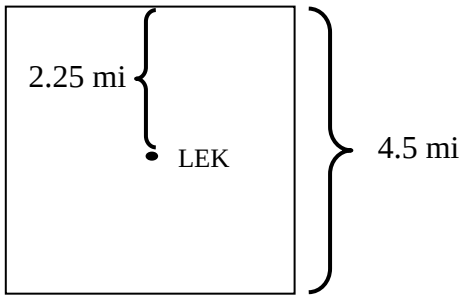

Fig 1. 20 mi^2 protected habitat.

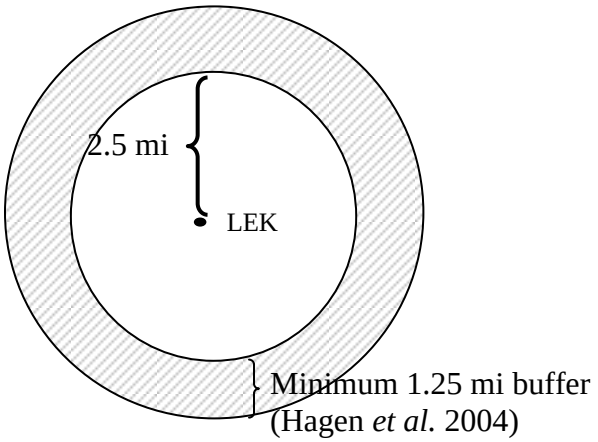

Fig 2. 20 mi^2 protected habitat using 2.5 mi radius from lek; with additional buffer zone recommended by Hagen *et al.* (2004), protected area = 44.2 mi^2.

Figures 1 and 2 illustrate the minimum scale of unfragmented habitat necessary to maintain a LPCH local population (S. Harmon 2004 pers. comm., B. Obermeyer 2004 pers. comm., after Mote *et al.* 1998:18).

Other individual studies however, discussed in the next several paragraphs, have suggested recommendations for protected distances less than those presented by Mote *et al.* (1998). These variations may reflect differences between individual populations, the variability in the complexity of different habitats, habitat fragmentation and disturbance, and other unknowns. For example, Pitman (2003:45, 49) and J. Pitman (2004 pers. comm.) noted that > 80% of LPCH hens nested closer to a lek other than their lek of capture and they moved on average > 1.9 mi (3 km) from their capture location to initiate a nest. He indicated that the presence of buildings, improved roads, power lines, agricultural edge, and oil and gas wellheads all eliminated potential nesting habitat for a radius of up to 0.62 mi (1 km; p. 46). Roads, power lines and sometimes agricultural edge are all anthropogenic features associated with wind energy facilities. He suggested that in order to maintain movement between sub-populations of LPCH, habitat fragments should not be further than 6.2 mi (10 km; p. 142) apart. The recommendation was based on the dispersal distance of juvenile females although the sample size was very small.

As a further example, Hagen (2003:156, 177) and C. Hagen (2004 pers. comm.) studied LPCH in southwestern KS. He concluded that landscape features, the proportion of an area occupied by power lines, and the proximity of human structures clearly reduced

otherwise suitable habitat. The mean distance chickens avoided structures was 0.9 mi (1.4 km; p. 162). However, Hagen (2004 pers. comm.) cautioned that data are presently lacking that indicate what happens to LPCH as habitat patches become smaller or as patch quality becomes less diverse and as anthropogenic features become more abundant. The distances in his study may reflect the "tolerance" level of LPCH to structures in fragments of < 12,350 ac (5,000 ha) in size of moderate quality. He recommended that as patch size becomes smaller and/or of lower quality, the LPCH will be less tolerant to disturbance and fragmentation. Until data can support an alternate hypothesis, Hagen (2003:159) and C. Hagen (2004 pers. comm.) suggested protecting as large a buffer around remaining habitat as possible.

Hagen *et al.* (2004:79), in "guidelines for managing lesser prairie-chicken populations and their habitats," recommended that wind turbines and other tall vertical structures be constructed >1.25 mi (2 km) from known or potentially occupied LPCH habitat, at a minimum. This recommended area represents a buffer beyond already existing LPCH home ranges (Figure 2). If wind facilities must be placed in known LPCH habitats, Hagen *et al.* (2004) suggested they be positioned along prairie edge or clustered in sites with other disturbances.

Wolfe *et al.* (2003a:18) assessed LPCH habitat use and avian impacts in OK and NM. They indicated that while a common suggestion is to manage for nesting habitat within 1 mile (1.6 km) of a gobbling ground (lek), much larger areas are more likely to sustain broods. On average, hens nested 2.3 miles (3.7 km) from the lek on which they were captured (the record distance was 13.7 mi [21.9 km], p. 9), while successful nests averaged 2.6 miles (4.2 km) from the lek upon which the hen was captured. Their research also suggested that fragmentation from roads, fences, and power lines are a greater mortality factor than what had previously been thought. Collisions with human-built structures may be additive to other mortality. Wolfe *et al.* (2003b) reported that fragmentation likely elevated LPCH mortality due to collisions with fences and power lines. Wolfe *et al.* (2003a:16 and 2003b) noted that scavenging, especially by mammals, can occur at > 50% of the carcasses within days, resulting in collision rates that are likely higher than they had reported. Wolfe *et al.* (2003b) and Patten *et al.* (2004a:1) reported that females in both NM and OK suffered greater mortality from collisions with human-built structures than did males. Females were reported less susceptible to predation in both NM and OK, but more susceptible to collisions with fences, power lines, and vehicles (Patten *et al.* 2004a:9; 0.29 for female mortality due to predation vs. 0.48 for female mortality due to collisions, N=79 females, based on the Kendall's τ correlation matrix).

Patten *et al*. (2004a:12-13) noted that female LPCHs tend to breed only during a single year in OK, making the OK population more susceptible to annual environmental stochasticity (randomness) and a higher probability of going extinct within the near future. In NM, breeding was more likely to also occur in the 2nd and 3rd years. Habitat fragmentation, based on evidence from their study, can markedly affect the likelihood of population persistence and survival (p. 14). Patten *et al*. (2004a:28) modeled the

probability of extirpation of LPCH in OK over the next 30 years. A few "bad years," they concluded (*i.e.,* climatic changes resulting in unfavorable weather conditions, low food yields, and heavy predation) could put the species over the brink, giving conservation professionals little time to react. This "too little, too late" scenario occurred with the Attwater's Prairie-chicken, largely due to the unavailability of necessary habitat that prairie grouse require (S. Harmon 2004 pers. comm.).

For LPHCs, increased habitat fragmentation and isolation of existing populations are of major concern. The placement of wind plants in a critical corridor area between 2 or more populations might permanently prevent connectivity. Potential connectivity corridors, however, have not been fully identified (D. Wolfe 2004 pers. comm.).

Greater Prairie-chickens

Although many studies have identified prairie grouse avoidance of vertical structures, to date, the only documented case of interaction specifically between prairie grouse and a commercial wind facility comes from northwestern MN. This information, however, is anecdotal in nature, collected peripheral to other research. As a result, no peer review or statistical testing of the findings are possible at this time. Society and Toepfer (2003:47) reported in their study area, composed of a habitat patch approximately 3 x 4 mi (4.8 x 6.4 km), that some individual Greater Prairie-chickens (GPCH) appeared to tolerate to some degree a small complex of 3 wind turbines. Specifically, researchers documented 6 active leks within 2 mi (3.2 km) of the 3 wind turbines, 1 lek within 0.6 mi (1 km) of the nearest turbine, and 1 hen with a brood immediately adjacent to a turbine. However, Society and Toepfer (2003:47) cautioned that further development and expansion of wind power on this site could negatively impact the use of the grassland by Chickens.

When considering this case, the Service contacted the primary investigator and discussed the observations at length. For the following 3 reasons, we find that Society and Toepfer's (2003) observations may not necessarily be in conflict with other researchers' findings and our voluntary siting guidelines. First, it is important to emphasize that this study site is relatively small and isolated within a landscape of primarily cultivated fields. As a result, individual GPCHs in the local population have little alternative than to continue using the habitat, regardless of its level of fragmentation.

Second, the documentation of active leks within 5 miles of the turbines may reinforce what is widely known about the behavior and life history of male Prairie Grouse. Within these species, females are the primary dispersers, whereas males "imprint" on a particular lek and nearby leks, and remain in the vicinity until their death. For this reason, males are very unlikely to leave historic leks, regardless of habitat quality or disturbance. Unless a particular human activity results in direct adult mortality, local lek counts may not decline for many years following a particular fragmentation event. An often-cited example of this behavior involves Greater Sage-grouse cocks observed strutting on the busy airport runway in Jackson Hole, WY. The runway was constructed over an historic

lek, yet cocks continued to display on the site for many years because there is little alternative habitat in the small, isolated valley (P. Deibert 2004, pers. comm.).

Third, the population of GPCHs inhabiting this particular study site is considered very robust compared to other studies of Prairie Grouse. Lek counts in the small study area are known to be as high as 40 birds/lek. Given the small habitat scale and high density of both leks and birds per unit area, it is clear that amount of habitat, and not necessarily survivability, is a primary limiting factor constraining this population. Consequently, birds within this population are likely to be observed in all portions of useable space, and anecdotal sitings near the wind turbines neither confirm nor deny prairie grouse tolerance of commercial wind facilities in more typical habitats. However, these sitings offer the possibility that prairie grouse may be more tolerant of wind turbines than current research data suggest (S. Harmon 2004 pers. comm., B. Obermeyer 2004 pers. comm.). The preliminary findings also imply that, if other factors are not limiting to GPCHs, turbines might not be avoided elsewhere. However, while birds may persist near turbines, survival of those individuals may be compromised, resulting in a population decline. Until more studies are conducted, we can only speculate about cause-and-effect and survivorship (B. Millsap 2004 pers. comm.).

Because Prairie Grouse are relatively long-lived birds (often 3-6 years), and because they exhibit high site fidelity and clumped distribution on the landscape, the Service cautions that anecdotal sitings of individuals near wind turbines are neither unexpected nor informative about the cumulative effects of structural avoidance and habitat fragmentation on populations as a whole. Comprehensive, long-term studies in unconstrained habitats are essential to determining what level of habitat avoidance can be expected in response to wind turbine construction in occupied Prairie Grouse range (S. Harmon 2004 pers. comm.).

Patten *et al.* (2004b:1-2, 32) examined habitat fragmentation and its impacts on GPCH. Because of virtually no habitat fragmentation and a high continuity of tallgrass prairie in their study area, their estimate of home range size was determined to be the smallest of any study for this species. The minimum habitat size needed to avoid impacts to GPCHs in their study area was estimated at about 38.5 mi^2 (99.7 km^2). If the hypothetical contiguous block were a circle (Figure 4), its radius would be 3.5 mi (5.6 km) in length from a lek located in its center. When we incorporated an additional minimum 1.25-mi (2 km) protection zone recommended by Hagen *et al* (2004:79), the area of the larger circular home range is 70.9 mi^2 (184.3 km^2). If this area represented a hypothetical square home range (Figure 3), its boundaries would be approximately 6.2 x 6.2 mi (10 km) and a lek located in its center would be 3.1 mi (5 km) from the nearest side.

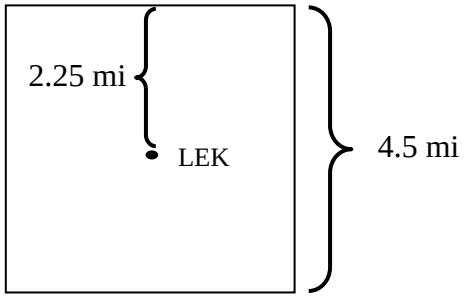

Fig 3. 20 mi^2 home range.

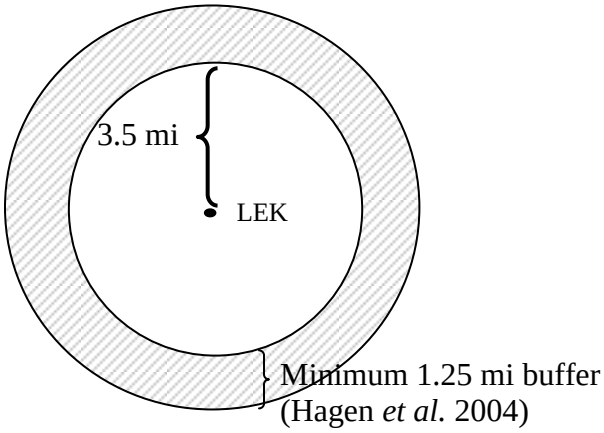

Fig 4. 38.5 mi^2 protected habitat using 3.5 mi radius from lek; with additional buffer zone recommended by Hagen *et al.* (2004), protected area = 70.9 mi^2.

Figures 3 and 4 show the minimum area of un-fragmented habitat necessary to maintain a local population of GPCH (S. Harmon 2004 pers. comm., B. Obermeyer 2004 pers. comm., after Patten *et al.* 2004b:1-2,32).

Results of the Patten *et al.* (2004b:2, 32) study predict that increased habitat fragmentation will force individual GPCHs to expand their home range, resulting in a decrease in survivorship from more predation, collisions, and energy expenditures.

Sage-grouse

Connelly *et al.* (2000) recently revised and expanded the guidelines for the management of Sage-grouse, originally published by Braun *et al.* (1977). Based on seasonal movements among populations, Connelly *et al.* (2000:969) summarized the 3 types of Sage-grouse populations: 1) those which are non-migratory and do not make long-distance movements (*i.e.* > 6 mi [10 km] one-way), 2) those which exhibit one-stage migration between 2 distinct seasonal ranges, and 3) those which exhibit 2-stage migration among 3 distinct seasonal ranges. Connelly *et al.* (2000:969) further reported that migratory Sage-grouse can occupy areas in excess of 1,042 mi^2 (2,700 km^2). Connelly *et al.* (2000:977-978) developed recommendations for habitat protection upon which, in part, the Service's guidance is based. Specifically, for non-migratory populations occupying habitats that are uniformly distributed, they recommended protecting sagebrush and herbaceous understory within 2 mi (3.2 km) of all occupied leks. For non-migratory populations, leks should be considered the center of year-round activity and treated as the focal points for management activities. For non-migratory populations where sagebrush is not uniformly distributed, suitable habitats should all be protected out to 3.1 mi (5 km) from all occupied leks. For migratory populations of Sage Grouse, breeding habitats within 11.2 mi (18 km) of active leks should be protected, recognizing that nesting birds may move > 11.2 mi (18 km) from leks to nest sites. This recommendation (Figures 5 and 6) obviously represents a protected area much larger than the 5-mile suggestion by the Service. While Connelly *et al.* (2000) made a distinction between resident and migratory (2 types) populations, in radio telemetry research

conducted by Hall in Lassen County, CA, from 1998-2001 (F. Hall 2004 pers. comm.), his team discovered that some Sage-grouse populations include both resident and migratory birds down to the individual lek level. Specifically, they found resident, 1-stage and 2-stage females present on each of 9 leks (unpublished data). Populations are not always either resident or migratory.

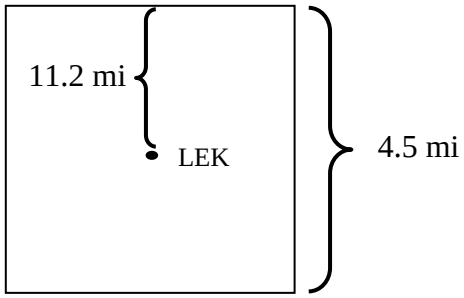

Fig 5. 502 mi^2 home range.

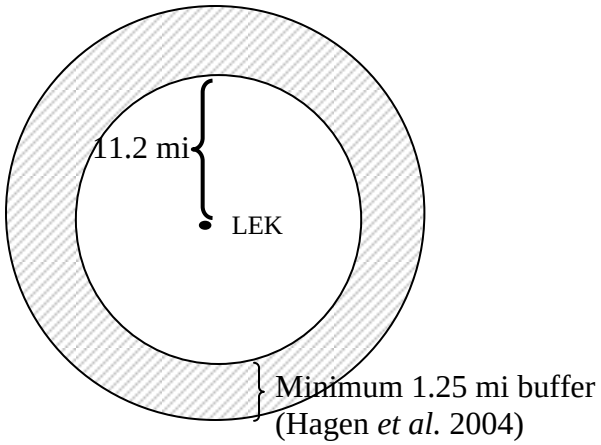

Fig 6. 394 mi^2 protected habitat using 11.2 mi radius from lek; with additional buffer zone recommended by Hagen *et al.* (2004), protected area = 486.95 mi^2.

Figures 5 and 6 illustrate the recommended protected breeding habitat for migratory populations of Sage-grouse based on a hypothetical square and circular home range, after Connelly *et al.* (2000:978) with buffer suggested by Hagen *et al.* (2004:79).

C. Braun (2004 pers. comm.) provided further comment on the recommendations discussed by Connelly *et al.* (2000:978) above (he was a coauthor of this article). For non-migratory populations of Sage-grouse, he felt a distance of 2 mi (3.2 km) was sufficient to protect breeding habitat from leks where no habitat disturbance was present. Where habitat disturbances were noted, he recommended a 3-mile (5 km) no-disturbance zone. For migratory populations, he reiterated Connelly *et al*'s 11-mile (18 km) no-disturbance zone from active leks. These recommendations he felt were based on "best professional judgment" and should change only when "no impacts could be demonstrated" by industry for zones of disturbance of lesser distance from leks. Wind generators, he indicated, were quite tall and could be seen and avoided by Sage-grouse for long distances. Noise (especially humming), motion, and height all may negatively affect Sage-grouse, although he indicated we still don't know the specific effects. Braun therefore felt that FWS could defend our 5-mile recommendation even though definitive data showing impacts are still being collected. C. Aldridge (2004 pers. comm.) also felt the Service's 5-mile distance recommendation "was reasonable" and represented an adaptive management approach by the FWS. He indicated that it was in "everybody's best interest to err on the safe side" especially due to issues regarding avoidance

(including known and unknown impacts), landscape effects of wind and other structures, and the simple occurrence of birds versus their overall survival.

For the biologists who have worked on Sage-grouse for some time, it was noted that birds seem to be especially susceptible to disturbance and will often abandon nests even in later stages of incubation. Certainly wind turbine construction and maintenance activities fall under the category of "disturbance" (J. Connelly 2004 pers. comm.).

Connelly *et al.* (2004) published the most comprehensive, science-based synthesis of the Greater Sage-grouse and its habitat needs yet conducted. While the Conservation Assessment did not provide minimum distance recommendations from wind turbines, it did discuss wind energy development as one of several factors that could impact sagebrush ecosystems and thereby Sage-grouse. Noise from wind turbine rotor blades and bird mortality were cited as issues of concern regarding wind energy (Chap. 7:42-43). Connelly *et al.* (2004) were not optimistic about the future of Sage-grouse because of long-term population declines coupled with loss and degradation of habitat and other factors such as disease (ES:5). They also raised concerns about the distribution, configuration, and characteristics of Grouse migration corridors which unfortunately are largely unknown in most portions of the Sage-grouse range (Chap. 4:19). Disturbance issues were also discussed regarding lek distribution and highways (Chap. 13:12-13. Lyon and Anderson (2003) further documented effects of disturbance on breeding Sage-grouse.

Braun *et al.* (2002:345, 346) reported that the sagebrush-obligate species, Gunnison and Greater Sage-grouse, were particularly susceptible to noise near leks and to the placement of overhead power lines at least 0.5 mi (0.8 km) from any Greater Sage-grouse breeding and nesting grounds. Development was viewed as a negative impact in this study, characterized by a loss of habitat and disturbances associated with structures, roads, and noise – especially during the breeding season.

F. Hall (2004 pers. comm.) in a Lassen County, CA study on Greater Sage-grouse has recently documented significant impacts from overhead power transmission and communication distribution lines to this species out to 3.7 mi (6 km). When these lines are placed near turbines, they could provide perches for Golden Eagles and nest sites for Common Ravens. This concern coincides with the Service's recommendation (see Turbine Design and Operation, no. 4, p. 4) to place electric power lines underground or on the surface as insulated, shielded wire to minimize strike and electrocution problems.

In a related study, Popham and Gutierrez (2003:331, 332) radio-tagged 65 female Greater Sage-grouse in northern CA of which 45 radio-tagged hens were tracked to their nests. Successful grouse nests were located farther from the nearest lek (2.2 mi [3.6 km], SE= 811 m) than were nests that were unsuccessful (1.2 mi [1.96 km], SE=384 m; p. 331). Others, however, have not noticed this difference (J. Connelly 2004 pers. comm.). Popham and Gutierrez noted that native shrub-steppe habitat had been degraded due to excessive grazing, juniper encroachment, agriculture, and anthropogenic development.

Results from the Popham and Gutierrez study represent a portion of the entire ongoing project being conducted by Hall and his team in Lassen County, CA (F. Hall 2004 pers. comm.).

Johnsgard (2002:116) indicated that there was no obvious relationship between lek location and nest site. In 5 different studies involving more than 300 nests the average distance between lek and Sage-grouse nest where the females was first seen or captured was 3.5 mi (5.6 km). This distance is greater than the mean interlek distance from several studies, which ranged from 0.8- 3 mi (1.3- 4.8 km; Wakkinen *et al.* 1992, Johnsgard 2002:116, J. Connelly 2004 pers. comm., R. Hazlewood 2004 pers. comm.).

Columbia Sharp-tailed Grouse

Disturbance to Sharp-tailed Grouse was reported by Baydack and Hein (1987:538) in southwestern Manitoba. While males were reported present during disturbances (*e.g.*, parked vehicles, propane exploders, scarecrows, taped voices, radio sounds, and a leashed dog), female Sharptails were not observed on leks during test disturbances. Disturbance appeared to limit reproductive opportunities for both sexes. They concluded that continued disturbance over several seasons could bring about population declines.

Giesen and Connelly (1993) reported on movements and management needs of Columbia Sharp-tailed Grouse in the West. While wind turbines were unavailable to assess during this time frame, reported Grouse movements between breeding areas and winter range – varying from 1.6 mi (2.6 km) to 12.4 mi (20 km) depending on study and location (p. 327) – could be impacted by current and proposed wind development. They specifically indicated the lack of experimental data on the effects of habitat alterations on this species. Among their recommendations, Giesen and Connelly (1993:331) suggested avoiding vegetation manipulation within a 1.25-mi (2 km) radius of the active lek in order to protect the nesting and brood-rearing habitats of this Sharp-tailed Grouse.

Suitable But Abandoned Habitat

During periods of population decline, prairie grouse may abandon lekking sites in smaller, fragmented habitats and congregate into larger, more intact areas (core habitat). Given that many grouse species are currently at population lows, human development of suitable but abandoned prairie grouse habitat could severely impede efforts to restore their numbers. In other words, protection of core prairie grouse habitat through the use of the Service's 5-mile buffer is a conservative approach (B. Obermeyer 2004 pers. comm.).

Obermeyer and Applegate (unpublished data) located 31 active GPCH leks in a 181-mi^2 area (465 km^2, 115,000 acres) of native rangeland in eastern Greenwood County, KS, during spring of 1997. Lek influence within the study area, as defined by a 1.9-mi (3-km) radius, was 152.6 mi^2 (391.4 km^2; Figure 7). Generally, the stronger leks were located in the more unfragmented areas of native rangeland. A much larger zone of lek influence at this study area was noted just a few years previous. Lek distribution along the western boundary shrank by approximately 6 miles between 1987 and 1997 (B. Obermeyer 2004 pers. comm.). Development of suitable but abandoned prairie grouse habitat (*e.g.*, unoccupied, historical leks) could seriously impede prairie grouse restoration efforts.

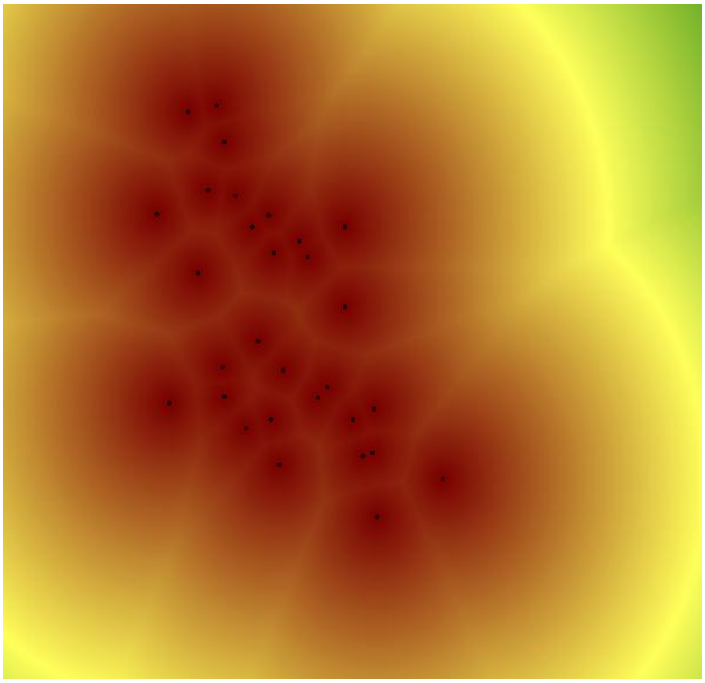

Figure 7. Dots represent 1997 locations of GPCH leks within a 115,000-acre block of tallgrass prairie in KS. Yellow area = ~237 mi^2 (608 km^2; unpubl. data).

Concerns for Other Grassland and Shrub-Steppe Avifauna in Relation to Wind Energy Development

Manes *et al.* (2004 manuscript in preparation, R. Manes, S. Harmon, B. Obermeyer, and R. Applegate 2004 pers. comm.) summarized the documented effects of wind facilities on birds, indicating that Golden Plovers and Lapwings had been displaced by as much as 0.5 mi (0.8 km) from wind facilities in Denmark (citing Pederson and Poulsen 1991) while in Netherlands, Lapwings and Curlews avoided areas within 0.15-0.3 mi (0.25 – 0.5 km) of wind turbines (citing Winkelman 1990).

Although focused on grassland passerines rather than prairie grouse, Leddy *et al.* (1999:101) recommended placing wind plants within cropland habitats in MN rather than in native grasslands. Research at the Buffalo Ridge Project in southwestern MN revealed that the Bobolink, Red-winged Blackbird, Savanna Sparrow, and Sedge Wren nested in densities 4 times higher in grasslands that were ~ 600 ft. (180 m) from wind turbines than those within ~ 260 ft (80 m) of turbines. Densities beyond 600 ft. were not evaluated (Leddy *et al.* 1999). Because of the trend for larger turbines, avoidance zones adjacent to the new generation turbines may differ from those of previous studies (R. Manes, S. Harmon, B. Obermeyer, and R. Applegate 2004 pers. comm.). Sage-steppe-obligate songbirds (*e.g.*, Sage Sparrow, Brewer's Sparrow, Sage Thrasher, and Black-chinned

Sparrow) are also showing population declines and management concerns should also focus on these species.

The Service asserts that by avoiding or minimizing construction of wind facilities in native prairie grasslands and native sage-steppe habitats, grassland- and sage-dependent native songbird species would be protected and habitat fragmentation would be avoided.

Service's Recommendation for 5-Mile Buffer from Leks

The intent of the Service's recommendation for a 5-mile zone of protection is to buffer against increased mortality (both human-caused and natural), against habitat degradation and fragmentation, and against disturbance. In considering our recommendation, FWS recognizes major declines in populations and habitats of prairie grouse. All species of prairie grouse are in varying stages of decline – some populations declining precipitously -- requiring a major focus on direct human impacts, disturbance from structures, and fragmentation of habitats. While wind plants are new additions to prairie grouse habitats in the Midwest and West, cumulative impacts from human development and exploitation must be assessed with great care and considerable detail. To reverse these declines will take significant commitment from industry, the Service, and other stakeholders. We view the voluntary nature of our guidance and specifically our 5-mile recommendation as a reasonable effort needed to conserve these important resources.

While migratory populations of Sage-grouse may require in excess of 11 miles in radius of protected habitat from active leks (Connelly *et al.* 2000:978), it can be argued that LPCH may require protection less than being suggested by FWS (Mote *et al.* 1998:18; 2.5 mi [4.1 km] distance from a lek located in the center of a circular home range). However, rangewide the majority of remaining LPCH populations are fragmented and isolated into "islands" of open prairie. Our 5-mile setback is intended to protect both Prairie Chickens and the wind industry. Later wind turbine construction, for example, could if in close proximity to leks significantly impact Prairie Chicken populations. Habitat corridors between leks and population centers could also be impacted by close development, likely impacting future recovery. Our distance recommendation will also help address decreasing habitat patch sizes and diminishing habitat complexity that will be affected as structures become more abundant and roads, power lines, vehicles, and human disturbance further fragment and impact habitats. Current distance recommendations for LPCHs may simply reflect the "tolerance" level of LPCHs to "structures" in fragments of < 12,350 ac (5,000 ha) in size of moderate complexity (C. Hagen 2004 pers. comm.). As patch size becomes smaller and less complex, the LPCH may likely be less tolerant of disturbance. Until data can support an alternate hypothesis, Hagen (2003:159) and C. Hagen (2004 pers. comm.) suggested protecting as large a buffer as possible for LPCH. Again, the Service's 5-mile recommendation seems reasonable (Figures 7 and 8) and applicable to all species of prairie grouse. As the necessary research is conducted to more clearly define the effects on grassland and sage-steppe species and as new data become publicly available, we will use it to refine our

recommendation.

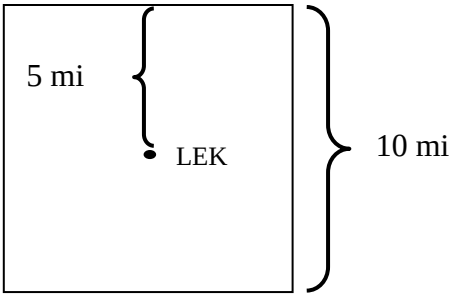

Fig 7. 100 mi^2

Fig 8. 78.5 mi^2

Figures 7 and 8. FWS summary of recommended 5-mile protection zone from active leks for populations of prairie grouse based on hypothetical square and circular home ranges with centrally-located leks, after S. Harmon (2004 pers. comm.), Connelly *et al.* (2000:978), Pitman (2003), Hagen (2003), C. Hagen (2004 pers. comm.), Wolfe *et al.* (2003a and 2003b), Patten *et al.* (2004a and 2004b), C. Braun (2004 pers. comm.), C. Aldridge (2004 pers. comm.), F. Hall (2004 pers. comm.), and B. Obermeyer (2004 pers. comm.).

The results from and concerns raised by a March 2003 Kansas City, MO, workshop on "Great Plains Wind Power and Wildlife" were used as further evidence by the Service to take a precautionary approach in recommending our 5-mile distance (R. Manes 2003 pers. comm.).

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