DEPARTMENT OF THE INTERIOR

Fish and Wildlife Service

50 CFR Part 17

[Docket No. FWS–R2–ES–2012–0071]

[4500030113]

RIN 1018–AY21

Endangered and Threatened Wildlife and Plants; Determination of Threatened Status for the Lesser Prairie-Chicken

AGENCY: Fish and Wildlife Service, Interior.

ACTION: Final rule.

SUMMARY: We, the U.S. Fish and Wildlife Service, determine threatened species status for the lesser prairie-chicken (*Tympanuchus pallidicinctus*), a grassland bird known

from southeastern Colorado, western Kansas, eastern New Mexico, western Oklahoma, and the Texas Panhandle, under the Endangered Species Act of 1973, as amended (Act). This final rule implements the Federal protections provided by the Act for the lesser prairie-chicken. Critical habitat is prudent but not determinable at this time. Elsewhere in today's **Federal Register**, we published a final special rule under section 4(d) of the Act for the lesser prairie-chicken.

DATES: This rule is effective on [INSERT DATE 30 DAYS AFTER DATE OF FEDERAL REGISTER PUBLICATION].

ADDRESSES: *Document availability:* You may obtain copies of this final rule on the Internet at *http://www.regulations.gov* at Docket No. FWS–R2–ES–2012–0071 or by mail from the Oklahoma Ecological Services Field Office (see **FOR FURTHER INFORMATION CONTACT** below). Comments and materials received, as well as supporting documentation used in preparing this final rule, are available for public inspection, by appointment, during normal business hours at: U.S. Fish and Wildlife Service, Oklahoma Ecological Services Field Office, 9014 East 21st Street, Tulsa, OK 74129; telephone 918–581–7458; facsimile 918–581–7467.

FOR FURTHER INFORMATION CONTACT: Alisa Shull, Acting Field Supervisor, Oklahoma Ecological Services Field Office, 9014 East 21st Street, Tulsa, OK 74129; by telephone 918–581–7458 or by facsimile 918–581–7467. Persons who use a telecommunications device for the deaf (TDD) may call the Federal Information Relay Service (FIRS) at 800–877–8339.

SUPPLEMENTARY INFORMATION:

Executive Summary

This document consists of: (1) A final rule to list the lesser prairie-chicken as a threatened species; and (2) a finding that critical habitat is prudent but not determinable at this time.

Why we need to publish a rule. Under the Endangered Species Act (Act), a species may warrant protection through listing if it is an endangered or threatened species throughout all or a significant portion of its range. The Act sets forth procedures for adding species to, removing species from or reclassifying species on the Federal Lists of Endangered and Threatened Wildlife and Plants. In this final rule, we explain why the lesser prairie-chicken warrants protection under the Act. This rule lists the lesser prairie-chicken as a threatened species throughout its range.

The Act provides the basis for our action. Under the Act, we can determine that a species is an endangered or threatened species based on any of five factors: (A) The present or threatened destruction, modification, or curtailment of its habitat or range; (B) overutilization for commercial, recreational, scientific, or educational purposes; (C) disease or predation; (D) the inadequacy of existing regulatory mechanisms; or (E) other natural or manmade factors affecting its continued existence. The primary factors supporting the determination of threatened status for the lesser prairie-chicken are the ongoing and probable future impacts of cumulative habitat loss and fragmentation. These impacts are the result of: Conversion of grasslands to agricultural uses; encroachment by invasive, woody plants; wind energy development; petroleum production; and presence of roads and manmade vertical structures including towers, utility lines, fences, turbines, wells, and buildings.

We requested peer review of the methods used in making our final determination. We obtained opinions from knowledgeable individuals having scientific expertise in this species or related fields (such as range and fire ecology, shrub management and grouse management) and solicited review of the scientific information and methods that we used in developing the proposal. We obtained opinions from two knowledgeable individuals with scientific expertise to review our technical assumptions, analysis, adherence to regulations, and whether we had used the best available information. These peer reviewers generally concurred with our methods and conclusions and provided additional information, clarifications, and suggestions to improve this final listing rule.

We sought public comment on the proposed listing rule and the proposed special rule under section 4(d) of the Act. During the first comment period, we received 879 comment letters directly addressing the proposed listing and critical habitat designation. During the second comment period, we received 56,344 comment letters addressing the proposed listing rule, proposed special rule, and related rangewide conservation plan. During the third comment period, we received 12 comments regarding the proposed listing. During the fourth comment period, we received 74 comments, primarily related to the proposed revised special rule.

Previous Federal Actions

In 1973, the Service's Office of Endangered Species published a list of threatened wildlife of the United States in Resource Publication 114, often referred to as the "Red Book." While this publication did not, by itself, provide any special protections, the publication served, in part, to solicit additional information regarding the status of the identified taxa. The lesser prairie-chicken was one of 70 birds included in this publication (Service 1973, pp. 134-135), but little Federal regulatory action occurred on the lesser prairie-chicken until 1995.

On October 6, 1995, we received a petition, dated October 5, 1995, from the Biodiversity Legal Foundation, Boulder, Colorado, and Marie E. Morrissey (petitioners). The petitioners requested that we list the lesser prairie-chicken as threatened throughout its known historical range in the United States. The petitioners defined the historical range to encompass west-central Texas north through eastern New Mexico and western Oklahoma to southeastern Colorado and western Kansas, and they stated that there may have been small populations in northeastern Colorado and northwestern Nebraska. The petitioners also requested that critical habitat be designated as soon as the needs of the species are sufficiently well known. However, from October 1995 through April 1996, we were under a moratorium on listing actions as a result of Public Law 104–6, which, along with a series of continuing budget resolutions, eliminated or severely reduced our listing budget through April 1996. We were unable to act on the petition during that period. On July 8, 1997 (62 FR 36482), we announced our 90-day finding that the petition presented substantial information indicating that the petitioned action may be warranted. In that notice, we requested additional information on the status, trend, distribution, and habitat requirements of the species for use in conducting a status review. We requested that information be submitted to us by September 8, 1997. In response to a request by the Lesser Prairie-Chicken Interstate Working Group dated September 3, 1997, we reopened the comment period for an additional 30 days, beginning on November 3, 1997 (62 FR 59334). We subsequently published our 12-month finding for the lesser prairie-chicken on June 9, 1998 (63 FR 31400), concluding that the petitioned action was warranted but precluded by other higher priority listing actions.

The 12-month finding initially identified the lesser prairie-chicken as a candidate for listing with a listing priority number (LPN) of 8. Our policy (48 FR 43098;

September 21, 1983) requires the assignment of an LPN to all candidate species. This listing priority system was developed to ensure that we have a rational system for allocating limited resources in a way that ensures those species in greatest need of protection are the first to receive such protection. The listing priority system considers magnitude of threat, immediacy of threat, and taxonomic distinctiveness in assigning species numerical listing priorities on a scale from 1 to 12. In general, a smaller LPN reflects a greater need for protection than a larger LPN. The lesser prairie-chicken was assigned an LPN of 8, indicating that the magnitude of threats was moderate and the immediacy of the threats to the species was high.

On January 8, 2001 (66 FR 1295), we published our resubmitted petition findings for 25 animal species, including the lesser prairie-chicken, having outstanding "warranted-but-precluded" petition findings as well as notice of one candidate removal. The lesser prairie-chicken remained a candidate with an LPN of 8 in our October 30, 2001 (66 FR 54808); June 13, 2002 (67 FR 40657); May 4, 2004 (69 FR 24876); May 11, 2005 (70 FR 24870); September 12, 2006 (71 FR 53756); and December 6, 2007 (72 FR 69034) candidate notices of review. In our December 10, 2008 (73 FR 75176), candidate notice of review, we changed the LPN for the lesser prairie-chicken from an 8 to a 2. This change in LPN reflected a change in the magnitude of the threats from moderate to high primarily due to an anticipated increase in the development of wind energy and associated placement of transmission lines throughout the estimated occupied range of the lesser prairie-chicken. Our June 9, 1998, 12-month finding (63 FR 31400) did not recognize wind energy and transmission line development as a threat because such development within the known range was almost nonexistent at that time. Changes in the magnitude of other threats, such as conversion of certain Conservation Reserve Program (CRP) lands from native grass cover to cropland or other less ecologically valuable habitat and observed increases in oil and gas development, also were important considerations in our decision to change the LPN. The immediacy of the threats to the species did not change and continued to be high. Our November 9, 2009 (74 FR 57804), November 10, 2010 (75 FR 69222), and October 26, 2011 (76 FR 66370) candidate notices of review retained an LPN of 2 for the lesser prairie-chicken.

Since making our 12-month finding, we have received several 60-day notices of intent to sue from WildEarth Guardians (formerly Forest Guardians) and several other parties for failure to make expeditious progress toward listing of the lesser prairie-chicken. These notices were dated August 13, 2001; July 23, 2003; November 23, 2004; and May 11, 2010. WildEarth Guardians subsequently filed suit on September 1, 2010, in the U.S. District Court for the District of Colorado. A revised notice of intent to sue dated January 24, 2011, in response to motions from New Mexico Oil and Gas Association, New Mexico Cattle Growers Association, and Independent Petroleum Association of New Mexico to intervene on behalf of the Secretary of the Interior, also was received from WildEarth Guardians.

This complaint was subsequently consolidated in the U.S. District Court for the District of Columbia along with several other cases filed by the Center for Biological Diversity or WildEarth Guardians relating to petition finding deadlines and expeditious progress toward listing. A settlement agreement in *In re Endangered Species Act Section 4 Deadline Litigation,* No. 10–377 (EGS), MDL Docket No. 2165 (D.D.C. May 10, 2011) was reached with WildEarth Guardians in which we agreed to submit a proposed listing rule for the lesser prairie-chicken to the **Federal Register** for publication by September 30, 2012.

On September 27, 2012, the settlement agreement was modified to require that the proposed listing rule be submitted to the **Federal Register** on or before November 29, 2012. On December 11, 2012, we published a proposed rule (77 FR 73828) to list the lesser prairie-chicken as a threatened species under the Act (16 U.S.C. 1531 *et seq*.). Publication of the proposed rule opened a 90-day comment period that closed on March 11, 2013. We held a public meeting and hearing in Woodward, Oklahoma, on February 5, 2013; in Garden City, Kansas, on February 7, 2013; in Lubbock, Texas, on February 11, 2013; and in Roswell, New Mexico, on February 12, 2013.

On May 6, 2013, we announced the publication of a proposed special rule under the authority of section 4(d) of the Act. At this time, we reopened the comment period on the proposed listing rule (77 FR 73828) to provide an opportunity for the public to simultaneously provide comments on the proposed listing rule, the proposed special rule, and a draft rangewide conservation plan for the lesser prairie-chicken. This comment period was open from May 6 to June 20, 2013.

On July 9, 2013, we announced a 6-month extension (78 FR 41022) of the final listing determination based on our finding that there was substantial disagreement regarding the sufficiency or accuracy of the available data relevant to our determination regarding the proposed listing rule. We again reopened the comment period to solicit additional information. This comment period closed on August 8, 2013. We reopened the comment period again on December 11, 2013 (78 FR 75306), to solicit comments on a revised proposed special rule and our December 11, 2012, proposed listing rule. This comment period closed on January 10, 2014. However, the endorsed version of the Western Association of Fish and Wildlife Agencies' Lesser Prairie-Chicken Range-wide Conservation Plan was not available on the websites, as stated in the December 11, 2013, revised proposed special 4(d) rule (78 FR 75306), at that time. We subsequently reopened the comment period on January 29, 2014 (79 FR 4652), to allow the public the opportunity to have access to this rangewide plan and submit comments on the revised proposed special rule and our December 11, 2012, proposed listing rule. This comment period closed on February 12, 2014.

Summary of Comments and Recommendations

We requested written comments from the public on the proposed listing of the lesser prairie-chicken during five comment periods: December 11, 2012, to March 11, 2013; May 6 to June 20, 2013; July 9 to August 8, 2013; December 11, 2013, to January 10, 2014; and January 29 to February 12, 2014. Additionally four public hearings were held in February 2013; February 5th in Woodward, Oklahoma; February 7th in Garden City, Kansas; February 11th in Lubbock, Texas; and February 12th in Roswell, New Mexico. We also contacted appropriate Federal, Tribal, State, and local agencies; scientific organizations; and other interested parties and invited them to comment on the proposed rule, proposed special rule, draft rangewide conservation plan, and final rangewide conservation plan during the respective comment periods.

Over the course of the five comment periods, we received approximately 57,350 comment submissions. Of these, approximately 56,800 were form letters. Additionally, during the February 2013 public hearings, 85 individuals or organizations provided comments on the proposed rule. All substantive information provided during these comment periods, including the public hearings, has either been incorporated directly into this final determination or is addressed below. Comments from peer reviewers and State agencies are grouped separately. In addition to the comments, some commenters submitted additional reports and references for our consideration, which we reviewed and incorporated into this final rule as appropriate.

Peer Reviewer Comments

In accordance with our peer review policy published on July 1, 1994 (59 FR 34270), we solicited expert opinions from nine knowledgeable individuals with scientific expertise that included familiarity with the species, the geographic region in which the species occur, and conservation biology principles. We received responses from two of the nine peer reviewers we contacted.

We reviewed all comments received from the two peer reviewers regarding the analysis of threats to the lesser prairie-chicken and our proposed threatened listing determination. The peer reviewers generally concurred with our methods and conclusions, and provided additional information, clarifications, and suggestions to improve this final rule. Peer reviewer comments are addressed in the following summary and incorporated into the final rule, as appropriate.

(1) *Comment*: Conservation efforts to date have not been adequate to address known threats.

Our Response: While considerable effort has been expended over the past several years to address some of the known threats throughout portions or all of the species' estimated occupied range, threats to the continued viability of the lesser prairie-chicken into the future remain. Recent development of conservation plans has highlighted the importance of not only habitat restoration and enhancement but also the role of the States and other partners in reducing many of the known threats to the lesser prairie-chicken. Consequently, we proposed a special rule under section 4(d) of the Act that facilitates conservation implementation and threat reduction through development or implementation of certain types of conservation plans and efforts. Such plans will help provide the ongoing, targeted implementation of appropriate conservation actions that are an important aspect of collaborative efforts to improve the status of the species. We discuss the various conservation efforts occurring within the estimated occupied range of the lesser prairie-chicken in more detail in the **Summary of Ongoing and Future Conservation Efforts**, below.

(2) *Comment*: Grain crops may be used by lesser prairie-chickens more extensively than indicated in the rule, particularly considering that conversion of the prairies to crop production led to expansion, at least temporarily, of lesser prairie-chicken populations.

Our Response: Grain crops are used by lesser prairie-chickens and may have temporarily led to range expansion, but the best available information does not detail how extensively grains are used by lesser prairie-chickens. Considering food is likely rarely limiting for lesser prairie-chickens, grains are likely used advantageously and are not necessary for survival. However, lesser prairie-chickens may be more dependent upon waste grain during drought or prolonged periods of extreme winter weather. Lesser prairie-chickens tend to predominantly rely on cultivated grains when production of natural foods, such as acorns and grass and forb seeds, are deficient (Copelin 1963, p. 47). Therefore, agricultural grain crops, particularly when irrigated and with additional nutrient inputs, can be a more reliable, but temporary, food source than native foods that fluctuate with environmental conditions. However, there is a cost to the species associated with using grain fields in terms of exposure to predation, energy expenditure, and weather. Copelin (1963, entire) indicates that lesser prairie-chickens will occasionally use grain crops, but it appears that native foods are generally preferred. Additionally, as the extent of agricultural lands increases within the landscape, native grass and shrubland habitats that are used by lesser prairie-chickens for all life-history stages, not limited to foraging, decline. Kukal (2010, pp. 22, 24) found that lesser prairie-chickens did not move long distances to access grain fields and may spend the fall and winter exclusively in grasslands even when grain fields, primarily wheat, are available. While this likely indicates that wheat is not a preferred grain source, or that grains are not readily available on winter wheat fields, the best scientific information indicates that crop fields are less important to lesser prairie-chicken survival than are native grasslands in good condition because native grasslands are more likely to provide necessary habitat for lekking, nesting, brood rearing, feeding for young, and feeding for adults, among other things. Accordingly, this rule characterizes waste grains and grain agriculture as important during prolonged periods of adverse winter weather but unnecessary for lesser prairie-chicken survival during most years and in most regions. A more detailed discussion of lesser prairie-chicken use of grain crops is provided in the "Life-History Characteristics" section, below.

(3) *Comment*: The Service should not list population segments of the lesser prairie-chicken in Kansas, where those populations meet or exceed population thresholds established by an objective and independent team of species experts. Specifically, the Service could designate a distinct population segment in Kansas and exclude it from any listing action.

Our Response: The Act allows us to list only species, subspecies, or distinct population segments of a species or subspecies, as section 3(16) of the Act defines species to include "any subspecies of fish or wildlife or plants, and any distinct population segment of any species of vertebrate fish or wildlife which interbreeds when mature." The Service and the National Marine Fisheries Service jointly published a "Policy Regarding the Recognition of Distinct Vertebrate Population Segments Under the Endangered Species Act" (DPS Policy) in the **Federal Register** on February 7, 1996 (61 FR 4722). Under the DPS Policy, three factors are considered in a decision concerning whether to establish and classify a possible DPS. The first two factors, (1) discreteness of the population segment in relation to the remainder of the taxon and (2) the significance of the population segment to the taxon to which it belongs, bear on whether the population segment can be a possible DPS. The third factor bears on answering the question of whether the population segment, when treated as if it were a species, is endangered or threatened. In order to establish a DPS, all three factors must be met. Under the DPS Policy, a population may be considered discrete if (1) it is markedly separated from other populations of the same taxon as a consequence of physical, physiological, ecological, or behavioral factors; or (2) it is delimited by international governmental boundaries with differences in control of exploitation, management of habitat, conservation status, or relevant regulatory mechanisms. The best scientific and commercial information available does not indicate that lesser prairie-chicken populations in Kansas are discrete from the populations in the neighboring States of Colorado or Oklahoma because there is no marked separation from other populations. Thus, we do not have the discretion to exclude populations in Kansas from the listing because they do not meet the definition of a listable (or delistable) entity. Please refer to the **Determination** section of this final listing rule for further discussion.

(4) *Comment*: A recovery team should be established and critical habitat proposed as quickly as possible following the final listing decision.

Our Response: Under section 4(f)(1) of the Act, we are required to develop and implement plans for the conservation and survival of endangered and threatened species, unless the Secretary of the Interior finds that such a plan will not promote the conservation of the species. We will move to accomplish these tasks as soon as feasible. We have determined in this final rule that critical habitat is not determinable at this time; however, we are required under section 4(b)(6)(C)(ii) of the Act to make our critical habitat determination within one year from the publication date of this final rule.

(5) *Comment*: Speciation in members of the genus *Tympanuchus* may be incomplete, and statements regarding taxonomy should be revised to more fully disclose the current state of genetic and taxonomic information. Electronic copies of several publications were provided to aid the Service's review of this information.

Our Response: As stated in the final rule, we agree that there is some uncertainty regarding the taxonomic status of the lesser prairie-chicken and other related members of the genus. For example, Johnsgard (1983, p. 316) initially considered the greater and lesser prairie-chickens to be allopatric subspecies, meaning that they originated as the same species but populations became isolated from each other to an extent that prevented genetic interchange, causing speciation. However, the American Ornithologists Union recognizes the lesser prairie-chicken as a species, and we have concluded that the lesser prairie-chicken is sufficiently distinct from other members of the genus to meet the Act's definition of a species. The American Ornithologists Union considers the lesser prairie-chicken to be distinct from the greater prairie-chicken based on known differences in behavior, habitat affiliation, and social aggregation (Ellsworth *et al.* 1994, p. 662). We have revised the rule to include a more thorough discussion of prairie grouse phylogeny (the evolutionary history of taxonomic groups).

(6) *Comment*: Under conditions of high production and large population size, lesser prairie-chickens would be able to disperse up to 48 kilometers (km) (30 miles (mi)) annually and be able to recolonize areas fairly quickly. Similarly, if birds were at least

partially migratory in the past, recolonization could occur more rapidly than indicated in the proposed rule.

Our Response: There is limited information available on the dispersal capabilities of lesser prairie-chickens, but the best scientific information available to us supports that lesser prairie-chickens exhibit limited dispersal tendencies and do not disperse over long distances. In Texas, Haukos (1988, p. 46) recorded daily movements of 0.1 km (0.06 mi) to greater than 6 km (3.7 mi) by female lesser prairie-chickens prior to onset of incubation. Taylor and Guthery (1980b, p. 522) documented a single male moving 12.8 km (8 mi) in 4 days, which they considered to be a dispersal movement. This information does not support the conclusion that individuals have or could disperse up to 48 km (30 mi). Due to their heavy wing loading, they are relatively poor fliers. For these reasons, we do not consider lesser prairie-chickens to be good dispersers.

The existence of large-scale migration movements of lesser prairie-chickens is not known, but it is possible that the species was at least partially migratory in the past. Both Bent (1932, pp. 284–285) and Sharpe (1968, pp. 41–42) thought that the species, at least historically, might have been migratory with separate breeding and wintering ranges. Taylor and Guthery (1980a, p. 10) also thought the species was migratory prior to widespread settlement of the High Plains, but migratory movements have not recently been documented. The lesser prairie-chicken is now thought to be nonmigratory.

The species' limited dispersal and migration capabilities are unlikely to significantly contribute to recolonization under current conditions, particularly considering the fragmented nature of the occupied range.

Recolonization of former lesser prairie-chicken habitat is most likely to occur in habitats that are located in close proximity to existing populations, particularly considering the extent of habitat fragmentation that exists within the occupied range and reduced population size. Due to the lesser prairie chicken's relatively limited movements, their site fidelity, and difficulty in translocating individuals, management efforts are best concentrated on improving habitat conditions in areas adjacent to existing populations and allowing individuals to recolonize those habitats naturally. Under appropriate conditions, populations can recolonize these adjacent areas relatively quickly, provided surplus numbers exist to support dispersal. As evidenced by the reoccupation of former range in Kansas, where large blocks of high-quality habitat were created through the CRP, recolonization is possible but is most likely to occur over the long term (8 to 12 years) in habitats within close proximity to existing populations. As conservation efforts for this species continue and recovery planning would be initiated post-listing, conservation actions such as habitat improvement may include areas that are most likely to support population expansion.

(7) *Comment*: The extent of the historical range provides little information with regard to density of lesser prairie-chickens, and some portions of the historical range may

not have been suitable for lesser prairie-chickens even 100 years ago. The extent of the historical range is a somewhat arbitrary benchmark and should not be used when making comparisons with respect to currently occupied range.

Our Response: We recognize that not all of the Service's defined historical range was optimal habitat, and very little information regarding historical densities of lesser prairie-chickens exists. However, one of the factors we must consider in our listing determination relates to the present or threatened destruction, modification, or curtailment of a species' habitat or range. Accordingly, comparing the likely extent of historical range with currently occupied range provides insight into whether the range of a species has been lost or reduced over time. We agree that the extent of the historical range is an estimate and use this term, and the term "approximate," in referring to the historical range. We also recognize that the extent of historical range may have fluctuated over time, based on habitat conditions evident at any one period, and the estimated historical range may represent the maximum range that was occupied during historical times. The information we present in this rule serves to reflect the estimated extent of the historical range based on the best available information and provides some context with which we can discuss the estimated occupied range. While our calculations of the loss of historical range are an estimate and not an exact value, they demonstrate that the range of the lesser prairie-chicken likely has contracted substantially since pre-European settlement.

(8) *Comment*: The rule fails to consider that the occupied range of the lesser prairie-chicken has expanded to include portions of northwest Kansas and may be larger than in the recent past.

Our Response: Our proposed rule clearly states that the lesser prairie-chicken occupies areas in Ellis, Graham, Sheridan, and Trego Counties in Kansas that extend beyond the previously delineated historical range. Our calculations of the estimated occupied range and the estimated occupied range plus a 16-km (10-mi) buffer also recognize the existence of populations in those counties. However, the best scientific and commercial information available indicates the range in northwestern Kansas does not represent a range expansion for lesser prairie-chicken; instead, we consider this to be a reoccupation of former range.

(9) *Comment*: The extent of agricultural land within the range of the lesser prairie-chicken may decline, particularly considering the High Plains (Ogallala) Aquifer may be economically depleted in 20 years.

Our Response: The best scientific and commercial information available does not indicate that the extent of agricultural land will decline significantly in the near future, even if the level of the High Plains Aquifer declines. Terrell *et al.* (2002, p. 35), Sophocleous (2005, p. 361), and Drummond (2007, p. 142) all concluded that, while declining water levels in the High Plains Aquifer may cause some areas of cropland to revert to grassland, most of the irrigated land likely will transition to dryland agriculture, despite the increased use of more efficient methods of irrigation in response to declining water supplies for irrigation. This information has been incorporated into this final rule.

(10) *Comment*: Work by Hovick *et al.* (unpublished manuscript in review) on anthropogenic structures and grouse that has been submitted for publication should be considered. This work shows a consistent and negative relationship between grouse and certain manmade structures, including oil and gas infrastructure, power lines, and wind turbines.

Our Response: We agree with this comment and have incorporated the findings of this study into this rule. This study examined the effect of 23 different types of anthropogenic structures on grouse displacement behavior and found that all structure types examined resulted in displacement, but oil structures and roads had the greatest impact on grouse avoidance behavior (Hovick *et al.* unpublished manuscript under review, p. 11). They also examined the effect of 17 of these structures on survival and found all of the structures examined also decreased survival in grouse, with lek attendance declining at a greater magnitude than other survival parameters measured (Hovick *et al.* unpublished manuscript under review, p. 12). This information supports our conclusion that the presence of vertical structures contributes to functional fragmentation of lesser prairie-chicken habitat.

(11) *Comment*: Statements regarding the impact of recreational viewing, particularly with respect to the size of the lek, are speculative and more information should be provided.

Our Response: There is little direct evidence regarding impacts of recreational viewing at lesser prairie-chicken leks. Consequently, we cannot provide more definitive information within this section than the discussion in the proposed and final rules. Based on the best scientific and commercial information available at this time, we do not consider recreational viewing to be a significant impact to the species as a whole. Please refer to the *Hunting and Other Forms of Recreational, Educational, or Scientific Use* section, below, for our discussion of potential impacts from recreational viewing.

(12) *Comment*: In the section on hybridization, the Service incorrectly describes the lesser prairie-chicken populations in Kansas that occur north of the Arkansas River as low density.

Our Response: We have revised that discussion to more clearly reflect observed densities in the area of hybridization.

(13) *Comment*: The section on hybridization should be expanded and clarified with respect to the fertility of hybrids. Populations within the zone of overlap are not low density or ephemeral, and the zone of overlap is more extensive than indicated by Bain

and Farley (2000). The hybridization issue, combined with information on speciation and possibility of introgression, should be a high priority for research.

Our Response: We have expanded the section on hybridization to include discussion related to fertility of first and second generation hybrids. We have concerns with respect to the implications of hybridization, but the best available information at this time does not indicate that hybridization is a threat at current levels.

Comments from States

Section 4(i) of the Act states, "the Secretary shall submit to the State agency a written justification for [her] failure to adopt regulations consistent with the agency's comments or petition." Comments received from the States of Colorado, Kansas, New Mexico, Oklahoma, and Texas regarding the proposal to list the lesser prairie-chicken as a threatened species are addressed below.

(14) *Comment*: Evidence shows that the lesser prairie-chicken population is not only surviving, but has stabilized or increased, despite other conditions, including drought in much of the region. This conclusion is supported by Hagen 2012. Lesser prairie-chicken populations can experience large fluctuations in numbers, but they have remained within normal limits given annual precipitation over the past 12 years with no

significant decrease; further, they have demonstrated the ability to recover from similar drought episodes in the past.

Our Response: In June 2012, we were provided with the referenced interim assessment of lesser prairie-chicken population trends since 1997 (Hagen 2012, entire). While the results of this analysis suggest that lesser prairie-chicken population trends have increased since 1997, we are reluctant to place considerable weight on the interim assessment for a number of reasons as discussed in the rule. The “Rangewide Population Estimates” section of this final listing rule includes a full discussion of these reasons, in addition to a full discussion of population estimates for the species. In summary, Hagen’s preliminary analysis evaluates lesser prairie-chicken population trends from 1997 to 2012, whereas the Service’s analysis of population estimates as presented in the final rule dates back as far as records are available.

Although lesser prairie-chicken populations can fluctuate considerably from year to year in response to variable weather and habitat conditions, generally the overall population size has continued to decline from the estimates of population size available in the early 1900s (Robb and Schroeder 2005, p. 13). The ability of any species to recover from an event, such as drought, is fully dependent upon the density of individuals, the environmental conditions, the time that those environmental conditions persist, and, most importantly, the habitat quality and quantity available(including connectivity of that habitat). An examination of anecdotal information on historical numbers of lesser prairie-chickens indicates that numbers likely have declined from possibly millions of birds to current estimates of thousands of birds. Further, examination of the trends in the five lesser prairie-chicken States for most indicator variables, such as males per lek and lek density, over the last 3 years are indicative of declining populations. The total estimated abundance of lesser prairie-chickens in 2012 was 34,440 individuals (90 percent upper and lower confidence intervals of 52,076 and 21,718 individuals, respectively; McDonald *et al.* 2013, p. 24). The total estimated abundance of lesser prairie-chickens in 2013 dropped to 17,616 individuals (90 percent upper and lower confidence intervals of 20,978 and 8,442 individuals, respectively) (McDonald *et al.* 2013, p. 24). The best scientific and commercial information available supports that lesser prairie-chicken populations have declined since pre-European settlement.

(15) *Comment*: Listing the lesser prairie-chicken is contrary to the best available science and current information. Current research and conservation efforts support that the species does not warrant listing.

Our Response: As required by section 4(b) of the Act, we used the best scientific and commercial data available in making this final determination. We solicited peer review from knowledgeable individuals with scientific expertise that included familiarity with the species, the geographic region in which the species occurs, and conservation biology principles to ensure that our listing is based on scientifically sound data, assumptions, and analysis. Additionally, we requested comments or information from other concerned governmental agencies, Native American Tribes, the scientific community, industry, and any other interested parties concerning the proposed rule. Comments and information we received helped inform this final rule. We used multiple sources of information including: results of numerous surveys, peer-reviewed literature, unpublished reports by scientists and biological consultants, geospatial analysis, and expert opinion from biologists with extensive experience studying the lesser prairie-chicken and its habitat. The commenter provides no rationale (e.g., literature or scientific evidence) to indicate the species does not meet the definition of a threatened species under the Act. Please refer to the **Determination** section of this final listing rule for further discussion on whether or not the species meets the definition of an endangered or threatened species.

(16) *Comment*: A final determination to list the species as endangered or threatened would have negative impacts on economics, communities, and private landowners. Economic impacts may affect agriculture (farming and ranching), oil and gas, potash, dairy, wind energy, electricity generation, mineral royalties, and transportation. Many industries may incur additional project costs and delays due to the regulatory and economic burden created by the listing. As industry experiences economic impacts, commenters stated that additional impacts could include decreased tax revenues; a reduction in jobs; effects to school, hospital, and county government operations; increased development pressure; and greater land fragmentation.

Our Response: For listing actions, the Act requires that we make determinations "solely on the basis of the best available scientific and commercial data available" (16 U.S.C. 1533(b)(1)(A)). Therefore, we do not consider information concerning economic impacts when making listing determinations. However, section 4(b)(2) of the Act states that the Secretary shall designate and make revisions to critical habitat on the basis of the best available scientific data after taking into consideration the economic impact, national security impact, and any other relevant impact of specifying any particular area as critical habitat. Therefore, we will consider the provisions of 4(b)(2) when we designate critical habitat for the species in the future.

(17) *Comment*: The proposed listing is premature. Adequate time must be provided to determine if conservation efforts, such as the candidate conservation agreements with assurances (CCAAs) and the Lesser Prairie-Chicken Range-wide Conservation Plan, are sufficient to maintain a viable lesser prairie-chicken population.

Our Response: We recognize the significant efforts of all of our partners in the conservation of the lesser prairie-chicken, and these conservation efforts and the manner in which they are helping to ameliorate threats to the species are considered in our final listing determination. Section 4(b)(1)(A) of the Act requires us to take into account those efforts being made by a State or foreign nation, or any political subdivision of a State or foreign nation, to protect such species, and we fully recognize the contributions of the State and local programs. However, the Act requires us to make determinations based on the best scientific and commercial data available “at the time of listing” after conducting a review of the status of the species and after taking into account those efforts, if any, being made to protect such species.

The lesser prairie-chicken has been identified as a candidate species since 1998. Since that time, annual candidate notices of review have been conducted, and the scientific literature and data continued to indicate that the lesser prairie-chicken is detrimentally impacted by ongoing threats, and we continued to find that listing the species was warranted. Our determination is guided by the Act and its implementing regulations, considering the five listing factors and using the best available scientific and commercial information.

(18) *Comment*: The Lesser Prairie-Chicken Range-wide Conservation Plan effectively addresses the threats being faced by the species throughout the range. By using voluntary, incentive-based programs, the Range-wide Conservation Plan encourages effective management on private lands for the lesser prairie-chicken and implements mechanisms for industry to avoid, minimize, and mitigate impacts to the species’ habitat. These efforts effectively ameliorate the threats identified in the proposed rule for listing and, therefore, support a not-warranted finding.

Our Response: The Service supports the efforts of the Western Association of Fish and Wildlife Agencies (WAFWA) in the development of the rangewide plan and has recognized it as a landmark effort in collaborative, rangewide planning for conservation of an at-risk species. On October 23, 2013, the Service announced its endorsement of the plan as a comprehensive conservation program that reflects a sound conservation design and strategy that, when implemented, will provide a net conservation benefit to lesser prairie-chicken. The plan includes a strategy to address threats to the prairie-chicken throughout its range, establishes measurable biological goals and objectives for population and habitat, provides the framework to achieve these goals and objectives, demonstrates the administrative and financial mechanisms necessary for successful implementation, and includes adequate monitoring and adaptive management provisions. For these reasons, elsewhere in today's **Federal Register**, we are finalizing a special rule under section 4(d) of the Act that, among other things, specifically exempts from regulation the take of lesser prairie-chicken if that take is incidental to carrying out the rangewide plan.

The Service's Policy for Evaluation of Conservation Efforts When Making Listing Decisions (PECE) provides guidance on how to evaluate conservation efforts that have not yet been fully implemented or have not yet demonstrated effectiveness. The policy presents criteria for evaluating the certainty of implementation and the certainty of effectiveness for such conservation efforts. The Service has evaluated the rangewide plan under the PECE criteria. A summary of that evaluation follows.

At the time of the listing decision, based upon the criteria in PECE, the Service is uncertain concerning availability of funding and the level of voluntary participation in the rangewide plan in the future. At this time, the measures in the rangewide plan do not allow the Service to conclude that the lesser prairie-chicken no longer meets the Act's definition of a threatened or endangered species. Additionally, due to the flexibility that is necessarily built into the implementation of the rangewide plan, there is uncertainty about when and where impacts and offsets will occur. Most importantly, even if the plan is implemented in the future as written and is effective at achieving its goals, we must be able to show that the plan has contributed to the elimination of one or more threats to the species identified through the 4(a)(1) analysis at the time of the listing determination such that the species no longer meets the definition of threatened or endangered. Largely as a result of the degree of coordination and adaptive management built into the rangewide plan, there is a high degree of certainty that the plan will achieve its stated purposes of creating a net conservation benefit to the species and moving the species towards its population goals if there is sufficient participation and enrollment from landowners and industry. However, generally owing to the uncertainty of the timing of conservation delivery and the funds generated by current industry enrollment, the rangewide plan has not eliminated or adequately reduced the threats identified such that the species no longer meets the Act's definition of threatened or endangered at this time, as discussed below.

The conservation strategy employed in the rangewide plan (1) complements and builds on existing conservation efforts (e.g., CRP), (2) uses an "avoid, minimize, and mitigate" strategy to address industry impacts, and (3) provides financial incentives to landowners to manage lands to benefit lesser prairie-chickens. Through the mitigation framework and application of adaptive management principles, the rangewide plan, if enrollment is sufficient and if the plan is appropriately managed, will provide a net conservation benefit to the species and result in incremental improvements to the level and quality of suitable habitat over time.

Lands to be enrolled as offsets to impacts are not necessarily currently occupied high quality habitats, and the location of offset units is entirely driven by the willingness of landowners to participate. They are lands where management practices are to be implemented that would improve the suitability of those lands for lesser prairie-chickens. These landowners are not required to implement identical management practices, but are rather provided a suite of management options for their lands. Until those practices are identified for each parcel combined with the length of the contract and the quality and location of the lands, we have little certainty about how much conservation uplift can be expected or in what timeframe the benefit will accrue. Even if there would be significant enrollment of lands into the rangewide plan in the short term, it will still take several years for habitat improvement practices to take effect for some of the conservation practices and for lesser prairie-chicken populations to improve.

The effectiveness of the rangewide plan is further complicated by the impact of continued drought on the landscape. If the current drought subsides, the rangewide plan’s improved management on lands could result in an upturn in the status of the species. However, if the drought persists, the rangewide plan will not create additional usable habitat necessary for the species quickly or at all. This particular threat is largely outside of the ability of management actions to address; therefore, it is a threat that is not addressed by the rangewide plan, at least over the short term. Given the particularly dire status of the lesser prairie-chicken in 2013 due to ongoing drought (approximately 17,000 birds estimated), this threat is of high magnitude and immediacy. Over the longer term, the rangewide plan may ameliorate the threat of drought by creating additional habitat so that the birds can rebound to higher numbers that can better withstand this threat.

Finally, the Service is uncertain concerning the potential for a lag time between authorizing impacts, securing contracts with landowners to apply conservation to mitigate for those impacts, and implementing the conservation actions through those contracts. While mitigation fees must be paid and conservation contracts must be in place prior to impacts occurring, the rangewide plan does not require habitat improvement or creation of suitable habitat prior to impacts occurring. The rangewide plan grants a waiver period for the oil and gas industry wherein while all impacts must ultimately be mitigated for, the waiver grants oil and gas impacters the ability to develop enrolled lands in advance of conservation delivery. The mitigation metrics are set up such that over the life of the plan, we anticipate improvement in the status of the species, but that some of the conservation delivery will take at least a few years to start being realized. At the time of the listing decision, we do not have certainty of the timeframe and the extent of the habitat improvement.

In conclusion, we have a high level of certainty that the rangewide plan will improve the status of the species into the future if sufficient enrollment occurs and the plan is implemented accordingly. However, the rangewide plan has not contributed to the elimination or adequate reduction of the threats to the species at the current time to the point that the species does not meet the definition of threatened or endangered.

Public Comments

Species' Populations

(19) *Comment*: The proposed rule states that very little information is available regarding lesser prairie-chicken population size prior to 1900 and further states that rangewide population estimates were almost nonexistent until the 1960s. The lack of practical baseline population estimates and historical population studies result in considerable data gaps regarding the significance of population fluctuations as well as the establishment of a trend-line on the actual population estimates of the species. Commenters question how the Service can make a reasonable determination that listing is warranted without historical information prior to 1900.

Our Response: We recognize that data gaps exist in the estimated historical population size of the species and in the development of population trends for the species, but we are required by the Act to determine whether or not the species meets the definition of an endangered or threatened species on the basis of the best scientific and commercial data available. We recognize that population fluctuations are common for the lesser prairie-chicken in response to variable weather and habitat conditions, but the best available science supports that the overall population size has likely declined from possibly millions of birds to current estimates of thousands of birds. We present the best available information on population sizes in the "Rangewide Population Estimates" and "State-by-State Information on Population Status" sections of this final determination. Under section 4(a)(1) of the Act, we determine whether a species is an endangered or threatened species because of any of the following five factors: (A) The present or threatened destruction, modification, or curtailment of its habitat or range; (B) overutilization for commercial, recreational, scientific, or educational purposes; (C) disease or predation; (D) the inadequacy of existing regulatory mechanisms; and (E) other natural or manmade factors affecting its continued existence. We examined the best scientific and commercial information available regarding present and future threats faced by the lesser prairie-chicken in the **Summary of Factors Affecting the Species**. Please refer to the **Determination** section of this final listing rule for further discussion.

(20) *Comment*: The Service incorrectly points to the effects of inconsistent data, methods, and effort levels in existing survey and trend data and then dismisses a study that scientifically addresses these flaws. The Interim Assessment of Lesser Prairie-Chicken Trends since 1997 (Hagen 2012) standardizes inconsistencies among previous

survey studies and calculates the population trend of the species from the standardized survey data. At a minimum, the Service should explain why it dismissed this study.

Our Response: We discuss the Hagen (2012) interim assessment in the "Rangewide Population Estimates" of this final listing determination. We are reluctant to place considerable weight on this interim assessment for several reasons, as discussed below in that section. We evaluated all sources of the best scientific and commercial data available and found other lines of evidence more compelling. More specifically, the rangewide aerial survey results show that the total estimated abundance of lesser prairie-chickens dropped from 34,440 individuals (90 percent upper and lower confidence intervals of 52,076 and 21,718 individuals, respectively) in 2012, to 17,616 individuals (90 percent upper and lower confidence intervals of 20,978 and 8,442 individuals, respectively) in 2013 (McDonald *et al.* 2013, p. 24).

(21) *Comment*: The Service needs a scientifically sound estimate of current lesser prairie-chicken populations and habitats to use as a baseline to determine future population increases and to delineate critical habitat. Similarly, the Service should define a population threshold necessary to be considered recovered post-listing.

Our Response: In the springs of 2012 and 2013, the States, in conjunction with the Western Association of Fish and Wildlife Agencies, implemented a rangewide sampling framework and survey methodology. This aerial survey protocol was developed to provide a more consistent approach for detecting rangewide trends in lesser prairie-chicken. The aerial surveys conducted in 2012 and 2013 provide the best estimate of current rangewide population size of the lesser prairie-chicken. The results of the aerial surveys are discussed in more detail in the "Rangewide Population Estimates" section of this final listing determination. Recovery planning, as outlined in more detail in section 4(f)(1) of the Act, is the mechanism by which the Service determines what is necessary for the conservation and survival of the species. Recovery plans must include objective, measurable criteria that, when met, would result in a determination that the species be removed from the List of Endangered and Threatened Wildlife. As mentioned above, recovery planning for the lesser prairie-chicken will be initiated after the listing determination is finalized.

Species' Habitat

(22) *Comment*: The Service inaccurately identified the lesser prairie-chicken's historical range in the proposed rule. Some areas identified as historical range have never been lesser prairie-chicken habitat.

Our Response: As required by section 4(b) of the Act, we used the best scientific and commercial data available in this final listing determination. The commenters provided no indication of specific areas they believe were inaccurately identified as part of the historical range and, similarly, provided no rationale (e.g., literature or scientific evidence) to indicate any specific areas that should be removed from the historical range. Please refer to the “Historical Range and Distribution” section for a discussion of the best scientific and commercial data available regarding the historical range of the lesser prairie-chicken. In addition, please refer to our response to comment 7 in *Peer Reviewer Comments*, above.

(23) *Comment*: Based on anecdotal evidence and specimen collections, the actual historical range of the lesser prairie-chicken for a period from at least 1877 through 1925 may have included from southwestern Nebraska (northern limits) and southeastward to southwestern Missouri (eastern limits). Given this information, the apparent “increased range expansion” in Kansas is really movement back into its previous range, and not an expansion. Additionally, this reestablishment back to its former range appears to be within artificial habitat (i.e., CRP grasslands).

Our Response: The extent of the historical range is an estimate, and we, therefore, use this term and the term “approximate” in referring to the historical range in this final listing rule. We also recognize that the extent of the historical range may have fluctuated over time, based on habitat conditions evident at any one period. The information we present in our rule serves to reflect the estimated extent of the historical range and provides some context with which we can discuss the estimated occupied range. We recognize that lesser prairie-chickens have been documented from Nebraska based on specimens collected during the 1920s. Sharpe (1968, pp. 51, 174) considered the occurrence of lesser prairie-chickens in Nebraska to be the result of a short-lived range expansion facilitated by settlement and cultivation of grain crops. Sharpe did not report any confirmed observations since the 1920s (Sharpe 1968, entire), and no sightings have been documented despite searches over the last 5 years in southwestern Nebraska (Walker 2011, entire). Therefore, Nebraska is not included in the delineated historical range of the species; further, the best scientific and commercial information available does not indicate that lesser prairie-chickens currently occur in Nebraska.

Lawrence (1877), as cited in the comment, documented finding 30 lesser prairie-chicken specimens for sale in New York that he ascertained had originated from southern Missouri; however, the origin of these birds is questionable (Sharpe 1968, p. 42). This anecdotal evidence is the only evidence that the species may have one time occurred in Missouri; therefore, there is not enough evidence to support that Missouri was within the historical range of the species. Thus, Nebraska and Missouri are not included in the estimated historical range of the species. However, as discussed in our response to comment 8 above, given the historical records, we agree that the currently occupied range in northwestern Kansas does not represent a range expansion for lesser prairie-chicken. Instead, we consider this to be a reoccupation of former range.

(24) *Comment*: The data cited and relied upon by the Service show that previous declines in lesser prairie-chicken range have stabilized. The Service argues that range occupation trends are key indicators in determining whether the lesser prairie-chicken is a

threatened species; however, the data provided and utilized by Service show that, between 1980 and 2007, the occupied range increased 159 percent. The increase over that period totaled more than 43,253 square kilometers (sq km) (16,700 square miles (sq mi)). In its evaluation of whether the lesser prairie-chicken range is increasing, the Service examined the period preceding European settlement of the United States to 1980. The Service failed to consider all range-occupancy trend data after 1980. The Service should explain its decision to base range decline estimates on the time period from pre-European settlement to 1980 when more recent and reliable data were available.

Our Response: The total maximum historically occupied range prior to European settlement is estimated to be about 466,998 sq km (180,309 sq mi), whereas the total estimated occupied range is now estimated to encompass 70,602 sq km (27,259 sq mi) as of 2007. The currently occupied range now represents roughly 16 percent of the estimated historical range. This value is a close approximation because a small portion of the range in Kansas lies outside the estimated maximum historical range and was not included in this analysis. This is further explained in the "Historical Range and Distribution" and "Current Range and Distribution" sections of the rule. Thus, we based our range decline estimates on the time period from pre-European settlement to 2007. At stated in the response to comment 7 under *Peer Reviewer Comments*, above, our calculations of the loss of historical range are an estimate and not an exact value, but they demonstrate that the range of the lesser prairie-chicken likely has contracted substantially since historical times. In the **Summary of Factors Affecting the Species**, we provide evidence to support that the species is imperiled throughout all of its range due to ongoing and future impacts of cumulative habitat loss and fragmentation as a result of conversion of grasslands to agricultural uses; encroachment by invasive, woody plants; wind energy development; petroleum production; roads; and the presence of manmade vertical structures. These threats are currently impacting lesser prairie-chickens throughout their range and are projected to continue and to increase in severity into the future.

(25) *Comment*: The lesser prairie-chicken does not naturally exist in Deaf Smith County, Texas, and was incorrectly identified in the area occupied by the species.

Our Response: In March 2007, the Texas Parks and Wildlife Department (TPWD) reported that lesser prairie-chickens were suspected in portions of Deaf Smith County. Aerial and road surveys conducted in 2010 and 2011 did not detect lesser prairie-chickens in Deaf Smith County; however, in 2012, Timmer (2012, pp. 36, 125–131) observed lesser prairie-chickens in Deaf Smith County. The western portion of Deaf Smith County is included in the Lesser Prairie-Chicken Range-wide Conservation Plan as part of the shinnery oak prairie (Van Pelt *et al.* 2013, p. 87). Based upon a review of the best scientific and commercial information available, Deaf Smith County is included as part of the estimated occupied range of the species.

(26) *Comment*: Southwest Quay County, New Mexico, is incorrectly identified in the lesser prairie-chicken ecoregion map as being comprised of shinnery oak prairie. There are no shinnery oak vegetative sites within the Southwest Quay Soil and Water Conservation District.

Our Response: On *http://www.regulations.gov*, we provided an estimated occupied range map as supporting information for the proposed listing rule; although Quay County is identified in the map as part of the estimated historical range, the current estimated occupied range includes only very small portions of southeastern Quay County. The ecoregion map referenced by the commenter is provided in the Lesser Prairie-Chicken Range-wide Conservation Plan. Southeastern Quay County is identified as part of the shinnery oak prairie in the figures provided in the Lesser Prairie-Chicken Range-wide Conservation Plan, but the southwestern portion of the county is not included (Van Pelt *et al.* 2013, p. 80). As stated in the proposed rule, the New Mexico Department of Game and Fish (NMDGF) reports that no leks have been detected in northeastern New Mexico, where Quay County occurs. However, habitat in this area appears capable of supporting lesser prairie-chicken, but the lack of any known leks in this region since 2003 suggests that lesser prairie-chicken populations in northeastern New Mexico, if still present, are very small.

(27) *Comment*: The outer extent of the currently defined range is drawn, especially in the southeast quadrant, based on references to places where prairie-chickens

were reported to have been seen with no documentation to indicate the resident or transient status of the birds. Thus, the potential range of the species needs to be better defined.

Our Response: In the "Current Range and Distribution" section, we discuss the currently occupied range as provided by a cooperative mapping effort between the Playa Lakes Joint Venture and the five State wildlife agencies within the range of the lesser prairie-chicken. The resulting map was provided on *http://www.regulations.gov* as supplemental information to the proposed rule. We consider this mapping effort the best scientific and commercial data available regarding the estimated current occupied range. The commenter provided no rationale (e.g., literature or scientific evidence) to indicate which specific areas they believe should or should not be included in the range map.

(28) *Comment*: Grain production in certain areas has provided desirable, though unnatural, feeding habitat for lesser prairie-chickens in the past. However, changes in farming practices and decline in grain production, rather than habitat degradation, has caused the appearance of lesser prairie-chicken population declines.

Our Response: The Service recognizes that, when available, lesser prairie-chickens will use cultivated grains, such as grain sorghum (*Sorghum vulgare*) and corn (*Zea mays*), during the fall and winter months (Snyder 1967, p. 123; Campbell 1972, p. 698; Crawford and Bolen 1976c, pp. 143–144; Ahlborn 1980, p. 53; Salter *et al.* 2005, pp. 4–6). However, lesser prairie-chickens tend to predominantly rely on cultivated grains when production of natural foods, such as acorns and grass and forb seeds, are deficient, particularly during drought and severe winters (Copelin 1963, p. 47; Ahlborn 1980, p. 57). Overall, the amount of land used for crop production nationally has remained relatively stable over the last 100 years, although the distribution and composition have varied (Lubowski *et al*. 2006, p. 6; Sylvester *et al*. 2013, p. 13). Despite the stability in crop production, the availability of grains has not slowed the decline of the species since pre-European settlement. As some cropland is transitioned to non-agricultural uses, new land is being brought into cultivation helping to sustain the relatively constant amount of cropland in existence over that period. Nationally, the amount of cropland that was converted to urban uses between 1982 and 1997 was about 1.5 percent (Lubowski *et al*. 2006, p. 3). During that same period nationally, about 24 percent of cultivated cropland was converted to less intensive uses such as pasture, forest, and CRP (Lubowski *et al*. 2006, p. 3). Thus, a decline in grain production is not directly associated with lesser prairie-chicken population declines.

Threats

(29) *Comment*: Members of the public stated that hunting is driving the species to extinction and should be banned before listing is enacted. Others simply stated that hunting (or overutilization) is not a significant issue for the species or a cause for overutilization.

Our Response: Hunting programs are administered by State wildlife agencies. Currently, lesser prairie-chicken harvest is allowed only in Kansas. As discussed in the *Hunting and Other Forms of Recreation, Educational, or Scientific Use* section of the rule, we do not consider hunting to be a threat to the species at this time. However, as populations become smaller and more isolated by habitat fragmentation, their resiliency to the influence of any additional sources of mortality will decline. Intentional hunting of the lesser prairie-chicken will be prohibited when this listing goes into effect. Please refer to the final 4(d) special rule published elsewhere in today's **Federal Register** for an explanation of the prohibited actions, and exceptions to those prohibitions, that are necessary and advisable for the conservation of the lesser prairie-chicken.

(30) *Comment:* The proposed rule indicates that collisions with fences are an important source of mortality, but no actual data or numbers killed were given. Further, any risk posed by fences should be discounted because ranchers will remove or replace fences in the future, which could benefit lesser prairie-chickens. The most recent data do not support that fence collision takes a significant number of birds (Hagen 2012, entire; Grisham *et al.* 2012, entire). Additionally, the Service fails to acknowledge the amount of fence removal conducted through conservation efforts like the Wildlife Habitat Incentive Program (WHIP).

Our Response: We provide a complete discussion of the impacts associated with fence collisions in the *Collision Mortality* section of the **Summary of Factors Affecting the Species**. This section also includes metrics on collision mortality associated with fences and other manmade structures; however, precisely quantifying the scope of the impact of fence collisions rangewide is largely unquantified due to a lack of relevant information. However, the prevalence of fences and power lines within the species' range suggests these structures may have at least localized, if not widespread, detrimental effects. While some conservation programs, including WHIP, have emphasized removal of unneeded fences, it is likely that a majority of existing fences will remain on the landscape indefinitely without substantially increased removal efforts. Existing fences likely operate cumulatively with other mechanisms described in this rule to diminish the ability of the lesser prairie-chicken to persist, particularly in areas with a high density of fences.

(31) *Comment*: Disease and predation are not significant issues for the lesser prairie-chicken.

Our Response: We do not consider disease or parasite infections to be a significant factor in the decline of the lesser prairie-chicken. However, should populations continue to decline or become more isolated by fragmentation, even small changes in habitat abundance or quality could have a more significant influence on the impact of parasites and diseases. Alternatively, predation has a strong relationship with certain anthropogenic factors, such as fragmentation, vertical structures, and roads, and continued development is likely to increase the effects of predation on lesser prairie-chickens beyond natural levels. As a result, predation is likely to contribute to the declining status of the species. This is discussed further in the *Predation* section of the final rule. The commenter provides no rationale (e.g., literature or scientific evidence) to support his assertion that predation is not a threat to the lesser prairie-chicken.

(32) *Comment*: The broad statement regarding the avian toxicity of dimethoate (an insecticide) to lesser prairie-chickens made by the Service is not scientifically defensible. The statement was based on a single study that was outdated and of questionable quality and the Service's conclusion attributing sage grouse mortality to the chemical is not supported by the study. First, the study was on sage grouse, which have very different behavior patterns than lesser prairie-chickens; this makes data from a sage grouse field study a poor surrogate for assessing risks to lesser prairie-chickens. Second, it is unclear from the study if the source of toxicity was the application of the insecticide to the alfalfa field or a different insecticide applied to a nearby field prior to initiation of the study.

Our Response: We stated in the proposed rule that in the absence of more conclusive evidence, we do not currently consider application of insecticides for most agricultural purposes to be a threat to the species. However, we also state the primary conclusion of the only study we are aware of that has evaluated the use of dimethoate on grouse species. The study finds that, of approximately 200 greater sage grouse known to be feeding in a block of alfalfa sprayed with dimethoate, 63 were soon found dead, and many others exhibited intoxication and other negative symptoms (Blus *et al.* 1989, p. 1139). Because lesser prairie-chickens are known to selectively feed in alfalfa fields (Hagen *et al.* 2004, p. 72), there is cause for concern that similar impacts could occur. Although we acknowledge that greater sage grouse have different behavior patterns than the lesser prairie-chicken, there are no peer-reviewed studies available to us that specifically analyze the effects of insecticides on lesser prairie-chickens. Therefore, it is reasonable to use this study to draw a broad conclusion that similar impacts to the lesser prairie-chicken are possible. The researchers note that a flock of about 200 sage grouse occupied a field that was sprayed with the insecticide on August 1; about 30 intoxicated and dead grouse were observed the following day with the last verified insecticide-related mortality occurring on August 12 (Blus *et al.* 1989, p. 1142). The study further verifies, through brain chemistry analysis of the greater sage grouse, that at least 10 deaths directly resulted from dimethoate (Blus *et al.* 1989, p. 1142). Therefore, this study represents the best available science and provides evidence to support that insecticides may present a concern for the lesser prairie-chicken; however, we also recognize that there is not enough evidence provided to determine that insecticides present a threat to the species as a whole.

(33) *Comment*: The proposed rule states the distance that the lesser prairie-chicken avoids around manmade infrastructure, including a wind turbine, is more than

1.6 km (1 mi). The Service should provide conclusive evidence or studies that birds entirely disappear from a habitat area due to manmade structures. The science is unclear on whether or not individual birds will return to areas where wind and transmission lines have been developed after initial construction ceases.

Our Response: In the “Causes of Habitat Fragmentation Within Lesser Prairie-Chicken Range” section, we present the results of the following studies to provide evidence that natural vertical features like trees and artificial above ground vertical structures such as power poles, fence posts, oil and gas wells, towers, and similar developments can cause general habitat avoidance and displacement in lesser prairie-chickens and other prairie grouse: Anderson 1969, entire; Robel 2002, entire; Robel *et al.* 2004, entire; Hagen *et al.* 2004, entire; Pitman *et al.* 2005, entire; Pruett *et al.* 2009a, entire; and Hagen *et al.* 2011 entire. This avoidance behavior is presumably a behavioral response that serves to limit exposure to predation.

The observed avoidance distances vary depending upon the type of structure and are likely also influenced by disturbances such as noise and visual obstruction associated with these features. According to Robel (2002, p. 23), a single commercial-scale wind turbine creates a habitat avoidance zone for the greater prairie-chicken that extends as far as 1.6 km (1 mi) from the structure. Pitman *et al.* 2005 (pp. 1267–1268) provides evidence to support that lesser prairie-chickens likely exhibit a similar response to tall structures like wind turbines. These studies do not indicate that lesser prairie-chickens will never occur within 1.6 km (1 mi) of a manmade structure, but they provide evidence to support that observed avoidance distances can be much larger than the actual footprint of the structure. Thus, these structures can have significant negative impacts by contributing to further fragmentation of otherwise suitable habitats. As human-made structures continue to be developed across the landscape, other factors contributing to habitat loss and fragmentation include conversion of grasslands to agricultural uses; encroachment by invasive, woody plants; wind energy development; petroleum production; and roads. The cumulative effect of these factors is readily apparent at the regional scale, causing isolation of populations at regional, landscape, and local levels.

(34) *Comment*: Vodenhal *et al.* (2011, entire) found greater prairie-chickens to lek, nest, brood, and remain in the proximity of a Nebraska wind farm despite the presence of localized, towering structures. This study is at odds with the notion of site fidelity.

Our Response: Male lesser prairie-chickens have high site fidelity and consistently return to a particular lek site (Copelin 1963, pp. 29–30; Hoffman 1963, p. 731; Campbell 1972, pp. 698–699). Once a lek site is selected, males persistently return to that lek year after year (Wiley 1974, pp. 203–204). They often will continue to use these traditional areas even when the surrounding habitat has declined in value (for example, concerning greater sage-grouse; see Harju *et al.* 2010, entire). The Service recognizes that Vodenhal *et al.* (2011, unpaginated) observed greater prairie-chickens lekking near the Ainsworth Wind Energy Facility in Nebraska since 2006. The average distance of the observed display grounds to the nearest wind turbine tower was 1,430 m (4,689 ft) for greater prairie-chickens. The Vodenhal *et al.* (2011, unpaginated) study appears to indicate that greater prairie-chickens may be more tolerant of wind turbine towers than other species of prairie grouse because they continued to use areas near the wind facility despite presence of the towers. Occurrence near these structures may actually be due to strong site fidelity or continued use of suitable habitat remnants, though these populations may not be able to sustain themselves without immigration from surrounding populations (i.e., population sink) (Hagen 2004, p. 101). Thus, we conclude that this study supports the concept of site fidelity, as birds appear to return to the area despite the diminished habitat quality. Other recent research supports that vertical features, including wind turbines, cause general habitat avoidance and displacement in lesser prairie-chickens and other prairie grouse (Anderson 1969, entire; Robel 2002, entire; Robel *et al.* 2004, entire; Hagen *et al.* 2004, entire; Pitman *et al.* 2005, entire; Pruett *et al.* 2009a, entire; Hagen *et al.* 2011, entire; Hovick *et al.* unpublished manuscript, entire).

(35) *Comment*: The Service relies heavily on the potential for predation facilitated by tall structures like wind turbines without substantial research. Predation is hypothesized to be a reason for lesser prairie-chicken avoidance of tall structures, but this hypothesis has not been adequately studied.

Our Response: Recent research, as cited in the final rule, demonstrates that natural vertical features like trees and artificial, aboveground vertical structures (such as power poles, fence posts, oil and gas wells, towers, and similar developments) can cause general habitat avoidance and displacement in lesser prairie-chickens and other prairie grouse (Anderson 1969, entire; Fuhlendorf *et al.* 2002a, pp. 622–625; Robel 2002, entire; Robel *et al.* 2004, entire; Hagen *et al.* 2004, entire; Pitman *et al.* 2005, entire; Pruett *et al.* 2009a, entire; Hagen *et al.* 2011 entire). This avoidance behavior is presumed to be a behavioral response that serves to limit exposure to predation. We are concerned not only with an actual increase in the impact of avian predation, but also, and even more so, with the avoidance behavior of the lesser prairie-chicken causing individuals to leave fragmented areas of otherwise suitable habitats. Further discussion is provided in the *Predation* and "Causes of Habitat Fragmentation within Lesser Prairie-Chicken Range" sections.

(36) *Comment*: Studies including Toepfer and Vodehnal (2009) and Sandercock *et al*. (2012) require further analysis in the listing rule. These studies bring into question the Service's central premise that fragmented habitat causes the species to be in danger of extinction in the foreseeable future.

Our Response: We have added a discussion of these studies in the *Wind Power and Energy Transmission Operation and Development* section, below. The most significant impact of wind energy development on lesser prairie-chickens is caused by the avoidance of useable space due the presence of vertical structures (turbine towers and transmission lines) within suitable habitat. The noise produced by wind turbines also is anticipated to contribute to behavioral avoidance of these structures. Avoidance of these vertical structures by lesser prairie-chickens can be as much as 1.6 km (1 mi), resulting in large areas (814hectares (ha) (2,011 acres (ac)) for a single turbine) of unsuitable habitat relative to the overall footprint of a single turbine. Where such development has occurred or is likely to occur, these areas are no longer suitable for lesser prairie-chicken even though many of the typical habitat components used by lesser prairie-chicken remain. Therefore, the significant avoidance response of the species to these developments and the scale of current and future wind development likely to occur within the range of the lesser prairie-chicken leads us to conclude that wind energy development is a threat to the species, especially when considered in combination with other habitat-fragmenting activities.

(37) *Comment*: In its assessment of risks from herbicides, the Service never acknowledges current limited use of herbicides to remove shinnery oak and also fails to acknowledge that the New Mexico and Texas CCAAs require reductions in herbicide use. The Service never addresses the Grisham (2012) 10-year study, which "…ultimately suggests that reduced rates of herbicide and short-duration grazing treatments are not detrimental to lesser prairie-chicken nesting ecology."

Our Response: Grisham (2012, p. 115) states that the low dose of herbicide used in the study was designed to reduce, not eliminate, shrubs; most nests maintained some form of shrub component. Grisham caveats his management implications by stating that higher doses may be detrimental to nesting lesser prairie-chickens because high doses completely eliminate shinnery oak from the community (Peterson and Boyd 1998, as cited in Grisham 2012, p. 115). In their analysis of the status of the species, the Service considered the conservation measures currently implemented to reduce herbicide use.

(38) *Comment*: Although the Service seems to acknowledge that climate change is not presently harming the lesser prairie-chicken and will occur over the next 60 years, the available data do not support a conclusion that any of those potential effects are foreseeable. Alternatively, other commenters assert that the effects of climate change needs to be more thoroughly included in the future threats that are challenging this species, otherwise the disturbances to the species' habitat is under-represented.

Our Response: We used the best scientific and commercial information available to develop the analysis of climate change presented in the proposed rule. Since the publication of the proposed rule, Grisham *et al.* (2013, entire) published a new study evaluating the influence of drought and projected climate change on the reproductive ecology of the lesser prairie-chicken in the Southern High Plains. They hypothesized that average daily survival would decrease dramatically under all climatic scenarios they examined. Nest survival from onset of incubation through hatching were predicted to be less than or equal to 10 percent in this region within 40 years. Modeling results indicated that nest survival would fall well below the threshold for population persistence during that time (Grisham *et al.* 2013, p. 8). We have incorporated a discussion of Grisham *et al.* (2013, entire) in this final rule.

Although estimates of persistence of lesser prairie-chickens provided by Garton (2012, pp. 15–16) indicated that lesser prairie-chickens in the Shinnery Oak Prairie Region had a relatively high likelihood of persisting over the next 30 years, the implications of climate change were not fully considered in his analysis, as little information evaluating the effects of climate change on the species and its habitat was available at that time. Predictions provided by Grisham *et al.* (2013, p. 8) indicate that the prognosis for persistence of lesser prairie-chickens within this isolated region on the southwestern periphery of the range is considerably worse than previously predicted. This provides further evidence that climate change is likely to contribute to the current and future threats affecting the lesser prairie-chicken. This new information has been added to the rule and further supports that these impacts are likely to occur in the foreseeable future. We anticipate that climate-induced changes in ecosystems, including grassland ecosystems used by lesser prairie-chickens, coupled with ongoing habitat loss and fragmentation, will interact in ways that will amplify the individual negative effects of these and other threats identified in this final rule (Cushman *et al*. 2010, p. 8). Furthermore, ongoing and future habitat fragmentation is likely to negatively affect the species' ability to respond to climate change.

Conservation Efforts

(39) *Comment*: The effect of the Wind Energy Habitat Conservation Plan (HCP) on the need to list the species is not adequately discussed. The Service failed to analyze the expected positive impact of the HCP on lesser prairie-chicken populations.

Our Response: The Service anticipates that the conservation program of the Great Plains Wind Energy HCP could involve measures such as acquisition and setting aside of conservation or mitigation lands. A draft HCP was submitted for review by the Service and State agency partners in November of 2013, but is not expected to be completed until the fall of 2015. Thus, this conservation effort is still in the development phase, and the HCP has not yet been formalized. The future of the HCP and its potential contribution to lesser prairie-chicken conservation is unclear at this time, and we cannot conclude that these efforts will be finalized as they are in draft form at this time. The HCP is further discussed in the *Multi-State Conservation Efforts* section of this final rule.

(40) *Comment*: The proposal for listing should better recognize current and ongoing voluntary conservation efforts in addition to conservation measures that are in place to minimize potential adverse effects resulting from activities including livestock grazing, pesticide use, and oil and gas development.

Our Response: We analyzed the best scientific and commercial information available on both conservation efforts and conservation measures intended to minimize potential adverse effects to the species and its habitat. Where commenters provided additional specific information for us to consider, we have included that information in our consideration of the status of the species in the development of this final rule. In most instances, however, the commenters did not provide specific information on additional conservation efforts and measures that warrant further consideration. Without this information, we cannot specifically address these concerns.

Service Policy

(41) *Comment*: An environmental impact statement should be prepared to assess the social and economic impact of endangered or threatened listing.

Our Response: As stated in the proposed rule, we have determined that environmental assessments and environmental impact statements need not be prepared in connection with regulations adopted under section 4(a)(1) of the Act. We published a notice outlining our reasons for this determination in the **Federal Register** on October 25, 1983 (48 FR 49244).

(42) *Comment*: The Service has not adequately defined "foreseeable future" as it relates to the status of the lesser prairie-chicken. The Service needs to establish the

“foreseeable future” as a period of years. In addition, the Service’s discussion of foreseeable future and the status of the lesser prairie-chicken uses vague terms (e.g., “near term,” “near future”) that suggest an undefined future point in time marks the point where the species passes from not being on the brink of extinction to being on the brink of extinction.

Our Response: The Act does not define the term “foreseeable future,” and the Act and its implementing regulations do not require the Service to quantify the time period of foreseeable future. Further, in a 2009 memorandum (M–37021, January 16, 2009) addressed to the Acting Director of the Service, the Office of the Solicitor, Department of the Interior, concluded that “as used in the [Act], Congress intended the term ‘foreseeable future’ to describe the extent to which the Secretary can reasonably rely on predictions about the future in making determinations about the future conservation status of the species.” The memorandum (M–37021, January 16, 2009) goes on to state, “the foreseeable future is not necessarily reducible to a particular number of years. Rather, it relates to the predictability of the impact or outcome for the specific species in question. … Such definitive quantification, however, is rarely possible and not required for a ‘foreseeable future’ analysis.” In assessing the status of the lesser prairie-chicken, we applied the general understanding of “in danger of extinction” discussed in the December 22, 2010, memo to the polar bear listing determination file, “Supplemental Explanation for the Legal Basis of the Department’s May 15, 2008, Determination of Threatened Status for the Polar Bear,” signed by then Acting Director Dan Ashe (hereafter referred to as Polar Bear Memo). A complete discussion of how the Service has applied these terms to the lesser prairie-chicken is provided in the **Determination** section.

(43) *Comment*: The Service failed to evaluate whether the species is endangered within any significant portion of its range. The lesser prairie-chicken's 81-percent decline in Texas, from 236,000 sq km to 12,000 sq km (91,120 sq mi to 4,633 sq mi) and 94 percent in New Mexico (mostly in the mixed grass prairie Bird Conservation Region) clearly qualifies the species for protection as endangered based on threats within a significant portion of its range.

Our Response: Under the Act and our implementing regulations, a species may warrant listing if it is endangered or threatened throughout all or a significant portion of its range. To determine whether or not a species is endangered or threatened, we evaluate the five listing factors, which include "the present or threatened destruction, modification, or curtailment of its habitat or range." The historical decline of the species' range, while highly relevant in considering the existence or effect of threats to the species in its current range, cannot itself be the basis for listing. In the **Determination** section, below, we outline that the ongoing and future impacts of cumulative habitat loss and fragmentation are the primary threats to the species. These impacts are the result of conversion of grasslands to agricultural uses; encroachment by invasive, woody plants; wind energy development; petroleum production; roads; and presence of manmade vertical structures, including towers, utility lines, fences, turbines, wells, and buildings. The threats to the survival of the lesser prairie-chicken occur with equal force throughout all of the species' remaining range and are not restricted to any particular portion of its currently occupied range. In other words, there is no indication that the threat of fragmentation occurs with greater or lesser force in any portion of the species' range. Accordingly, our assessments and determinations apply to this species throughout its entire range.

(44) *Comment*: The Service should revise its listing proposal to establish several distinct population segments (DPSs) of the lesser prairie-chicken in the final rule and list each DPS as endangered, threatened, or not warranted depending on the best available science.

Our Response: Commenters generally did not provide specific information as to what populations they felt meet the definition of a DPS; thus, we cannot analyze what the commenter presumes to be a DPS. We specifically discuss this issue as it relates to the Kansas population of lesser prairie-chicken in our response to comment 3 in *Peer Reviewer Comments*, above. Please refer to the **Determination** section of this final listing rule for further discussion.

(45) *Comment*: Prohibiting actions on private lands as a result of listing the species as threatened or endangered will constitute an uncompensated taking under the Eminent Domain Law and would impair private property rights. The Service should

include better data on the social and economic values of private enterprise and private property rights.

Our Response: Listing a species as threatened or endangered does not affect constitutionally protected property rights (see the Fifth Amendment to the U.S. Constitution). Executive Order 12630 (Government Actions and Interference with Constitutionally Protected Private Property Rights) requires that we analyze the potential takings implications of designating critical habitat for a species in a takings implications assessment. However, the listing of a species does not affect property rights, and, therefore, an assessment of potential takings of land is not necessary.

(46) *Comment*: The proposed rule is devoid of a discussion of whether the lesser prairie-chicken is still warranted-but-precluded from listing due to higher priority listing actions and what changed since earlier warranted but precluded findings for this species that now led to the issuance of a proposed rule. The Service should consider and document examples of changes in the basis that would justify not continuing to make a warranted-but-precluded finding. Such examples would include scientific information that indicates increased threats to the viability of the species, a change in the Service's resources to address listing decisions since the date of the 2011 candidate notice of review (76 FR 66370, October 26, 2011), and the absence of other candidate species that have the same or a lower listing priority number.

Our Response: The lesser prairie-chicken was originally identified as a candidate for listing with a listing priority number (LPN) of 8 (63 FR 31400, June 9, 1998). In 2008, we changed the LPN for the lesser prairie-chicken from an 8 to a 2 due to a change in the magnitude of threats from moderate to high (73 FR 75176, December 10, 2008). The changes in threats was primarily due to an anticipated increase in the development of wind energy and associated placement of transmission lines throughout the estimated occupied range of the lesser prairie-chicken. Conversion of certain CRP lands from native grass cover to cropland or other less ecologically valuable habitat and observed increases in oil and gas development also were important considerations in our decision to change the LPN. Our December 10, 2008 (73 FR 75176), candidate notice of review, provides the factual or scientific basis for changing the listing priority number.

(47) *Comment*: The proposed rule summarily dismisses conservation measures without fairly addressing their breadth, effectiveness, and chance of success. The Service must evaluate the conservation measures through, among other things, PECE, and must fully consider how conservation measures will reduce or remove threats. A fair evaluation of the conservation efforts will demonstrate that they are sufficient to protect the lesser prairie-chicken.

Our Response: We recognize the numerous conservation actions within the historical range of the lesser prairie-chicken, with many focused primarily on the currently occupied portion of the range, during the last 10 to 15 years. See the **Summary**

of Ongoing and Future Conservation Actions section of this rule. PECE applies to formalized conservation efforts that have not yet been implemented or those that have been implemented, but have not yet demonstrated whether they are effective at the time of listing. Conservation efforts that are being implemented and have demonstrated effectiveness are not within the scope of PECE. The effect of such conservation efforts on the status of a species is considered as part of the analysis of the five listing factors in section 4(a)(1) of the Act.

The PECE states that conservation efforts that have not yet been implemented or those that have been implemented, but have not yet demonstrated whether they are effective, must have reduced the threat at the time of listing, rather than reducing the threat in the future. To consider if a formalized conservation effort contributes to forming a basis for not listing a species or for listing a species as threatened rather than endangered, we must find that the conservation effort is sufficiently certain to be implemented and effective so as to have contributed to the elimination or adequate reduction of one or more threats to the species identified through the analysis of the five listing factors in section 4(a)(1) of the Act. PECE states that the Service must have a high level of certainty that the conservation effort will be implemented and effective, and has resulted in reduction or elimination of one or more threats at the time of listing.

In this final rule, we considered whether formalized conservation efforts are included as part of the baseline through the analysis of the five listing factors, or are appropriate for consideration under the PECE policy.

(48) *Comment*: The Service's application of the categories of species "in danger of extinction" identified in the Polar Bear Memo when determining whether to list the lesser prairie-chicken is inappropriate in several respects. First, the Service's definition of categories of species "in danger of extinction" constitutes an improper rulemaking without adequate opportunity for notice and comment. Second, the Service's reliance on this general categorization is inconsistent with the Act, which requires individual analyses of the factors affecting each species when evaluating whether listing is warranted, and is therefore arbitrary and capricious.

Our Response: As required by section 4(a)(1) of the Act, the Service determined whether the lesser prairie-chicken is an endangered or threatened species based on the five listing factors. See the **Summary of Factors Affecting the Species** section of this rule for our analysis.

As outlined in our response to comment 42, above, the Polar Bear Memo provides further guidance on the statutory difference between a threatened species and an endangered species. This memo was not a rulemaking document that required the opportunity for notice and comment—its categorizations are not binding; they are merely a helpful analytical tool. As explained more fully in the rule, the Polar Bear Memo clarifies that if a species is in danger of extinction now, it is an endangered species. In contrast, if it is in danger of extinction in the foreseeable future, it is a threatened species.

Moreover, we provided the public the opportunity to comment on the use of the Polar Bear Memo as it applies to the lesser prairie-chicken through the publication of the proposed listing rule. We did not receive any substantive comments providing evidence contrary to our application of the memo to the lesser prairie-chicken. Thus, this is an appropriate use of our guidance.

(49) *Comment*: Individuals requested the Service provide land management recommendations for post-listing conservation of the species and its habitat. Specifically, the public requested details on compatible grazing management, predator control plans, relocation of birds, etc.

Our Response: Management recommendations as may be necessary to achieve conservation and survival of the species will be addressed through recovery planning efforts. Under section 4(f)(1) of the Act, we are required to develop and implement plans for the conservation and survival of endangered and threatened species, unless the Secretary of the Interior finds that such a plan will not promote the conservation of the species. We will move to accomplish these tasks as soon as feasible.

(50) *Comment*: The Service should use the same standard of review and documentation of science as outlined in the 1994 Interagency Cooperative Policy on Information Standards under the Act (59 FR 34271, July 1, 1994); in many instances in the proposed rule, the Service cites a supporting source, which cites another source as the original scientific information.

Our Response: Without specific identification of the instances in the proposed rule where the Service cites other sources than the original scientific information, we are unable to provide a specific response. However, we acknowledge that in five instances we reference information that was cited in another document. We clearly identified each of these five instances within the proposed rule, as well as the final rule. In four of the five instances, we provided at least one additional citation to support the information provided.

(51) *Comment*: The Service cites multiple masters' theses in the proposed rule, and these documents are not peer-reviewed, published literature. Therefore, they do not represent the best available science.

Our Response: Our policy on information standards under the Act (published in the **Federal Register** on July 1, 1994 (59 FR 34271)), the Information Quality Act (section 515 of the Treasury and General Government Appropriations Act for Fiscal Year 2001 (Pub. L. 106-554; H.R. 5658)), and our associated Information Quality Guidelines, provide criteria, establish procedures, and provide guidance to ensure that our decisions are based on the best scientific data available. Information sources may include the recovery plan for the species, articles in peer-reviewed journals, conservation plans developed by States and counties, scientific status surveys and studies, biological assessments, other unpublished materials, or experts' opinions or personal knowledge. Despite the fact that these theses were not published, they still contain credible scientific information and represent the best scientific and commercial data available.

(52) *Comment*: The science for the proposed rule should be peer-reviewed based on National Academy of Science standards for conflicts of interest, and the Service should provide specific questions to be addressed in the peer review.

Our Response: In accordance with our joint policy published in the **Federal Register** on July 1, 1994 (59 FR 34270), we sought the expert opinions of at least three appropriate and independent specialists regarding the proposed rule. The purpose of such review is to ensure that our determination of status for this species is based on scientifically sound data, assumptions, and analyses. We invited these peer reviewers to comment, during the public comment period, on our use and interpretation of the science used in developing our proposal to list the lesser prairie-chicken. Comments from these peer reviewers have been reviewed, considered, and incorporated into this final rule, as appropriate.

Summary of Changes from the Proposed Rule

Based upon our review of the public comments, comments from other Federal and State agencies, peer review comments, issues addressed at the public hearings, and any new relevant information that may have become available since the publication of the proposal, we reevaluated our proposed rule and made changes as appropriate. Other than minor clarifications and incorporation of additional information on the species' biology, this determination differs from the proposal by:

(1) Based on comments and our analyses of the available literature, we have added a section on Taxonomy of the genus *Tympanuchus*, with particular emphasis on the lesser prairie-chicken.

(2) We have updated the **Summary of Ongoing and Future Conservation Efforts** section below and included an evaluation of conservation efforts pursuant to our Policy for Evaluation of Conservation Efforts When Making Listing Decisions (68 FR 15100, March 28, 2003).

(3) We have added a section on the influence of noise associated with development activities.

(4) We have added information on wing loading in grouse and a section on conservation genetics.

(5) We have also updated the “Rangewide Population Estimates” section to reflect the most current State survey information.

Summary of Ongoing and Future Conservation Efforts

In this section we review current efforts that are providing some conservation benefits to the lesser prairie-chicken and describe any significant conservation efforts that appear likely to occur in the future. We also completed an analysis of the Western Association of Fish and Wildlife Agencies’ Lesser Prairie-Chicken Range-wide Conservation Plan (rangewide plan), developed in association with the Interstate Working Group, pursuant to PECE.

Numerous conservation actions have been implemented within the historical range of the lesser prairie-chicken, many focused primarily on the currently occupied portion of the range, during the last 10 to 15 years. In the past, prairie grouse translocation efforts have been implemented for both conservation and recreation purposes. Releases of prairie chickens in Hawaii may have been one of the first attempts at relocation outside of the historical range in North America (Phillips 1928, p. 16; see “Historical Range and Distribution” section below). Most releases of lesser prairie-chickens have been in an attempt to repatriate portions of the historical range. Kansas began efforts to raise lesser prairie-chickens in captivity during the 1950s in an effort to secure sufficient numbers for limited releases (Coats 1955, p. 3). Toepfer *et al*. (1990, entire) summarized historical attempts to supplement or reestablish populations of prairie grouse; most met with poor success. Prior to 1970, there had been few attempts to supplement or reestablish populations of lesser prairie-chickens (Toepfer *et al*. 1990, p. 570). Kruse (1973, as cited in Toepfer *et al*. 1990, p. 570) reported on a release of lesser prairie-chickens in Colorado during 1962 that was unsuccessful. Snyder *et al*. (1999, entire) summarized more recent attempts to translocate prairie grouse in the United States. They reported on two separate releases of lesser prairie-chickens, one in Texas and one in Colorado, during the 1980s, both of which were unsuccessful (Snyder *et al*. 1999, p. 429). Despite the lack of success, translocations are becoming increasingly popular as a means of conserving populations of rare and declining species (Bouzat *et al*. 2009, p. 192). Although the best available information does not indicate any current efforts to propagate or translocate lesser prairie-chickens, future conservation efforts may involve such measures.

The State conservation agencies have taken a primary role in implementation of the conservation actions described below, but several Federal agencies and private conservation organizations have played an important supporting role in many of these efforts. Recently, several multi-State efforts have been initiated, and the following section discusses the known conservation efforts for the lesser prairie-chicken.

Multi-State Conservation Efforts

The Conservation Reserve Program (CRP), administered by the U.S. Department of Agriculture's (USDA) Farm Service Agency (FSA) and focused on certain agricultural landowners, has provided short-term protection and enhancement of millions of acres within the range of the lesser prairie-chicken. The CRP is a voluntary program that allows eligible landowners to receive annual rental payments and cost-share assistance to remove land from agricultural production and establish vegetative cover for the term of the contract. Contract terms are for 10 to 15 years, and the amount and dispersion of land enrolled in CRP fluctuates as contracts expire and new lands are enrolled. All five States within the range of the lesser prairie-chicken have lands enrolled in CRP. Initially, many enrolled CRP lands, except those in Kansas, were planted in nonnative grasses as the predominant cover type. In the State of Kansas, enrolled lands were planted in native species of grasses as the cover type, resulting in a considerable benefit to lesser prairie-chicken conservation. As the program has evolved since its inception in 1985, the FSA and their conservation partners have encouraged the use of native grasses as the predominant cover type in CRP lands, resulting in improved conservation benefits for lesser prairie-chickens. Use of native grasses in the CRP helps create suitable nesting, wintering, and brood rearing habitat for the lesser prairie-chicken.

In accordance with general CRP guidelines, crop producers can voluntarily enroll eligible lands in 10- to 15-year contracts in exchange for payments, incentives, and cost-share assistance to establish appropriate vegetation on enrolled lands. Program administrators may focus efforts on certain environmentally sensitive lands under a continuous signup process. The State Acres for Wildlife Enhancement program (SAFE) is a specific conservation practice utilized under CRP to benefit high-priority wildlife species including the lesser prairie-chicken. Landowners may elect to enroll in this program at any time under continuous sign-up provisions. Beginning in 2008, the SAFE program was implemented in Colorado, Kansas, New Mexico, Oklahoma, and Texas to target grassland habitat improvement measures within the range of the lesser prairie-chicken. These measures help improve suitability of existing grasslands for nesting and brood rearing by lesser prairie-chickens. Currently, there are almost 86,603 hectares (ha) (214,000 acres (ac)) allocated for the lesser prairie-chicken SAFE program (CP-38E) in Colorado, Kansas, New Mexico, Oklahoma, and Texas. Allocated acres for the SAFE program vary by State and are as follows: Colorado 8,700 ha (21,500 ac); Kansas 21,084 ha (52,100 ac); New Mexico 1,052 ha (2,600 ac); Oklahoma 6,111 ha (15,100 ac); and Texas 49,655 ha (122,700 ac). The current status of the SAFE program, organized by State, is provided in the *State-Specific Conservation Efforts* section, below.

In 2012, the FSA announced another CRP initiative addressing highly erodible lands. This nationwide initiative, the CRP Highly Erodible Land Initiative, is intended to protect certain environmentally sensitive lands by allowing landowners nationally to enroll up to 303,500 ha (750,000 ac) of lands having an erodibility index of 20 or greater. The initiative may further contribute to the short-term protection and enhancement of additional acres within the range of the lesser prairie-chicken. On average, lands with an erodibility index of 20 or greater have an erosion rate that exceeds 20 tons of soil eroded per acre per year. The term of these contracts is a 10 year period. The FSA, based on an analysis by Playa Lakes Joint Venture, estimates that there are 278,829 ha (689,000 ac) of active cropland with an erodibility index of 20 or higher remaining within the estimated occupied range of the lesser prairie-chicken (FSA 2013, p. 41). The vast majority of these lands occur in eastern New Mexico, the west Texas panhandle, western Oklahoma, and southwestern Kansas. More detailed information on the CRP is provided in the "Conservation Reserve Program (CRP)" section below.

In 2010, the USDA Natural Resources Conservation Service (NRCS) began implementation of the Lesser Prairie-Chicken Initiative (LPCI). The LPCI strategically provides conservation assistance, both technical and financial, to landowners throughout the LPCI's action area, which encompasses the lesser prairie-chicken's estimated occupied range plus a 16-km (10-mi) buffer. The LPCI focuses on maintenance and enhancement of suitable habitat while benefiting agricultural producers by maintaining the farming and ranching operations throughout the region. Twenty-seven different practices, under the core conservation practice Upland Wildlife Habitat Management (645), are used in implementation of the LPCI. Examples of the various practices, which are explained in more detail in the November 22, 2013, conference opinion described below, include prescribed grazing, prescribed burning, and the management or removal of woody plants including invasive species. These practices are applied or maintained annually for the life of the practice, typically 1 to 15 years, to treat or manage habitat for lesser prairie-chickens.

The LPCI and related NRCS activities were the focus on the November 22, 2013, conference opinion that the NRCS developed in coordination with the Service. In the conference opinion, the Service states that implementation of the NRCS conservation practices and their associated conservation measures described in the conference opinion are anticipated to result in a positive population response by the species by reducing or eliminating adverse effects. Furthermore, the Service states that overwhelming conservation benefits of implementation of the proposed action within selected priority areas, maintenance of existing habitat, and enhancement of marginal habitat will outweigh short-term negative impacts to individual lesser prairie-chickens. Implementation of the LPCI is expected to result in: Management of threats that adversely affect populations, an increase in habitat under the appropriate management prescriptions, and the development and dissemination of information on the compatibility of sustainable ranching operations with the persistence of this species across the landscape. Through the conference opinion, the Service found that effective implementation of conservation practice standards and associated conservation measures for the LPCI are anticipated to result in a positive population response by the species.

The NRCS has partnered with other stakeholders to fund, through the Strategic Watershed Action Teams program, additional staff positions dedicated to providing accelerated and targeted technical assistance to landowners within the current range of the lesser prairie-chicken. Technical assistance is voluntary help provided by NRCS that is intended to assist non-federal land users in addressing opportunities, concerns, and problems related to the use of natural resources and to help land users make sound natural resource management decisions on private, tribal, and other non-federal land. This assistance may be in the form of resource assessment, practice design, resource monitoring, or follow-up of installed practices. Numerous partners are involved in the multi-state LPCI, including the State conservation agencies, the Playa Lakes Joint Venture, and the Wood Foundation. The Environmental Quality Incentives Program (EQIP) and the Wildlife Habitat Incentives Program (WHIP), through the Working Lands for Wildlife partnership, are the primary programs used to provide for conservation through the LPCI. The lesser prairie-chicken is one of seven focal species being addressed by the Working Lands for Wildlife partnership. Through the Working Lands for Wildlife Partnership, participating landowners and other cooperators who agree to adhere to the requirements of the program are provided with regulatory predictability; they are exempted from the Act's "take" prohibition of listed species for up to 30 years, as long as the covered conservation practices are maintained and take is incidental to the implementation of these conservation practices.

The EQIP is a voluntary program that provides financial and technical assistance to agricultural producers through contracts up to a maximum term of 10 years in length. These contracts provide financial assistance to help plan and implement conservation practices that address natural resource concerns and opportunities to improve soil, water, plant, animal, air, and related resources on agricultural land. Similarly, WHIP is a voluntary program designed for landowners who want to develop and improve wildlife habitat on agricultural land, including tribal lands. Through WHIP, NRCS may provide both technical assistance and up to 75 percent cost-share assistance to establish and improve fish and wildlife habitat. Cost-share agreements between NRCS and the landowner may extend up to 15 years from the date the agreement is signed. By entering into a contract with NRCS, the landowner agrees to implement specified conservation actions through provisions of the applicable Farm Bill conservation program, such as WHIP or EQIP. Between the LPCI's inception in 2010 and the close of 2012, NRCS has established 701 contracts on over 381,000 ha (942,572 ac), with the majority of contracts (65 percent) and area (46 percent) under contract occurring in Texas (Shaughnessy 2013, pp. 29–30). Over $24.5 million in funding has been committed to implementation of the LPCI between 2010 and the close of 2012. In 2013, an additional 67 contracts were established on about 89,272 ha (220,598 ac) (Ungerer 2013a). The majority of the 2013 contracts were established in the estimated occupied range in Kansas (37 contracts totaling 14,672 ha (36, 256.1 ac)), although New Mexico had the largest acreage (11 contracts on 53,522 ha (132,255.8 ac)) placed under contract in 2013.

The NRCS also jointly administers the Grassland Reserve Program with the FSA. The Grassland Reserve Program is a voluntary conservation easement program that emphasizes, among other things, enhancement of plant and animal biodiversity and protection of grasslands under threat of conversion to other uses. Participants may choose a 10-, 15-, or 20-year contract, or they may opt to establish a permanent/perpetual conservation easement. Participants voluntarily limit future development and cropping uses of the easement land while retaining the right to conduct common grazing practices, through development of a grazing management plan, and operations related to the production of forage and seeding, subject to restrictions during nesting seasons. Within the five lesser prairie-chicken States, there were a total of two parcels totaling 494.5 ha (1,221.9 ac) under permanent easement, both in Texas (Ungerer 2013b). Only one of these parcels was within a county that included portions of the estimated occupied range. The other, located in Armstrong County, lies within the historical range in Texas. There also are several Wetland Reserve Program easements within the five lesser prairie-chicken States that may include some areas of grassland adjacent to the identified wetland resource. Several of these parcels are within or adjacent to the estimated occupied range, but most of these parcels are small, generally less than 81 ha (200 ac) in size (Ungerer 2013b).

The North American Grouse Partnership, in cooperation with the National Fish and Wildlife Foundation and multiple State conservation agencies and private foundations, have embarked on the preparation of the prairie grouse portions of an overarching North American Grouse Management Strategy. The Prairie Grouse Conservation Plan, which was completed in 2007 (Vodehnal and Haufler 2007, entire), provides recovery actions and defines the levels of funding necessary to achieve management goals for all species of prairie grouse in North America, including the lesser prairie-chicken. The plan uses an ecosystem approach to address habitat needs of prairie grouse within the Great Plains, concentrating on grassland conservation and restoration that will provide habitat conditions for lesser prairie-chickens, among other prairie grouse (Vodehnal and Haufler 2007, p. 1). The plan also specifically states that, for the lesser prairie-chicken, grasslands should be managed to protect and maintain existing tracts of native mixed-grass, shinnery oak, and sagebrush prairies, and that conservation efforts to retain and restore grasslands acres should include reestablishing grassland and shrublands within the species' range (Vodehnal and Haufler 2008, p. 16). The plan outlines recommendations to improve CRP lands for lesser prairie-chickens, such as converting CRP lands planted in nonnative grasses to native grass mixes (Vodehnal and Haufler 2008, pp. 18–19). The prairie grouse portions of this plan encompass about 26 million ha (65 million ac) of grassland habitat in the United States and Canada. The extent to which this strategy is being implemented for the lesser prairie-chicken is not known.

The Lesser Prairie-Chicken Interstate Working Group (Working Group) was formed in 1996. This group, composed largely of State agency biologists, which is currently under the oversight of the Western Association of Fish and Wildlife Agencies' Grassland Coordinator, meets annually to share information on the status of the lesser prairie-chicken, results of new research, and ongoing threats to the species. The Working Group has played an important role in defining and implementing conservation efforts for the lesser prairie-chicken. In 1999, they published a conservation strategy for the lesser prairie-chicken (Mote *et al.* 1999, entire). Then, in 2008, the Working Group published a lesser prairie-chicken conservation initiative (Davis *et al.* 2008, entire). Most recently, the Working Group and the Western Association of Fish and Wildlife Agencies (WAFWA) expended considerable effort to develop the Lesser Prairie-Chicken Range-Wide Conservation Plan (hereafter referred to as rangewide plan) that encompassed all five States within the occupied range of the species (Van Pelt *et al*. 2013, entire). In October of 2013, we determined that the rangewide plan, when implemented, would provide a net conservation benefit for the lesser prairie-chicken, and, we, in turn, provided our endorsement of the rangewide plan (Ashe 2013).

The rangewide plan is a voluntary conservation strategy that establishes a mitigation framework administered by WAFWA for the purpose of allowing plan participants the opportunity to mitigate any unavoidable impacts of a particular development activity on the lesser prairie-chicken and providing financial incentives to landowners who voluntarily participate and manage their property for the benefit of the lesser prairie-chicken. The rangewide plan specifically allocates conservation objectives such that 25 percent of the conservation would be in long-term agreements (over 10 years) while the remaining 75 percent of the conservation would be in short-term (5- or 10-year) contracts. Compensation for unavoidable impacts would be provided, when possible, through off-site mitigation actions. Within the plan, the service areas coincide with the four ecoregions described by McDonald *et al.* (2012, p. 7): the Shinnery Oak Prairie Region (eastern New Mexico and southwest Texas panhandle), the Sand Sagebrush Prairie Region (southeastern Colorado, southwestern Kansas, and western Oklahoma panhandle), the Mixed Grass Prairie Region (northeastern Texas panhandle, western Oklahoma, and south central Kansas), and the Short Grass/CRP Mosaic region (northwestern Kansas).

Development activities that would be covered under the rangewide plan include oil and gas development (seismic and land surveying, construction, drilling, completion, workovers, operations and maintenance, and remediation and restorations activities), agricultural activities (brush management, building and maintaining fences and livestock structures, grazing, water/windmills, disturbance practices, and crop production), wind power, cell and radio towers, power line activities (construction, operations and maintenance, and decommissioning and remediation), road activities (construction, operation and maintenance, and decommissioning and remediation), and finally general activities (hunting, off-highway vehicle (OHV) activity, general construction, and other land management), all of which are further defined within the plan.

The rangewide plan identifies rangewide and ecoregional population goals for the lesser prairie-chicken and the amount and condition of habitat desired to achieve the population goals, including focal areas and connectivity zones where much of the conservation would be targeted. The rangewide population goal, based on an annual spring average over a 10-year time frame, is set at 67,000 birds. Ecoregional specific goals have been set at 8,000 birds in the Shinnery Oak Prairie Region, 10,000 birds in the Sand Sagebrush Prairie Region, 24,000 birds in the Mixed Grass Prairie Region and 25,000 birds in the Short Grass/CRP Mosaic region. These regional goals and the overall rangewide population goal may be adjusted after the first 10 years of implementation using principles of adaptive management. In addition to an adaptive management framework, the rangewide plan also identifies specific monitoring and research needs. The plan also includes a number of conservation measures designed to avoid, offset, or minimize anticipated impacts of proposed developments that likely will be implemented by those participating in the plan. The specific language for each of the identified measures is provided in more detail within the plan.

The rangewide plan incorporates a focal area strategy as a mechanism to identify and target the population and habitat goals established by the plan. This focal area strategy is intended to direct conservation efforts into high priority areas and facilitate creation of large blocks of quality habitat in contrast to untargeted conservation efforts spread across larger areas that typically result in smaller, less contiguous blocks of appropriately managed habitat. These focal areas typically would have the following characteristics: Average focal area size of at least 20,234 ha (50,000 ac); at least 70 percent of habitat within each focal area would be high quality, as defined in the plan; and enhanced connectivity, with each focal area generally located no more than 32 km

(20 mi) apart and connected by delineated zones between neighboring focal areas that would provide suitable habitat and allow for movement between the focal areas. The corridors connecting the focal areas also would generally have certain characteristics: Habitat within the identified corridors would consist of at least 40 percent good- to high-quality habitat; distances between existing habitat patches would be no more than 3.2 km (2 mi) apart; and corridor widths would be at least 8 km (5 mi), and would contain few, if any, barriers to lesser prairie-chicken movement. The lack of an identified connection between focal areas in the Shinnery Oak Prairie Region with focal areas in the remaining regions is the obvious exception to the identified guidelines. The Shinnery Oak Prairie Region is separated from the other regions by a distance of over 300 km (200 mi) of unfavorable land uses and very little suitable lesser prairie-chicken habitat.

Quality habitat used in determining appropriate focal areas and connectivity zones has been defined in the rangewide plan and will not be repeated here (Van Pelt *et al.* 2013, pp. 75–76). These habitat characteristics generally consist of specific canopy covers, grass composition and heights, and understory density that comprise quality nesting and brood rearing habitat that may be observed within the four regions delineated in the rangewide plan. Quality habitat as depicted in the rangewide plan corresponds with habitat characteristics described in the **Background** section of this final rule. The identified focal areas would encompass over 2.9 million ha (7.1 million ac) and represents approximately 36 percent of the estimated occupied range.

Since 2004, the Sutton Center has been working to reduce or eliminate the mortality of lesser prairie-chickens due to fence collisions on their study areas in Oklahoma and Texas. Forceful collisions with fences during flight can cause direct mortality of lesser prairie-chickens (Wolfe *et al.* 2007, pp. 96–97, 101). However, mortality risk appears to be dependent on factors such as fencing design (height, type, number of strands), length, and density, as well as landscape topography and proximity of fences to habitats used by lesser prairie-chickens. The Sutton Center has used competitive grants and other funding sources to either physically remove unnecessary fencing or to apply markers of their own design (Wolfe *et al.* 2009, entire) to the top two strands to increase visibility of existing fences. To date, the Sutton Center has removed or improved approximately 335 kilometers (km) (208 miles (mi)) of barbed-wire fence in Oklahoma and Texas. Treatments are typically concentrated within 1.6 km (1 mi) of active lesser prairie-chicken leks. Approximately 208 km (129 mi) of unneeded fences have been removed. Collectively, these conservation activities have the potential to significantly reduce the threat of collision mortality on 44,110 ha (109,000 ac) of occupied habitat.

Our Partners for Fish and Wildlife Program (PFW) initiated a similar fence marking effort in New Mexico during 2008. Although the amount of marked fences has not been quantified, the effort is an important contribution to ongoing conservation efforts. The Texas PFW program has marked 108 km (67 mi) and removed 53 km (33 mi) of fences throughout the State of Texas through the end of 2013. The Colorado PFW program, in association with its many partners, has marked approximately 16 km (10 mi) of fence. However, continued fence construction throughout the range of the lesser prairie-chicken and the localized influence of these conservation efforts likely limits the effectiveness of such measures at the population level.

In 2008, the Service and nine States, including the five States encompassing the range of the lesser prairie-chicken, began working with 17 wind energy development companies to develop a programmatic habitat conservation plan (HCP). An HCP is a planning document required as part of an application for a permit for incidental take of a Federally listed species. An HCP describes the anticipated effects of the proposed taking, how those impacts will be minimized or mitigated, and how the HCP is to be funded. Initially, the endangered whooping crane (*Grus americana*) was the primary focus of this HCP (the Great Plains Wind Energy HCP). Since that time, the endangered interior least tern (*Sterna antillarum athalassos*) and the threatened piping plover (*Charadrius melodus*) have been included in ongoing planning efforts. As planning efforts for the Great Plains Wind Energy HCP continued to move forward, the lesser prairie-chicken was included in the list of species to be covered by the HCP. In November 2013, a draft HCP was submitted for review by the Service and State agency partners. The review is ongoing, and the Service anticipates returning our initial comments back by April 2014. The Great Plains Wind Energy HCP is intended to provide take coverage for activities such as siting, construction, operation, and decommissioning of wind facilities within the planning area, which includes the whooping crane migration corridor and wintering grounds, and the range of the lesser prairie-chicken. The length of the permit is proposed to be 45 years. The HCP is scheduled to be completed in the fall of 2015. We anticipate the conservation program of the HCP could involve measures such as acquisition and setting aside of conservation or mitigation lands.

A diverse group of stakeholders representing energy, agricultural, and conservation industries and organizations (Stakeholders) across five States within the occupied range of the lesser prairie-chicken, as well as Nebraska, have recently developed a rangewide conservation plan (Stakeholder Conservation Strategy) for the lesser prairie-chicken. The intent of this Stakeholder Conservation Strategy is to provide a framework for offsetting industry impacts to habitat while providing incentives that would encourage landowners to conserve and manage habitat to the overall benefit of the lesser prairie-chicken rangewide. The proposed permit area includes the estimated occupied range of the lesser prairie-chicken plus a 16-km (10-mi) buffer (EOR + 10; described in more detail in the "Current Range and Distribution" section, below), including portions of New Mexico, Colorado, Kansas, Oklahoma, and Texas. Additionally, the planning area includes areas outside of the estimated occupied range. Such areas would allow for population expansion, provided implementation of appropriate conservation initiatives that facilitate population expansion, and would extend the reach of the overall planning area to portions of Nebraska. Member Stakeholders include: Colorado Cattlemen's Association, Kansas Farm Bureau, Oklahoma Farm Bureau, Texas Farm Bureau, Texas and Southwestern Cattle Raisers

Association, Plains Cotton Growers, Texas Wheat Growers Association, Texas Watershed Management Foundation, Environmental Defense Fund, The Nature Conservancy, Oklahoma State University, USDA Agricultural Research Service, British Petroleum, Chesapeake Energy Corporation, Chevron U.S.A., SandRidge Exploration and Production, and XTO Energy/ExxonMobil. Additional companies or organizations may become involved as the planning process proceeds.

The Stakeholder Conservation Strategy contains three primary components: a Habitat Exchange for the lesser prairie-chicken, a Habitat Quantification Tool (HQT) and a regional HCP for the lesser prairie-chicken. The Habitat Exchange would consist of an independent third party that facilitates transactions between a mitigation credit buyer (an entity engaging in an otherwise lawful activity that impacts lesser prairie-chicken habitat) and a mitigation credit producer (a landowner). The credit producers (*e.g.*, cattlemen, farmers, and others) would be paid on a performance contract basis for achieving specific and measurable conservation outcomes. The credit buyers (*e.g.*, energy and other developers) would be provided a predictable, effective, and timely means to achieve the mitigation required to offset habitat impacts. The regional HCP references the HQT as the scientifically measurable means for determining debits and identifies the Habitat Exchange as the primary means of securing mitigation obligations.

The American Habitat Center has submitted an application to the Service on behalf of the above Stakeholders for a permit to support a regional HCP pursuant to section 10 of the Act. This section 10 permit would provide incidental take authorization for the covered activities stipulated in the Stakeholder Conservation Strategy. The Service currently intends to develop an environmental impact statement pursuant to the National Environmental Policy Act (42 U.S.C. 4321 et seq.) to solicit public comment on the Stakeholder Conservation Strategy and the Service's pending permitting decision. A decision on issuance of the permit is anticipated in the summer of 2014.

The Stakeholder Conservation Strategy and associated permit, if approved, is intended to provide incidental take authorization for covered activities, including agricultural production and energy development. Entities wishing to gain regulatory assurances and coverage under an incidental take permit could enroll in this regional HCP. The Stakeholder Conservation Strategy proposes a multifaceted approach involving avoidance, minimization using proven and defined best management practices, mitigation of impacts through permanent and temporary habitat preservation, restoration, and enhancement and other measures. Adequate funding for implementation, including biological and compliance monitoring, also would be an important component of the Stakeholder Conservation Strategy.

Several potential conservation banking proposals, in various states of development, are being considered over the range of the lesser prairie-chicken. A conservation bank consists of permanently protected lands that are conserved and permanently managed for endangered, threatened, and other imperiled species. In exchange for permanently protecting the land and managing it for these species, the Service approves a specified number of habitat or species credits that the bank owners may sell. These credits may then be used to offset adverse impacts to these species and their habitats that occurred in other locations.

A proposed programmatic conservation banking agreement has been submitted by Common Ground Capital that would consist of an independent conservation banking system intended to facilitate permanent conservation for the lesser prairie-chicken through multiple conservation banks located across the range of the lesser prairie-chicken. The Service is currently reviewing this proposed banking agreement, and, if approved, the agreement would allow the establishment of conservation banks for the lesser prairie-chicken. The estimated timeline for the Common Ground Capital banking agreement approval process is spring 2014, with implementation to follow sometime after the approval process is complete.

Other independent bankers have had informal discussions with the Service and intend to submit additional conservation banking proposals for permanent conservation banks in various areas within the lesser prairie-chicken's range. The Service anticipates we will receive these requests in the spring of 2014, with bank establishment to follow sometime in 2014, pending full review and completion of the approval process.

The five State conservation agencies developed an Internet-based mapping tool, initially a pilot project under the Western Governors' Association Wildlife Council. This tool, now known as the Southern Great Plains Crucial Habitat Assessment Tool (CHAT), was made accessible to the public in September 2011, and a second version of the CHAT was developed in 2013. The CHAT is available for use by conservation managers, industry, and the public to aid in conservation planning for the lesser prairie-chicken. The tool identifies priority habitat for the lesser prairie-chicken, including possible habitat corridors linking important conservation areas. The CHAT will be an important tool for implementation of the rangewide plan's mitigation framework by using the CHAT categories as ratio multipliers. The CHAT classifies areas on a scale of 1 to 4 by their relative value as lesser prairie-chicken habitat. According to Van Pelt *et al.* (2013, pp. 54–55), the CHAT 1 category is comprised of focal areas for lesser prairie-chicken conservation; the CHAT 2 category is comprised of corridors for lesser prairie-chicken conservation; the CHAT 3 category is comprised of available and potential habitat, as developed through modeling efforts; and the CHAT 4 category is comprised of the EOR + 10. The CHAT includes other data layers that may facilitate conservation planning, including current and historical lesser prairie-chicken range, land cover types, oil and gas well density, presence of vertical structures, and hexagonal summary polygon to provide users contextual information about the surrounding landscape. The CHAT tool will be updated annually. Use of the tool is currently voluntary but ultimately may play an important role in guiding future development and conserving important habitats.

Candidate Conservation Agreements (CCAs) and Candidate Conservation Agreements with Assurances (CCAAs) are formal, voluntary agreements between the Service and one or more parties to address the conservation needs of one or more candidate species or species likely to become candidates in the near future. These agreements are intended to reduce or remove identified threats to a species. Implementing conservation efforts before species are listed increases the likelihood that simpler, more cost-effective conservation options are available and that conservation efforts will succeed. Development of CCAs and CCAAs is guided by regulations at 50 CFR 17.22(d) and 50 CFR 17.32(d).

Under a CCA, Federal managers and other cooperators (nongovernmental organizations and lease holders) implement conservation measures that reduce threats on Federal lands and leases. Under a CCAA, non-federal landowners and lease holders voluntarily provide habitat protection or enhancement measures on their lands, thereby reducing threats to the species. A section 10(a)(1)(A) enhancement of survival permit is issued in association with a CCAA. If the species is later listed under the Act, the permit authorizes take that is incidental to otherwise lawful activities specified in the agreement, when performed in accordance with the terms of the agreement. Further, the CCAA provides assurances that if the subject species is later listed under the Act, participants who are appropriately implementing certain conservation actions under the CCAA will not be required to implement additional conservation measures.

An “umbrella” CCA and CCAA with the Bureau of Land Management (BLM) in New Mexico and two “umbrella” CCAAs, one each in Oklahoma and Texas, are being implemented for the lesser prairie-chicken. An additional CCAA was previously established with a single landowner in southwestern Kansas; however, this CCAA expired in May of 2012. Under these agreements, the participants agree to implement certain conservation measures that are anticipated to reduce threats to lesser prairie-chicken; improve their habitat; reduce habitat fragmentation; and increase population stability, through increases in adult and juvenile survivorship, nest success, and recruitment rates and reduced mortality. Dependent upon the level of participation, expansion of the occupied range may occur. Conservation measures typically focus on maintenance, enhancement, or restoration of nesting and brood rearing habitat. Some possible conservation measures include removal of invasive, woody plants, such as *Prosopis* spp. (mesquite) and *Juniperus virginiana* (eastern red cedar); implementation of prescribed fire; marking of fences; removal of unneeded fences; improved grazing management; and similar measures that help reduce the impact of the existing threats.

On December 18, 2013, we announced receipt of an application from WAFWA for an enhancement of survival permit associated with anticipated implementation of another CCAA (78 FR 76639). This Rangewide Oil and Gas Industry CCAA for the Lesser Prairie-Chicken (78 FR 76639) incorporates measures to address impacts to the lesser prairie-chicken from oil and gas activities on non-federal lands throughout the species’ range and provides coverage for a period of 30 years, offering the oil and gas industry the opportunity to voluntarily conserve the lesser prairie-chicken and its habitat while receiving assurances provided by the Service. Within New Mexico, oil and gas operators have the option to choose to enroll under the 2008 CCAA or the new rangewide oil and gas CCAA. On February 28, 2014, we announced in a press release that we had signed the CCAA, issued the enhancement of survival permit, and released the accompanying final environmental assessment and finding of no significant impact. When undertaking certain actions that impact the species or its habitat, participants will be required to pay mitigation fees; funds generated through these fees will enable implementation of conservation actions on enrolled lands elsewhere. This rangewide CCAA is one mechanism for implementing the rangewide plan previously discussed.

All of the State conservation agencies and many Federal agencies within the range of the lesser prairie-chicken conduct outreach efforts intended to inform and educate the public about the conservation status of the species. Many of these efforts specifically target landowners and other interested stakeholders involved in lesser prairie-chicken conservation. Annual festivals focused on the lesser prairie-chicken have been held in several States (Milnesand, New Mexico; Woodward, Oklahoma; and Canadian, Texas) and help inform and raise awareness of lesser prairie-chickens for the public; however, the lesser prairie-chicken festival in Milnesand, New Mexico, was cancelled in 2013 and 2014 due to low populations of lesser prairie-chickens. Often festival participants are able to visit an active lesser prairie-chicken breeding area to observe courtship displays. Festivals and similar community efforts such as these can help promote the concept that stewardship of the lesser prairie-chicken and other wildlife can facilitate economic growth and viable farming and ranching operations.

State-Specific Conservation Efforts

Colorado

The Colorado Parks and Wildlife (CPW) hosted a workshop on the conservation of the lesser prairie-chicken in late 2009. This workshop provided information to local landowners and other interested parties on conservation of the lesser prairie-chicken. Specific management actions, such as grassland restoration and enhancement, intended to benefit conservation of the lesser prairie-chicken were highlighted. Subsequently, Colorado implemented a habitat improvement program (HIP) for the lesser prairie-chicken that provides cost-sharing to private landowners, subject to prior consultation and approval from a CPW biologist, for enrolling fields or conducting habitat enhancements beneficial to the species. By mid-2012, approximately 4,537 ha (11,212 ac) in the estimated occupied range had been enrolled in this program (Van Pelt *et al*. 2013, p. 62). Additionally, in 2006, Colorado initiated a wildlife habitat protection program designed to facilitate acquisition of conservation easements and purchase of lands for the lesser prairie-chicken and other wildlife species. The lesser prairie-chicken was one of five priorities for 2012, and up to $14 million was available in the program.

Currently about 4,433 ha (10,954 ac) have been enrolled under the lesser prairie-chicken CRP SAFE continuous sign-up in Colorado. These enrolled areas are typically recently expired CRP lands and contain older grass stands in less than optimal habitat condition. In late winter 2010 or early spring 2011, one-third of these enrolled lands received a forb (broad-leaved herb other than a grass) and legume inter-seeding consisting of dryland alfalfa and other species to improve habitat quality. This effort is anticipated to result in the establishment of alfalfa and additional forbs, resulting in improved nesting and brood-rearing habitat. About 4,249 ha (10,500 ac) of the initial 8,701 ha (21,500 ac) allocated for SAFE remain to be enrolled.

Our Partners for Fish and Wildlife Program (PFW) program has contributed financial and technical assistance for restoration and enhancement activities benefitting the lesser prairie-chicken in Colorado. The PFW program has executed 14 private lands agreements facilitating habitat restoration and enhancement for the lesser prairie-chicken on about 9,307 ha (23,000 ac) of private lands in southeastern Colorado.

A cooperative project between the CPW and the U.S. Forest Service (USFS) has established several temporary grazing exclosures adjacent to active leks on the Comanche National Grassland in an attempt to improve nesting habitat. The efficacy of these treatments is unknown, and further monitoring is planned to determine the outcome of these efforts (Verquer and Smith 2011, p. 7).

In addition, more than 4,450 ha (11,000 ac) have been protected by perpetual conservation easements held by CPW, The Nature Conservancy, and the Greenlands Reserve Land Trust.

Kansas

The Kansas Department of Wildlife, Parks, and Tourism (KDWPT) has targeted lesser prairie-chicken habitat improvements through various means including the landowner incentive program (LIP), voluntary mitigation projects for energy development, and a State-level WHIP. Through the LIP, KDWPT provides direct technical and financial assistance to private landowners interested in contributing to the conservation of species in greatest conservation need, including lesser prairie-chickens. The LIP improved about 9,118 ha (22,531 ac) for lesser prairie-chickens during the period from 2007 to 2011. Some examples of LIP projects include planting native grasses, brush management efforts, and implementation of prescribed fire. Since 2008, the KDWPT has provided $64,836 in landowner cost-share through the WHIP for practices benefitting the lesser prairie-chicken on about 2,364 ha (5,844 ac). Currently more than 11,662 ha (28,819 ac) of the original allocation have been enrolled under the lesser prairie-chicken CRP SAFE continuous sign-up in Kansas. Primary practices include tree removal, prescribed fire, grazing management (including perimeter fencing to facilitate livestock management), and native grass establishment that will improve lesser prairie-chicken nesting and brood rearing habitat.

Funds available through the State wildlife grants program also have been used to benefit the lesser prairie-chicken in Kansas. The KDWPT was awarded a 5-year State wildlife grant in 2009, focusing on lesser prairie-chicken habitat improvements. Like several of the other States within the range of the lesser prairie-chicken, the KDWPT partnered with Pheasants Forever and NRCS to fund three employee positions that provide technical assistance to private landowners participating in conservation programs with an emphasis on practices favorable to the lesser prairie-chicken. These employees primarily assist in the implementation and delivery of the NRCS's LPCI in Kansas.

Additionally, KDWPT has a walk-in hunting program that was initiated in 1995, in an effort to enhance the hunting tradition in Kansas. The program provides hunters access to private property, including many lands enrolled in CRP, and has become one of the most successful access programs in the country. By 2004, more than 404,000 ha (1 million ac) had been enrolled in the program. Landowners receive a small payment in exchange for allowing public hunting access to enrolled lands. Payments vary by the amount of acres enrolled and length of contract period. Conservation officers monitor the areas, and violators are ticketed or arrested for offenses such as vandalism, littering, or failing to comply with hunting or fishing regulations. Such incentives, although relatively small, help encourage landowners to provide habitat for resident wildlife species including the lesser prairie-chicken.

The Service's PFW program has contributed financial and technical assistance for restoration and enhancement activities that benefit the lesser prairie-chicken in Kansas. Primary activities include control of invasive, woody plant species, such as eastern red cedar and enhanced use of prescribed fire to improve habitat conditions in native grasslands. The PFW program has executed 63 private lands agreements on about 56,507 ha (139,633 ac) of private lands benefitting conservation of the lesser prairie-chicken in Kansas. An approved CCAA was developed on 1,133 ha (2,800 ac) in south-central Kansas; however, this CCAA expired in 2012.

The Comanche Pool Prairie Resource Foundation (Comanche Pool) is a landowner-driven, nonprofit resource foundation that promotes proper grassland management throughout the mixed-grass vegetative ecoregion of southern Kansas and northern Oklahoma. Ranching is one of the major land uses in this ecoregion, and ranchers have been generally receptive to lesser prairie-chicken conservation strategies that are compatible with their ongoing land use plans. The mission of the Comanche Pool is to provide demonstrations, education, and consultation to other landowners for the purpose of regenerating natural resources and promoting the economic growth of the rural community.

The Comanche Pool has secured over $850,000 in grant funding utilized to restore and enhance rangelands, which has been matched by other partners. Landowner in-kind contributions of almost one million dollars have been provided. Past rangeland improvement agreements include 43 projects affecting over 100,000 acres of improved habitat for the lesser prairie-chicken. Numerous project boundaries often are shared, resulting in larger, contiguous blocks of habitat

The Kansas Grazing Lands Coalition (KGLC) is another landowner-driven initiative that has a mission to regenerate Kansas grazing land resources through cooperative management, economics, ecology, production, education, and technical assistance programs. The Service’s PFW program in Kansas has partnered with the KGLC to provide technical guidance and financial assistance to restore and enhance native grasslands through voluntary agreements with Kansas landowners. The KGLC administers numerous outreach and education events for regional grazing groups and plays an integral role in conservation delivery. They coordinate with other conservation organizations in Kansas.

Lesser prairie-chicken habitat benefits from periodic burns that improve habitat quality and various organizations in Kansas support the use of prescribed fire. The Kansas Prescribed Burn Association (KPBA) is a not-for-profit burn association that serves to encourage the use of prescribed fire and is comprised of private landowners. The mission of KPBA is to promote better rangeland management practices through the use of prescribed fire, with emphasis on safety and training for those members and associates with less experience in prescribed fire and adherence to the use of standard prescribed burning practices. The Kansas Prescribed Fire Council (KPFC) also works to support prescribed burning in Kansas by promoting safe, legal, and responsible use of prescribed fire as a natural resource tool through information exchange and prescribed fire advocacy. The Comanche Pool, KGLC and KPFC recently were awarded a National Fish and Wildlife Foundation grant to support two prescribed fire specialist positions within the mixed grass and sand sagebrush ecoregions of Kansas to support lesser prairie-chicken habitat maintenance and restoration on private lands.

In 2013, a coalition of 29 county governments in Kansas joined in an effort to coordinate conservation for the lesser prairie-chicken. The involved counties encompass 64,954 sq km (25,079 sq mi) in western and southern Kansas, including most of the estimated occupied range of the lesser prairie-chicken in Kansas. In August of 2013, this coalition prepared a conservation, management, and study plan for the lesser prairie-chicken (Kansas Natural Resource Coalition 2013, entire). The plan summarizes some of the available information regarding lesser prairie-chickens and has the stated goal of preserving, maintaining, and increasing lesser prairie-chicken populations in balance with and respect for human, private, and industrial systems within the 29 county region under governance by the coalition members. The plan identified several conservation actions, such as prescribed fire, being undertaken by the coalition or its member organizations that fall within six major categories of conservation focus: population monitoring, habitat, nest success, predation and interspecific competition, hunting, and program funding.

New Mexico

In January 2003, a working group composed of local, State, and Federal officials, along with private and commercial stakeholders, was formed to address conservation and management activities for the lesser prairie-chicken and dunes sagebrush lizard (*Sceloporus arenicolus*) in New Mexico. This working group, formally named the New Mexico Lesser Prairie-Chicken/Sand Dune Lizard Working Group, published the Collaborative Conservation Strategies for the Lesser Prairie-Chicken and Sand Dune Lizard in New Mexico (Strategy) in August 2005. This Strategy provided guidance in the development of BLM's Special Status Species Resource Management Plan Amendment (RMPA), approved in April 2008, which also addressed the concerns and future management of lesser prairie-chicken and dunes sagebrush lizard habitats on BLM lands, and established the Lesser Prairie-Chicken Habitat Preservation Area of Critical Environmental Concern. Both the Strategy and the RMPA prescribe active cooperation among all stakeholders to reduce or eliminate threats to these species in New Mexico. As an outcome, the land-use prescriptions contained in the RMPA now serve as baseline mitigation (for both species) to those operating on Federal lands or non-federal lands with Federal minerals.

Following approval of the RMPA, a CCA was drafted by a team including the Service, BLM, Center of Excellence for Hazardous Materials Management, and participating cooperators. The CCA addresses the conservation needs of the lesser prairie-chicken and dunes sagebrush lizard on BLM lands in New Mexico by undertaking habitat restoration and enhancement activities and by minimizing habitat degradation. These efforts would protect and enhance existing populations and habitats, restore degraded habitat, create new habitat, augment existing populations of lesser prairie-chickens, restore populations, fund research studies, or undertake other activities on their Federal leases or allotments that improve the status of the lesser prairie-chicken. Through this CCA, Center of Excellence for Hazardous Materials Management will work with participating cooperators who voluntarily commit to implementing or funding specific conservation actions, such as burying powerlines, controlling mesquite, minimizing surface disturbances, marking fences, and improving grazing management, in an effort to reduce or eliminate threats to both species. The CCA builds upon the BLM's RMPA for southeast New Mexico. The RMPA established the foundational requirements that will be applied to all future Federal activities, regardless of whether a permittee or lessee participates in this CCA. The strength of the CCA comes from the implementation of additional conservation measures that are additive, or above and beyond those foundational requirements established in the RMPA. In addition to the CCA, a CCAA has been developed in association with the CCA to facilitate conservation actions for the lesser prairie-chicken and dunes sagebrush lizard on private and State lands in southeastern New Mexico.

Since the CCA and CCAA were finalized in December 2008, 31 oil and gas companies have enrolled a total of 354,100 ha (875,000 ac) of mineral holdings under the

CCA and CCAA. In addition, 50 private landowners in New Mexico have enrolled about 704,154 ha (1,740,000 ac) under the CCAA. On March 1, 2012, the New Mexico State Land Office enrolled all State Trust lands in lesser prairie-chicken and dunes sagebrush lizard habitat (about 248,000 ac) into a certificate of inclusion under the CCAA. On these enrolled State Trust lands, the herbicide tebuthiuron will no longer be used to treat shinnery oak. Please refer to the "Shrub Control and Eradication" section, below, for more information on tebuthiuron. There currently are four pending ranching enrollment applications being reviewed and processed for inclusion. Recently, BLM also has closed 149,910 ha (370,435 ac) to future oil and gas leasing and closed about 342,770 ha (847,000 ac) to wind and solar development. Part of the purpose for these closures was to improve lesser prairie-chicken habitat. The BLM has reclaimed about 328 ha (810 ac) of abandoned well pads and associated roads (Watts 2014, pers. comm.). The BLM also requires burial of powerlines within 3.2 km (2 mi) of leks. Approximately 52 km (32.5 mi) of aboveground powerlines have been removed to date. Additionally, BLM has implemented control efforts for mesquite (*Prosopis glandulosa*) on 157,397 ha (388,937 ac) and has plans to do so on an additional 140,462 ha (347,091 ac). More discussion of mesquite control is addressed in the "Shrub Control and Eradication" section, below.

Acquisition of land for the protection of lesser prairie-chicken habitat also has occurred in New Mexico. The New Mexico Department of Game and Fish (NMDGF) currently has designated 29 areas specifically for management of the lesser prairie-chickens totaling more than 11,850 ha (29,282 ac). These areas are closed to the public during the breeding and nesting season (March 1 to July 30) each year, and restrictions are in place to minimize noise and other activities associated with oil and gas drilling. In 2007, the State Game Commission used New Mexico State Land Conservation Appropriation funding to acquire 2,137 ha (5,285 ac) of private ranchland in Roosevelt County. This property, the Sandhills Prairie Conservation Area (formerly the Lewis Ranch), is located east of Milnesand, New Mexico, and adjoins two existing Commission-owned prairie-chicken areas. The BLM, on March 3, 2010, also acquired 3,010 ha (7,440 ac) of land east of Roswell, New Mexico, to protect key habitat for the lesser prairie-chicken. The Nature Conservancy owns and manages the 11,331 ha (28,000 ac) Milnesand Prairie Preserve near Milnesand, New Mexico. Habitat management efforts on this preserve target the lesser prairie-chicken.

The Service's PFW program also has been active in lesser prairie-chicken conservation efforts in the State of New Mexico. Private lands agreements have been executed on 65 properties encompassing 28,492 ha (70,404 ac) of lesser prairie-chicken habitat in New Mexico. Additionally, the entire 1,052 ha (2,600 ac) allotted to the lesser prairie-chicken CRP SAFE continuous signup in New Mexico (Lea County only) have been enrolled under the Service's PFW program.

Oklahoma

The ODWC partnered with the Service, the Oklahoma Secretary of Environment, The Nature Conservancy, the Sutton Center, and the Playa Lakes Joint Venture to develop the Oklahoma Lesser Prairie-Chicken Spatial Planning Tool in 2009. The goal of the Oklahoma Lesser Prairie-Chicken Spatial Planning Tool is to reduce the impacts of ongoing and planned development actions within the range of the lesser prairie-chicken by guiding development away from sensitive habitats used by the species. The Oklahoma Lesser Prairie-Chicken Spatial Planning Tool assigns a relative value rank to geographic areas to indicate the value of the area to the conservation of the lesser prairie-chicken. The higher the rank (on a scale of 1 to 8), the more important the area is to the lesser prairie-chicken. The Oklahoma Lesser Prairie-Chicken Spatial Planning Tool, therefore, can be used to identify areas that provide high-quality habitat and determine where development, such as wind power, would have the least impact to the species. The Oklahoma Lesser Prairie-Chicken Spatial Planning Tool also can be used to determine a voluntary offset payment based on the cost of mitigating the impact of the anticipated development through habitat replacement. The voluntary offset payment is intended to be used to offset the impacts associated with habitat loss. Use of the Oklahoma Lesser Prairie-Chicken Spatial Planning Tool and the voluntary offset payment is voluntary.

To date, in excess of $11.1 million has been committed to the ODWC through the voluntary offset payment program. Most recently, the ODWC entered into a memorandum of agreement with Chermac Energy Corporation to partially offset potential habitat loss from a planned 88.5-km (55-mi) high-voltage transmission line.

The line would run from near the Kansas State line to the Oklahoma Gas and Electric Woodward Extra High Voltage substation and will be used to carry up to 900 megawatts of wind energy from an existing wind farm in Harper County. The memorandum of agreement facilitates voluntary offset payments for impacts to the lesser prairie-chicken and its habitat. The agreement calls for the payment of a total of $2.5 million, with the money being used to help leverage additional matching funds from private and Federal entities for preservation, enhancement, and acquisition of lesser prairie-chicken habitat. A large percentage of the voluntary offset payment funds have been used to acquire lands for the conservation of the lesser prairie-chicken and other fish and wildlife resources.

In 2008, the ODWC acquired two properties known to be used by the lesser prairie-chicken. The Cimarron Bluff Wildlife Management Area encompasses 1,388 ha (3,430 ac) in northeastern Harper County, Oklahoma. The Cimarron Hills Wildlife Management Area in northwestern Woods County, Oklahoma, encompasses 1,526 ha (3,770 ac). The ODWC also recently purchased 5,580 ha (13,789 ac) within the range of the lesser prairie-chicken to expand both the Beaver River and Packsaddle Wildlife Management Areas in Beaver and Ellis Counties, respectively.

Oklahoma State University hosts prescribed fire field days to help inform landowners about the benefits of prescribed fire for controlling invasion of woody vegetation in prairies and improving habitat conditions for wildlife in grassland ecosystems. Prescribed burning is an important tool landowners can use to improve the value of CRP fields and native prairie for wildlife, including the lesser prairie-chicken, by maintaining and improving vegetative structure, productivity, and diversity and by controlling exotic plant species. In 2009, the Environmental Defense Fund partnered with Oklahoma State University to prepare a report on the management of CRP fields for lesser prairie-chicken management. The document (Hickman and Elmore 2009, entire) was designed to provide a decision tree that would assist agencies and landowners with mid-contract management of CRP fields.

Like the other States, ODWC has partnered in the implementation of a State WHIP designed to enhance, create, and manage habitat for all wildlife species, including the lesser prairie-chicken. The State WHIP recently has targeted money for lesser prairie-chicken habitat improvements.

Several different "Ranch Conversations" have been held in northwestern Oklahoma over the past 10 years, most recently hosted by the Oklahoma High Plains Resource Development and Conservation Office. These meetings invited private landowners and the general public to discuss lesser prairie-chicken conservation and management, receive information, and provide input on programs and incentives that are available for managing the lesser prairie-chicken on privately owned lands.

In an effort to address ongoing development of oil and gas resources, the Oklahoma Wildlife Conservation Commission voted to approve a memorandum of understanding with the Oklahoma Independent Petroleum Association in February 2012 to establish a collaborative working relationship for lesser prairie-chicken conservation. Through this memorandum of understanding, the ODWC and Oklahoma Independent Petroleum Association will identify and develop voluntary steps (best management practices) that can be taken by the Oklahoma Independent Petroleum Association's members to avoid and minimize the impacts of their operations on the lesser prairie-chicken. These best management practices are currently under development.

The Oklahoma Association of Conservation Districts received a USDA Conservation Innovation Grant to develop the concept of a wildlife credits trading program as it applies to the lesser prairie-chicken. This pilot project entailed creating protocols for defining, quantifying and qualifying a credit; developing a credit verification system; and measuring the projects effect on Oklahoma's lesser prairie-chicken population. As a part of this grant, the Oklahoma Association of Conservation Districts currently provides financial incentives ($8 per acre) over a 5-year period to agricultural producers who enroll in the habitat credit training program and participate in the Oklahoma CCAA. The grant provided funding for enrollment of up to 4,046 ha (10,000 ac) over the 5-year period, but no acres have been enrolled in the habitat credit training program as of the end of 2013. When completed, the credit trading program staff also will develop a handbook that can be used by others when providing incentives to landowners who manage their lands for conservation of the lesser prairie-chicken and other species. The Oklahoma USDA FSA and ODWC have worked to enroll about 2,819 ha (6,965 ac) of the 6,111 ha (15,100 ac) allocated under the lesser prairie-chicken CRP SAFE continuous sign-up in Beaver, Beckham, Ellis, and Harper Counties.

The ODWC, in early 2012, entered into a contract with Ecosystem Management Research Institute to develop a conservation plan for the lesser prairie-chicken in Oklahoma. Public comments on the draft plan were solicited through August 30, 2012, and a final plan was completed in September of 2012. The primary goal of the Oklahoma Lesser Prairie Chicken Conservation Plan was to develop an overall strategy for conservation of the lesser prairie-chicken in Oklahoma. The Oklahoma Lesser Prairie Chicken Conservation Plan included a synthesis of all currently available, pertinent information and input from a variety of stakeholders. The Oklahoma Lesser Prairie Chicken Conservation Plan also identifies priority conservation areas, population goals, and conservation strategies and actions to improve lesser prairie-chicken viability through habitat improvements.

As discussed above, the ODWC applied for an enhancement of survival permit pursuant to section 10(a)(1)(A) of the Act that included a draft umbrella CCAA between the Service and ODWC for the lesser prairie-chicken in 14 Oklahoma counties (77 FR 37917, June 25, 2012). The draft CCAA and associated draft environmental assessment was made available for public review and comment from June 25, 2012 through August 24, 2012 (77 FR 37917). The CCAA was approved on January 25, 2013, and ODWC began enrollment of private lands at that time. Since being approved, 16 landowners have enrolled 7,115 ha (17,582 ac). Several applications are currently being reviewed and processed for enrollment. On December 20, 2013, we announced availability of a draft amendment to the Oklahoma agricultural CCAA (78 FR 77153). This amendment would increase acreage eligible for enrollment from 80,937 ha (200,000 ac) to 161,874 ha (400,000 ac). The comment period on this proposed amendment closed January 21, 2014. A permitting decision is anticipated in March 2014.

The Service's PFW program also has contributed financial and technical assistance for restoration and enhancement activities that benefit the lesser prairie-chicken in Oklahoma. Important measures include control of eastern red cedar and fence marking and removal to minimize collision mortality. The Oklahoma PFW program has implemented 154 private lands agreements on about 38,954 ha (96,258 ac) of private lands for the benefit of the lesser prairie-chicken in the State.

Texas

The Texas Parks and Wildlife Department (TPWD) hosted a series of landowner meetings and listening sessions in 6 (Hemphill, Wheeler, Gray, Bailey, Cochran, and Gaines) of the 13 counties confirmed to be occupied by the lesser prairie-chicken in Texas. Private landowners and the general public were invited to discuss conservation and management, receive information, and provide input on programs and incentives that are available for managing the lesser prairie-chicken on privately owned lands. In response to these meetings, TPWD worked with the Service and landowners to finalize the first Statewide umbrella CCAA for the lesser prairie-chicken in Texas. The conservation goal of the Texas CCAA is to encourage protection and improvement of suitable lesser prairie-chicken habitat on non-federal lands by offering private landowners incentives to implement voluntary conservation measures through available funding mechanisms and by providing technical assistance and regulatory assurances concerning land use restrictions that might otherwise apply should the lesser prairie-chicken become listed under the Act. The conservation measures would generally consist of prescribed grazing; prescribed burning; brush management; cropland and residue management; range seeding and enrollment in various Farm Bill programs such as the CRP, the Grassland Reserve Program, and SAFE program; and wildlife habitat treatments through the EQIP. The Texas CCAA covers 50 counties, largely encompassing the Texas panhandle region, and was finalized on May 14, 2009. This CCAA covers the lands currently occupied in Texas, plus those lands that are unoccupied and have potential habitat and those lands that could contain potential habitat should the lesser prairie-chicken population in Texas increase. Total landowner participation, by the close of December 2013, is 68 properties (totaling approximately 572,999 enrolled ac) in 15 counties (Texas Parks and Wildlife Department 2014, entire). Approximately 12 applications are currently being reviewed and processed for enrollment.

In May of 2009, the TPWD, along with other partners, held an additional five meetings in the Texas panhandle region as part of an effort to promote lesser prairie-chicken conservation. These meetings were intended to inform landowners about financial incentives and other resources available to improve habitat for the lesser prairie-chicken, including the SAFE program. The objective of the Texas SAFE program, administered by the FSA, is to restore native mixed-grassland habitat for the lesser prairie-chicken in Texas. The current allocation is 49,655 ha (122,700 ac), and 31,245 ha (77,209 ac) have been enrolled through 2012. TPWD continues efforts to promote lesser prairie-chicken conservation on private lands. In March 2010, TPWD staff conducted a 2-day upland bird workshop where lesser prairie-chicken research and management was discussed.

Since 2008, the NRCS and TPWD have partnered in the implementation of an EQIP focused on lesser prairie-chicken conservation. This program provides technical and financial assistance to landowners interested in implementing land management practices for the lesser prairie-chicken within its historical range. Twenty-two counties were targeted in this initial effort, and preliminary analysis indicated that an agricultural producer's profitability and equity could be improved by enrolling in this program (Jones *et al*. 2008, p. 3).

The Service's PFW program and the TPWD have been actively collaborating on range management programs designed to provide cost-sharing for implementation of habitat improvements for lesser prairie-chickens. The Service provided funding to TPWD to support a Landscape Conservation Coordinator position for the Panhandle and

Southern High Plains region, as well as funding to support LIP projects targeting lesser prairie-chicken habitat improvements (brush control and grazing management) in this region. More than $200,000 of Service funds were committed in 2010, and an additional $100,000 was committed in 2011. Since 2008, Texas has addressed lesser prairie-chicken conservation on 5,693 ha (14,068 ac) under the LIP. Typical conservation measures include native plant restoration, control of exotic vegetation, prescribed burning, selective brush management, and prescribed grazing. Currently, the PFW program has executed 66 private lands agreements on about 53,091 ha (131,190 ac) of privately owned lands for the benefit of the lesser prairie-chicken in Texas.

The TPWD continues to establish working relationships with wind developers and provides review and comment on proposed developments whenever requested. Through this voluntary comment process, TPWD provides guidance on how to prevent, minimize, and mitigate impacts from wind and transmission development on lesser prairie-chicken habitat and populations.

A Lesser Prairie-Chicken Advisory Committee also has been established in Texas and functions to provide input and information to the State's Interagency Task Force on Economic Growth and Endangered Species. The purpose of the task force is to provide policy and technical assistance regarding compliance with endangered species laws and regulations to local and regional governmental entities and their communities engaged in economic development activities so that compliance with endangered species laws and regulations is as effective and cost-efficient as possible. According to the Task Force, input provided by the Lesser Prairie-Chicken Advisory Committee serves to help the Task Force prevent listing and minimize harm to economic sectors if listing does occur. The advisory committee also assists in outreach and education efforts on potential listing decisions and methods to minimize the impact of listing.

The TPWD has worked in conjunction with several Texas universities to fund several lesser prairie-chicken research projects. In one of those projects, TPWD evaluated the use of aerial line transects and forward-looking infrared technology to survey for lesser prairie-chickens. Other ongoing research includes evaluation of lesser prairie-chicken population response to management of shinnery oak and evaluation of relationships among the lesser prairie-chicken, avian predators, and oil and gas infrastructure.

In 2009, the U.S. Department of Energy awarded Texas Tech University and the TPWD a collaborative grant to conduct aerial surveys on approximately 75 percent of the estimated currently occupied range. This project aided in the initial development of a standardized protocol for conducting aerial surveys for the lesser prairie-chicken across the entire range. All five States are currently participating in these surveys; and a complete analysis of the results is available (MacDonald *et al.* 2013, entire). A summary of the results has been incorporated into this final rule (see “Rangewide Population Estimates” section, below).

In 2007, The Nature Conservancy of Texas acquired approximately 2,428 ha (6,000 ac) of private ranchland in Yoakum and Terry Counties for the purpose of protecting and restoring lesser prairie-chicken habitat. This acquisition helped secure a geographically important lesser prairie-chicken population. Since the original acquisition, additional lands have been acquired, and the Yoakum Dunes Preserve now encompasses 4,342.7 ha (10,731 ac).

In addition to participation in annual lesser prairie-chicken festivals, the TPWD published an article on the lesser prairie-chicken and wind development in Texas in their agency magazine in October of 2009. The TPWD and the Dorothy Marcille Wood Foundation also produced a 12-page color brochure in 2009 about the lesser prairie-chicken entitled "A Shared Future."

Conservation Programs Summary

In summary, a variety of important conservation efforts have been undertaken across the range of the lesser prairie-chicken. These actions, as outlined above, have, at least in some instances, slowed, but not halted, alteration of lesser prairie-chicken habitat. In many instances, these efforts have helped reduce the severity of the threats to the species, particularly in localized areas. Continued implementation of these and similar future actions is crucial to lesser prairie-chicken conservation. However, our review of these conservation efforts indicates that most of the measures identified are not adequate to fully address the known threats, including the primary threat of habitat fragmentation, in a manner that effectively reduces or eliminates the threats. All of the efforts are limited in size or duration, and the measures typically are not implemented at a scale that would be necessary to effectively reduce the threats to this species across its known range. Often the measures are voluntary, with little certainty that the measures, once implemented, will be maintained over the long term. In a few instances, mitigation for existing development within the range of the lesser prairie-chicken has been secured, but the effectiveness of the mitigation is unknown. Conservation of this species will require persistent, targeted implementation of appropriate actions over the entire range of the species to sufficiently reduce or eliminate the primary threats to the lesser prairie-chicken.

Background

Species Information

The lesser prairie-chicken (*Tympanuchus pallidicinctus*) is a species of prairie grouse endemic to the southern high plains of the United States, commonly recognized for its feathered tarsi (legs), stout build, ground-dwelling habit, and lek mating behavior. The lesser prairie-chicken is closely related and generally similar in life history strategy, although not identical in every aspect of behavior and life history, to other species of North American prairie grouse (e.g., greater prairie-chicken (*T. cupido pinnatus*), Attwater's prairie-chicken (*T. cupido attwateri*), sharp-tailed grouse (*T. phasianellus*), greater sage-grouse (*Centrocercus urophasianus*), and Gunnison's sage-grouse (*C. minimus*)). Plumage of the lesser prairie-chicken is characterized by a cryptic pattern of alternating brown and buff-colored barring, and is similar in mating behavior and appearance, although somewhat lighter in color, to the greater prairie-chicken. Males have long tufts of feathers on the sides of the neck, termed pinnae, which are erected during courtship displays. Pinnae are smaller and less prominent in females. Males also display brilliant yellow supraorbital eyecombs and dull reddish esophageal air sacs during courtship displays (Copelin 1963, p. 12; Sutton 1977, entire; Johnsgard 1983, p. 318). A more detailed summary of the appearance of the lesser prairie-chicken is provided in Hagen and Giesen (2005, unpaginated).

Lesser prairie-chickens are dimorphic in size, with the females being smaller than the males (See Table 1 in Hagen and Giesen 2005, unpaginated). Adult lesser prairie-chicken body length varies from 38 to 41 centimeters (cm) (15 to 16 inches (in)) (Johnsgard 1973, p. 275; Johnsgard 1983, p. 318), and body mass varies from 618 to 897 grams (g) (1.4 to 2.0 pounds (lbs)) for males and 517 to 772 g (1.1 to 1.7 lbs) for females (Haukos *et al*. 1989, pp. 271; Giesen 1998, p. 14). Adults weigh more than yearling birds.

Taxonomy

The lesser prairie-chicken is in the Order Galliformes, Family Phasianidae, subfamily Tetraoninae, and is generally recognized as a species separate from the greater prairie-chicken (Jones 1964, pp. 65–73; American Ornithologist's Union 1998, p. 122). The lesser prairie-chicken was first described as a subspecies of the greater prairie-chicken (Ridgway 1873, p. 199) but was later named a full species in 1885 (Ridgway 1885, p. 355). As recently as the early 1980s, some species experts (Johnsgard 1983, p. 316) still regarded the extinct heath hen, the greater prairie-chicken, the lesser prairie-chicken, and the Attwater's prairie-chicken to be four separate subspecies within *Tympanuchus cupido*. Others, as outlined in Hagen and Giesen (2005, unpaginated), considered the lesser prairie-chicken to be a distinct species.

Recent molecular analyses have suggested that phylogenetic relationships in the genus *Tympanuchus* remain unresolved. Ellsworth *et al.* (1994, p. 664; 1995, p. 497) confirmed that the genus *Tympanuchus* is distinct, but their analysis did not show strong differentiation between the taxa within that genus. Ellsworth *et al.* (1994 pp. 666, 668) believed that subdivision between the prairie grouse occurred during the recent Wisconsin glacial period and that adequate time had not elapsed to allow sufficient genetic differentiation between the taxa. Subsequently, Ellsworth *et al.* (1996, entire) expanded their study in an attempt to resolve the evolutionary relationships among the grouse. Yet, they were unable to partition members of the genus *Tympanuchus* along typical taxonomic boundaries, likely due to insufficient time for genetic change to accumulate (Ellsworth *et al*. 1996, p. 814). Similarly, Lucchini *et al*. (2001 p. 159) and Drovetski (2002, p. 941) also confirmed that speciation in *Tympanuchus* has been recent and may be incomplete.

While advances in molecular genetics, in many instances, have helped clarify taxonomic relationships, some disagreement between molecular and traditional phylogenetic approaches is not entirely unexpected (Lucchini *et al*. 2001, p. 150). Several scientists have argued that strong sexual selection characteristics of grouse that exhibit lek mating behavior resolves the apparent lack of agreement between the molecular data and the observed phenotypical and behavioral differences (Ellsworth 1994, p. 669; Spaulding 2007, pp. 1083–1084; Oyler-McCance *et al*. 2010, p. 121). As explained by Oyler-McCance *et al*. (2010, p. 121) strong sexual selection often occurs in lekking grouse that have highly skewed mating systems in which relatively few males are responsible for most of the mating. In such cases, sexual selection may drive changes in morphological and behavioral traits much more rapidly than occurs in some genetic markers. The readily observed differences in appearance, morphology, behavior, social interaction, and ecological affinities facilitate reproductive isolation and speciation within the prairie grouse. Although prairie grouse do not yet exhibit complete reproductive isolation, as evidenced by the presence of hybrid individuals in areas where their ranges overlap, the incidence of hybridization appears to be low and is not significantly impacting their gene pools (Johnsgard 2002, p. 32) (see Hybridization section, below.

For purposes of this rule, we will follow the American Ornithologist's Union taxonomic classification, which is based on observed differences in appearance, morphology, behavior, social interaction, and habitat affinities. While this more traditional taxonomic approach may not always agree with recent molecular analyses, it is widely accepted by taxonomists, and most taxonomists agree that the lesser prairie-chicken is distinct from other prairie grouse (Johnsgard 2002, p. 32; Johnson 2008, p. 168). Speciation is a continuous process and in lekking grouse, where strong sexual selection is operating, males may undergo rapid changes in morphology and behavior that can be the driving force in speciation. Additionally, much of the observed genetic diversity in prairie grouse is residual from when the species group originally diverged and likely accounts for the lack of resolution reported in previous taxonomic studies (Johnson 2008, p. 168).

Life-History Characteristics

Lesser prairie-chickens are polygynous (a mating pattern in which a male mates with more than one female in a single breeding season) and exhibit a lek mating system. The lek is a place where males traditionally gather to conduct a communal, competitive courtship display. The males use their specialized plumage and vocalizations to attract females for mating. The sequence of vocalizations and posturing of males, often described as "booming, gobbling, yodeling, bubbling, or duetting," has been described by

Johnsgard (1983, p. 336) and Haukos (1988, pp. 44–45) and is well summarized by Hagen and Giesen (2005, unpaginated). Male lesser prairie-chickens gather to display on leks at dawn and dusk beginning as early as late January and continuing through mid-May (Copelin 1963, p. 26; Hoffman 1963, p. 730; Crawford and Bolen 1976a, p. 97; Sell 1979, p. 10; Merchant 1982, p. 40), although fewer numbers of birds generally attend leks during the evening (Taylor and Guthery 1980a, p. 8). Male birds may remain on the lek for up to 4 hours (Copelin 1963, pp. 27–28; Sharpe 1968, p. 76; Crawford and Bolen 1975, pp. 808–810; Giesen 1998, p. 7), with females typically departing the lek following successful copulation (Sharpe 1968, pp. 154, 156). Dominant, usually older, males occupy and defend territories near the center of the lek where most of the copulations occur, while younger males occupy the periphery and compete for central access (Sharpe 1968, pp. 73–89; Wiley 1974, p. 203; Ehrlich *et al.* 1988, p. 259). A relatively small number of dominant males account for the majority of copulations at each lek (Sharpe 1968, p. 87; Wiley 1974, p. 203; Locke 1992, p. 1). Young males are rarely successful in breeding due to the dominance by older males. The spring display period may extend into June (Hoffman 1963, p. 730; Jones 1964, p. 66); however, Jones (1964, p. 66) observed some courtship activity as late as July in Oklahoma.

Leks are normally located on the tops of wind-swept ridges, exposed knolls, sparsely vegetated dunes, and similar features in areas having low vegetation height (10 cm (4 in) or less) or bare soil and enhanced visibility of the surrounding area (Copelin 1963, p. 26; Jones 1963a, p. 771; Taylor and Guthery 1980a, p. 8). The features associated with lek sites also may contribute to the transmission of sounds produced during lekking (Sparling 1983, pp. 40–41; Butler *et al.* 2010, entire) and these sounds may aid females in locating lek sites (Hagen and Giesen 2005, unpaginated). Background noises are known to increase in landscapes altered by human development and may interfere with normal behavioral activities (Francis *et al.* 2009, p. 1415). Birds may be particularly vulnerable to elevated levels of background noise, due to their reliance on acoustic communication, and elevated noise levels may negatively impact breeding in some birds particularly where acoustic cues are used during the reproductive process (Francis *et al.* 2009, pp. 1415, 1418). In sage grouse, sound levels exceeding 40 decibels (dB) were found to reduce breeding activity and increase stress, as determined by hormone levels (Blickley *et al*. 2012b, p. 4–5) (See section on *Influence of Noise* below).

Areas that have been previously disturbed by humans, such as infrequently used roads, abandoned drilling pads, abandoned farmland, recently cultivated fields, and livestock watering sites also can be used as lek sites (Crawford and Bolen 1976b, pp. 238–239; Davis *et al.* 1979, pp. 81, 83; Sell 1979, p. 14; Taylor 1979, p. 707). However, ongoing human activity, such as presence of humans or noise, may discourage lekking by causing birds to flush, and, in some instances, may cause lek sites to be abandoned (Hunt and Best 2004, pp. 2, 124). Leks often are surrounded by taller, denser cover that may be used for nesting, escape, thermal cover, and feeding cover. New leks can be formed opportunistically at any appropriate site within or adjacent to nesting habitat. Evidence of expanding lesser prairie-chicken populations tends to be demonstrated by increases in the number of active leks rather than by increases in the number of males displaying per lek (Hoffman 1963, p. 731; Snyder 1967, p. 124; Cannon and Knopf 1981, p. 777; Merchant 1982, p. 54; Locke 1992, p. 43). Temporary or satellite leks occasionally may be established during the breeding season and appear indicative of population fluctuations (e.g., an expanding population has more satellite leks than a declining population) (Hamerstrom and Hamerstrom 1973, pp. 7, 13; Schroeder and Braun 1992, p. 280; Haukos and Smith 1999, pp. 415, 417) or habitat quality (Cannon and Knopf 1979, p. 44; Merrill *et al.* 1999, pp. 193–194). Lesser prairie-chicken satellite leks have been observed to form later in the breeding season and coincide with decreased attendance at the permanent leks (Haukos and Smith 1999, p. 418). These satellite leks consisted primarily of birds that were unable to establish territories on the permanent leks (Haukos and Smith 1999, p. 418). Locations of traditional, permanent lek sites also may change in response to disturbances (Crawford and Bolen 1976b, pp. 238–240; Cannon and Knopf 1979, p. 44).

Females arrive at the lek in early spring after the males begin displaying, with peak hen attendance at leks typically occurring in early to mid-April (Copelin 1963, p. 26; Hoffman 1963, p. 730; Crawford and Bolen 1975, p. 810; Davis *et al.* 1979, p. 84; Merchant 1982, p. 41; Haukos 1988, p. 49). Sounds produced by courting males serve to advertise the presence of the lek to females in proximity to the display ground (Robb and Schroeder 2005, p. 29). Within 1 to 2 weeks of successful mating, the hen will select a nest site, normally within 1 to 4 km (0.6 to 2.4 mi) of an active lek (Copelin 1963, p. 44; Giesen 1994a, p. 97; Kukal 2010, pp. 19–20), construct a nest, and lay a clutch of 8 to 14 eggs (Bent 1932, p. 282; Copelin 1963, p. 34; Merchant 1982, p. 44; Fields 2004, pp. 88, 115–116; Hagen and Giesen 2005, unpaginated; Pitman *et al.* 2006a, p. 26). Nesting is generally initiated in mid-April and concludes in late May (Copelin 1963, p. 35; Snyder 1967, p. 124; Merchant 1982, p. 42; Haukos 1988, pp. 7–8). Hens most commonly lay one egg per day and initiate incubation once the clutch is complete (Hagen and Giesen 2005, unpaginated). Incubation lasts 24 to 27 days (Coats 1955, p. 18; Sutton 1968, p. 679; Pitman *et al.* 2006a, p. 26) with hatching generally peaking in late May through mid-June (Copelin 1963, p. 34; Merchant 1982, p. 42; Pitman *et al.* 2006a, p. 26). Hens typically leave the nest within 24 hours after the first egg hatches (Hagen and Giesen 2005, unpaginated). Renesting may occur when the first attempt is unsuccessful (a successful nest is one in which at least one egg hatches) (Johnsgard 1973, pp. 63–64; Merchant 1982, p. 43; Pitman *et al.* 2006a, p. 25). Renesting is more likely when nest failure occurs early in the nesting season and becomes less common as the nesting season progresses (Pitman *et al.* 2006a, p. 27). Clutches associated with renesting attempts tend to be smaller than clutches at first nesting (Fields 2004, p. 88; Pitman *et al.* 2006a, p. 27).

Nests generally consist of bowl-shaped depressions in the soil (Giesen 1998, p. 9). Nests are lined with dried grasses, leaves, and feathers, and there is no evidence that nests are reused in subsequent years (Giesen 1998, p. 9). Adequate herbaceous cover, including residual cover from the previous growing season, is an important factor influencing nest success, primarily by providing concealment of the nest (Suminski 1977, p. 32; Riley 1978, p. 36; Riley *et al.* 1992, p. 386; Giesen 1998, p. 9). Young are precocial (mobile upon hatching) and nidifugous (typically leaving the nest within hours of hatching) (Coats 1955, p. 5). Chicks are usually capable of short flights by 14 days of age (Hagen and Giesen 2005, unpaginated). Broods may remain with females for up to 18 weeks (Giesen 1998, p. 9; Pitman *et al.* 2006c, p. 93), but brood breakup generally occurs by September when the chicks are approximately 70 days of age (Taylor and Guthery 1980a, p. 10). Males do not incubate the eggs, assist in chick rearing, or provide other forms of parental care (Wiley 1974, p. 203). Nest success (proportion of nests that hatch at least one egg) varies, but averages about 30 percent (range 0–67 percent) (Hagen and Giesen 2005, unpaginated).

Male lesser prairie-chickens exhibit strong site fidelity (loyalty to a particular area; philopatry) to their display grounds (Copelin 1963, pp. 29–30; Hoffman 1963, p. 731; Campbell 1972, pp. 698–699). Such behavior is typical for most species of prairie grouse (e.g., greater prairie-chicken, lesser prairie-chicken, sharp-tailed grouse, greater sage-grouse, and Gunnison's sage-grouse) in North America (Schroeder and Robb 2003, pp. 231–232). Once a lek site is selected, males persistently return to that lek year after year (Wiley 1974, pp. 203–204) and may remain faithful to that site for life. They often will continue to use these traditional areas even when the surrounding habitat has declined in value (for example, concerning greater sage-grouse; see Harju *et al.* 2010, entire). Female lesser prairie-chickens, due to their tendency to frequently nest within 2.5

km (1.5 mi) of a lek (Giesen 1994a, p. 97), also may display fidelity to nesting areas but the degree of fidelity is not clearly established (Schroeder and Robb 2003, p. 292). However, Haukos and Smith (1999, p. 418) observed that female lesser prairie-chickens are more likely to visit older, traditionally used lek sites than temporary, nontraditional lek sites (those used for no more than 2 years).

Because of this fidelity to breeding areas, prairie grouse may not immediately demonstrate a population response when faced with environmental change. Considering that landscapes and habitat suitability can change rapidly, strong site fidelity in prairie grouse can result in a lag period between when a particular landscape degradation occurs and when an associated population response is observed (Gregory *et al.* 2011, pp. 29-30). In some birds exhibiting strong philopatry, Wiens *et al.* (1986, p. 374) thought that the overall response to a particular habitat alteration might not become evident until after the most site-tenacious individuals had died. Delayed population responses have been observed in birds impacted by wind energy development (Stewart *et al.* 2007, pp. 5–6) and in greater sage-grouse impacted by oil and gas development (Doherty *et al.* 2010, p. 5). Consequently, routine lek count surveys typically used to monitor prairie grouse may be slow in revealing impacts of environmental change (Gregory *et al.* 2011, pp. 29–30).

Typically, lesser prairie-chicken home ranges (geographic area to which an organism typically confines its activity) vary both by sex and by season and may be influenced by a variety of factors. However, Toole (2005, pp. 12–18) observed that home range sizes did not differ by season, sex or age. A general lack of suitable habitats outside of Toole's study areas may have contributed to similarity in home range size and movements of birds within his study sites (Toole 2005, pp. 24–28). Lesser prairie-chickens are not territorial, except for the small area defended by males on the lek, so home ranges of individual birds likely overlap to some extent. Habitat quality presumably influences the extent to which individual home ranges overlap.

Males tend to have smaller home ranges than do females, with the males generally remaining closer to the leks than do the females (Giesen 1998, p. 11). In Colorado, Giesen (1998, p. 11) observed that spring and summer home ranges for males were 211 ha (512 ac) and for females were 596 ha (1,473 ac). In the spring, home ranges are fairly small when daily activity focuses on lekking and mating. Home ranges of nesting females in New Mexico varied, on average, from 8.5 to 92 ha (21 to 227 ac) (Merchant 1982, p. 37; Riley *et al.* 1994, p. 185). Jamison (2000, p. 109) observed that range size peaked in October as birds began feeding in recently harvested grain fields. Median range size in October was 229 to 409 ha (566 to 1,400 ac). In Texas, Taylor and Guthery (1980b, p. 522) found that winter monthly home ranges for males could be as large as 1,945 ha (4,806 ac) and that subadults tended to have larger home ranges than did adults. More typically, winter ranges are more than 300 ha (740 ac) in size, and the size declines considerably by spring. Based on observations from New Mexico and Oklahoma, lesser prairie-chicken home ranges increase during periods of drought (Giesen 1998, p. 11; Merchant 1982, p. 55), possibly because of reduced food availability and cover. Davis

(2005, p. 3) states that the combined home range of all lesser prairie-chickens at a single lek is about 49 square kilometers (sq km) (19 square miles (sq mi) or 12,100 ac).

Dispersal plays an important role in maintaining healthy, robust populations by contributing to population expansion, recolonization, and gene flow (Sutherland *et al.* 2000, unpaginated). Many grouse species are known to exhibit relatively limited dispersal tendencies and juvenile dispersal is normally less than 40 km (25 mi) (Braun *et al.* 1994, pp. 432–433; Ellsworth *et al.* 1994, p. 666). Adults tend to spend much of their daily and seasonal activity within 4.8 km (3.0 mi) of a lek (Giesen 1994, p. 97; Riley *et al.* 1994, p. 185; Woodward *et al.* 2001, p. 263). Greater sage-grouse populations, for example, were shown to follow an isolation-by-distance model of localized gene flow that results primarily from a tendency for individuals to move between neighboring populations rather than through longer distance dispersal across the range (Oyler-McCance *et al*. 2005, p. 1306). Similarly a genetic analysis of greater prairie-chickens by Johnson *et al*. (2003, pp. 3341–3342) revealed that greater prairie-chickens also generally displayed isolation by distance. More recent work in Kansas concluded that isolation by distance did not explain the distribution of genetic diversity in greater prairie-chickens (Gregory 2011, p. 64). Instead isolation by resistance, where landscape characteristics, primarily habitat composition and configuration, influence the permeability of the landscape to dispersal, best described gene flow (dispersal) in greater prairie-chickens (Gregory 2011, p. 66). Thus landscape structure and arrangement, with its corresponding resistance to dispersal, exerts a strong influence on dispersal and the resulting connectivity between, and distribution of, genetic structure in greater prairie-chicken populations (Gregory 2011, p. 68). Environmental factors also may influence dispersal patterns in lesser prairie-chickens, particularly in fragmented landscapes where predation rates may be higher and habitat suitability may be reduced in smaller sized parcels. Lesser prairie-chickens appear to be sensitive to the size of habitat fragments and may avoid using parcels below a preferred size regardless of habitat type or quality (see separate discussion under “Effects of Habitat Fragmentation” below). As the landscape becomes more fragmented, longer dispersal distances over areas of unsuitable habitats may be required. However, should distances between suitable habitat patches in fragmented landscapes exceed 50 km (31 mi), the maximum dispersal distance observed by Hagen *et al.* (2004, p. 71), dispersal may be significantly reduced. Under such conditions, populations will become more isolated.

In lesser prairie-chickens, most seasonal movements are less than 10 km (6.2 mi), but Jamison (2000, p. 107) thought that movements as large as 44 km (27.3 mi) might occur in fragmented landscapes. Recent studies of lesser prairie-chicken in Kansas demonstrated some birds may move as much as 50 km (31 mi) from their point of capture (Hagen *et al.* 2004, p. 71). Although recorded dispersal movements indicate that lesser prairie-chickens are obviously physically capable of longer distance dispersal movements, these longer movements appear to be infrequent. Jamison (2000, p. 107) recorded only 2 of 76 tagged male lesser prairie-chickens left the 5,760 ha (14,233 ac) primary study area over a 3-year period. He thought site fidelity rather than habitat was more important in influencing movements of male lesser prairie-chickens (Jamison 2000, p. 111). A tendency to move among neighboring populations rather than long distance dispersal over the range, as demonstrated by greater sage-grouse (Oyler-McCance *et al*. 2005, p. 1306), may partially explain why lesser prairie-chickens in Kansas recolonized areas of native grassland in CRP but past efforts to translocate individuals over long distances have largely been unsuccessful.

Physiology influences dispersal capabilities and also plays a role in dispersal and movement patterns exhibited by lesser prairie-chickens. Lesser prairie-chickens and other species of grouse are generally considered poor fliers due to their high (heavy) wing loading and low wing aspect (Drovetski 1996, pp. 805–806; Bevanger 1998, p. 69). Birds with high wing loading have relatively small wings compared to their body mass. Birds with low wing aspect are those birds having relatively short, broad wings. Fast flight and a large turning radius are characteristic of birds with heavy wing loading (Drovetski 1996, p. 806). The combination of high wing loading and low wing aspect impacts aerodynamic performance and limits flight maneuverability. These birds typically are adapted to make relatively long, fast, straight and efficient flights, spending less time in the air than is typical for other species of birds (Drovetski, 1996, pp. 809–810). Consequently, the combination of a heavy body with smaller wings, coupled with their rapid flight, restricts the ability of most prairie grouse to react swiftly to unexpected obstacles. Such birds, like the lesser prairie-chicken, have a high risk of colliding with objects, such as powerlines or fences, within their flight path (Bevanger 1998, p. 67).

Daily movements of males tend to increase in fall and winter and decrease with onset of spring, with median daily movements typically being less than 786 meters (2,578 ft) per day (Jamison 2000, pp. 106, 112). In Texas, Haukos (1988, p. 46) recorded daily movements of 0.1 km (0.06 mi) to greater than 6 km (3.7 mi) by female lesser prairie-chickens prior to onset of incubation. Taylor and Guthery (1980b, p. 522) documented a single male moving 12.8 km (8 mi) in 4 days, which they considered to be a dispersal movement. Because lesser prairie-chickens exhibit limited dispersal tendencies and do not typically disperse over long distances, they may not readily recolonize areas following localized extinctions, particularly where the distance between habitat patches exceeds their typical dispersal capabilities.

In general, there is little documentation of historical dispersal patterns, and the existence of large-scale migration movements is not known. However, both Bent (1932, pp. 284–285) and Sharpe (1968, pp. 41–42) thought that the species, at least historically, might have been migratory with separate breeding and wintering ranges. Taylor and Guthery (1980a, p. 10) also thought the species was migratory prior to widespread settlement of the High Plains, but migratory movements have not recently been documented. The lesser prairie-chicken is now thought to be nonmigratory.

Lesser prairie-chickens forage during the day, usually during the early morning and late afternoon, and roost at night (Jones 1964, p. 69). Diet of the lesser prairie-chicken is very diverse, primarily consisting of insects, seeds, leaves, and buds and varies by age, location, and season (Giesen 1998, p. 4). They forage on the ground and within the vegetation layer (Jones 1963b, p. 22) and are known to consume a variety of invertebrate and plant materials. For example, in New Mexico, Smith (1979, p. 26) documented 30 different kinds of food items consumed by lesser prairie-chickens. In Texas, Crawford and Bolen (1976c, p. 143) identified 23 different plants in the lesser prairie-chicken diet. Jones (1963a, pp. 765–766), in the *Artemesia filifolia* (sand sagebrush) dominated grasslands of Oklahoma, recorded 16 different plant species eaten by lesser prairie-chickens.

Lesser prairie-chicken energy demands are almost entirely derived from daily foraging activities rather than stored fat reserves (Giesen 1998, p. 4). Olawsky (1987, p. 59) found that, on average, lesser prairie-chicken body fat reserves were less than 4.5 percent of body weight. Consequently, quality and quantity of food consumed can have a profound effect on the condition of individual birds. Inadequate food supplies and reduced nutritional condition can affect survival, particularly during harsh winters, and reproductive potential. Poor condition can lead to poor performance on display grounds, impact nesting success, and reduce overwinter survival. Sufficient nutrients and energy levels are important for reproduction and overwintering. Males expend energy defending territories and mating while females have demands of nesting, incubation, and any renesting. Reduced condition can lead to smaller clutch sizes. Because lesser prairie-chicken diets vary considerably by age, season, and habitat type and quality, habitat alteration can influence availability of certain foods. While not as critical for adults, presence of forbs and associated insect populations can be very important for proper growth and development of chicks and poults (juvenile birds).

Generally, chicks and young juveniles tend to forage almost exclusively on insects, such as grasshoppers and beetles, and other animal matter while adults tend to consume a higher percentage of vegetative material (Giesen 1998, p. 4). The majority of the published diet studies have been conducted in the southwestern portions of the historical range where the *Quercus havardii* (shinnery oak) dominated grasslands are prevalent. Throughout their range, when available, lesser prairie-chickens will use cultivated grains, such as *Sorghum vulgare* (grain sorghum) and *Zea mays* (corn), during the fall and winter months (Snyder 1967, p. 123; Campbell 1972, p. 698; Crawford and Bolen 1976c, pp. 143–144; Ahlborn 1980, p. 53; Salter *et al.* 2005, pp. 4–6). However, lesser prairie-chickens tend to predominantly rely on cultivated grains when production of natural foods, such as acorns and grass and forb seeds are deficient, particularly during drought and severe winters (Copelin 1963, p. 47; Ahlborn 1980, p. 57). Cultivated grains may be temporarily important during prolonged periods of adverse winter weather but are not necessary for survival during most years and in most regions. Use of cultivated grain fields is dependent upon the availability of waste grains on the soil surface during the fall and winter period. More efficient harvesting methods in use today likely reduce the availability of waste grain.

Food availability for young is most critical during the first 20 days (3 weeks) post-hatching when rapid growth is occurring (Dobson *et al.* 1988, p. 59). Food shortages during critical periods will negatively impact development and survival. Diet of lesser prairie-chicken chicks less than 5 weeks of age is entirely composed of insects and similar animal matter. Specifically, diet of chicks in New Mexico that were less than 2 weeks of age was 80 percent treehoppers (Mebracidae) (Davis *et al.* 1979, p. 71; Davis *et al.* 1980 p. 78). Overall, chicks less than 5 weeks of age consumed predominantly (87.7 percent) short-horned grasshoppers (Acrididae), treehoppers, and long-horned grasshoppers (Tettigonidae) (Davis *et al.* 1980, p. 78). Ants (Formicidae), mantids (Mantidae), snout beetles (Curculionidae), darkling beetles (Tenebrionidae), robber flies (Asilidae), and cockroaches (Blattidea) collectively provided the remaining 12.3 percent of the chicks' diet (Davis *et al.* 1980, p. 78). Similarly Suminski (1977, pp. 59–60) examined diet of chicks 2 to 4 weeks of age in New Mexico and found that diet was entirely composed of insects. Treehoppers, short-horned grasshoppers, and ants were the most significant (95 percent) items consumed, by volume. Insects and similar animal matter are a particularly prevalent component in the diet of young prairie-chickens (Drake 1994, pp. 31, 34, 36). Insects are high in protein (Riley *et al.* 1998, p. 42), and a high-protein diet was essential in pheasants for normal growth and feather development (Woodward *et al.* 1977. p. 1500). Insects and other arthropods also have been shown to be extremely important in the diet of young sage grouse and Attwater's prairie-chicken (Service 2010, pp. 30–31).

Older chicks between 5 and 10 weeks of age ate almost entirely short-horned grasshoppers (80.4 percent) (Davis *et al.* 1980, p. 78). They also began to consume plant material during this period. Shinnery oak acorns, seeds of *Lithospermum incisum* (narrowleaf stoneseed), and foliage and flowers of *Commelina erecta* (erect dayflower) comprised less than 1 percent of the diet (Davis *et al.* 1980, p. 78). Correspondingly, Suminski (1977, pp. 59, 61) observed that chicks between 6 and 10 weeks of age had begun to consume very small quantities (1.3 percent by volume) of plant material. The remainder of the diet was still almost entirely composed of insects. By far the most prevalent insect was short–horned grasshoppers (Acrididae), accounting for 73.9 percent of the diet (Davis *et al.* 1980, p. 78). As the birds grew, the sizes of insects eaten increased. Analysis of food habits of juvenile birds from 20 weeks of age and older, based on samples collected between August and December, revealed that 82.6 percent of diet was plant material by volume and 17.4 percent was invertebrates (Suminski 1977, p. 62). Shinnery oak acorns contributed 67 percent of the overall diet, by volume. Key insects included crickets (Gryllidae), short-horned grasshoppers, mantids, and butterfly (Lepidoptera) larvae.

Plant materials are a principal component of the diet for adult lesser prairie-chickens; however, the composition of the diet tends to vary by season and habitat type. The majority of the diet studies examined foods contained in the crop (an expanded, muscular pouch within the digestive tract of most birds that aids in breakdown and digestion of foods) and were conducted in habitats supporting shinnery oak. However, Jones (1963b, p. 20) reported on lesser prairie-chicken diets from sand sagebrush habitats.

In the spring (March, April, and May), lesser prairie-chickens fed heavily on green vegetation (60 to 79 percent) and mast and seeds (15 to 28 percent) (Davis *et al.* (1980, p. 76; Suminski 1977, p. 57). Insects comprised less than 13 percent of the diet primarily due to their relative scarcity in the spring months. Treehoppers and beetles were the most common types of insects found in the spring diet. The proportion of vegetative material provided by shinnery oak leaves, catkins, and acorns was high. Similarly, Doerr (1980, p. 8) also examined the spring diet of lesser prairie-chickens. However, he compared diets between areas treated with the herbicide tebuthiuron and untreated areas, and it is unclear whether the birds he examined came from treated or untreated areas. Birds collected from treated areas likely would have limited access to shinnery oak, possibly altering the observed occurrence of shinnery oak in the diet. He reported that animal matter was the dominant component of the spring diet and largely consisted of short-horned grasshoppers and darkling beetles (Doerr 1980, pp. 30–31). Ants, ground beetles (Carabidae), and stinkbugs (Pentatomidae) were slightly less prevalent in the diet. Shinnery oak acorns and plant seeds were the least common component, by volume, in the diet in the Doerr (1980) studies.

In the summer, insects become a more common component of the adult diet. In New Mexico, insects comprised over half (55.3 percent) of the overall summer (June, July, and August) diet with almost half (49 percent) of the insects being short- and long-horned grasshoppers and treehoppers (Davis *et al.* 1980, p. 77). Plant material consumed was almost equally divided between foliage (leaves and flowers; 23.3 percent) and mast and seeds (21.4 percent). Shinnery oak parts comprised 22.5 percent of the overall diet. Olawsky (1987, pp. 24, 30) also examined lesser prairie-chicken diets during the summer season (May, June, and July); however, he also compared diets between areas treated with tebuthiuron and untreated pastures in Texas and New Mexico. While the diets in treated and untreated areas were different, the diet from the untreated area should be representative of a typical summer diet. Total plant matter from birds collected from the untreated areas comprised 68 to 81 percent, by volume (Olawsky 1987, pp. 30–32). Foliage comprised 21 to 25 percent, and seeds and mast, 36 to 60 percent, of the diet from birds collected in the untreated area. Shinnery oak acorns were the primary form of seeds and mast consumed. Animal matter comprised 19 to 32 percent of the overall diet, and almost all of the animal matter consisted of treehoppers and short-horned grasshoppers (Olawsky 1987, pp. 30–32).

Several studies have reported on the fall and winter diets of lesser prairie-chickens. Davis *et al.* (1979, pp. 70–80), Smith (1979, pp. 24–32), and Riley *et al.* (1993, pp. 186–189) all reported on lesser prairie-chicken food habits from southeastern New Mexico (Chaves County), where the birds had no access to grain fields (Smith 1979, p. 31). They generally found that fall (October to early December) and winter (January and February) diets generally consist of a mixture of seeds, vegetative material, and insects.

The fall diet differed between years primarily due to reduced availability of shinnery oak acorns (Smith 1979, p. 25). Reduced precipitation in the fall of 1976 was thought to have influenced acorn production in 1977 (Riley *et al.* 1993, pp. 188). When acorns were available, shinnery oak acorns comprised almost 62 percent, by volume, of the diet but less than 17 percent during a year when the acorn crop failed (Smith 1979, p. 26). On average, total mast and seeds consumed was 43 percent, vegetative material was 39 percent, and animal matter was 18 percent by volume of the fall diet (Davis *et al.* 1979, p. 76). Over 81 percent of the animal matter consumed was short-horned grasshoppers (Davis *et al.* 1979, p. 76).

Crawford (1974, pp. 19–20, 35–36) and Crawford and Bolen (1976c, pp. 142–144) reported on the fall (mid-October) diet of lesser prairie-chickens in west Texas over a 3-year period. Twenty-three species of plants were identified from the crops over the course of the study. Plant matter accounted for 90 percent of the food present by weight and 81 percent by volume. Grain sorghum also was prevalent, comprising 63 percent by weight and 43 percent by volume of total diet. Alhborn (1980, pp. 53–58) also documented use of grain sorghum during the fall and winter in eastern New Mexico. The remainder of the diet (10 percent by weight and 19 percent by volume) was animal matter (insects only). Over 62 percent, by volume, of the animal matter was composed of short-horned grasshoppers. Other insects that were important in the diet included darkling beetles, walking sticks (Phasmidae), and wingless long-horned grasshoppers

(Gryllacrididae). During the fall and winter in eastern New Mexico, Alhborn (1980, pp. 53–58) reported that vegetative material from shinnery oak constituted 21 percent of the total diet.

Similarly, Doerr (1980, p. 32) reported on the lesser prairie-chickens from west Texas in the fall (October). The diet largely comprised animal matter (86 percent by volume) with short-horned grasshoppers contributing 81 percent by volume of the total diet. Stinkbugs also were prevalent in the diet. Foliage was the least important component, consisting of only 2.5 percent by volume. Seeds and acorns comprised 11 percent of the diet and consisted entirely of shinnery oak acorns and seeds of *Linum rigidum* (stiffstem flax).

Shinnery oak acorns (69 percent) and annual buckwheat (14 percent) were the primary components of the winter (January and February) diet of lesser prairie-chickens in southeastern New Mexico (Riley *et al.* 1993, p. 188). Heavy selection for acorns in winter was attributed to need for a high energy source to help sustain body temperature in cold weather (Smith 1979, p. 28). Vegetative matter was about 26 percent of overall diet, by volume, with 5 percent of the diet consisting of animal matter, almost entirely comprising ground beetles (Carabidae) (Davis *et al.* 1979, p. 78).

In contrast to the above studies, Jones (1963b, p. 20) and Doerr (1980, p. 8) examined food items present in the droppings rather than from the crops. Although this approach is valid, differential digestion of the food items likely overemphasizes the importance of indigestible items and underrepresents occurrence of foods that are highly digestible (Jones 1963b, p. 21; Doerr 1980, pp. 27, 33). Jones' study site was located in the sand sagebrush dominated grasslands in the more northern portion of the historical range where shinnery oak was unavailable. However, Doerr's study site was located in the shinnery oak dominated grasslands of the southwest Texas panhandle.

In the winter (December through February), where *Rhus trilobata* (skunkbush sumac) was present, Jones (1963b, pp. 30, 34) found lesser prairie-chickens primarily used sumac buds and foliage of sumac, sand sagebrush, and *Gutierrezia sarothrae* (broom snakeweed), particularly when snow was on the ground. Small annual plants present in the diet were *Vulpia* (*Festuca*) *octoflora* (sixweeks fescue), annual buckwheat, and *Evax prolifera* (big-headed evax; bigheaded pygmycudweed) (Jones 1963b, p. 30). Grain sorghum wasn't used to any appreciable extent, particularly when skunkbush sumac was present, but was eaten when available. Relatively few insects were available during the winter period. However, beetles were consumed throughout the winter season and grasshoppers were important in December. Doerr (1980, p. 28) found grasshoppers, crickets, ants, and wasps were the most commonly observed insects in the winter diet. Foliage from sand sagebrush and *Cryptantha cinerea* (James' cryptantha) was prevalent, but shinnery oak acorns were by far the most significant plant component detected in the winter diet.

In the spring (March through May), lesser prairie-chickens used seeds and foliage of early spring annuals such as *Viola bicolor* (johnny jumpup) and *Silene antirrhina* (sleepy catchfly) (Jones 1963b, p. 49). Skunkbush sumac continued to be an important component of the diet. Insect use increased as the spring season progressed. Doerr (1980, p. 29) also observed that grasshoppers and crickets were prevalent in the spring diet. However, foliage and acorns of shinnery oak were more abundant in the diet than any other food item.

In the summer (June through August), lesser prairie-chickens continued to use sumac and other plant material, but insects dominated the diet (Jones 1963b. pp. 64–65). Grasshoppers were the principal item found in the diet, but beetles were particularly favored in shrubby habitats. Similarly, Doerr (1980, p. 25) found grasshoppers and crickets were the most important component of the summer diet followed in importance by beetles. Jones (1963b, pp. 64–65) reported fruits from skunkbush sumac to be the most favored plant material in the diet. Doerr (1980, p. 25) found James cryptantha and erect dayflower were the two most important plants in the diet in his study. Insects remained a principal food item in the fall (September through November), at least until November when plant foods, such as *Cyperus schweinitzii* (flatsedge) and *Ambrosia psilostachya* (western ragweed) became more prevalent in the diet (Jones 1963b, pp. 80–81).

Little is known regarding the specific water requirements of the lesser prairie-chicken, but their distribution does not appear to be strongly influenced by the presence of surface water. Total annual precipitation across the range of the lesser prairie-chicken varies, on average, from roughly 63 cm (25 in) in the eastern portions of the historical range to as little as 25 cm (10 in) in the western portions of the range. Consequently, fewer sources of free-standing surface water existed in lesser prairie-chicken historical range prior to settlement than currently exist. Lesser prairie-chickens likely rely on food sources and consumption of dew to satisfy their metabolic moisture requirement (Snyder 1967, p. 123; Hagen and Giesen 2005, unpaginated; Bidwell *et al.* 2002, p. 6) but will use surface water when it is available. Boal and Pirius (2012, p. 6) observed that 99.9 percent of lesser prairie-chicken locations they recorded in west Texas were within 3.2 km (2.0 mi) of an available water source and may be indicative of the importance of surface water sources. Grisham *et al.* (2013, p. 7) believed that use of available standing water may be particularly important for egg development during drought conditions and its importance may be overlooked. Because much of the historically occupied range is now used for domestic livestock production, numerous artificial sources of surface water, such as stock ponds and stock tanks, have been developed throughout the region. Several studies have documented use of these water sources by lesser prairie-chickens during the spring, late summer, and fall seasons (Copelin 1963, p. 20; Jones 1964, p. 70; Crawford and Bolen 1973, pp. 471–472; Crawford 1974, p. 41; Sell 1979, p. 31), and they may be particularly important during periods of drought (Crawford and Bolen 1973, p. 472; Crawford 1974, p. 41). Hoffman (1963, p. 732) supported development of supplemental water sources (i.e., guzzlers) as a potential habitat improvement tool. Others, such as Davis *et al.* (1979, pp. 127–128) and Applegate and Riley (1998, p. 15) cautioned that creating additional surface water sources will influence grazing pressure and possibly contribute to degradation of habitat conditions for lesser prairie-chickens. Rosenstock *et al.* (1999, p. 306) reported that some predators, particularly raptors, benefit from the presence of surface water sources developed for wildlife in arid environments. Additionally, some livestock watering facilities may create other hazardous conditions (e.g., drowning; Sell 1979, p. 30), but the frequency of these incidents is unknown.

Lesser prairie-chickens have a relatively short lifespan and high annual mortality. Campbell (1972, p. 694) estimated a 5-year maximum lifespan, although an individual nearly 7 years old has been documented in the wild by the Sutton Avian Research Center (Sutton Center) (Wolfe 2010, pers. comm.). Average natural lifespan or generation time was calculated, based on work by Farner (1955, entire), to be 1.95 years (Van Pelt *et al.* 2013, p. 130). Pruett *et al.* (2011, p. 1209) also estimated generation time in lesser prairie-chickens and found generation times were slightly lower in Oklahoma (1.92 years) than in New Mexico (2.66 years). Lesser prairie-chickens and other galliform birds appear to have particularly short lifespans for their size (Lindstedt and Calder 1976, p. 91).

Differences in survival may be associated with sex, weather, harvest (where allowed), age, and habitat quality. Campbell (1972, p. 689), using 9 years of band recovery data from New Mexico, estimated annual mortality for males to be 65 percent. Hagen *et al.* (2005, p. 82) specifically examined survival in male lesser prairie-chickens in Kansas and found apparent survival varied by year and declined with age. Annual mortality was estimated to be 55 percent (Hagen *et al.* 2005, p. 83). Survival rates for lesser prairie-chickens in northeastern Texas were lower for both sexes during the breeding season than during the non-breeding season (Jones 2009, p. 16). Estimated survival was 52 percent. Lesser prairie-chickens in New Mexico and Oklahoma also had higher mortality during the breeding season than at other times of the year (Patten *et al*. 2005b, p. 240; Wolfe *et al*. 2007). Male survival may be lower during the breeding season due to increased predation or costs associated with territorial defense while lekking (Hagen *et al.* 2005, p. 83). In female lesser prairie-chickens, Hagen *et al.* (2007, p. 522) estimated that annual mortality in two remnant patches of native sand sagebrush prairie near Garden City, Finney County, Kansas was about 50 percent at a study site southwest of Garden City and about 65 percent at a study site southeast of Garden City. Female survival may be lower during the breeding season due to the costs associated with reproduction (see both Hagen *et al.* 2005 and 2007.). Grisham (2012, pp. 19–20) found that female survival (at least 71 percent) was higher than male survival (57 percent). Observed female survival rates were much higher than those reported elsewhere in the literature (see Campbell 1972, Merchant 1982, and Hagen *et al.* 2007) but may have been a function of the statistical test used in the analysis (Grisham 2012, pp. 21–22). Principally, the study by Grisham (2012, entire) demonstrated lesser prairie-chickens may have high survival during the breeding season in shinnery oak habitats.

Adult annual survival in Texas apparently varied by habitat type. In sand sagebrush habitat, survival was estimated to be 0.52, whereas survival was only 0.31 in shinnery oak habitat (Lyons *et al.* 2009, p. 93). For both areas, survival was about 4 percent lower during the breeding season than during the nonbreeding period (Lyons *et al.* 2009, p. 93). Hagen *et al.* (2007, p. 522) also reported lower survival during the reproductive season (31 percent mortality) compared to the nonbreeding season (23 percent mortality) in Kansas. In contrast with Lyons *et al.* (2009), survival times did not differ between sand sagebrush habitats in Oklahoma and shinnery oak habitats in New Mexico (Patten *et al.* 2005a, p. 1274). Birds occupying sand shinnery sites with greater than 20 percent shrub cover survived longer than those in areas with less dense shrub cover (Patten *et al.* 2005a, p. 1275). Areas with greater than 20 percent shrub cover likely provided a more suitable microclimate through enhanced thermal protection than areas with less shrub cover.

Availability of food and cover are key factors that affect chick and juvenile survival. Habitats used by lesser prairie-chicken broods had greater biomass of invertebrates and forbs than areas not frequented by broods in Kansas (Hagen *et al.* 2005, p. 1087); Jamison *et al*. 2002, p. 524). Chick survival averaged only about 25 percent during the first 35 days following hatching (Hagen 2003, p. 135). Survival for chicks between 35 days of age and the following spring was estimated to be 53.9 percent in southwestern Kansas (Hagen *et al.* 2009, p. 1326). Jamison (2000, p. 57) estimated survival of chicks from hatching to early autumn (60 days post-hatching), using late summer brood sizes provided in several early studies, to be 27 percent in Kansas and 43–65 percent in Oklahoma. These values were considerably higher than the 19 percent Jamison observed in his study and may reflect an inability in the earlier studies to account for the complete loss of broods and inclusion of mixed broods (combined broods from several females) when estimating brood size (Jamison 2000, p. 57). Pitman *et al.* (2006b, p. 677) estimated survival of chicks from hatching to 60-days post-hatching to be 17.7 percent. Recruitment was characterized as low with survival of juvenile birds from hatching to the start of the first breeding season the following year estimated to be only 12 percent (Pitman *et al.* 2006b, pp. 678–680), which may be a significant limiting factor in southwestern Kansas. However, the authors cautioned that these estimates might not be indicative of survival estimates in other areas due to low habitat quality, specifically poor distribution of nesting and brood-rearing habitats within the study area (Pitman *et al.* 2006b, p. 680).

Conservation Genetics

Persistence of wild populations is usually influenced more by ecological rather than by genetic effects; however, as population size declines, genetic factors often become increasingly important (Lande 1995, p. 318). Considering that lesser prairie-chickens have one of the smallest population sizes and most restricted geographic distributions of any native North American grouse (Hagen and Giesen 2005, unpaginated), an understanding of relevant genetic factors can be valuable when implementing conservation efforts, particularly where translocation and other forms of reintroduction may be considered. Van Den Bussche *et al*. (2003, entire) examined genetic variation within the lesser prairie-chicken using mitochondrial deoxyribonucleic acid (DNA) (mtDNA, maternally-inherited DNA located in cellular organelles called mitochondria) and nuclear microsatellite (short, tandem repeating sequences of DNA nucleotide base pairs) data from 20 lek sites in Oklahoma and New Mexico. They found that these lesser prairie-chicken populations maintain high levels of genetic variation and genetic diversity did not differ between leks in Oklahoma and New Mexico (Van Den Bussche *et al*. 2003, p. 680). Historical gene flow between birds in Oklahoma and New Mexico was considered to be low, leading to some genetic differentiation between the two populations (Van Den Bussche *et al*. 2003, p. 681). These findings are not unexpected, considering these populations are fragmented and separated by at least 300 km (200 mi). Bouzat and Johnson (2004, entire) examined genetic structure between four closely spaced leks within a lesser prairie-chicken population in New Mexico. They detected increased inbreeding within these closely spaced leks, leading to an increase in homozygosity (having the same inherited alleles (gene form), rather than different alleles at a particular gene location on both homologous chromosomes (threadlike linear strands of DNA and associated proteins in the cell nucleus that carries the genes and functions in the transmission of hereditary information)) within these leks (Bouzat and Johnson 2004, p. 503). Although no deleterious effects to demographic rates have yet been documented in New Mexico populations, a loss of genetic diversity and inbreeding can lead to a reduction in reproductive fitness in prairie grouse (Bouzat *et al.* 1998a, p. 841; Bouzat *et al.* 1998b, p. 4).

Hagen *et al*. (2010, entire) examined variability in mtDNA of lesser prairie-chickens across their range, with the exception of Texas. They observed low levels of population differentiation (p. 33) with relatively high levels of genetic diversity in most populations (pp. 33-34). Their data suggest that gene flow continues to occur over most of the occupied range, with significant differences between New Mexico populations and the rest of the studied range. As previously indicated the New Mexico population is separated by considerable distance from the remainder of the studied range. The population in New Mexico was significantly different from the others examined and lacked gene flow with the remainder of the populations in Colorado, Kansas and Oklahoma (Hagen *et al*. 2010, p. 34). This suggests that lesser prairie-chickens in New Mexico are isolated from populations in Colorado, Kansas and Oklahoma.

Complementary work by Corman (2011, entire) examined genetic diversity in lesser prairie-chicken populations in Texas. In examining population differentiation, the population in Deaf Smith County was not significantly different from the remainder of the populations in the southwestern panhandle and eastern New Mexico nor was this population significantly different from the population in Lipscomb, Hemphill, and Wheeler counties (Corman 2011, p. 47). The Gray and Donley County population and the Lipscomb, Hemphill, Wheeler population of northeast Texas panhandle had the lowest differentiation of the four geographical regions studied. The Deaf Smith County and the Gray and Donley County populations had the greatest differentiation even though they were intermediate by distance between the regions. The southwest Texas panhandle population revealed little differentiation with the New Mexico population (Corman 2011, p. 48). Genetic clustering efforts without regard to region indicated the northeast Texas populations and the southwest Texas panhandle-New Mexico populations were the two primary geographic clusters of lesser prairie-chickens in Texas. Genetic clustering within these two primary geographic clusters indicated that additional clusters were present. Within the southwest Texas panhandle-New Mexico cluster, the population in Deaf Smith County clustered separately from the remainder of the population in the southwest Texas and New Mexico cluster. In the northeastern Texas cluster, the Gray and Donley County population clustered separately from the remainder of the populations in Lipscomb, Hemphill, and Wheeler counties (Corman 2011, p. 49). The two primary population clusters are separated by a geographical distance of about 160 to 250 km (99 to 155 mi). Overall genetic diversity in Texas has remained relatively high despite observed population declines since 1900 (Corman 2011, p. 112). Genetic diversity tends to be higher in northeastern Texas Panhandle relative to the rest of Texas and New Mexico (Corman 2011, p. 112). This population likely maintains gene flow with populations in adjacent portions of Oklahoma. The population cluster that persists in the Deaf Smith County region had much lower diversity than other locations in Texas. Diversity estimates obtained by Corman (2011, p.113) were comparable with those provided by Hagen *et al*. (2010, entire). Genetic diversity is particularly important to maintaining reproductive fitness. Gregory (2011, p. 18) observed that for greater prairie-chickens, the most genetically diverse males were more likely to live longer than less diverse males and were more likely to be the most successful male on the lek.

Corman (2011, p. 142) estimates that the lesser prairie-chicken effective population size is about 560 to 610 individuals are required for the southwestern Texas Panhandle and New Mexico populations and about 120 to 260 individuals for the northeast Texas Panhandle region. Consistent with previous studies, the southwest Texas/eastern New Mexico lesser prairie-chicken population is isolated from the remainder of the range (a condition which has been in place for perhaps at least 6-7 decades) and exhibits effects from genetic drift as indicated by lower genetic variability (Corman 2011, p. 116). Based on estimates of the effective population size, the southwest Texas/eastern New Mexico population may be large enough to maintain evolutionary potential (ability to adapt to changing conditions over time) if there were no further population declines or changes in habitat conditions (Corman 2011, p. 120). However, the lesser prairie-chicken populations in the northeast Texas panhandle do not appear to be large enough to maintain evolutionary potential without stabilizing populations and continued connectivity to populations in Oklahoma (Corman 2011, p. 120).

Pruett *et al*. (2011, entire) examined effective population size in lesser prairie-chickens from New Mexico and Oklahoma. Effective population size is useful for determining extinction risk in small populations and is a measure of the actual number of breeding individuals in a population. The effective size of a population is often much less than the actual number of individuals within the same population. It is defined as the size of an idealized population of breeding adults that would experience the same rate of (1) loss of heterozygosity (the amount and number of different genes within individuals in a population), (2) change in the average inbreeding coefficient (a calculation of the amount of breeding by closely related individuals), or (3) change in variance in allele (one member of a pair or series of genes occupying a specific position in a specific chromosome) frequency through genetic drift (the fluctuation in gene frequency occurring in an isolated population) as the actual population. As the effective population size decreases, the rate of loss of allelic diversity via genetic drift increases, reducing adaptive potential and increasing the risk of inbreeding depression.

Estimates of effective population size, based on the parameters for the demographic variables they modeled, was estimated to be between 341 and 1,023 individuals in Oklahoma and between 944 and 2,375 individuals in New Mexico (Pruett *et al*. (2011, p. 1209). Using genetic information, which generally yields smaller effective population sizes, Pruett *et al*. (2011, p. 1211) estimated current effective population size in Oklahoma to be about 115 individuals and about 55 individuals in New Mexico. This value for New Mexico is considerably smaller than the value determined for New Mexico by Corman (560 to 610 individuals) (2011, p. 142). However, Corman included birds from southwest Texas in his estimates of the Texas Panhandle and New

Mexico populations, which likely contributed to the higher estimate of effective population size. Despite these low numbers resulting from genetic analysis, based on estimates of the effective population size, we conclude that the southwest Texas/eastern New Mexico population may be able to maintain evolutionary potential (ability to adapt to changing conditions over time) if there are no further population declines or changes in habitat conditions.

Garton (2012, entire) conducted a reconstruction analysis of lesser prairie-chicken population abundance through time to model the likely future of lesser prairie-chicken populations. His analysis evaluated both rangewide populations and each of the four ecoregions where the lesser prairie-chicken occurs. To do so, Garton (2012, p. 5) used the effective population size values of 50 individuals for short-term (30 year) persistence and 500 for long-term (100 year) persistence and adjusted these for count composition of sexes resulting in an estimated effective population size of 85 birds for short-term persistence and 852 birds for long-term persistence. Using these estimated effective population sizes, Garton (2012, p. 16–17) projected that in 30 years the estimated rangewide carrying capacity of lesser prairie-chickens would be about 10,000 birds and less than 1,000 birds in 100 years, provided existing conditions did not change. Based on these numbers, Garton (2012, p. 18, 32) concludes from the most recent data, two of the eco-regions (sand sagebrush prairie and mixed grass/CRP) and the rangewide species population have high to very high probabilities of falling below quasi-extinction thresholds within 30 years. Garton (2012, p. 18) also concludes that analysis across the long-term data paint a more optimistic picture of the rangewide species carrying capacity, but the fundamental pattern is still one of declining trends that must be reversed in the long term to conserve the species.

Habitat

The preferred habitat of the lesser prairie-chicken is native prairies composed of short- and mixed-grasses with a shrub component dominated by *Artemesia filifolia* (sand sagebrush) or *Quercus havardii* (shinnery oak) (hereafter described as native rangeland) (Donaldson 1969, pp. 56, 62; Taylor and Guthery 1980a, p. 6; Giesen 1998, pp. 3–4). In more moist, less sandy soils, other small shrubs, such as plums and sumac, become more prevalent; however, the habitat remains suitable for lesser prairie-chickens. Small shrubs, along with tall grasses, provide cover/concealment for nesting hens and broods and are important for summer shade (Copelin 1963, p. 37; Donaldson 1969, pp. 44–45, 62), winter protection, and as supplemental foods (Johnsgard 1979, p. 112). Typically the height and structure of short-grass prairie alone does not provide suitable cover when shrubs or taller grasses are absent. Historically, trees and other tall, woody vegetation were largely absent from these grassland ecosystems, except in canyons and along water courses. Prairie landscapes supporting less than 63 percent native rangeland appear incapable of supporting self-sustaining lesser prairie-chicken populations (Crawford and Bolen 1976a, p. 102).

Outside of the CRP dominated grasslands in Kansas, lesser prairie-chickens are primarily found in the sand sagebrush dominated native rangelands of Colorado, Kansas, Oklahoma, and Texas, and in the shinnery oak-bluestem grasslands of New Mexico, Oklahoma, and Texas. Sand sagebrush is a 0.6- to 1.8-m (2- to 6-ft) tall shrub that occurs in 11 States of the central and western United States (Shultz 2006, p. 508). Within the central and southern Great Plains, sand sagebrush is often a dominant species on sandy soils and may exhibit a foliar cover of 20 to 50 percent (Collins *et al.* 1987, p. 94; Vermeire 2002, p. 1). Sand-sage shrublands have been estimated to occupy 4.8 million ha (11.8 million ac) in the central and southern Great Plains (Berg 1994, p. 99).

The shinnery oak vegetation type is endemic to the southern great plains and is estimated to have historically covered an area of 2.3 million ha (over 5.6 million ac), although its current range has been considerably reduced through eradication (Mayes *et al.* 1998, p. 1609). The distribution of shinnery oak overlaps much of the historical lesser prairie-chicken range in New Mexico, Oklahoma, and Texas (Peterson and Boyd 1998, p. 2). Shinnery oak is a rhizomatous (a horizontal, usually underground stem that often sends out roots and shoots from its nodes) shrub that reproduces slowly and does not invade previously unoccupied areas (Dhillion *et al.* 1994, p. 52). Mayes *et al.* (1998, p. 1611) documented that a single rhizomatous shinnery oak can occupy an area exceeding 7,000 square meters (sq m) (75,300 square feet (sq ft)). Shinnery oak in some areas multiplies by slow rhizomatous spread and eventual fracturing of underground stems from the original plant. In this way, single clones have been documented to occupy up to

81 ha (200 ac) over an estimated timeframe of 13,000 years (Cook 1985, p. 264; Anonymous 1997, p. 483), making shinnery oak possibly the largest and longest-lived plant species in the world.

Within the historical range of the species, the USDA's CRP, administered by the FSA, has promoted the establishment and conservation of certain grassland habitats. Originally funded as a mechanism to reduce erosion from highly erodible soils, the program has since become a means to at least temporarily retire any environmentally sensitive cropland from production and establish vegetative cover on that land. Initially, many types of grasses were approved for use as permanent vegetative cover, including several that are nonnative. The use of native grasses has become more prevalent over time. In Kansas in particular, much of the vegetative cover established through the CRP within the historical range of the lesser prairie-chicken was a mix of native warm-season grasses such as *Schizachyrium scoparium* (little bluestem), *Bouteloua curtipendula* (sideoats grama), and *Panicum virgatum* (switchgrass) (Rodgers and Hoffman 2005, p. 120). These grasses are important components of lesser prairie-chicken habitat and have led to reoccupation of large areas of the historical range in western Kansas by lesser prairie-chickens, particularly north of the Arkansas River.

In other areas, nonnative grasses were used that displaced the native, warm season grasses, providing little, if any, habitat value for the lesser prairie-chicken. Exotic old world bluestems and *Eragrostis curvula* (weeping lovegrass) were extensively seeded in

CRP tracts in Texas, New Mexico, and Oklahoma (Haufler *et al.* 2012, p. 17; Hickman and Elmore 2009, p. 54). For example, about 70 to 80 percent of the original CRP seedings in eastern New Mexico consisted of dense, single-species stands of weeping lovegrass, *Bothriochloa bladhii* (Caucasian bluestem), or *B. ischaemum* (yellow bluestem) (Rodgers and Hoffman 2005, p. 122). Monocultures of old world bluestem and other exotic grasses contribute very little to lesser prairie-chicken conservation as they provide poor-quality nesting and brood rearing habitat. Toole (2005, p. 21) reported that the abundance of invertebrates, which are used as food for both adults and young, was over 32 times lower in weeping lovegrass CRP fields than in pastures containing native warm season grasses. However, as these nonnative CRP grasslands have matured over the last two decades, some species of native grasses and shrubs are beginning to reestablish within these fields. The lesser prairie-chicken will occasionally use these older stands of exotic grasses for roosting and nesting (Rodgers and Hoffman 2005, p. 122), but such fields often continue to provide limited habitat value for lesser prairie-chickens. In contrast, where CRP lands support native, warm season grasses having the suitable vegetative structure and species composition required by lesser prairie-chickens, these fields can provide high quality habitat. See section on "Conservation Reserve Program (CRP)" for more information on CRP.

Leks are characterized by areas of sparse or low vegetation (10 cm (4 in) or less) cite for height see Plan) and are generally located on elevated features, such as ridges or grassy knolls (Giesen 1998, p. 4). Vegetative cover characteristics, primarily height and density, may have a greater influence on lek establishment than elevation (Giesen 1998, p. 4). Copelin (1963, p. 26) observed display grounds within short grass meadows of valleys where sand sagebrush was tall and dense on the adjacent ridges. Early spring fires also encouraged lek establishment when vegetation likely was too high (0.6 to 1.0 m (2.0 to 3.3 ft)) to facilitate displays (Cannon and Knopf 1979, pp. 44–45). Several authors, as discussed in Giesen (1998, p. 4), observed that roads, oil and gas pads, and similar forms of human disturbance can create habitat conditions that may encourage the establishment of artificial lek sites (as opposed to those in native grasslands). Site fidelity also may play a role in continued use of certain areas as lek sites, despite some forms of human disturbance. However, Taylor (1979, p. 707) emphasized that human disturbance, which is often associated with these artificial lek sites, is detrimental during the breeding season and did not encourage construction of potential lek sites in or near areas subject to human disturbance. Leks are typically located near areas that provide good nesting habitat. Giesen (1998, p. 9) reported that hens usually nest and rear broods within 3.4 km (2.1 mi) of leks and may return to nest in areas of previously successful nests (Riley 1978, p. 36). Giesen (1994a, pp. 97–98) and Hagen and Giesen (2005, unpaginated) also reported that hens often nest closer to a lek other than the one on which they mated. Adequate nesting and brood rearing habitats are crucial to population growth as they influence nest success and brood survival.

Typical nesting habitat can be generally described as native rangeland, although vegetation structure, such as the height and density of forbs and residual grasses, is frequently greater at nesting locations than on adjacent rangeland (Giesen 1998, p. 9). Adequate herbaceous cover, including residual cover from the previous growing season, is an important factor influencing nest success, primarily by providing concealment of the nest (Suminski 1977, p. 32; Riley 1978, p. 36; Riley *et al.* 1992, p. 386; Giesen 1998, p. 9). Concealment of the nest is important as successful nests are often associated with greater heights and cover of shrubs and perennial grasses than are unsuccessful nests. Nests are often located on north and northeast facing slopes as protection from direct sunlight and the prevailing southwest winds (Giesen 1998, p. 9).

Giesen (1998, p. 9) reports that habitat used by young is similar to that of adults, but good brood rearing habitat will have less grass cover and higher amounts of forb cover than nesting habitat (Hagen *et al.* 2013, p. 4). Dense grass cover impedes movements of the chicks (Pitman et al. 2009, p. 680). Forbs are important for the insects they produce which in turn influences body mass of the chicks (Pitman *et al.* 2006b, p. 680). Considering the limited mobility of broods—daily movement of the broods is usually 300 m (984 ft) or less (Candelaria 1979, p. 25)—optimum brood rearing habitat is typically found close to nesting areas. In Kansas, habitats used by broods had greater total biomass of invertebrates and forb cover than areas not frequented by broods, emphasizing the importance of forbs in providing the invertebrate populations used by young lesser prairie-chickens (Jamison *et al.* 2002, pp. 520, 524). Grisham (2012, p. 153) observed that brood survival through 14 days post-hatching was the primary factor limiting population growth of lesser prairie-chickens and that a lack of forbs necessary to support abundant insects was implicated as a primary factor influencing brood survival. After the broods break up, the juveniles form mixed flocks with adult birds (Giesen 1998, p. 9), and juvenile habitat use is similar to that of adult birds.

The rangewide plan provides a detailed characterization of lesser prairie-chicken preferred nesting and brood rearing habitat in native rangelands with a shinnery oak or sand sagebrush shrub component and in areas dominated by CRP fields where native shrubs are often absent (Van Pelt *et al.* 2013, pp 75–76). Additionally, Hagen *et al.* (2013, entire) conducted a meta-analysis (analysis of information from multiple studies) of lesser prairie chicken nesting and brood rearing habitat within both sand sagebrush and shinnery oak dominated vegetative communities and the mixed grass community. They reported average values for 10 different parameters and used these summarized values derived from 14 different studies (Hagen *et al.* 2013, p. 755). In general, they reported that lesser prairie-chicken nesting habitat in sand sagebrush regions have at least 60 percent canopy cover of forbs, and shrubs and grasses that are at least 25 cm (9.8 in) tall in western portions of the range to over 40 cm (15.7 in) tall in the eastern portion of the range.

Habitat use at finer scales indicates that lesser prairie-chickens throughout the year consistently occupied sites with greater cover than what was available across the landscape (Larrson *et al.* 2013, pp. 138, 140). Microhabitats selected were based on presence of specific species of grasses and forbs and specific vegetative structure

(Larrson *et al.* 2013, p. 138–139). The researchers inferred that predation and temperature influenced habitat selection by lesser prairie-chickens, with birds using more open areas during periods with cooler temperatures and more dense vegetation during periods with hotter temperatures (Larrson *et al.* 2013, p. 141). However, there may be a tradeoff between sites that are thermally favorable and sites that minimize the risk of predation. Maintaining a diverse native plant community with a suite of structural composition (e.g., height and density) that meets all of the lesser prairie-chicken cover requirements for breeding, nesting and brood rearing may help compensate for tradeoffs between microclimate preferences and predator avoidance.

Giesen (1998, p. 4) reports that fall and winter habitat requirements are similar to those used during the nesting and brood rearing seasons, with the exception that cultivated grain fields are used more heavily during these periods than during the breeding season. Considering lesser prairie-chickens tend to spend most of their daily and seasonal activity near (within 4.8 km (3.0 mi)) the display grounds even during the non-breeding season (Giesen 1994, p. 97; Riley *et al.* 1994, p. 185; Woodward *et al.* 2001, p. 263), similarity in habitat use across seasons is not surprising. Boal and Pirius (2012, p. 6) observed that slightly more than 97 percent of the radio-marked birds they followed were relocated within 3.2 km (2 mi) of the breeding ground on which they were captured and just under 97 percent of the marked birds were located within 3.2 km (2 mi) of a known lek. Similarly Kukal (2010, p. 19) reported almost 98 percent of male lesser prairie-chickens were located within 5 km (3 mi) of the lek on which they were captured and 98 percent were within 2.3 km (1.4 mi) of a known lek. Observations for females were very similar. Almost 98 percent of females were located within 3.8 km (2.4 mi) of the lek on which they were captured and roughly 98 percent were within 2.4 km (1.5 mi) from a known lek (Kukal 2010, pp. 19–20).

There is considerable overlap in lesser prairie-chicken habitat requirements, with the lek being the common focal point for most activities. A mixture of lekking, nesting, brood rearing, and wintering habitat, all in close proximity to the other, provides optimum habitat conditions needed to support lesser prairie-chickens. Considering that nest success and brood survival are the most critical factors influencing population viability (Pitman *et al*. 2006b, p. 679; Hagen *et al*. 2009, pp. 1329–1330; Grisham 2012, p. 153), Hagen *et al.* (2013, p. 750), a habitat mosaic consisting of approximately one-third brood rearing habitat and two-thirds nesting habitat are key to conservation and management of the lesser prairie-chicken (Hagen *et al.* 2013, p. 756).

Reported home ranges, seasonal movement patterns, and dispersal distances of lesser prairie-chickens, as previously discussed, are indicative of their requirement for large blocks of interconnected, ecologically diverse native grassland. Taylor and Guthery (1980a, p. 11) used lesser prairie-chicken movements in west Texas to estimate the area needed to meet the minimum requirements of a lek population. A contiguous area of suitable habitat encompassing at least 32 sq km (12 sq mi or 7,900 ac) would support about 90 percent of the annual activity associated with a given lek and an area of 72 sq km (28 sq mi or 17,791 ac) would include all of the annual activity associated with a lek except for some movements of juveniles (Taylor and Guthery (1980a, p. 11). Bidwell *et al.* (2002. p. 3) speculated that at least 101.2 sq km (39 sq mi or 25,000 ac) of contiguous high-quality habitat may be needed to maintain a sustainable population of lesser prairie-chickens. Because lesser prairie-chickens typically nest and rear their broods in proximity to a lek other than the one used for mating (Giesen 1998, p. 9), a complex of two or more leks is likely the very minimum required to sustain a viable lesser prairie-chicken population. Hagen *et al.* (2004, p. 76) recommended that lesser prairie-chicken management areas be at least 4,096 sq km (1,581 sq mi or 1,012,140 ac) in size. Management areas of this size would incorporate the longest-known movements of individual birds and be large enough to maintain healthy lesser prairie-chicken populations despite the presence of potentially large areas of unsuitable habitat.

Historical Range and Distribution

Prior to description by Ridgeway in 1885, most observers did not differentiate between the lesser and greater prairie-chicken. Consequently, estimating historical abundance and occupied range is difficult. Historically, the lesser prairie-chicken is known to have occupied native rangeland in portions of southeastern Colorado (Giesen 1994b, pp. 175–182), southwestern Kansas (Baker 1953, p. 9; Schwilling 1955, p. 10), western Oklahoma (Duck and Fletcher 1944, p. 68), the Texas panhandle (Henika 1940, p. 15; Oberholser 1974, p. 268), and eastern New Mexico (Ligon 1927, pp. 123–127).

Lesser prairie-chickens also have been documented from Nebraska, based on at least four specimens known to have been collected near Danbury in Red Willow County during the 1920s (Sharpe 1968, p. 50). Sharpe (1968, pp. 51, 174) considered the occurrence of lesser prairie-chickens in Nebraska to be the result of a short-lived range expansion facilitated by settlement and cultivation of grain crops. Lesser prairie-chickens are not currently believed to occur in Nebraska. Sharpe did not report any confirmed observations since the 1920s (Sharpe 1968, entire), and no sightings have been documented despite searches over the last 5 years in southwestern Nebraska (Walker 2011). Therefore, Nebraska is generally considered outside the historical range of the species.

Based on a single source, Crawford (1974, p. 4) reported that the lesser prairie-chicken was successfully introduced to the island of Niihau in the State of Hawaii. Prairie-chickens were known to have been released on Niihau, a privately owned island, in 1934 (Fisher 1951, p. 37), but the taxonomic identity of those birds has not ever been confirmed. Schwartz and Schwartz (1949, p. 120) believed that these birds were indeed lesser prairie-chickens. Fisher and members of his expedition did observe at least eight individual prairie-chickens during a visit to Niihau in 1947, but no specimens were collected due to their scarcity and the landowner’s requests (Fisher 1951, pp. 33–34, 37). Consequently, the specific identity of these birds could not be confirmed, and their current status on the island remains unknown (Pratt *et al.* 1987, p. 324; Pyle and Pyle

2009, p. 5). Similarly, Jeschke and Strayer (2008, p. 127) indicate that both lesser and greater prairie-chickens were introduced to parts of Europe, but both species failed to become established there. We do not believe that either greater or lesser prairie-chickens still persist in Hawaii or Europe, and we did not receive any comments during the comment periods that confirmed their continued existence in either location.

Johnsgard (2002, p. 32) estimated the maximum historical range of the lesser prairie-chicken to have encompassed between 260,000 and 388,500 sq km (100,000 to 150,000 sq mi), with about two-thirds of the historical range occurring in Texas. Taylor and Guthery (1980a, p. 1, based on Aldrich 1963, p. 537) estimated that, by the 1880s, the area occupied by lesser prairie-chicken was about 358,000 sq km (138,225 sq mi), and, by 1969, they estimated the occupied range had declined to roughly 125,000 sq km (48,263 sq mi) due to widespread conversion of native prairie to cultivated cropland. Taylor and Guthery (1980a, p. 4) estimated that, by 1980, the occupied range encompassed only 27,300 sq km (10,541 sq mi), representing a 90 to 93 percent reduction in occupied range since pre-European settlement and a 92 percent reduction in the occupied range since the 1880s.

In 2007, cooperative mapping efforts by species experts from the Colorado Parks and Wildlife (CPW) (formerly Colorado Division of Wildlife), Kansas Department of Wildlife, Parks and Tourism (KDWPT) (formerly Kansas Department of Wildlife and Parks), New Mexico Department of Game and Fish (NMDGF), Oklahoma Department of

Wildlife Conservation (ODWC), and Texas Parks and Wildlife Department (TPWD), in cooperation with the Playa Lakes Joint Venture, reestimated the maximum historical and occupied ranges. They determined the maximum occupied range, prior to European settlement, to have been approximately 456,087 sq km (176,096 sq mi) (Playa Lakes Joint Venture 2007, p. 1). The approximate historical range, by State, based on this cooperative mapping effort is the following: 21,911 sq km (8,460 sq mi) in Colorado; 76,757 sq km (29,636 sq mi) in Kansas; 52,571 sq km (20,298 sq mi) in New Mexico; 68,452 sq km (26,430 sq mi) in Oklahoma; and 236,396 sq km (91,273 sq mi) in Texas. Since 2007, the CPW slightly expanded the historical range in Colorado, based on new information. The total maximum historically occupied range, based on this adjustment, is now estimated to be about 466,998 sq km (180,309 sq mi) (Table 1.).

TABLE 1.—Estimated historical and current occupied lesser prairie-chicken range by State.

State	Historical Range	Current Range	Extent Historical	Current
Colorado	6 counties	4 counties	32,821.1 sq km (12,672.3 sq mi)	4,456.4 sq km (1,720.6 sq mi)
Kansas	38 counties	35 counties	76,757.4 sq km (29,636.2 sq mi)	34,479.6 sq km (13,312.6 sq mi)
New	12 counties	7 counties	52,571.2 sq km	8,570.1 sq km

Mexico			(20,297.9 sq mi)	(3,308.9 sq mi)
Oklahoma	22 counties	9 counties	68,452.1 sq km (26,429.5 sq mi)	10,969.1 sq km (4,235.2 sq mi)
Texas	34 counties (1940s-50s)	21 counties*	236,396.2 sq km (91,273.1 sq mi)	12,126.5 sq km (4,682.1 sq mi)
TOTAL	107 counties	76 counties	466,998.0 sq km (180,308.9 sq mi)	70,601.7 sq km (27,259.5 sq mi)

*Timmer (2012, p. 36) observed lesser prairie-chickens in only 12 counties.

Current Range and Distribution

The lesser prairie-chicken still occurs within the States of Colorado, Kansas, New Mexico, Oklahoma, and Texas (Giesen 1998, p. 3). During the 2007 mapping effort (Playa Lakes Joint Venture 2007, p. 1; Davis *et al.* 2008, p 19), the State conservation agencies estimated the current occupied range encompassed 65,012 sq km (25,101 sq mi). The approximate occupied range, by State, based on this cooperative mapping effort was 4,216 sq km (1,628 sq mi) in Colorado; 29,130 sq km (11,247 sq mi) in Kansas; 8,570 sq km (3,309 sq mi) in New Mexico; 10,969 sq km (4,235 sq mi) in Oklahoma; and 12,126 sq km (4,682 sq mi) in Texas. About 95 percent of the currently estimated occupied range occurs on privately owned land, as determined using the Protected Areas Database of the United States hosted by the U.S. Geological Survey Gap Analysis Program. This database represents public land ownership and conservation lands, including voluntarily provided privately protected areas, and the extent of private ownership can be determined by subtracting the amount of public lands from the total land base encompassed by the occupied range.

Since 2007, the occupied and historical range in Colorado and the occupied range in Kansas have been adjusted to reflect new information. The currently occupied range in Colorado is now estimated to be 4,456 sq km (1,721 sq mi), and, in Kansas, the lesser prairie-chicken is now thought to occupy about 34,480 sq km (13,313 sq mi). In Colorado, this adjustment is the result of survey efforts that recommended the addition of 240 sq km (93 sq mi) of suitable habitat in the occupied range. In Kansas, the adjustment was due to expansion of lesser prairie-chicken populations in Ellis, Graham, Sheridan, and Trego Counties. The total estimated occupied range is now believed to encompass 70,602 sq km (27,259 sq mi) (Table 1). The currently occupied range now represents roughly 16 percent of the revised historical range. This value is a close approximation because a small portion of the expanded range in Kansas lies outside the estimated maximum historical range and was not included in this analysis. Considering there are historical records from Nebraska, the maximum historical range currently in use is likely smaller than the maximum that would exist if the temporarily occupied range in Nebraska was included in the analysis.

Many of the ongoing conservation efforts, including the rangewide plan and the LPCI, established a 16-km (10-mi) buffer around the estimated occupied range for planning and implementation purposes. This approach, EOR + 10, was used for a variety of reasons. Most importantly, this approach recognizes that the boundaries delineating the occupied range are not static and may vary from year to year depending on size of lesser prairie-chicken populations within the respective polygon. Considering population size may vary annually, the precise extent of the occupied range also may vary annually. This approach helps ensure that all of the occupied range is captured during planning efforts and is consistent with the action area used by the LPCI. This approach also is consistent with the action area used by the FSA for their section 7 consultation purposes. The area encompassed by the EOR + 10 varies slightly by planning effort depending on how the area was mapped and derived from geographical mapping software used in geographical information systems. The rangewide plan estimates that the EOR + 10 encompasses 162,478 sq km (62,733 sq mi) or 16,247,912 ha (40,149,404 ac) (Van Pelt *et al*. 2013, p. 129). When the CHAT tool is used to derive the EOR + 10, however, the extent is 16,653,390 ha (41,151,360 ac) (Van Pelt *et al*. 2013, p. 137). During the development of the final rangewide plan in the fall of 2013, the CHAT tool was revised to account for additional information obtained by the States, resulting in the difference of the EOR + 10 compared to the rangewide plan. However, the CHAT decision support tool is a work in process and is expected to continue to change as geospatial modeling techniques are refined and additional datasets are obtained. Therefore, we used the area presented in the rangewide plan as the EOR + 10 throughout this final rule.

Although the mapped polygons used to determine the estimated occupied range appear contiguous and may leave the impression that the entire polygon is uniformly occupied by lesser prairie-chickens, such is not the case. Over much of the area within each occupied polygon, the habitat has been fragmented and provides suitable habitat in patches of various sizes. Consequently, within each polygon designated as occupied range, there will be areas that do not provide suitable habitat and are unlikely to be occupied by lesser prairie-chickens. The estimates of occupied range, in acres or hectares, are therefore not accurate in the sense that they include areas that are not occupied but were included in the larger mapping unit for calculation purposes. The actual amount of occupied habitat is likely less than the areas, in acres or hectares, presented in this discussion.

As derived from the estimated historical and occupied ranges described above, the overall distribution of lesser prairie-chicken within all States except Kansas has declined sharply since pre-European settlement, and the species is generally restricted to variously sized, often highly fragmented parcels of untilled native rangeland (Taylor and Guthery 1980a, pp. 2–5) or areas with significant CRP enrollments that were initially seeded with native grasses (Rodgers and Hoffman 2005, pp. 122–123). The estimated current occupied range, based on cooperative mapping efforts described above, and as derived from calculations of the area of each mapped polygon using geographical information software, represents about an 84 percent reduction in overall occupied range since pre-European settlement.

Rangewide Population Estimates

Very little information is available regarding the size of lesser prairie-chicken populations prior to 1900. Once the five States supporting lesser prairie-chickens were officially opened for settlement beginning in the late 1800s, settlement occurred quickly and the landscape began to change rapidly. Numbers of lesser prairie-chickens likely changed rapidly as well. Despite the lack of conclusive information on population size, the lesser prairie-chicken was reportedly quite common throughout its range in Colorado, Kansas, New Mexico, Oklahoma, and Texas in the early 20th century (Bent 1932, pp. 280–281, 283; Baker 1953, p. 8; Bailey and Niedrach 1965, p. 51; Sands 1968, p. 454; Fleharty 1995, pp. 38–44; Robb and Schroeder 2005, p. 13). Litton (1978, p. 1) suggested that as many as two million birds may have occurred in Texas alone prior to 1900. By the 1930s, the species had begun to disappear from areas where it had been considered abundant, and the decline was attributed to extensive cultivation, overgrazing by livestock, and drought (Bent 1932, p. 280). Populations were nearly extirpated from Colorado, Kansas, and New Mexico, and were markedly reduced in Oklahoma and Texas (Baker 1953, p. 8; Crawford 1980, p. 2).

Rangewide estimates of population size were almost nonexistent until the 1960s and likely corresponded with more frequent and consistent efforts by the States to monitor lesser prairie-chicken populations. Although lesser prairie-chicken populations can fluctuate considerably from year to year in response to variable weather and habitat conditions, generally the overall population size has continued to decline from the estimates of population size available in the early 1900s (Robb and Schroeder 2005, p. 13). By the mid-1960s, Johnsgard (1973, p. 281) estimated the total rangewide population to be between 36,000 and 43,000 individuals. In 1980, the estimated rangewide fall population size was thought to be between 44,400 and 52,900 birds (Crawford 1980, p. 3). Population size in the fall is likely to be larger than population estimates derived from spring counts due to recruitment that occurs following the nesting season. By 2003, the estimated total rangewide population was 32,000 birds, based on information provided by the Lesser Prairie-Chicken Working Group (Rich *et al.* 2004, unpaginated). Prior to the implementation of the rangewide survey effort in 2012, the best available population estimates indicate that the lesser prairie-chicken population likely would be approximately 45,000 birds or fewer (see Table 2). This estimate is a rough approximation of the maximum population size and should not be considered as the actual current population size. Although the estimate uses the most current information available, population estimates for some States have not been determined in several years and reported values may not represent actual population sizes. For example, the values reported for Colorado and Oklahoma were published in 2000, and recent estimates of total population size for these States have not been determined. The aerial surveys conducted in 2012, as explained below, provide the best estimate of current population size.

TABLE 2. —Recent population estimates prior to 2012 by State (Modified from Hagen *et al.* 2010, p. 30)

State	Recent Population Estimates Prior to 2012
Colorado	< 1,500 (in 2000)
Kansas	19,700 – 31,100 (in 2006)
New Mexico	6,130 (in 2011)
Oklahoma	< 3,000 (in 2000)
Texas	1,254 – 2,649 (in 2010-11)
TOTAL	< 45,000

In the spring (March 30 to May 3) of 2012, the States, in conjunction with the Western Association of Fish and Wildlife Agencies, implemented a rangewide sampling framework and survey methodology using small aircraft. This aerial survey protocol was developed to provide a more consistent approach for detecting rangewide trends in lesser prairie-chicken population abundance across the occupied range. The goal of this survey was to estimate the abundance of active leks and provide information that could be used to detect trends in lek abundance over time. The sampling framework used 15-by-15-km (9-by-9-mi) grid cells overlapping the estimated occupied range, as existed in 2011, plus a 7.5-km (4.6-mi) buffer. Additional information on the survey approach is provided in McDonald *et al.* 2011, entire.

The aerial survey study area was divided into four regions that encompassed the estimated occupied range of the lesser prairie-chicken. These regions were delineated largely based on habitat type and results were not grouped by individual State. The four regional groupings were the Shinnery Oak Prairie Region of eastern New Mexico and southwest Texas; the Sand Sagebrush Prairie Region located in southeastern Colorado, southwestern Kansas, and western Oklahoma Panhandle; the Mixed Grass Prairie Region located in the northeastern Texas panhandle, northwestern Oklahoma, and south-central Kansas; and the Short Grass/CRP Mosaic in northwestern Kansas and eastern Colorado. During surveys of the 264 blocks selected, 40 lesser prairie-chicken leks, 6 mixed leks comprised of both lesser and greater prairie-chickens, and 100 non-lek aggregations of lesser prairie-chickens were observed (McDonald *et al.* 2012, p. 15). For this particular study, an active lek was defined as having five or more birds per lek. If fewer than five individual birds were observed, ground surveys were conducted of those bird groups to determine if lekking birds were present. If not, those areas were classified as "non-leks." After the survey observations were adjusted to account for probability of detection (standard method used to adjust counts to account for individuals present but not detected), 3,174 lesser prairie-chicken leks were estimated to occur over the entire occupied range (McDonald *et al.* 2012, p. 18). Another 441 mixed leks, consisting of both lesser and greater prairie-chickens, were estimated to occur within the occupied range. These mixed leks were limited to the Short Grass/CRP Mosaic region where the range of the two species overlaps. Using the respective average group size, by each identified region, an estimate of the total number of lesser prairie-chickens and lesser/greater prairie-chicken hybrids could be derived (McDonald *et al.* 2012, p. 20). The total estimated abundance of lesser prairie-chickens was 37,170 individuals, with the number of hybrids estimated to be 309 birds (McDonald *et al.* 2012, p. 21). The estimated total number of lesser prairie-chicken leks and population size, by habitat region, are as follows: Shinnery Oak Prairie Region—428 leks and 3,699 birds; Sand Sagebrush Prairie Region—105 leks and 1,299 birds; Mixed Grass Prairie Region—877 leks and 8,444 birds; and the Short Grass/CRP Mosaic Region—1,764 leks and 23,728 birds (McDonald *et al.* 2012, pp. 20, 23).

In 2013, the States and the Western Association of Fish and Wildlife Agencies repeated the aerial survey and reanalyzed the 2012 survey results based on ecoregion specific estimated population parameters and a pooled analysis of the data for both years (McDonald *et al.* 2013, entire). The revised total estimated abundance of lesser prairie-chickens in 2012 was 34,440 individuals (90 percent upper and lower confidence intervals of 52,076 and 21,718 individuals, respectively; McDonald *et al.* 2013, p. 24). The total estimated abundance of lesser prairie-chickens in 2013 dropped to 17,616 individuals (90 percent upper and lower confidence intervals of 20,978 and 8,442 individuals, respectively). The number of hybrids in 2012 was estimated to be 350 birds (McDonald *et al.* 2013, p. 25). In 2013, the number of hybrid birds was estimated to be 342. The estimated total number of lesser prairie-chicken leks and population size, by ecoregion, for 2012 are as follows: Shinnery Oak Prairie Region—366 leks and 2,946 birds; Sand Sagebrush Prairie Region—327 leks and 3,005 birds; Mixed Grass Prairie

Region—794 leks and 8,076 birds; and the Short Grass/CRP Mosaic Region—1,443 leks and 20,413 birds (McDonald *et al.* 2012, pp. 24, 25). In 2013, the estimated total number of lesser prairie-chicken leks and population size, by ecoregion, are as follows: Shinnery Oak Prairie Region—118 leks and 1,967 birds; Sand Sagebrush Prairie Region—323 leks and 1,802 birds; Mixed Grass Prairie Region—356 leks and 3,567 birds; and the Short Grass/CRP Mosaic Region—1,240 leks and 10,279 birds (McDonald *et al.* 2012, pp. 24, 25).

Garton (2012, entire) used estimates of the minimum population size derived from the 2012 aerial survey (McDonald *et al.* 2012, entire), based on estimated rates of change and thetas (index of the relative size of the previous year's population) as described in Garton *et al.* (2011, p. 301) and past lek counts by the States to reconstruct historical population levels over time. However, ground surveys within the sand sage regions yielded higher estimated minimum population size than did the aerial survey data, and Garton used the higher ground survey results rather than that obtained from the aerial surveys in the analysis for this particular ecoregion. Based on Garton's analysis, lesser prairie-chicken populations generally increased during the mid-1960s to early 1970s (Garton 2012, pp. 6, 11). Since the early 1970s to the mid-1990s, the population experienced a long-term decline. The reconstructed population estimate for 1970 was almost 300,000 birds but had declined to less than 50,000 birds by the mid-1990s. Following the mid-1990s, populations appear to have stabilized somewhat but at levels considerably below those from the 1970s through the early 1990s (Garton 2012, pp. 6-11).

In June 2012, we were provided with an interim assessment of lesser prairie-chicken population trends since 1997 (Hagen 2012, entire). The objective of this analysis was to provide an evaluation of recent lesser prairie-chicken population trends both rangewide and within the four primary habitat types (CRP-shortgrass prairie dominated landscape, mixed grass prairie landscape, sand sagebrush prairie landscape, and shinnery oak landscape) that encompass the occupied range of the species. The analysis employed modeling techniques intended to provide a more unified assessment of population trends, considering that each State uses slightly different methods to monitor lesser prairie-chickens and that sampling effort has varied over time, with sampling efforts typically increasing in recent years. The results of this analysis suggest that lesser prairie-chicken population trends have increased since 1997.

However, we are reluctant to place considerable weight on this interim assessment for several reasons. First, and perhaps most important, is that the analysis we were provided is a preliminary product. We anticipated that a more complete, and perhaps peer-reviewed, product would be submitted during the comment period on the proposed rule; however, we did not receive an updated assessment. Second, we have concerns with the differences in how lek counts are conducted and how those differences were addressed. For example, when the States conduct flush counts at the leks, all of the

States, except Oklahoma, count the number of males flushed from the lek. However, since 1999, Oklahoma has counted all birds flushed from the lek and did not differentiate between males and females. Additionally, some of the States use numbers derived from lek counts conducted over large areas rather than road side surveys. We are unsure how these differences in sampling methodology would influence the pooled trend information presented, particularly for large geographical areas where two different sampling methods are used in the analysis. Third, the trend information presents only information gathered since 1997 or more recently, without considering historical survey information. The trends evident from sampling efforts since 1997 likely reflect increased sampling effort following publication of the Service's 12-month finding (63 FR 31400, June 9, 1998), and increased sampling effort could lead to biased results. Furthermore, trend analyses in general are dependent upon the timeframe chosen. The population reconstruction information used in Garton (2012, entire) shows that the lowest modeled abundance occurred in 1997, the starting point of Hagen's analysis. Thus, it is likely that a trend analysis for a different timeframe, dating either further back or more recently than 1997, would result in a different outcome. Further, Hagen's analysis does not consider the most recent rangewide aerial survey results, which were used to derive a population estimate of 17,616 individuals (90 percent upper and lower confidence intervals of 20,978 and 8,442 individuals, respectively) in 2013 (McDonald *et al.* 2013, p. 24). This represents a substantial decrease in population estimates compared to recent years and inclusion of the 2013 rangewide population estimates would likely change Hagen's analysis.

In some instances, sampling methodology by agency likely varied between years during the analyzed time period as access to some study areas was restricted and new areas were established in their place. For example, in southwest Texas, two study areas were used until 1999, when an additional sampling area in Yoakum County was added. Then in 2007, the original Gaines County study area was dropped and a new, smaller Gaines County study area was established to replace the original study area. Similar changes occurred in the northeastern panhandle of Texas where a new study area in Gray County was added in 1998. These changes in sampling location can confound efforts to make comparisons between years. The interim assessment does not include an explanation regarding how these changes were addressed.

We also recognize the limitations of using lek counts to derive population trends over large areas. The deficiencies and limitations of lek counts include that not all leks are known, making it difficult to draw a random or representative sample from which to make inferences; not all known leks are counted and those that are may not represent the full set of known leks; leks may not be well-defined with sharply or spatially defined boundaries; not all birds are present at a lek at any given time, as influenced by the date, time of day, weather conditions, the presence of predators, and other influences; the age composition of birds at a lek varies seasonally; not all birds at a lek are counted; and the number of times a lek is counted each year varies (Johnson and Rowland 2007, pp. 17-20). Consequently, we caution against using available data from lek counts to derive rangewide population trends as these analyses can be misleading. However, information on historical and recent lesser prairie-chicken population trends over large geographical areas would improve our analysis of the status of the species, and we support efforts to provide a reliable, accurate analysis of rangewide population trends, particularly if those analytical methods are repeatable over time and peer-reviewed.

State-by-State Information on Population Status

Each of the State conservation agencies within the occupied range of the lesser prairie-chicken provided us with information regarding the current population estimates of the lesser prairie-chicken within their respective States, and most of the following information was taken directly from agency reports, memos, and other status documents. Population survey data are collected from spring lek surveys in the form of one or both of the following indices: average lek size (i.e., number of males or total birds per lek); or density of birds or leks within a given area. Most typically, the data are collected along fixed survey routes where the number of displaying males counted is assumed to be proportional to the population size, or the number of leks documented is assumed to be an index of population size or occupied range. These techniques are useful in evaluating long-term trends and determining occupancy and distribution but are very limited in their usefulness for reliably estimating population size (Johnson and Rowland 2007, pp. 17–20). However, given existing constraints, such as available staff and funding, they provide the best opportunity to assess lesser prairie-chicken populations.

Although each State annually conducts lesser prairie-chicken surveys according to standardized protocols, those protocols vary by State. Thus, each State can provide information relative to lesser prairie-chicken numbers and trends by State, but obtaining consistent information across the entire range is difficult given the current approach to population monitoring. However, in the absence of more reliable estimators of bird density, total counts of active leks over large areas were recommended as the most reliable trend index for prairie grouse populations such as lesser prairie-chickens (Cannon and Knopf 1981, p. 777; Hagen *et al.* 2004, p. 79).

Colorado—Lesser prairie-chickens were likely resident in six counties (Baca, Bent, Cheyenne, Kiowa, Kit Carson, and Prowers Counties) in Colorado prior to European settlement (Giesen 2000, p. 140). At present, lesser prairie-chickens are known to occupy portions of Baca, Cheyenne, Prowers, and Kiowa Counties, but are not known to persist in Bent or Kit Carson Counties. Present delineated range includes portions of eastern Lincoln County where suitable habitat persists, although breeding birds have not been documented from this county. Populations in Kiowa and Cheyenne Counties number fewer than 100 individuals and appear to be isolated from other populations in Colorado and adjacent States (Giesen 2000, p. 144). The lesser prairie-chicken has been State-listed as threatened in Colorado since 1973. Colorado Department of Wildlife (now CPW) estimated 800 to 1,000 lesser prairie-chicken in the State in 1997. Giesen (2000,

p. 137) estimated the population size, as of 2000, to be fewer than 1,500 breeding individuals (see Table 2, above).

CPW has been monitoring leks annually since 1959, primarily by using standard survey routes (Hoffman 1963, p. 729). A new survey method was initiated in 2004, designed to cover a much broader range of habitat types and a larger geographic area, particularly to include lands enrolled in the CRP. The new methodology resulted in the discovery of more leks and the documented use of CRP fields by lesser prairie-chickens in Colorado. In 2011, CPW used aerial surveys in addition to the more traditional ground surveys in an attempt to identify new leks in Cheyenne County (Remington 2011).

Lesser prairie-chicken populations in Colorado have declined steadily since 2011, likely the result of deteriorating habitat conditions due to prolonged drought (Smith 2013, pp. 1–3). In 2013, the total number of birds counted was 84, down from 105 birds in 2012, and 161 birds in 2011 (Smith 2013, pp. 2–3). The number of active leks detected in 2013 was 10, down from 14 in 2012, and 17 in 2011. For this study, a lek is considered active when at least three males are observed displaying on the lek. There were three active leks in Baca County, four active leks in Prowers County, and three active leks in Cheyenne County. One of the leks detected in Cheyenne County was considered a new lek. The number of leks declined in all counties except Cheyenne since 2011. In 2011, there were six active leks in Baca County, nine active leks in Prowers County, and two active leks in Cheyenne County (Verquer and Smith 2011, pp. 1–2). No active leks have been detected in Kiowa County since 2008 (Verquer 2008, p. 1). Habitat provided by CRP is likely to be important to persistence of lesser prairie-chickens in Colorado.

The annual survey report provides information on the total count of lesser prairie-chickens from 1977 to the present. Since 1977, the total number of birds observed during routine survey efforts has varied from a high of 448 birds in 1990, to a low of 74 birds in 2007. The general population trajectory, based on number of birds observed on active leks during the breeding season is declining, excluding information from 1992, when limited survey data were collected. The number of active leks remained fairly stable between 1999 and 2006. During this period, the highest number of active leks recorded, 34, occurred in 2004 and again in 2006. The fewest number of active leks observed occurred in 2002, when 24 leks were observed. The average number of active leks observed between 1999 and 2006 was 30.1.

Beginning in 2007 and continuing to present, the number of active leks observed has remained fairly stable. Since 2007, the highest recorded number of active leks was 18, which occurred in 2007. The fewest number of active leks observed was 10 recorded in 2013. The average number of active leks over this period was 16.4, roughly half of the average number of active leks (30) observed during the period between 1999 and 2006. Drought conditions observed in 2006, followed by severe winter weather, probably account for the decline in the number of lesser prairie-chickens observed in 2007

(Verquer 2007, pp. 2–3). In the winter of 2006–2007, heavy snowfall severely reduced food and cover in Prowers, southern Kiowa, and most of Baca Counties for over 60 days. Then, in the spring of 2008, nesting and brood rearing conditions were unfavorable due to drought conditions in southeastern Colorado (Verquer 2009, p. 5).

As a complement to, and included within, CPW surveys, counts are completed on the USFS Comanche National Grassland in Baca County. On the Comanche National Grassland, the estimated area occupied by the lesser prairie-chicken over the past 20 years was approximately 27,373 ha (65,168 ac) (Augustine 2005, p. 2). Surveys conducted during 1984 to 2005 identified 53 different leks on or immediately adjacent to USFS lands. Under this survey methodology, leks were identified based on the presence of at least three birds on the lek. Lek censuses conducted from 1980 to 2005 showed the number of males counted per lek since 1989 has steadily declined (Augustine 2006, p. 4). The corresponding population estimate, based on number of males observed at leks, on the Comanche National Grassland was highest in 1988, with 348 birds, and was lowest in 2005, with approximately 64 birds and only 8 active leks (Augustine 2006, p. 4). The estimate of males per lek in 2005 declined more than 80 percent from that of 1988, from 174 males per lek to 32 males per lek, respectively. In 2009, each historical lek was surveyed 2 to 3 times, and 4 active leks were observed (Shively 2009b, p. 1). A high count of 25 males was observed using these four leks. In the spring of 2008, five active leks and 34 birds were observed (Shively 2009a, p. 3).

Kansas—In the early part of the last century, the lesser prairie-chicken's historical range included all or part of 38 counties, but by 1977, the species was known to exist in only 17 counties, all located south of the Arkansas River (Waddell and Hanzlick 1978, pp. 22–23). Since 1999, biologists have documented lesser prairie-chicken expansion and reoccupation of 17 counties north of the Arkansas River, primarily attributable to favorable habitat conditions (e.g., native grasslands) created by implementation of the CRP in those counties. Currently, lesser prairie-chickens occupy approximately 34,479 sq km (13,312 sq mi) within all or portions of 35 counties in western Kansas. Greater prairie-chickens in Kansas also have expanded their range, and, as a result, mixed leks of both lesser prairie-chickens and greater prairie-chickens occur within an overlap zone covering portions of 7 counties (2,500 sq km (965 sq mi)) in western Kansas (Bain and Farley 2002, p. 684). Within this zone, apparent hybridization between lesser prairie-chickens and greater prairie-chickens is now evident (Bain and Farley 2002, p. 684). Three survey routes (162.65 sq km, 62.8 sq mi) used by KDWPT are located within this overlap zone. Although hybrid individuals are included in the counts, the number of hybrids observed is typically less than 5 percent of the total number of individual birds observed on the surveyed areas annually. In 2013, seven hybrid individuals, representing 3 percent of the birds observed, were detected (Pitman 2013, p.10). These hybrids were detected on survey routes in Gove, Ness, and Logan counties.

Since inception of standard lesser prairie-chicken survey routes in 1967, the number of standard survey routes has gradually increased. The number of standard routes currently surveyed in Kansas for lesser prairie-chickens is 14, and encompasses an area of 679.3 sq km (262.3 sq mi). Flush counts are taken twice at each lek located during the standard survey routes. An estimated population density is calculated for each route by taking the higher of the two flush counts, doubling that count primarily to account for females, and then dividing the estimated number of birds by the total area surveyed per route. The current Statewide trend in lesser prairie-chicken abundance between 2004 and 2013 indicates a declining population (Pitman 2013, p. 15). The KDWPT reported that recent declines are largely due to severe drought, which negatively impacted habitat quality, and not to significant habitat loss (Pitman 2013, p. 15).

In 2006, KDWPT estimated the breeding population of lesser prairie-chickens in the State to be between 19,700 and 31,100 individuals (Rodgers 2007a, p. 1). The total breeding population estimates were derived using the National Gap Analysis Program, where the population indices from each habitat type along 15 survey routes were extrapolated for similar habitat types throughout total occupied lesser prairie-chicken range Statewide.

New Mexico—In the 1920s and 1930s, the former range of the lesser prairie-chicken in New Mexico was described as all of the sand hill rangeland of eastern New Mexico, from Texas to Colorado, and as far west as Buchanan in DeBaca County. Ligon (1927, pp. 123–127) mapped the breeding range at that time as encompassing portions of seven counties, a small subset of what he described as former range. Ligon (1927, pp.

123–127) depicted the historical range in New Mexico as encompassing all or portions of 12 counties. In the 1950s and 1960s, occupied range was more extensive than the known occupied range in 1927 (Davis 2005, p. 6), indicating reoccupation of some areas since the late 1920s. Presently, the NMDGF reports that lesser prairie-chickens are known from six counties (Chaves, Curry, DeBaca, Lea, Roosevelt, and Quay Counties) and suspected from one additional county (Eddy County). The occupied range of the lesser prairie-chicken in New Mexico is conservatively estimated to encompass approximately 5,698 sq km (2,200 sq mi) (Davis 2006, p. 7) compared with its historical range of 22,390 sq km (8,645 sq mi). Based on the cooperative mapping efforts conducted by the Playa Lakes Joint Venture and the Lesser Prairie-Chicken Interstate Working Group, occupied range in New Mexico was estimated to be 8,570 sq km (3,309 sq mi), considerably larger than the conservative estimate used by Davis (2006, p. 7). One possible reason for the difference in occupied range is that Davis (2006, p. 7) did not consider the known distribution to encompass any portion of Eddy County or southern Lea County. Approximately 59 percent of the historical lesser prairie-chicken range in New Mexico is privately held, with the remaining historical and occupied range occurring on lands managed by the BLM, USFS, and New Mexico State Land Office (Davis 2005, p. 12).

In the 1950s, the lesser prairie-chicken population in New Mexico was estimated at 40,000 to 50,000 individuals, but, by 1968, the population had declined to an estimated 8,000 to 10,000 individuals (Sands 1968, p. 456). Johnsgard (2002, p. 51) estimated the number of lesser prairie-chickens in New Mexico at fewer than 1,000 individuals by

2001. Similarly, the Sutton Center estimated the New Mexico lesser prairie-chicken population to number between 1,500 and 3,000 individuals, based on observations made over a 7-year period from the late 1990s to mid-2000s (Wolfe 2007, pers. comm.). Using lek survey data, NMDGF currently estimates the Statewide lesser prairie-chicken population in 2013 to be about 1,705 birds (Beauprez 2013, p. 6). This is the lowest estimated spring breeding population observed since 2001 and represents a 72 percent decline in estimated population size since 2011 (Beauprez 2013, pp. 16–17). The total number of leks detected in 2013 also was the lowest on record (Beauprez 2013, p. 16). Longer term trends are not available as roadside listening routes did not become established until 1998. Prior to that date, counts were conducted on some of the NMDGF Prairie Chicken Areas or on lands under the jurisdiction of the BLM. The current roadside survey uses 29 standard routes established since 1999, 10 additional routes established in 2003 within the northeastern part of lesser prairie-chicken historical range, and 41 routes randomly selected from within the 382 townships located within the survey boundary. The NMGF reported that population declines observed since 2011 are believed to be at least partially attributed to poor nesting and brood rearing habitat due to the persistent drought (Beauprez 2013, p. 17).

Since initiating the 10 additional northeastern routes in 2003, NMDGF reports that no leks have been detected in northeastern New Mexico. Results provide strong evidence that lesser prairie-chickens no longer occupy their historical range within Union, Harding, and portions of northern Quay Counties (Beauprez 2009, p. 8).

However, a solitary male lesser prairie-chicken was observed and photographed in northeastern New Mexico by a local wildlife law enforcement agent in December 2007. Habitat in northeastern New Mexico appears capable of supporting lesser prairie-chickens, but the lack of any known leks in this region since 2003 suggests that lesser prairie-chicken populations in northeastern New Mexico, if still present, are very small.

The core of occupied lesser prairie-chicken range in this State lies in east-central New Mexico (Chaves, Curry, DeBaca, Lea, and Roosevelt Counties). Populations in southeastern New Mexico, defined as the area south of U.S. Highway 380, remain low and continue to decline. The majority of historically occupied lesser prairie-chicken habitat in southeastern New Mexico occurs primarily on BLM land. Snyder (1967, p. 121) suggested that this region is only marginally populated except during favorable climatic periods. Best *et al.* (2003, pp. 225, 232) concluded anthropogenic factors including, but not limited to, incompatible livestock grazing, habitat conversion, and shrub control have, in part, rendered lesser prairie-chicken habitat south of U.S. Highway 380 inhospitable for long-term survival of lesser prairie-chickens in southeastern New Mexico. Similarly, NMDGF suggests that habitat quality likely limits recovery of populations in southeastern New Mexico (Beauprez 2009, p. 13).

The New Mexico State Game Commission owns and manages 30 Prairie Chicken Areas ranging in size from 10.5 to 3,171 ha (29 to 7,800 ac) within the core of occupied range in east central New Mexico. These Prairie Chicken Areas total approximately 109 sq km (42 sq mi), or roughly 1.6 percent of the total occupied lesser prairie-chicken range in New Mexico. Instead of the typical roadside counts, the NMDGF conducts "saturation" surveys on each individual Prairie Chicken Area to determine the presence of lesser prairie-chicken leks and individual birds over the entire Prairie Chicken Area (Beauprez 2013, p. 8). Lands adjacent to the Prairie Chicken Areas are included within these surveys, including other State Trust Lands, some adjacent BLM lands, and adjacent private lands. The results of these saturation counts are included in their estimate of the spring breeding population size. The Prairie Chicken Areas are important to persistence of the lesser prairie-chicken in New Mexico. However, considering the overall extent of the Prairie Chicken Areas and that many Prairie Chicken Areas are small and isolated, continued management of the surrounding private, Federal and trust lands is integral to viability of the lesser prairie-chicken in New Mexico.

Oklahoma—Lesser prairie-chickens historically occurred in 22 Oklahoma counties. By 1961, Copelin (1963, p. 53) reported lesser prairie-chickens from only 12 counties. By 1979, lesser prairie-chickens were verified in eight counties, and the remaining population fragments encompassed an estimated area totaling 2,792 sq km (1,078 sq mi), a decrease of approximately 72 percent since 1944. At present, the ODWC reports lesser prairie-chickens continue to persist in eight counties with an estimated occupied range of approximately 950 sq km (367 sq mi). Horton (2000, p. 189) estimated the entire Oklahoma lesser prairie-chicken population numbered fewer than 3,000 birds in 2000. A more recent estimate has not been conducted.

The ODWC is aware of 96 known historical and currently active leks in Oklahoma. During the mid-1990s, all of these leks were active. Systematic survey efforts to document the current number of active leks over the occupied range were completed in 2011. About 220 survey routes were conducted over 11 counties in northwestern Oklahoma (Larsson *et al.* 2012, p. 1). In total, 72 active leks were detected. No leks were detected in either Cimarron or Beckham Counties.

The number of roadside listening routes currently surveyed annually in Oklahoma has varied from five to seven over the last 20 years, and counts of the number of males per lek have been conducted since 1968. Beginning with the 2002 survey, male counts at leks were replaced with flush counts, which did not differentiate between the sexes of birds flushed from the surveyed lek (ODWC 2007, pp. 2, 6). Comparing the total number of males observed during survey efforts between the years 1977 through 2001 reveals a declining trend. However, the overall density of leks (number per sq mi), another means of evaluating population status of lesser prairie-chickens, for five of the standard routes since 1985 is stable to slightly declining. Information on lek density prior to 1985 was unavailable. The standard route in Roger Mills County was not included in this analysis because the lek was rarely active and has not been surveyed since 1994. A survey route in Woods County was included in the analysis even though surveys on this route did not begin until 2001. However, excluding the Woods County route did not alter the apparent trend. The average lek density since 2001 is 0.068 leks per sq mi (Schoeling 2010, p. 3).

Between 1985 and 2000, the average lek density was 0.185 leks per sq mi, when the route in Roger Mills County is excluded from the analysis. Over the last 10 years, the density of active leks has varied from a low of 0.02 leks per sq km (0.05 leks per sq mi) in 2004, 2006, and 2009, to a high of 0.03 leks per sq km (0.09 leks per sq mi) in 2005 and 2007 (Schoeling 2010, p. 3).

Texas—Systematic surveys to identify Texas counties inhabited by lesser prairie-chickens began in 1940 (Henika 1940, p. 4). From the early 1940s (Henika 1940, p. 15; Sullivan *et al.* 2000) to mid-1940s (Litton 1978, pp. 11–12), to the early 1950s (Seyffert 2001, pp. 108–112), the range of the lesser prairie-chicken in Texas was estimated to encompass all or portions of 34 counties. Species experts considered the occupied range at that time to be a reduction from the presettlement range. By 1989, TPWD estimated occupied range encompassed all or portions of only 12 counties (Sullivan *et al.* 2000, p. 179). In 2005, TPWD reported that the number of occupied counties likely has not changed since the 1989 estimate. In March 2007, TPWD reported that lesser prairie-chickens were confirmed from portions of 13 counties (Ochiltree, Lipscomb, Roberts, Hemphill, Gray, Wheeler, Donley, Bailey, Lamb, Cochran, Hockley, Yoakum, and Terry Counties) and suspected in portions of another 8 counties (Moore, Carson, Oldham, Deaf Smith, Randall, Swisher, Gaines, and Andrews Counties).

Based on aerial and road surveys conducted in 2010 and 2011, new leks were detected in Bailey, Cochran, Ochiltree, Roberts, and Yoakum Counties, expanding the estimated occupied ranges in those counties (TPWD 2011). However, no lesser prairie-chickens were detected in Andrews, Carson, Deaf Smith, Oldham, or Randall Counties. Active leks were reported from the same 13 counties identified in 2007. However, in 2012, Timmer (2012, pp. 36, 125–131) observed lesser prairie-chickens in only 12 counties: Bailey, Cochran, Deaf Smith, Donley, Gray, Hemphill, Lipscomb, Ochiltree, Roberts, Terry, Wheeler, and Yoakum. Lesser prairie-chicken populations in Texas primarily persist in two disjunctive regions—the Permian Basin/Western Panhandle region and the Northeastern Panhandle region.

Maximum occupied range in Texas, as of September 2007, was estimated to be 12,787 sq km (4,937.1 sq mi), based on habitat conditions in 20 panhandle counties (Davis *et al.* 2008, p. 23). Conservatively, based on those portions of the 13 counties where lesser prairie-chickens are known to persist, the area occupied by lesser prairie-chickens in Texas is 7,234.2 sq km (2,793.1 sq mi). Using an estimated mean density of 0.0088 lesser prairie-chickens per ac (range 0.0034–0.0135 lesser prairie-chickens per ac), the Texas population was estimated at a mean of 15,730 individuals in the 13 counties where lesser prairie-chickens are known to occur (Davis *et al.* 2008, p. 24).

Since 2007, Texas has been evaluating the usefulness of aerial surveys as a means of detecting leks and counting the number of birds attending the identified lek (McRoberts 2009, pp. 9–10). Initial efforts focused on measuring lek detectability and assessing the response of lekking birds to disturbance from survey aircraft. More recently, scientists at Texas Tech University used aerial surveys to estimate the density of lesser prairie-chicken leks and Statewide abundance of lesser prairie-chickens in Texas. This study conducted an inventory of 208 survey blocks measuring 7.2 by 7.2 km (4.5 by 4.5 mi), encompassing some 87 percent of the occupied range in Texas during the spring of 2010 and 2011 (Timmer 2012, pp. 26–27, 33). Timmer (2012, p. 34) estimated 2.0 leks per 100 sq km (0.02 leks per sq km). Previously reported estimates of rangewide average lek density varied from 0.10 to 0.43 leks per sq km (Davison 1940; Sell 1979; Giesen 1991; Locke 1992 as cited in Hagen and Giesen 2005, unpaginated). The total estimate of the number of leks was 293.6 and, based on the estimated number of birds observed using leks, the statewide population was determined to be 1,822.4 lesser prairie-chickens (Timmer 2012, p. 34).

Lesser prairie-chicken population trends in Texas, based on annual monitoring efforts, have been declining over the last 15 years (1997-2012), with the exception of the Bailey County Study Area (Martin 2013, p. 9). However the Bailey County Study Area has not been surveyed since 2007, so recent trend information from this area is unavailable. Since 2010, the overall average number of males per lek have declined, but the density of leks (number per square mile) has remained fairly constant (Martin 2013, p. 11).

Summary of Population Status Information

Lesser prairie-chicken populations are distributed over a relatively large area, and these populations can fluctuate considerably from year to year, a natural response to variable weather and habitat conditions. Changes in lesser prairie-chicken breeding populations may be indicated by a change in the number of birds attending a lek (lek size), the number of active leks, or both. Although each State conducts standard surveys for lesser prairie-chickens, the application of survey methods and effort varies by State. Such factors complicate interpretation of population indices for the lesser prairie-chicken and may not reliably represent actual populations. Caution should be used in evaluating population trajectories, particularly short-term trends. In some instances, short-term analyses could reveal statistically significant changes from one year to the next but actually represent a stable population when evaluated over longer periods of time. For example, increased attendance of males at leks may be evident while the number of active leks actually declined.

An examination of anecdotal information on historical numbers of lesser prairie-chickens indicates that numbers likely have declined from possibly millions of birds to current estimates of thousands of birds. Examination of the trends in the five lesser prairie-chicken States for most indicator variables, such as males per lek and lek density, over the last 3 years shows the trends are indicative of declining populations. Much of these recent declines are due, at least in part, to habitat degradation resulting from incidence of severe drought over much of the occupied range. Habitat conditions may improve with the return of more normal precipitation patterns in the near future.

However, the numbers of lesser prairie-chickens reported per lek are considerably fewer than the numbers reported during the 1970s. While habitat conditions may improve in the future, the low lek attendance observed at many leks is likely due to longer term reductions in population size. It is unlikely that populations will recover to historical levels observed just 40 years ago, particularly when considered in light of the loss and alteration, including fragmentation, of lesser prairie-chicken habitat throughout its historical range over the past several decades. Information regarding habitat loss and fragmentation, as well as other factors, impacting the lesser prairie-chicken is provided in the sections that follow.

Summary of Factors Affecting the Species

The Act defines an endangered species as any species that is "in danger of extinction throughout all or a significant portion of its range" and a threatened species as any species "that is likely to become endangered throughout all or a significant portion of its range within the foreseeable future." Thus, a species may be listed as a threatened species if it is likely to qualify for endangered status in the foreseeable future, or in other words, likely to become "in danger of extinction" within the foreseeable future. The Act does not define the term "foreseeable future." However, in a January 16, 2009, memorandum addressed to the Acting Director of the Service, the Office of the Solicitor, Department of the Interior, concluded, "* * * as used in the [Act], Congress intended the term 'foreseeable future' to describe the extent to which the Secretary can reasonably rely on predictions about the future in making determinations about the future conservation status of the species" (M–37021, January 16, 2009).

In considering the foreseeable future as it relates to the status of the lesser prairie-chicken, we considered the factors acting on the species and looked to see if reliable predictions about the status of the species in response to those factors could be drawn. We considered the historical data to identify any relevant existing trends that might allow for reliable prediction of the future (in the form of extrapolating the trends). We also considered whether we could reliably predict any future events that might affect the status of the species, recognizing that our ability to make reliable predictions into the future is limited by the variable quantity and quality of available data.

Under section 4(a)(1) of the Act, we determine whether a species is an endangered or threatened species because of any of the following five factors: (A) The present or threatened destruction, modification, or curtailment of its habitat or range; (B) overutilization for commercial, recreational, scientific, or educational purposes; (C) disease or predation; (D) the inadequacy of existing regulatory mechanisms; and (E) other natural or manmade factors affecting its continued existence. Listing actions may be warranted based on any of the above threat factors, singly or in combination.

After a review of the best available scientific information as it relates to the status of the species and the five listing factors described above, we have determined that the lesser prairie-chicken meets the definition of a threatened species (i.e., is likely to become in danger of extinction in the foreseeable future throughout all or a significant portion of its range). Following, we present a very brief explanation of the rationale leading to this conclusion followed by an in-depth discussion of the best available scientific information.

The range of the lesser prairie-chicken has been reduced by an estimated 84 percent (see discussion above in "Current Range and Distribution"). The primary factor responsible for the range reduction is habitat fragmentation due to a variety of mechanisms that contribute to habitat loss and alteration. This habitat loss significantly increases the extinction risk for the lesser prairie-chicken because the species requires large parcels of intact native grassland and shrubland, often in excess of 8,100 ha (20,000 ac) to maintain self-sustaining populations (Woodward *et al.* 2001, p. 261; Flock 2002, p. 130; Fuhlendorf *et al.* 2002a, p. 618; Davis 2005, p. 3). Further, the life history of the species, primarily its lek breeding system and behavioral avoidance of vertical structures that increase predation risk, make it especially vulnerable to ongoing impacts on the landscape, especially at its currently reduced numbers. The total estimated population abundance in 2013 dropped to 17,616 individuals (90 percent upper and lower confidence intervals of 20,978 and 8,442 individuals, respectively) from 34,440 individuals (90 percent upper and lower confidence intervals of 52,076 and 21,718 individuals, respectively) in 2012 (McDonald *et al.* 2013, p. 24). Finally, the species has a reduced population size and faces ongoing habitat loss and degradation. The species will lack sufficient redundancy and resiliency to ensure its viability from present and future threats. While the current status of the lesser prairie-chicken has been substantially compromised by historical and current threats, there appear to be sufficient stable populations to ensure the persistence of the species over the near term. That is, the Service does not believe the species is currently at risk of extinction. However, as a result of continued population declines predicted into the future, the species is likely to become in danger of extinction in the foreseeable future.

Following, we present our analysis of the best available scientific and commercial data that has led to this conclusion.

Habitat Fragmentation

Spatial habitat fragmentation occurs when some form of disturbance, usually habitat alteration or loss, results in the separation or splitting apart of larger, previously contiguous, functional components of habitat into smaller, often less valuable, noncontiguous parcels (Wilcove *et al.* 1986, p. 237; Johnson and Igl 2001, p. 25; Franklin *et al.* 2002, entire). Fragmentation influences habitat availability and quality in three primary ways: total area of available habitat; size of habitat patches, including edge effects; and patch isolation (Johnson and Igl 2001, p. 25; Stephens *et al.* 2003, p. 101). Initially, reduction in the total area of available habitat (i.e., habitat loss) may be more significant than fragmentation and can exert a much greater effect of extinction (Fahrig (1997, pp. 607, 609). However, as habitat loss continues, the effects of fragmentation often compound effects of habitat loss and produce even greater population declines than habitat loss alone (Bender *et al.* 1998, pp. 517–518, 525). At the point where some or all of the remaining habitat fragments or patches are below some minimum required size, the impact of additional habitat loss, when it consists of inadequately sized parcels, is minimal (Herkert 1994, p. 467). In essence, once a block of suitable habitat becomes so fragmented that the size of the remaining patches become biologically unsuitable, the continued loss of these smaller, suitable patches, , is of little further consequence to the species (Bender *et al.* 1998, p. 525).

Both habitat loss and fragmentation correlate with an ecological concept known as carrying capacity. Within any given block or patch of habitat, carrying capacity is the maximum number of organisms that can be supported indefinitely within that area, provided sufficient food, space, water, and other necessities are available, without causing degradation of the habitat within that patch. Theoretically, as habitat loss increases and the size of an area shrinks, the maximum number of individuals that could inhabit that particular habitat patch also would decline. Consequently, a reduction in the total area of available habitat can negatively influence biologically important characteristics such as the amount of space available for establishing territories and nest sites (Fahrig 1997, p. 603). Over time, the continued conversion and loss of habitat to other land uses will reduce the ability of the land to support historical population levels, causing a decline in population sizes. Where the ability to effect restoration of these habitats is lost, the observed reduction in fish or wildlife populations is likely to be permanent.

Fragmentation not only contributes to overall habitat loss but also causes a reduction in the size of individual habitat patches and influences the proximity of these patches to other patches of similar habitat (Stephens *et al.* 2003, p. 101; Fletcher 2005, p. 342). Habitat quality for many species is a function of fragment size and declines as the size of the fragment decreases (Franklin *et al.* 2002, p. 23). Fahrig and Merriam (1994, p. 53) reported that both the size and shape of the fragment have been shown to influence population persistence in many species. The size of the fragment can influence reproductive success, survival, and movements. As the distance between habitat fragments increases, dispersal between the habitat patches may become increasingly limited and ultimately cease, impacting population persistence and potentially leading to both localized and regional extinctions (Harrison and Bruna 1999, p. 226; With *et al.* 2008, p. 3153).

The proportion of habitat edge to interior habitat increases as the size of a fragment declines. The edge is the transition zone between the original habitat type and the adjacent altered habitat. In contrast, the core is the area within a fragment that remains intact and is largely or completely uninfluenced by the margin or edge of the fragment. Edge habitat proliferates with increasing fragmentation (Sisk and Battin 2002, p. 31). The response of individual species to the presence of edges varies markedly depending on their tolerance to the edge and the nature of its effects (Sisk and Battin

2002, p. 38). The effects often depend on the degree of contrast between the habitat edge and the adjacent land use matrix. The transition can be abrupt or something more gradual and less harsh. Most typically, edges to influence movements and survival, particularly for species that use interior or core habitats, serve as points of entry for parasites and predators (such as presence of fences adjacent to grasslands which provide hunting perches for avian predators), alter microclimates, subsidize feeding opportunities (such as providing access to waste grains in cropland areas), and influence species interactions, particularly with cosmopolitan species that tend to be habitat generalists (Sisk and Battin 2002, p. 38).

Fragmentation also can influence the heterogeneity or variation within the resulting fragment. Heterogeneity, in turn, influences the quality of the habitat within the fragment, with more homogeneous fragments generally being less valuable. Grasslands tend to be structurally simple and have little vertical layering. Instead, habitat heterogeneity tends to be largely expressed horizontally rather than vertically (Wiens 1974b, pp. 195–196). Prior to European settlement, the interaction of grazing by wild ungulates, drought and fire created a shifting mosaic of vegetative patches having various composition and structure (Derner *et al*. 2009, p. 112; Pillsbury *et al.* 2011, p. 2). Under these conditions, many grassland birds distribute their behavioral activities unevenly throughout their territories by nesting in one area, displaying in another, and foraging in still others (Wiens 1974b, p. 208). Lesser prairie-chickens exhibit this pattern and cue on specific vegetation structure and microenvironment features depending on the specific phase of their life cycle. Consequently, blocks of habitat that collectively or individually encompass multiple successional states that comprise tall grasses and shrubs needed for nesting, and are in proximity to more open grasslands supporting forbs for brood rearing, and are combined with smaller areas of short grass and bare ground used for breeding, support all of the habitat types used by lesser prairie-chickens throughout the year. Considering habitat diversity tends to be greater in larger patches, finding the appropriate mosaic of these features is more likely in larger fragments rather than smaller fragments (Helzer and Jelinski 1999, p. 1456).

Such habitat heterogeneity is very different from habitat fragmentation. Habitat fragmentation occurs when the matrix separating the resulting fragments is converted to a use that is not considered habitat whereas habitat heterogeneity implies that patches each having different vegetative structure exist within the same contiguous block of habitat. Habitat heterogeneity may influence habitat quality, but it does not represent fragmentation (Franklin *et al.* 2002, p. 23).

Isolation is another factor that influences suitability of habitat fragments. As habitat loss continues to progress over time, the remnants not only become smaller and more fragmented, they become more isolated from each other. When habitat patches become more isolated and the amount of unusable, unsuitable land use surrounding the islands of habitat increases, even patches of suitable quality and size may no longer be occupied. As fragmentation progresses, the ability of available dispersers to locate suitable fragments will decline. At some point, the amount of intervening unusable and unsuitable land comprising the matrix between the patches grows so wide that it exceeds the organism's dispersal capabilities, rendering the matrix impermeable to dispersal. In such instances, colonizers are unavailable to occupy the otherwise suitable habitat and reestablish connectivity. While extinctions at the local level, and subsequent recolonization of the vacant patch, are common phenomena, recolonization depends on the availability of dispersing individuals and their ability to disperse within the broader landscape (Fahrig and Merriam 1994, p. 52). Without available dispersing individuals with the ability to disperse, these isolated patches may remain vacant indefinitely. When the number of individuals at the landscape or regional level that are available to disperse declines, the overall population begins to decline and will, in turn, affect the number of individuals available to disperse. Connectivity between habitat patches is one means of facilitating dispersal, but the appropriate size or configuration of the dispersal corridors needed to facilitate connectivity for many species is unknown. The rangewide plan (Van Pelt *et al.* 2013, p. 77), delineates connectivity zones based on criteria that provide a foundation upon which to base suitable dispersal corridors for the lesser prairie-chicken. Suitable dispersal corridors should contain at least 40 percent good to high quality habitat, be at least 8 km (5 mi) wide and contain few, if any, features, such as roads or transmission lines, that function as barriers to movement. Additionally, suitable habitat patches within a corridor should be separated by no more than 3.2 km (2 mi). In the absence of specific studies that define suitable dispersal corridors, the criteria provided in the rangewide plan (Van Pelt *et al*. 2013, p. 77) provide suitable guidelines that can be used to facilitate development of appropriate dispersal corridors.

Causes of Habitat Fragmentation Within Lesser Prairie-Chicken Range

A number of factors can cause or contribute to habitat fragmentation. Generally, fragmentation can result from the direct loss or alteration of habitat due to conversion to other land uses or from habitat alteration which indirectly leaves the habitat in such a condition that the remaining habitat no longer functionally provides the preferred life-history requisites needed to support breeding or feeding or to provide shelter. Functional habitat impacts can include disturbances that alter the existing successional state of a given area, create a physical barrier that precludes use of otherwise suitable areas, or triggers a behavioral response by the organism such that otherwise suitable habitats are abandoned or no longer used. Fragmentation tends to be most significant when human developments are dispersed across the landscape rather than being concentrated in fewer areas. Anthropogenic causes of fragmentation tend to be more significant than natural causes because the organism has likely evolved in concert with the natural causes.

Initially, settlement and associated land use changes had the greatest influence on fragmentation in the Great Plains. Knopf (1994, p. 249) identified four universal changes that occurred in Great Plains grasslands postsettlement, based on an evaluation of observations made by early explorers. These changes were identified as a change in the native grazing community, cultivation, wetland conversion, and encroachment of woody vegetation.

EuroAmerican settlement of much of the Great Plains began in earnest with passage of the Homestead Act of 1862. Samson *et al*. (2004, p. 7) estimated that about 1.5 million people acquired over 800,000 sq km (309,000 sq mi) of land through the Homestead Act, mostly within the Great Plains region. Continued settlement and agricultural development of the Great Plains during the late 1800s and early 1900s, facilitated by railroad routes and cattle and wagon trails, contributed to conversion and fragmentation of once open native prairies into an assortment of varied land uses and habitat types such as cultivated cropland, expanding cedar woodlands, and remnants of grassland (NRCS 1999, p. 1; Coppedge *et al.* 2001, p. 47; Brennan and Kuvlesky 2005, pp. 2–3). This initial settlement altered the physical characteristics of the Great Plains and the biodiversity found in the prairies (Samson *et al*. 2004, p. 7). Changes in agricultural practices and advancement of modern machinery combined with an increasing demand for agricultural products continued to spur conversion of native prairies well into the mid-1900s (NRCS 1999a, p. 2). Increasing human population densities in rural areas of the Great Plains led to construction of housing developments as growing cities began to expand into the surrounding suburban landscapes. Development and intensification of unsuitable land uses in these urbanizing landscapes also contributed to conversion and fragmentation of grasslands, further reducing richness and abundance of avian populations (Perlut *et al.* 2008, p. 3149; Hansen *et al.* 2011, p. 826). See additional discussions related to population growth and settlement below.

Oil and gas development began during the mid to late 1800s. Eventually, invention of the automobile in the early twentieth century and its rise to prominence as the primary mode of personal transportation stimulated increased exploration and development of oil and gas (Hymel and Wolfsong 2006, p. 4). Habitat loss and fragmentation associated with access roads, drill pads, pipelines, waste pits, and other components typically connected with exploration and extraction of oil and gas are considered to be among the most significant ecological impacts from oil and gas development and the impacts often extend beyond the actual physical structures (Weller *et al.* 2002, p. 2). See the section on energy development below for related discussion.

Information on human population size and growth in the five lesser prairie-chicken States is collected by the U.S. Census Bureau, and recent trends have been reported by the USDA Economic Research Service (2013). Population size in each of the five States has grown since 1980. The percent population growth since 2010 varies from a low of 1.1 percent in Kansas to a high of 3.6 percent in Texas. Examination of growth in human populations within rural areas reveals that rural populations also have grown in every State except Kansas since 1980. In Kansas, rural population size during this period peaked in 1980.

Human population trends within the counties that encompass the estimated occupied range of the lesser prairie-chicken were inconsistent and varied considerably across the range. For example, in Colorado since 2010, human populations declined by about 1 percent in both Baca and Prowers counties but populations in both Cheyenne and Kiowa counties grew by at least 2.1 percent. However, since 1990, populations in all four counties have declined. Similar trends were observed in Oklahoma with five counties having a declining population and four showing increasing human populations since 2010. But unlike Colorado, three counties within the estimated occupied range in Oklahoma have increased in population size since 1990. In New Mexico, most, but not all, of the counties within the estimated occupied range of the lesser prairie-chicken have increased since 1990.

We used projections of human population growth, based on U.S. Census Bureau data, developed by the U.S. Forest Service for their Forest and Rangeland Renewable Resources Planning Act of 1974 (RPA) Assessment to forecast how human populations within the estimated historical and occupied ranges of the lesser prairie-chicken would change into the future. The USFS used a medium population growth scenario, taking the implications of climate change into consideration, to predict how human populations nationwide would change between 2010 and 2060 (U.S. Forest Service 2012, entire). Using the counties encompassed within the historical and estimated occupied range, we were able to determine, by range within the respective States, how human populations would be projected to change by 2060.

In Colorado within the historical range, two of the six counties were projected to experience a decline in human population while the remaining four counties were expected to see an increase in human population growth rate. The overall net gain in population size over the 50 year period was 3,490 individuals. Within the four counties located within the estimated occupied range, projected population size was predicted to decline in two counties and increase in two counties. The overall net gain in human population size within the estimated occupied range in Colorado by 2060 was 280 individuals.

In the Kansas historical range, 29 counties were projected to experience a decline in human population while the remaining 13 counties were expected to see an increase in population. The overall net gain in population size over the 50 year period in the 29 counties within the Kansas historical range was 22,376 individuals. Within just the counties located within the estimated occupied range, projected population size was predicted to decline in 24 counties and increase in 11 counties. The overall net gain in human population size within the Kansas portion of the estimated occupied range by 2060 was 39,190 individuals.

In Oklahoma, similar trends for both the historical and estimated occupied ranges were predicted. Nineteen counties within the historical range were projected to experience a decline in human population. The overall net gain in population size over the 50 year period within the estimated historical range was 85,310 individuals. Within the nine counties that comprise the estimated occupied range, projected population size was predicted to decline in seven counties and increase in two counties. The overall net gain in human population size within the Oklahoma estimated occupied range by 2060 was 5,830 individuals.

In Texas, where the largest extent of historical range occurs, human population growth was projected to be larger than those projected in the previous three States. Within the historical range, 43 counties were projected to experience a decline in human population while the remaining 51 counties were projected to see an increase in population. The overall net gain in population size over the 50 year period in the counties within the estimated historical range was 368,770 individuals. Within the estimated occupied range of Texas, human populations were projected to decline in 12 counties and increase in eight counties. The overall net gain in human population size within the estimated occupied range by 2060 was 61,780 individuals.

Population growth in New Mexico is expected to be more substantial than in the other States. Within the historical range, only two counties were projected to experience a decline in human population while the remaining nine counties were projected see an increase in population. The overall net gain in human population size over the 50 year period in the counties within the estimated historical range was estimated to be 89,380 individuals. Within the counties located within the estimated occupied range, projected population size was predicted to decline in one county and increase in six counties. The projected overall net gain in human population size within the New Mexico portion of the estimated occupied range by 2060 was 81,690 individuals.

Overall, within the historical range human population growth is projected to experience a net increase in human population by 2060 of about 569,326 individuals or 1.2 individuals per sq km (3.2 per sq mi). The estimated occupied range is projected to experience a net increase in human population by 2060 of about 188,770 individuals or 2.3 individuals per sq km (6.04 per sq mi). Human population density, based on the projected population growth, within the estimated occupied range is projected to increase by almost double that of the entire historical range.

As human populations continue to expand, as projected, the growth is expected to alter the landscape by modifying land use patterns much like the changes that occurred during settlement of the Great Plains. Forecasts of human population growth through the year 2060 revealed that nationwide the land area encompassed by urbanization will increase by 24 million ha (59 million ac) to 35 million ha (86 million ac), depending on whether a slower or more rapid growth scenario is used in the analysis (Wear 2011, p. 14). Increases in land area under urban development are expected to result in reductions in the area that is in cropland, pastureland and rangeland. Forecasts of cropland loss vary between 7.6 million ha (19 million ac) and 11 million ha (28 million ac), depending on which growth scenario is selected. Under the scenario of intermediate levels of human population growth and strong growth in personal income, about 85 percent (9.7 million ha; 24 million ac) of the cropland losses would occur in regions along and east of the Mississippi River and in coastal areas (Wear 2011, pp. 15, 22, 24). Forecasts of rangeland loss vary between 3.2 million ha (8 million ac) and 4.4 million ha (12 million ac), depending on which growth scenario is selected. Colorado and Texas are projected to experience some of the greatest losses of rangeland (Wear 2011, p. 23). In general, human populations in the Great Plains are expected to remain unchanged or decline slightly by 2060, particularly in the Oklahoma and Texas panhandles and portions of western and central Kansas (Wear 2011, p. 13).

As human populations, as projected, continue to expand, particularly into rural regions outside of existing urban and suburban areas, an increasing array of human features such as powerlines, highways, secondary roads, communication towers, and other types of infrastructure necessary to support these human populations are expected to appear on the landscape (Leu *et al.* 2008, p. 1119). We believe this infrastructure tends to remain in place even if human populations decline after initial expansion. Often these developments can degrade ecosystem functions and lead to fragmentation even when the overall development footprint is relatively small.

Natural vertical features, such as trees and man-made, above ground vertical structures such as power poles, fence posts, oil and gas wells, towers, and similar developments can cause general habitat avoidance and displacement in lesser prairie-chickens and other prairie grouse (Anderson 1969, entire; Robel 2002, entire; Robel *et al.* 2004, entire; Hagen *et al.* 2004, entire; Pitman *et al.* 2005, entire; Pruett *et al.* 2009a, entire; Hagen *et al.* 2011, entire; Hovick *et al.* unpublished manuscript, entire). This avoidance behavior is presumably a behavioral response that serves to limit exposure to predation. The observed avoidance distances can be much larger than the actual footprint of the structure and appear to vary depending upon the type of structure. These structures can have significant negative impacts by contributing to further fragmentation of otherwise suitable habitats. Hovick *et al.* (unpublished manuscript under review, entire) examined the influence of several anthropogenic structures, including oil and gas infrastructure, powerlines and wind turbines on displacement behavior and survival in grouse. They conducted a meta-analysis that examined 23 different structures and found that all structure types examined resulted in displacement but oil structures and roads had the greatest impact on grouse avoidance behavior (Hovick *et al.* unpublished manuscript under review, p. 11). They also examined the effect of 17 of these structures on survival and found all of the structures examined also decreased survival in grouse, with lek attendance declining at a greater magnitude than other survival parameters measured (Hovick *et al.* unpublished manuscript under review, p. 12).

Prairie grouse, such as the lesser prairie-chicken, did not evolve with tall, vertical structures present on the landscape and, in general, have low tolerance for tall structures. As discussed in "Altered Fire Regimes and Encroachment by Invasive, Woody Plants" below, encroachment of trees into native grasslands preferred by lesser prairie-chickens ultimately renders otherwise suitable habitat unsuitable unless steps are taken to remove these trees. Even placement of cut trees in a pattern that resembled a wind break were observed to cause an avoidance response. Anderson (1969, pp. 640–641) observed that greater prairie-chickens abandoned lek territories when a 4-m (13-ft) tall coniferous wind break was artificially erected 52 m (170 ft) from an active lek.

Increasingly, man-made vertical structures are appearing in landscapes used by lesser prairie-chickens. The placement of these vertical structures in open grasslands represents a significant change in the species' environment and is a relatively new phenomenon over the evolutionary history of this species. The effects of these structures on the life history of prairie grouse are only beginning to be evaluated, with similar avoidance behaviors also having been observed in sage grouse (75 FR 13910, March 23, 2010).

Robel (2002, p. 23) reported that a single commercial-scale wind turbine creates a habitat avoidance zone for the greater prairie-chicken that extends as far as 1.6 km (1 mi) from the structure. Lesser prairie-chickens likely exhibit a similar response to tall structures, such as wind turbines (Pitman *et al.* 2005, pp. 1267–1268). The Lesser

Prairie-Chicken Interstate Working Group (Mote *et al.* 1999, p. 27) identified the need for a contiguous block of 52 sq km (20 sq mi) of high-quality rangeland habitat to successfully maintain a local population of lesser prairie-chicken. Based on this need and the fact that the majority of remaining populations are fragmented and isolated into islands of unfragmented, open prairie habitat, the Service recommended that an 8-km (5-mi) voluntary no-construction buffer be established around prairie grouse leks to account for behavioral avoidance and to protect lesser prairie-chicken populations and habitat corridors needed for future recovery (Manville 2004, pp. 3–4). In Kansas, no lesser prairie-chickens were observed nesting or lekking within 0.8 km (0.5 mi) of a gas line compressor station, and otherwise suitable habitat was avoided within a 1.6-km (1-mi) radius of a coal-fired power plant (Pitman *et al.* 2005, pp. 1267–1268). Pitman *et al.* (2005, pp. 1267–1268) also observed that female lesser prairie-chickens selected nest sites that were significantly further from powerlines, roads, buildings, and oil and gas wellheads than would be expected at random. Specifically, they observed that lesser prairie-chickens seldom nested or reared broods within approximately 177 m (580 ft) of oil or gas wellheads, 400 m (1,312 ft) of electrical transmission lines, 792 m (2,600 ft) of improved roads, and 1,219 m (4,000 ft) of buildings; and, the observed avoidance was likely influenced, at least in part, by disturbances such as noise and visual obstruction associated with these features. Similarly, Hagen *et al* (2004, p. 75) indicated that areas used by lesser prairie-chickens were significantly further from these same types of features than areas that were not used by lesser prairie-chickens. They concluded that the observed avoidance was likely due to potential for increased predation by raptors or due to presence of visual obstructions on the landscape (Hagen *et al.* 2004, pp. 74–75).

Robel *et al.* (2004, pp. 256–262) determined that habitat displacement associated with avoidance of certain structures by lesser prairie-chickens can be substantial, collectively exceeding 21,000 ha (53,000 ac) in a three-county area of southwestern Kansas. Using information on existing oil and gas wells, major powerlines (115 kV and larger), and existing wind turbines and proposed wind energy development in northwestern Oklahoma, Dusang (2011, p. 61) modeled the effect of these anthropogenic structures on lesser prairie-chicken habitat in Oklahoma. He estimated that existing and proposed development of these structures potentially would eliminate approximately 960,917 ha (2,374,468 ac) of nesting habitat for lesser prairie-chickens, based on what is currently known about their avoidance of these structures.

Avoidance of vertical features such as trees and transmission lines likely is due to frequent use of these structures as hunting perches by birds of prey (Hagen *et al.* 2011, p. 72). Raptors actively seek out and use power poles and similar aboveground structures in expansive grassland areas where natural perches are limited. In typical lesser prairie-chicken habitat where vegetation is low and the terrain is relatively flat, power lines and power poles provide attractive hunting, loafing, and roosting perches for many species of raptors (Steenhof *et al*. 1993, p. 27). The elevated advantage of transmission lines and power poles serve to increase a raptor’s range of vision, allow for greater speed during attacks on prey, and serve as territorial markers. While the effect of avian predation on lesser prairie-chickens depends on raptor densities, as the number of hunting perches or structures to support nesting by raptors increase, the impact of avian predation will increase accordingly (see separate discussion under "*Predation*" below). The perception that these vertical structures are associated with predation may cause lesser prairie-chickens to avoid areas near these structures even when raptor densities are low. Sensitivity to electromagnetic fields generated by the transmission lines may be another reason lesser prairie-chickens might be avoiding these areas (Fernie and Reynolds 2005, p. 135) (see separate discussion under "*Wind Power and Energy Transmission Operation and Development*" below).

Where grassland patches remained, overgrazing, drought, lack of fire, woody plant and exotic grass invasions, and construction of various forms of infrastructure impacted the integrity of the remaining fragments (Brennan and Kuvlesky 2005, pp. 4–5). Domestic livestock management following settlement tended to promote more uniform grazing patterns, facilitated by construction of fences, which led to reduced heterogeneity in remaining grassland fragments (Fuhlendorf and Engle 2001, p. 626; Pillsbury *et al.* 2011, p. 2). See related discussions in the relevant sections below.

This ever-escalating fragmentation and homogenization of grasslands contributed to reductions in the overall diversity and abundance of grassland-endemic birds and caused populations of many species of grassland-obligate birds, such as the lesser prairie-chicken to decline (Coppedge *et al.* 2001, p. 48; Fuhlendorf and Engle, 2001, p. 626). Fragmentation and homogenization of grasslands is particularly detrimental for lesser prairie-chickens that typically prefer areas where individual habitat needs are in close proximity to each other. For example, in suitable habitats, desired vegetation for nesting and brood rearing typically occurs within relatively short distances of the breeding area.

Effects of Habitat Fragmentation

While much of the conversion of native grasslands to agriculture in the Great Plains was largely completed by the 1940s and has slowed in more recent decades, grassland bird populations continue to decline (With *et al.* 2008, p. 3153). Bird populations may initially appear resistant to landscape change only to decline inexorably over time because remaining grassland fragments may not be sufficient to prevent longer term decline in their populations (With *et al.* 2008, p. 3165). The decrease in patch size and increase in edges associated with fragmentation are known to have caused reduced abundance, reduced nest success, and reduced nest density in many species of grassland birds (Pillsbury *et al.* 2011, p. 2).

Habitat fragmentation has been shown to negatively impact population persistence and influence the species extinction process through several mechanisms (Wilcove *et al.* 1986, p. 246). Once fragmented, the remaining habitat fragments may be inadequate to support crucial life-history requirements (Samson 1980b, p. 297). The land-use matrix surrounding remaining suitable habitat fragments may support high densities of predators or brood parasites (organisms that rely on the nesting organism to raise their young), and the probability of recolonization of unoccupied fragments decreases as distance from the nearest suitable habitat patch increases (Wilcove *et al.* 1986, p. 248; Sisk and Battin 2002, p. 35). Invasion by undesirable plants and animals is often facilitated around the perimeter or edge of the patch, particularly where roads are present (Weller *et al.* 2002, p. 2). Additionally, as animal populations become smaller and more isolated, they are more susceptible to random (stochastic) events and reduced genetic diversity via drift and inbreeding (Keller and Waller 2002, p. 230). Population viability depends on the size and spacing of remaining fragments (Harrison and Bruna 1999, p. 226; With *et al.* 2008, p. 3153). O'Connor *et al.* (1999, p. 56) concluded that grassland birds, as a group, are particularly sensitive to habitat fragmentation, primarily due to sensitivity to fragment size. Consequently, the effects of fragmentation are the most severe on area-sensitive species (Herkert 1994, p. 468).

Area-sensitive species are those species that respond negatively to decreasing habitat patch size (Robbins 1979, p. 198; Finch 1991, p. 1. An increasing number of studies are showing that many grassland birds also are area-sensitive and have different levels of tolerance to fragmentation of their habitat (e.g., see Herkert 1994, entire; Winter and Faaborg 1999, entire). For species that are area-sensitive, once a particular fragment or patch of suitable habitat falls below the optimum size, populations decline or disappear entirely even though suitable habitat may continue to exist within the larger landscape. When the overall amount of suitable habitat within the landscape increases, the patch size an individual area-sensitive bird may utilize generally tends to be smaller (Horn and Koford 2006, p. 115), but they appear to maintain some minimum threshold (Fahrig 1997, p. 608; NRCS 1999a, p. 4). Winter and Faaborg (1999, pp. 1429, 1436) reported that the greater prairie-chicken was the most area-sensitive species observed during their study, and this species was not documented from any fragment of native prairie less than 130 ha (320 ac) in size. Sensitivity of lesser prairie-chickens likely is very similar to that of greater prairie-chickens; a more detailed discussion is provided below.

Franklin *et al.* (2002, p. 23) described fragmentation in a biological context. According to Franklin *et al.* (2002, p. 23) habitat fragmentation occurs when occupancy, reproduction, or survival of the organism has been affected. The effects of fragmentation can be influenced by the extent, pattern, scale, and mechanism of fragmentation (Franklin *et al.* 2002, p. 27). Habitat fragmentation also can have positive, negative, or neutral effects, depending on the species (Franklin *et al.* 2002, p. 27). As a group, grouse are considered to be particularly intolerant of extensive habitat fragmentation due to their short dispersal distances, specialized food habits, generalized antipredator strategies, and other life-history characteristics (Braun *et al.* 1994, p. 432). Lesser prairie-chickens in particular have a low adaptability to habitat alteration, particularly activities that fragment suitable habitat into smaller, less valuable pieces. Lesser prairie-chickens use habitat patches with different vegetative structure dependent upon a particular phase in their life cycle, and the loss of even one of these structural components can significantly reduce the overall value of that habitat to lesser prairie-chickens. Fragmentation not only reduces the size of a given patch but also can reduce the interspersion or variation within a larger habitat patch, possibly eliminating important structural features crucial to lesser prairie-chickens.

Lesser prairie-chickens and other species of prairie grouse require large expanses (i.e., 1,024 to 10,000 ha (2,530 to 24,710 ac)) of interconnected, ecologically diverse native rangelands to complete their life cycles (Woodward *et al.* 2001, p. 261; Flock 2002, p. 130; Fuhlendorf *et al.* 2002a, p. 618; Davis 2005, p. 3), more so than almost any other grassland bird (Johnsgard 2002, p. 124). Davis (2005, p. 3) states that the combined home range of all lesser prairie-chickens at a single lek is about 49 sq km (19 sq mi or 12,100 ac). According to Applegate and Riley (1998, p. 14), a viable lek will have at least six males accompanied by an almost equal number of females. Because leks need to be clustered so that interchange among different leks can occur in order to reduce interbreeding problems on any individual lek, they considered a healthy population to consist of a complex of six to ten viable leks (Applegate and Riley 1998, p. 14). Consequently, most grouse experts consider the lesser prairie-chicken to be an area-sensitive species, and large areas of intact, unfragmented landscapes of suitable mixed-grass, short-grass, and shrubland habitats are considered essential to sustain functional, self-sustaining populations (Giesen 1998, pp. 3–4; Bidwell *et al.* 2002, pp. 1–3; Hagen *et* *al.* 2004, pp. 71, 76–77). Therefore, areas of otherwise suitable habitat can readily become functionally unusable due to the effects of fragmentation.

The lesser prairie-chicken has several life-history traits common to most species of grouse that influence its vulnerability to the impacts of fragmentation, including short lifespan, low nest success, strong site fidelity, low mobility, and a relatively small home range. This vulnerability is heightened by the considerable extent of habitat loss that has already occurred over the range of the species. The resiliency and redundancy of these populations have been reduced as the number of populations that formerly occupied the known historical range were lost or became more isolated by fragmentation of that range. Isolation of remaining populations will continue to the extent these populations remain or grow more separated by areas of unsuitable habitat, particularly considering their limited dispersal capabilities (Robb and Schroeder 2005, p. 36).

Fragmentation is becoming a particularly significant ecological driver in lesser prairie-chicken habitats, and several factors are known to be contributing to the observed destruction, modification, or curtailment of the lesser prairie-chicken's habitat or range. Extensive grassland and untilled rangeland habitats historically used by lesser prairie-chickens have become increasingly scarce, and remaining areas of these habitat types continue to be degraded or fragmented by changing land uses. The loss and fragmentation of the mixed-grass, short-grass, and shrubland habitats preferred by lesser prairie-chickens has contributed to a significant reduction in the extent of the estimated occupied range that is inhabited by lesser prairie-chickens. Based on the cooperative mapping efforts led by the Playa Lakes Joint Venture and Lesser Prairie-Chicken Interstate Working Group, lesser prairie-chickens are estimated to now occupy only about 16 percent of their estimated historical range. What habitat remains is now highly fragmented (Hagen *et al.* 2011, p. 64). See previous discussion above in "Current Range and Distribution" for additional detail.

Several pervasive factors, such as conversion of native grasslands to cultivated agriculture; change in the historical grazing and fire regime; tree invasion and brush encroachment; oil, gas, and wind energy development; and road and highway expansion have been implicated in not only permanently altering the Great Plains landscape but in specifically causing much of the observed loss, alteration, and fragmentation of lesser prairie-chicken habitat (Hagen and Giesen 2005, np.; Elmore *et al.* 2009, pp. 2, 10–11; Hagen *et al.* 2011, p. 64). Additionally, lesser prairie-chickens actively avoid areas of human activity and noise or areas that contain certain vertical features, such as buildings, oil or gas wellheads and transmission lines (Robel *et al.* 2004, pp. 260–262; Pitman *et al.* 2005, pp. 1267–1268; Hagen *et al.* 2011, p. 70–71). Avoidance of vertical features such as trees and transmission lines likely is due to frequent use of these structures as hunting perches by birds of prey (Hagen *et al.* 2011, p. 72). .

Oil and gas development activities, particularly drilling and road and highway construction, also contribute to surface fragmentation of lesser prairie-chicken habitat for many of the same reasons observed with other artificial structures (Hunt and Best 2004, p. 92). The incidence of oil and gas exploration has been rapidly expanding within the range of the lesser prairie-chicken. A more thorough discussion of oil and gas activities within the range of the lesser prairie-chicken is discussed below.

Many of the remaining habitat fragments and adjoining land use types subsequently fail to meet important habitat requirements for lesser prairie-chickens. Other human-induced developments, such as buildings, fences, and many types of vertical structures, which may have an overall smaller physical development footprint per unit area, serve to functionally fragment otherwise seemingly suitable habitat; this causes lesser prairie-chickens to cease or considerably reduce their use of habitat patches impacted by these developments (Hagen *et al.* 2011 pp. 70–71). As the intervening matrix between the remaining fragments of suitable habitat becomes less suitable for the lesser prairie-chicken, dispersal patterns can be disrupted, effectively isolating remaining islands of habitat. These isolated fragments then become less resilient to the effects of change in the overall landscape and likely will be more prone to localized extinctions. The collective influence of habitat loss, fragmentation, and disturbance effectively reduces the size and suitability of the remaining habitat patches. Pitman *et al.* (2005, p. 1267) calculated that nesting avoidance at the distances they observed would effectively eliminate some 53 percent (7,114 ha; 17,579 ac) of otherwise suitable nesting habitat within their study area in southwestern Kansas. Once the remaining habitat patches fall below the minimum size required by individual lesser prairie-chickens, these patches become uninhabitable even though they may otherwise provide optimum habitat characteristics. Although a minimum patch size per individual has not been established, and will vary with the quality of the habitat, studies and expert opinion, including those regarding greater prairie-chickens, suggest that the minimum patch size is likely to exceed 100 ha (250 acres) per individual (Samson 1980b, p. 295; Winter and Faaborg 1999, pp. 1429, 1436; Davis 2005, p. 3). Specifically for lesser prairie-chickens, Giesen (1998, p. 11) and Taylor and Guthery (1980b, p. 522) reported home ranges of individual birds varied from 211 ha (512 ac) to 1,945 ha (4,806 ac) in size.

Fragmentation poses a threat to the persistence of local lesser prairie-chicken populations through many of the same mechanisms identified for other species of grassland birds. Factors such as habitat dispersion and the extent of habitat change, including patch size, edge density, and total rate of landscape change influence juxtaposition and size of remaining patches of rangeland such that they may no longer be large enough to support populations (Samson 1980b, p. 297; Woodward *et al.* 2001, pp. 269–272; Fuhlendorf *et al.* 2002a, pp. 623–626). Additionally, necessary habitat heterogeneity may be lost, and habitat patches may accommodate high densities of predators. Ultimately, lesser prairie-chicken interchange among suitable patches of habitat may decrease, possibly affecting population and genetic viability (Wilcove *et al.* 1986, pp. 251–252; Knopf 1996, p. 144). Predation can have a major impact on lesser prairie-chicken demography, particularly during the nesting and brood-rearing seasons (Hagen et al. 2007, p. 524). Patten *et al.* (2005b, p. 247) concluded that habitat fragmentation, at least in Oklahoma, markedly decreases the probability of long-term population persistence in lesser prairie-chickens.

Many of the biological factors affecting the persistence of lesser prairie-chickens are exacerbated by the effects of habitat fragmentation. For example, human population growth and the resultant accumulation of infrastructure such as roads, buildings, communication towers, and powerlines contribute to fragmentation. We expect that construction of vertical infrastructure such as transmission lines will continue to increase into the future, particularly given the increasing development of energy resources and urban areas (see "*Wind Power and Energy Transmission Operation and Development*" below). Where this infrastructure is placed in occupied lesser prairie-chicken habitats, the lesser prairie-chicken likely will be negatively affected. As the density and distribution of human development continues in the future, direct and functional fragmentation of the landscape will continue. The resultant fragmentation is detrimental to lesser prairie-chickens because they rely on large, expansive areas of contiguous native grassland to complete their life cycle. Given the large areas of contiguous grassland needed by lesser prairie-chickens, we expect that many of these types of developments anticipated in the future will further fragment remaining blocks of suitable habitat and reduce the likelihood of persistence of lesser prairie-chickens over the long term. Long-term persistence is reduced when the suitability of the remaining habitat patches decline, further contributing to the scarcity of suitable contiguous blocks of habitat and resulting in increased human disturbance as parcel size declines. Human populations are increasing throughout the range of the lesser prairie-chicken, and we expect this trend to continue. Given the demographic and economic trends observed over the past several decades, residential development will continue.

The cumulative influence of habitat loss and fragmentation on lesser prairie-chicken distribution is readily apparent at the regional scale. Lesser prairie-chicken populations in eastern New Mexico and the western Texas Panhandle are isolated from the remaining populations in Colorado, Kansas, and Oklahoma. On a smaller, landscape scale, core populations of lesser prairie-chickens within the individual States are isolated from other nearby populations by areas of unsuitable land uses (Robb and Schroeder 2005, p. 16). Then, at the local level within a particular core area of occupied habitat, patches of suitable habitat have been isolated from other suitable habitats by varying degrees of unsuitable land uses. Very few large, intact patches of suitable habitat remain within the historically occupied landscape.

We conducted two analyses of fragmentation. The first analysis was conducted in 2012 prior to publication of the proposed rule; this was a spatial analysis of the extent of fragmentation within the estimated occupied range of the lesser prairie-chicken. Infrastructure features such as roads, transmission lines, airports, cities and similar populated areas, oil and gas wells, and other vertical features such as communication towers and wind turbines were delineated. These features were buffered by known avoidance distances and compared with likely lesser prairie-chicken habitat such as that derived from the Southern Great Plains Crucial Habitat Tool and 2008 LandFire vegetation cover types. Based on this analysis, 99.8 percent of the suitable habitat patches were less than 2,023 ha (5,000 ac) in size. Our analysis revealed only 71 patches that were equal to, or larger than, 10,117 ha (25,000 ac) exist within the entire five-state estimated occupied range. Of the patches over 10,117 ha (25,000 ac), all were impacted by fragmenting features, just not to the extent that the patch was fragmented into a smaller sized patch. For example, oil and gas wells or vertical features like wind turbines may occur within these large patches but don't create a hard edge or barrier completely separating one patch from another; rather, these types of fragmenting features may create a mosaic of unsuitable lesser prairie-chicken habitat within the large patch, thereby affecting the habitat quality of the area.

The Service’s 2012 spatial analysis was a conservative estimate of the extent of fragmentation within the estimated occupied range. We only used readily available datasets. Some datasets were unavailable, such as the extent of fences, and other infrastructural features were not fully captured because our datasets were incomplete for those features. Unfortunately, a more precise quantification of the impact of habitat loss and alteration on persistence of the lesser prairie-chicken is complicated by a variety of factors including time lags in response to habitat changes and a lack of detailed historical information on habitat conditions.

To better quantify the extent of fragmentation within the estimated occupied range using the most recent data sets we could obtain and the buffer distances reported in the rangewide plan (Van Pelt *et al*. 2013, p. 95), we conducted a second spatial analysis of fragmentation during preparation of the final rule. We used existing data sources to identify natural grass and shrubland landcover types within the estimated occupied range. This data was used in the analysis to depict potential suitable vegetation where lesser prairie-chickens may occur but does not necessarily identify existing lesser prairie-chicken habitat or correlate with known lek locations. We took this approach because the more refined data sets do not yet exist to our knowledge. We then added the buffered existing data sets on threats, which included roads, developed areas, oil and gas wells, vertical structures, and transmission lines. This analysis served to quantify spatial information on the scope and scale of fragmentation and intactness of the potential suitable vegetation landcover types within the estimated occupied range. Based on this analysis, we found that 128,525 patches encompassing 3,562,168 ha (8,802,290.4 ac) of potential suitable vegetation exists within the estimated occupied range. Table 3, below, displays the breakdown in size and area of those patches. The patch size ranges we analyzed are based on the information provided in the discussion of minimum sizes of habitat blocks provided in the rangewide plan (Van Pelt *et al.* 2013, p. 19).

TABLE 3.—Potential Suitable Vegetation Patch Size Analysis Results.

Patch Size	**Number of Patches**	**Total Area of Patches**

Less than 486 ha (1,200 ac)	127,190	1,588,262.4 ha (3,924,681.8 ac)
486-6,474 ha (1,200-15,999 ac)	1,302	1,636,012 ha (4,042,673.7 ac)
6,475-8,497 ha (16,000-20,999 ac)	13	96,761.4 ha (239,102.6 ac)
Greater than 8,498 ha (21,000 ac)	20	241,124.8 ha (595,832.3 ac)
TOTAL	128,525	3,562,168 ha (8,802,290.4 ac)

When we conducted the second spatial analysis of fragmentation during preparation of the final rule, we also prepared a proximity analysis to help us achieve a better sense of how the various patches in the natural grass and shrubland landcover types relate to each other on the landscape. The proximity analysis groups individual patches, as described above, that are only separated by rural roads. These rural roads fragment the grass and shrub landscape, but they may not always prevent the species from moving between patches. Groups of patches (or remaining individual patches) under 64.7 ha (160 ac) were not included in this analysis. Because these areas were not included, the proximity model accounts for only 37 percent of all patches mapped in the patch analysis (47,157 patches in the proximity analysis compared to 128,525 patches in the patch analysis), but it also accounts for 93 percent of the total patch size acreage. Table 4, below, displays the breakdown in size and area of the various proximity groups (groups of patches).

TABLE 4.—Potential Suitable Vegetation Proximity Size Analysis Results.

Proximity Group	**Count**	**Individual Patches Within Group**	**Acreage**
64.7-485 ha (160-1,199 ac)	1,219	3,122	173,705.3 ha (429,235.2 ac)
485-6,474 ha (1,200-15,999 ac)	302	9,054	529,566.3 ha (1,308,586.9 ac)
6,475-8,497 ha (16,000-20,999 ac)	11	1,172	78,718.9 ha (194,518.7 ac)
8,498-20,234 ha (21,000-49,999 ac)	37	9,685	511,464.9 ha (1,263,857.4 ac)
20,234-40,468 ha (50,000-99,999 ac)	19	7,162	545,478.0 ha (1,347,905.6 ac)
Greater than 40,468 ha (100,000 ac)	22	16,962	1,481,324.0 ha (3,660,431.2 ac)
TOTAL	1,610	47,157	3,562,168 ha

			(8,204,535.0 ac)

In summary, habitat fragmentation is an ongoing threat that is occurring throughout the estimated occupied range of the lesser prairie-chicken. While 127,190 patches of potentially suitable vegetation are less than 486 ha (1,200 ac), only 20 patches of potentially suitable vegetation greater than 8,498 ha (21,000 ac) remain. Similarly, much of the historical range is disjunct and separated by large expanses of unsuitable habitat. In comparison to the patch size analysis, the proximity analysis shows that there are 1,219 proximity groups that are less than 4856 ha (1,200 ac) and 78 proximity groups that are greater than 8,498 ha (21,000 ac). Fragmentation impacts the lesser prairie-chicken by altering the juxtaposition of suitable habitat patches, by reducing the size of the available habitat patches causing those patches to be smaller than necessary to support stable to expanding populations, reducing the quality of the remaining habitat patches, eliminating the habitat heterogeneity needed to sustain all life history requirements of the species, facilitating increased density of predators that leads to increased rates of predation, and impacting the ability of lesser prairie-chickens to disperse between suitable patches of habitat. Once fragmented, most of the factors contributing to habitat fragmentation cannot be reversed and the effects are cumulative. Many types of human developments likely will exist for extended time periods and will have a significant, lasting adverse influence on persistence of lesser prairie-chickens. Therefore, current and future habitat fragmentation is a threat to the lesser prairie-chicken. In many of the sections that follow, we will examine in more detail the various causes of habitat fragmentation we identified within the estimated occupied range of the five States that support lesser prairie-chickens.

Habitat Conversion for Agriculture

At the time the lesser prairie-chicken was determined to be taxonomically distinct from the greater prairie-chicken in 1885, much of the historical range was already being altered as settlement of the Great Plains progressed. EuroAmerican settlement in New Mexico and Texas began prior to the 1700s, and at least one trading post already had been established in Colorado by 1825 (Coulson and Joyce 2003, pp. 34, 41, 44). Kansas had become a territory by 1854 and had already experienced an influx of settlers due to establishment of the Santa Fe Trail in 1821 (Coulson and Joyce 2003, p. 37). Western Oklahoma was the last area to experience extensive settlement with the start of the land run in 1889.

Settlement, as previously discussed, brought about many changes within the historical range of the lesser prairie-chicken. Between 1915 and 1925, considerable areas of prairie had been plowed in the Great Plains and planted to wheat (Laycock 1987, p. 4). By the 1930s, the lesser prairie-chicken had begun to disappear from areas where it had been considered abundant with populations nearing extirpation in Colorado, Kansas, and New Mexico, and markedly reduced in Oklahoma and Texas (Davison 1940, p.62; Lee

1950, p.475; Baker 1953, p.8; Oberholser 1974, p. 268; Crawford 1980, p. 2). Several experts on the lesser prairie-chicken identified conversion of native sand sagebrush and shinnery oak rangeland to cultivated agriculture as an important factor in the decline of lesser prairie-chicken populations (Copelin 1963, p. 8; Jackson and DeArment 1963, p. 733; Crawford and Bolen 1976a, p. 102; Crawford 1980, p. 2; Taylor and Guthery 1980b, p. 2; Braun *et al.* 1994, pp. 429, 432–433; Mote *et al.* 1999, p. 3). By the 1930s, Bent (1932, pp. 283–284) concluded that extensive cultivation and overgrazing had already caused the species to disappear from portions of the historical range where lesser prairie-chickens had once been abundant. Additional areas of previously unbroken grassland were brought into cultivation in the 1940s, 1970s, and 1980s (Laycock 1987, pp. 4–5; Laycock 1991, p. 2). Bragg and Steuter (1996, p. 61) estimated that by 1993, only 8 percent of the bluestem-grama association and 58 percent of the mesquite-buffalo grass association, as described by Kuchler (1964, entire), remained.

As the amount of native grasslands and untilled native rangeland declined in response to increasing settlement, the amount of suitable habitat capable of supporting lesser prairie-chicken populations declined accordingly. Correspondingly, as the amount of available suitable habitat diminished, carrying capacity was reduced and the number of lesser prairie-chickens declined. Although the literature supports that lesser prairie-chicken populations have experienced population declines and were nearly extirpated in Colorado, Kansas, and New Mexico, precisely quantifying the degree to which these settlement-induced impacts occurred is complicated by a lack of solid and consistent historical information on lesser prairie-chicken population size and extent of suitable habitat throughout the species' range. Additionally, because cultivated grain crops may have provided increased or more dependable winter food supplies (Braun *et al.* 1994, p. 429), the initial conversion of smaller patches of native prairie to cultivation may have been temporarily beneficial to the short-term needs of the species. Sharpe (1968, pp. 46–50) believed that the presence of cultivated grains may have facilitated the temporary occurrence of lesser prairie-chickens in Nebraska. However, landscapes having greater than 20 to 37 percent cultivated grains may not support stable lesser prairie-chicken populations (Crawford and Bolen 1976a, p. 102). While lesser prairie-chickens may forage in agricultural croplands, they avoid landscapes dominated by cultivated agriculture, particularly where small grains are not the dominant crop (Crawford and Bolen 1976a, p. 102). Areas of cropland do not provide adequate year-round food or cover for lesser prairie-chickens.

Overall, the amount of land used for crop production nationally has remained relatively stable over the last 100 years although the distribution and composition have varied (Lubowski *et al*. 2006, p. 6; Sylvester *et al*. 2013, p. 13). As cultivated land is converted to urbanization and other non-agricultural uses, new land is being brought into cultivation helping to sustain the relatively constant amount of cropland in existence over that period. Nationally, the amount of cropland that was converted to urban uses between 1982 and 1997 was about 1.5 percent (Lubowski *et al*. 2006, p. 3). During that same period nationally, about 24 percent of cultivated cropland was converted to less intensive uses such as pasture, forest and CRP (Lubowski *et al*. 2006, p. 3). The impact of CRP was most influential in the Great Plains States, particularly Colorado, Kansas, Oklahoma and Texas, which have most of the existing CRP lands (Lubowski *et al*. 2006, p. 50).

In our June 7, 1998, 12-month finding for the lesser prairie-chicken (63 FR 31400), we attempted to assess the regional loss of native rangeland using data available through the National Resources Inventory of the USDA NRCS. However, very limited information on lesser prairie-chicken status was available to us prior to 1982. When we examined the 1992 National Resources Inventory Summary Report, we were able to estimate the change in rangeland acreage between 1982 and 1992 by each State within the range of the lesser prairie-chicken. When the trends were examined statewide, each of the five States within the range of the lesser prairie-chicken showed a decline in the amount of rangeland acreage over that time period, indicating that conversion of lesser prairie-chicken habitat likely continued to occur since the 1980s. In assessing the change specifically within areas inhabited by lesser prairie-chickens, we then narrowed our analysis to just those counties where lesser prairie-chickens were known to occur. That analysis, which was based on the information available at that time, used a much smaller extent of estimated occupied range than likely occurred at that time. The analysis of the estimate change in rangeland acreage between 1982 and 1992, for counties specifically within lesser prairie-chicken range, did not demonstrate a statistically significant change, possibly due to small sample size and large variation about the mean. In this analysis, the data for the entire county was used without restricting the analysis to just those areas determined to be within the estimated historical and occupied ranges. A more recent, area-sensitive analysis was needed.

Although a more recent analysis of the Natural Resources Inventory information was desired, we were unable to obtain specific county-by-county information because the NRCS no longer releases county-level information. Release of Natural Resources Inventory results is guided by NRCS policy and is in accordance with Office of Management and Budget and USDA Quality of Information Guidelines developed in 2001. NRCS releases Natural Resources Inventory estimates only when they meet statistical standards and are scientifically credible in accordance with these policies. In general, the Natural Resources Inventory survey system was not developed to provide acceptable estimates for areas as small as counties but rather for analyses conducted at the national, regional, and state levels, and for certain sub-state regions (Harper 2012).

We then attempted to use the 1992 National Land Cover Data (NLCD) information to estimate the extent and change in certain land cover types. The NLCD was the first land-cover mapping project that was national in scope and is based on images from the Landsat thematic mapper. No other national land-cover mapping program had previously been undertaken, despite the availability of Landsat thematic mapper information since 1984. The 1992 NLCD provides information on 21 different land cover classes at a 30-meter resolution. Based on the 1992 NLCD, and confining our analysis to just the estimated known historical and occupied ranges, we estimated that there were 137,073.6 sq km (52,924.4 sq mi) of cultivated cropland in the entire historical range and 16,436.9 sq km (6,346.3 sq mi) in the estimated occupied range. Based on these estimates, 29.35 percent of the estimated historical range is in cultivated cropland, and 23.28 percent of the estimated occupied range is in cultivated cropland. This includes areas planted to row crops, such as corn and cotton, small grains such as wheat and *Hordeum vulgar*e (barley), and fallow cultivated areas that had visible vegetation at the time of the imagery.

Estimating the extent of untilled rangeland is slightly more complicated. The extent of grassland areas dominated by native grasses and forbs could be determined in a manner similar to that for cultivated cropland. We estimated from the 1992 NLCD that there were 207,846 sq km (80,250 sq mi) of grassland within the entire historical range, with only 49,000 sq km (18,919 sq mi) of grassland in the estimated occupied range. Based on these estimates, 44.51 percent of the estimated historical range and 69.4 percent of the estimated occupied range is in grassland cover. However, the extent of shrubland also must be included in the analysis because areas classified as shrubland (i.e., areas having a canopy cover of greater than 25 percent) are used by lesser prairie-chicken, such as shinnery oak grasslands, and also may be grazed by livestock. We estimated that there were 92,799 sq km (35,830 sq mi) of shrubland within the entire historical range with 4,439 sq km (1,714 sq mi) of shrubland in the estimated occupied range, based on the 1992 NLCD. Based on these estimates, 19.87 percent of the estimated historical range and 6.29 percent of the estimated occupied range is in shrubland.

These values can then be compared with those available through the 2006 NLCD information to provide a rough approximation of the change in land use since 1992. In contrast to the 1992 NLCD, the 2006 NLCD provides information on only 16 different land cover classes at a 30-meter resolution. Based on this dataset, and confining our analysis to just the known estimated historical and occupied ranges, we estimated that there were 126,579 sq km (48,872 sq mi) of cultivated cropland in the entire estimated historical range and 19,588 sq km (7,563 sq mi) in the estimated occupied range. Based on these results, 27.1 percent of the estimated historical range and 27.74 percent of the estimated occupied range is cultivated cropland. This cover type consists of any areas used annually to produce a crop and includes any land that is being actively tilled. Estimating the extent of untilled rangeland is conducted similarly to that for 1992. Using the 2006 NLCD, we estimated that there were 163,011 sq km (62,939 sq mi) of grassland within the entire estimated historical range with 42,728 sq km (16,497 sq mi) of grassland in the estimated occupied range. These results show that grasslands comprise 34.91 percent of the estimated historical range and 60.52 percent of the estimated occupied range. In 2006, the shrubland cover type was replaced by a shrub-scrub cover type. This new cover type was defined as the areas dominated by shrubs less than 5 m (16 ft) tall with a canopy cover of greater than 20 percent. We estimated that there were 146,818 sq km (56,686 sq mi) of shrub/scrub within the entire historical range, with 10,291 sq km (3,973 sq mi) of shrub/scrub in the estimated occupied range. Based on these results, shrub/scrub cover constitutes 31.44 percent of the estimated historical range and 14.58 percent of the estimated occupied range.

Despite the difference in the classification of land cover between 1992 and 2006, we were able to make rough comparisons between the two datasets. The extent of cropland within the entire historical range declined from 29.35 to 27.1 percent between 1992 and 2006. In contrast, the extent of cropland areas within the estimated occupied range increased from 23.28 to 27.74 percent during that same period. A comparison of the grassland and untilled rangeland indicates that the amount of grassland declined in both the estimated historical and occupied ranges between 1992 and 2006. Specifically, the extent of grassland within the estimated historical range declined from 44.51 to 34.91 percent, and the extent of grassland within the estimated occupied range declined from 69.4 to 60.52 percent. However, the amount of shrub-dominated lands increased in both the estimated historical and occupied ranges. Between 1992 and 2006, the extent of shrubland increased from 19.87 to 31.44 percent in the estimated historical range and from 6.29 to 14.58 percent in the estimated occupied range. Overall, the estimated amount of grassland and shrub-dominated land, as an indicator of untilled rangelands, increased from 64.38 to 66.34 percent over the estimated historical range during that period but declined from 75.69 to 75.1 percent within the estimated occupied range during the same period. Based on the definition of shrub/scrub cover type in 2006, the observed increases in shrub-dominated cover only could have been due to increased abundance of eastern red cedar, an invasive, woody species that tends to decrease suitability of grasslands and untilled rangelands for lesser prairie-chickens (Woodward *et al.* 2001, pp. 270–271; Fuhlendorf *et al.* 2002a, p. 625).

However, direct comparison between the 1992 and 2006 NLCD is problematic due to several factors. First, the 1992 NLCD used a different method to classify habitat than the NLCD 2001 and later versions. Second, NLCD 2001 and later versions used higher resolution digital elevation models than the 1992 NLCD. Third, the impervious surface mapping that is part of NLCD 2001 and later versions resulted in the identification of many more roads than could be identified in the 1992 NLCD. However, most of these roads were present in 1992. Fourth, the imagery for the 2001 NLCD and later versions was corrected for atmospheric effects prior to classification, whereas NLCD 1992 imagery was not. Lastly, there are subtle differences between the NLCD 1992 and NLCD 2001 land-cover legends. Additionally, we did not have an estimated occupied range for 1992. Instead we used the occupied range as is currently estimated. The comparison in the amount of cropland, grassland, and shrubland could be influenced by a change in the amount of occupied range in 1992. Due to the influence of CRP grasslands (discussed below) on the distribution of lesser prairie-chickens in Kansas, the estimated occupied range was much smaller in 1992. The Service expects that the influence of CRP establishment north of the Arkansas River in Kansas might have led to considerably more areas of grassland in 2006 as compared to 1992. However, the amount of grassland was observed to have declined within the estimated occupied range of the lesser prairie-chicken between 1992 and 2006, possibly indicating that the extent of grasslands continued to decline despite the increase in CRP grasslands.

If we restrict our analysis to Kansas alone, the extent of grasslands in 1992 was about 39,381 sq km (15,205 sq mi) within the estimated historical range and 22,923 sq km (8850 sq mi) in the estimated occupied range. In 2006, the extent of grasslands in Kansas was 27,351 sq km (10,560 sq mi) within the historical range and 18,222 sq km (7,035 sq mi) in the estimated occupied range. While not definitive, the analysis indicates that the total extent of grasslands continued to decline even in Kansas where there has been an increase in CRP grasslands.

Other studies have attempted to determine the change in land use patterns over time, particularly with respect to conversion of grasslands/rangelands but such studies are difficult to interpret as they often do not differentiate between native and non-native grassland. Additionally, short-term fluctuations in grassland and cropland acreages often occur at regional levels that may not be apparent at larger scales and often are not indicative of long-term changes in land cover. Reeves and Mitchell (2012, p. 14), using USDA Natural Resources Inventory data, estimated that between 1982 and 2007 non-federal rangelands in the United States, excluding CRP, declined by about 3.6 million ha (8.8 million ac) or about 142,000 ha (350,000 ac) annually. More recent data were not available at the time of their analysis. The estimated losses were largely due to conversion to cultivated agriculture and residential uses (Reeves and Mitchell 2012, p.

27). Four of the five States supporting lesser prairie-chicken populations lost rangeland during this period (Reeves and Mitchell 2012, pp. 15–16). Only Texas had a net gain in the area of rangeland. New Mexico and Oklahoma lost the most rangeland and Colorado lost the least. In all four of these States, cropland increased with New Mexico and Colorado having the largest net change in cropland of the four States (Reeves and Mitchell 2012, pp. 15–16).

When the historical extent of rangelands were examined in the five lesser prairie-chicken States, the estimated percentages of historical rangelands that have been permanently converted to another land use type break down as follows: 9 percent in New Mexico, 29 percent in Colorado, 36 percent in Texas, 59 percent in Oklahoma, and 75 percent in Kansas (Reeves and Mitchell 2012, pp. 26). Although these data are not specific to the estimated occupied range of the lesser prairie-chicken, they highlight the extent and types of changes that have occurred in this region. From a more regional perspective, within the Great Plains, Sylvester *et al*. (2013, p.7) concluded that the extent of grasslands fluctuates considerably as areas alternated between grassland and cultivation in response to conservation programs, masking the overall effect on land use change. However, they reported that the amount of untilled, native grassland, as determined from aerial photography, continued to decline. Within the Western High Plains (portions of west Texas, Oklahoma Panhandle, western Kansas, eastern Colorado and western Nebraska), grassland loss to agriculture, primarily cropland, was the most common form of land cover conversion between 1973 and 1986 (Drummond 2007, p

137). Between 1986 and 2000, grassland cover increased, primarily in response to CRP, but grassland conversion to agriculture continued to occur. Drummond (2007, p. 138) estimated 686,000 ha (1.7 million ac) of grassland was converted to agriculture, primarily cropland, in this region. Increased global demand for wheat and for irrigated grains to supply local feedlots was the primary driving factor (Drummond 2007, p 140). Drummond (2007, p. 141) also thought the observed changes in land cover were influenced by switching of cropland in and out of CRP enrollment. The location of grasslands changed spatially within the region but there was little actual overall gain in grassland cover. When conservation programs, such as cropland retirements, result in no real gain or even a loss in conservation success, this effect is termed “slippage” and will be discussed further under the section on CRP below.

In summary, conversion of the native grassland habitats used by lesser prairie-chickens for agricultural uses has resulted in the permanent, and in some limited instances, temporary loss or alteration of habitats used for feeding, sheltering, and reproduction. Consequently, populations of lesser prairie-chickens likely have been extirpated or significantly reduced, underscoring the degree of impact that historical conversion of native grasslands has posed to the species. We expect a very large proportion of the land area that is currently in cultivated agriculture likely will remain so over the future because we have no information to suggest that agricultural practices are likely to change in the future. While persistent drought and declining supplies of water for irrigation may lead to conversion of some croplands to a noncropland state, we anticipate that the majority of cropland will continue to be used to produce a crop. Groundwater levels in the High Plains Aquifer, which underlies much of the range of the lesser prairie-chicken and supplies about 30 percent of the groundwater used for irrigation in the United States (Sophocleous 2005, p. 352), have declined considerably since the 1950s, with an area-weighted, average water level decline of 4.3 m (14.2 ft) (McGuire 2013, pp. 8, 13). Declining water levels may cause some areas of cropland to revert to grassland but most of the irrigated land likely will transition to dryland agriculture, in spite of more efficient methods of irrigation, as water supplies dwindle (Terrell *et al*. 2002, p. 35; Sophocleous 2005, p. 361; Drummond 2007, p. 142). Because much of the suitable arable lands have already been converted to cultivated agriculture, we do not expect significant additional, future habitat conversions to cultivated agriculture within the range of the lesser prairie-chicken. However, as implementation of certain agricultural conservation programs, such as the CRP, change programmatically, some continued conversion of grassland, principally CRP, back into cultivation is still expected to occur (see section "Conservation Reserve Program" below). Conservation Reserve Program contracts, as authorized and outlined by regulation, are of limited, temporary duration, and the program is subject to funding by Congress. We also recognize that the historical large-scale conversion of grasslands to agricultural production has resulted in fragmented grassland and shrubland habitats used by lesser prairie-chickens such that currently occupied lands are not adequate to provide for the conservation of the species into the future, particularly when cumulatively considering the threats to the lesser prairie-chicken.

Conservation Reserve Program (CRP)

The loss of lesser prairie-chicken habitat due to conversion of native grasslands to cultivated agriculture has been mitigated somewhat, at least temporarily, by the CRP. The CRP is a voluntary program administered by the USDA's FSA and was established primarily to reduce the production of surplus agricultural commodities and control soil erosion on certain croplands by converting cropped areas to a vegetative cover such as perennial grassland. Authorization and subsequent implementation of the CRP began under the 1985 Food Security Act and, since that time, has facilitated restoration of millions of acres of marginal and highly erosive cropland to grassland, shrubland, and forest habitats (Riffell and Burger 2006, p. 6). Eligibility criteria for participation in CRP have been established by the FSA and not all lands are eligible for enrollment. Under the general signup process, lands are enrolled in CRP during designated periods using a competitive selection process. However, certain environmentally sensitive lands may be enrolled at any time under a continuous signup provision. The State Acres for Wildlife Enhancement program, previously discussed in the section highlighting Multi-State Conservation Efforts, is an example of a continuous signup program. Additional programs, such as the Conservation Reserve Enhancement Program and designation as a Conservation Priority Area can be used to target enrollment of CRP. Participating producers receive an annual rental payment for the duration of a multiyear CRP contract, usually 10 to 15 years. Cost sharing is provided to assist in the establishment of the vegetative cover and related conservation practices. Once the CRP contract expires, landowners have the option to either seek reenrollment or exit the program. Once a landowner exits the program, lands may then be converted back into cropland or other land use, or remain under a conservation cover. Laycock (1991, p. 4) believes that retention of the cropland base (base acres that are enrolled in the FSA program and are used to estimate the amount of production or dollars that are generated from the land) may be the single most important factor influencing a landowner's decision to convert CRP lands to cropland once the contract expires.

In 2009, the enrollment authority or national acreage cap for CRP was reduced from 15.9 million ha (39.2 million ac) nationwide to 12.9 million ha (32.0 million ac) through fiscal year 2012, with 1.8 million ha (4.5 million ac) allocated to targeted (continuous) signup programs. In 2014, the national acreage cap for CRP was reduced from 12.9 million ha (32.0 million ac) to 9.7 million ha (24 million ac) through fiscal year 2018. While this does not necessarily require a reduction in CRP enrollment within the range of the lesser prairie-chicken, it does indicate that funds available to enroll or reenroll CRP acres likely will decline over the next 5 years. We assume CRP administration within the lesser prairie-chicken range will be impacted by the reduction in funds or acreage caps over the next 5 years. Nationally, the land area enrolled in CRP has declined since 2006. As of July 2013, approximately 11 million ha (27 million ac) were enrolled in CRP nationwide. Within a given county, no more than 25 percent of that county's cropland acreage may be enrolled in CRP and the Wetland Reserve

Program. A waiver of this acreage cap may be granted by the Secretary of Agriculture under certain circumstances. These caps influence the maximum amounts of cropland that may exist in CRP at any one time. We are unsure whether or not waivers of the county acreage cap have been granted within the estimated occupied range of the lesser prairie-chicken.

Since May of 2003, midcontract management, typically implemented in years five through seven, has been required on contracts executed since the summer of 2003 (signup period 26) and is voluntary for contracts accepted before that time. Mid-contract management practices include disking, burning, spraying, or interseeding to help establish plants and to assure an early successful plant growth stage. Typically these midcontract management activities, including actions such as prescribed burning, managed grazing, tree thinning, disking, or herbicide application to control invasive species, are intended to enhance wildlife benefits and are generally prohibited during the primary avian nesting and brood rearing season. Within the five States encompassing the estimated occupied range of the lesser prairie-chicken, the primary avian nesting and brood rearing season ends no later than July 15th and varies by State. Under CRP, haying, grazing and several other forms of limited harvest, including emergency haying and grazing, are authorized under certain conditions. Managed haying and grazing may be authorized to improve the quality and performance of the CRP cover. Emergency haying and grazing may be granted on CRP lands to provide relief to livestock producers in areas affected by drought or other natural disaster to minimize loss or culling of livestock herds. In all instances, participants are assessed a payment reduction based on the number of acres harvested. Additionally, the installation of wind turbines, windmills, wind monitoring devices, or other wind-powered generation equipment may be installed on CRP acreage on a case-by-case basis. Up to 2 ha (5 ac) of wind turbines per contract may be approved.

Lands enrolled in CRP encompass a significant portion of estimated occupied range in several lesser prairie-chicken States, but particularly in Kansas where an increase in the lesser prairie-chicken population is directly related to the amount of land that was enrolled in the CRP and planted to mixtures of native grasses. Enrollment information at the county level is publicly available from the Farm Service Agency. However, specific locations of individually enrolled CRP acreages are not publicly available. The Playa Lakes Joint Venture has an agreement with the Farm Service Agency that allows them to use available data on individual CRP allotments for conservation purposes, provided the privacy of the landowner is protected. The Playa Lakes Joint Venture, using this information, determined the extent of CRP lands within the estimated occupied range plus a 16–km (10–mi) buffer (EOR + 10, as defined in the "Current Range and Distribution" section, above) (McLachlan *et al.* 2011, p. 24). In conducting this analysis, they restricted their analysis to only those lands that were planted to a grass type of conservation cover and they evaluated all lands within the estimated occupied range. However, in this study the estimated occupied range of 65,012 sq km (25,101 sq mi) was based on the 2007 cooperative mapping efforts conducted by species experts from CPW, KDWPT, NMDGF, ODWC, and TPWD, in cooperation with the Playa Lakes Joint Venture; this is a smaller estimated occupied range than is currently accepted (70,602 sq km (27,259 sq mi)). Based on this analysis, Kansas was determined to have the most land enrolled in CRP with a grass cover type. Kansas had approximately 600,000 ha (1,483,027 ac) followed by Texas with an estimated 496,000 ha (1,227,695 ac) of grassland CRP. Enrolled acreages in Colorado, New Mexico, and Oklahoma were 193,064 ha (477,071 ac), 153,000 ha (379,356 ac), and 166,000 ha (410,279 ac), respectively. The amount of grass type CRP within the study area (EOR + 10) totaled just over 1.61 million ha (3.97 million ac). Based on the estimated amount of occupied habitat remaining in these States, CRP fields having a grass type of conservation cover comprise some 20.6 percent of the estimated occupied lesser prairie-chicken range in Kansas, 45.8 percent of the estimated occupied range in Colorado, and 40.9 percent of the estimated occupied range in Texas. New Mexico and Oklahoma have smaller percentages of CRP within the occupied range, 17.9 and 15.1 percent, respectively. More recently, the FSA estimated the current CRP enrollment, as of March of 2013, within the CHAT EOR + 10 to be 2.05 million ha (5.06 million ac) or about 25 percent of acreage within the CHAT EOR + 10 (FSA 2013, pp. 89, 94).

The importance of CRP acres to the lesser prairie-chicken, particularly in Kansas, is apparent. Not only do CRP lands constitute about 25 percent of the acreage within the EOR +10 range, about 24 percent of the active lesser prairie-chicken leks may be found in or in close proximity to lands enrolled in CRP with another 22 percent of leks located within 1.6 km (1.0 mi) of CRP lands (FSA 2013, p. 84). The extent of CRP and the location of active leks serve to highlight the importance of CRP for lesser prairie-chickens. When the sizes of the CRP fields were examined, Kansas had 53 percent, on average, of the enrolled lands that constituted large habitat blocks. A large block was defined as areas that were at least 2,023 ha (5,000 ac) in size with minimal amounts of woodland, roads, and developed areas (McLachlan *et al.* 2011, p. 14). All of the other States had 15 percent or less of the enrolled CRP in a large block configuration. The importance of CRP habitat to the status and survival of lesser prairie-chicken also has been emphasized by Rodgers and Hoffman (2005, pp. 122–123). They determined that the presence of CRP lands planted with mixtures of native grasses, primarily little bluestem, switchgrass, and sideoats grama, facilitated the expansion of lesser prairie-chicken range in Colorado, Kansas, and New Mexico. The range expansion was most pronounced in Kansas and resulted in strong population increases there (Rodgers and Hoffman 2005, pp. 122–123). However, in Oklahoma, Texas, and some portions of New Mexico, many CRP fields were planted with a monoculture of introduced grasses. Between 1986 and 1991, 60 percent of the CRP planted in Oklahoma and 43 percent of the CRP planted in Texas were planted to introduced grasses (Farm Service Agency 2013, p. 87). Where introduced grasses were planted, lesser prairie-chickens did not demonstrate a range expansion or an increase in population size (Rodgers and Hoffman 2005, p. 123).

An analysis of lesser prairie-chicken habitat quality within a subsample of 1,019 CRP contracts across all five lesser prairie-chicken States was recently conducted by the Rocky Mountain Bird Observatory (Ripper and VerCauteren 2007, entire). They found that, particularly in Oklahoma and Texas, contracts executed during earlier signup periods allowed planting of monocultures of exotic grasses, such as *Bothriochloa* sp. (old-world bluestem) and *Eragrostis curvula* (weeping lovegrass), which provide poor-quality habitat for lesser prairie-chicken (Ripper and VerCauteren 2007, p. 11). Correspondingly, a high-priority conservation recommendation from this study intended to benefit lesser prairie-chickens was to convert existing CRP fields planted in exotic grasses into fields supporting taller, native grass species and to enhance the diversity of native forbs and shrubs used under these contracts. Although lesser prairie-chickens occasionally will use CRP fields planted to exotic grasses, particularly where suitable stands of native grasses are unavailable, monoculture stands of grass generally lack the habitat heterogeneity and structure preferred by lesser prairie-chickens. Subsequent program adjustments since 1991 have encouraged the planting of native grass species mixtures on new CRP enrollments. Expiring CRP fields formerly planted to monocultures of nonnative, exotic grasses can be reenrolled as native grass cover, provided at least 51 percent of the field has been established to a native grass mix. Native grass plantings now account for well over 80 percent of the cover types established on new CRP enrollments (Farm Service Agency 2013, p. 87). However, conversion of fields initially planted to old world bluestems and weeping lovegrass is difficult considering these species can readily regenerate from seed following land disturbance (Farm Service Agency 2013, p. 112).

Haying and grazing of CRP lands under both managed and emergency conditions have the potential to significantly negatively impact vegetation if the amount of forage removed is excessive and prolonged, or if livestock numbers are sufficient to contribute to soil compaction. Currently, managed haying may occur once every three years in Kansas, Oklahoma, and Texas; once every five years in New Mexico; and once every ten years in Colorado. Managed grazing frequency is currently established at once in every three years for Kansas, New Mexico, Oklahoma and Texas; and once every five years in Colorado. Older, unexpired contracts may have slightly different restrictions than those currently described. The FSA estimates that managed haying and grazing typically occurs on five percent or less of the enrolled acres within the lesser prairie-chicken range States. Acres subject to emergency haying and grazing activities are more substantial. The greatest proportion of emergency hayed or grazed lands in recent years occurred in 2012 (23 percent), 2011 (21 percent) and 2006 (12.4 percent). Emergency grazing is the predominant use, occurring on over 60 percent of the acres subject to emergency haying and grazing. Emergency grazing is of far greater concern relative to the lesser prairie-chicken, specifically considering lesser prairie-chicken habitat is sensitive to livestock grazing particularly during periods of drought (Holechek *et al*. 1982, pp. 206, 208). Additional discussion related to emergency haying and grazing is provided in the section on Drought.

Predicting the fate of CRP enrollments and their influence on the lesser prairie-chicken into the future is difficult. The expiration of a contract does not automatically trigger a change in land use and lands likely will continue to be enrolled in the program as long as the program exists and funds are available to implement the program. The future of CRP lands is dependent upon three sets of interacting factors: the long-term economies of livestock and crop production, the characteristics and attitudes of CRP owners and operators, and the direct and indirect incentives of existing and future agricultural policy (Heimlich and Kula 1990, p. 7). As human populations continue to grow, the worldwide demands for livestock and crop production are likely to continue to grow. If demand for U.S. wheat and feed grains is high, pressure to convert CRP lands back to cropland will be strong. However, in 1990, all five States encompassing the estimated occupied range of the lesser prairie-chicken were among the top 10 States expected to retain lands in grass following contract expiration (Heimlich and Kula 1990, p. 10). A survey of the attitudes of existing CRP contract holders in Kansas, where much of the existing CRP land occurs, revealed that slightly over 36 percent of landowners with an existing contract had made no plans or were uncertain about what they would do once the CRP contract expired (Diebel *et al.* 1993, p. 35). An equal percentage stated that they intended to keep lands in grass for livestock grazing (Diebel *et al.* 1993, p. 35). About 24 percent of enrolled landowners expected they would return to annual crop production in accordance with existing conservation compliance provisions (Diebel *et al.* 1993, p. 35). The participating landowners stated that market prices for crops and livestock was the most important factor influencing their decision, with availability of cost sharing for fencing and water development for livestock also being an important consideration. However, only a small percentage, about 15 percent, were willing to leave their CRP acreages in permanent cover after contract expiration where incentives were lacking (Diebel *et al.* 1993, p. 8).

Although demand for agricultural commodities and the opinions of the landowners are important, existing and future agricultural policy is expected to have the largest influence on the fate of CRP (Heimlich and Kula 1990, p.10). The CRP was most recently renewed under the Agricultural Act of 2014, which was signed by the President on February 7, 2014. The Agricultural Act of 2014 provides $5 billion annually in conservation funding through fiscal year 2018 and extends the CRP authority through 2018. Because the Agricultural Act of 2014 was just recently signed into law, the USDA will be responsible for its implementation, and their next steps include initiation of the rule-making process for many of the conservation program changes including those in CRP. Some of the changes in the CRP as a result of enactment of the new authority include:

- the reduction in the acreage cap (as mentioned earlier in this final rule);
- allowance of emergency haying and grazing use without a penalty in the rental rate paid to the landowner;
- allowance of managed haying at least every 5 years but not more than every 3 years for a 25 percent rental rate reduction;

- allowance of routine grazing no more often than once every 2 years;
- allowance of wind turbine installation with due consideration of threatened or endangered wildlife; and
- allowance for landowners to make conservation and land improvements for economic use 1 year before contract expiration.

The FSA anticipates preparation of a supplemental programmatic environmental impact statement assessing potential changes to the CRP, including the reduction of the CRP enrollment cap, in 2014 (78 FR 71561).

The possibility exists that escalating grain prices due to the potential to generate domestic energy from biofuels, such as ethanol from corn, grain sorghum, and switchgrass, combined with Federal budget reductions that reduce or eliminate CRP enrollments and renewals, will result in an unprecedented conversion of existing CRP acreage within the Great Plains back to cropland (Babcock and Hart 2008, p. 6). Between 2007 and 2013, Statewide enrollment in CRP within the five States where lesser prairie-chicken occurs decreased from 4,641,580 ha (11,469,593 ac) to 3,516,361 ha (8,689,117 ac). This reduction of 1,125,219 ha (2,780,476 ac) not only accounts for lands not re-enrolled in CRP and loss of lands due to attrition, but also accounts for new enrolled lands. The most recent CRP general signup for individual landowners began May 20, 2013, and expired June 14, 2013. Between September 30, 2013, and October 31, 2013, the FSA reported the net loss of 142,425 ha (351,939 ac) from CRP in the five

States that comprise the lesser prairie-chicken estimated occupied range; these lands will be eligible for conversion back to cropland production or other uses in 2014. Of the 358,741 ha (886,468 ac) in the five States that expired from CRP enrollment on September 30, 2013, 218,162 ha (539,091 ac) were reenrolled and 140,578 ha (347,375 ac) were not reenrolled. The opportunity to reenroll or extend existing CRP contracts is generally based on the relative environmental benefits of each contract. The Agricultural Act of 2014, however, adds authority for enrollment of 809,371 ha (2 million ac) of working grasslands in CRP, thereby replacing Grassland Reserve Program contracts. Working grasslands are defined as grasslands, including improved range or pasturelands, that contain forbs or shrublands for which grazing is the predominate use. As part of this change, enrollment priority of working grasslands can be given to expiring CRP contracts.

Between 2014 and 2018 (the year the CRP authority expires under the Agricultural Act of 2014), the FSA reports that 743,805 ha (1,837,983 ac) of enrolled CRP lands of all signup types within the five States where the lesser prairie-chicken occurs will expire. It is not yet known whether or not these lands will be reenrolled in the program. More specifically, the FSA estimates that 83, 961 ha (207,471 acres) of CRP within the EOR + 10 will annually be converted back to cropland after contract termination (FSA 2013, p. 181). The FSA states that it intends to enroll an equivalent amount so there is no net loss of reserved lands. However, the FSA is uncertain as to the likelihood of maintaining a no net loss of CRP lands.

The history of the Soil Bank Program provides additional insight into the possible future outcomes of CRP. The Soil Bank Program was initiated in 1956 as a voluntary program intended to divert land from crop production by establishing a permanent vegetative cover on the contracted lands. The contracts ran for periods of three to ten years and enrollment peaked between 1960 and 1961. At the peak of the program there were 306,000 farms with about 11.6 million ha (28.7 million ac) under contract (Laycock 1991, p. 3; Heimlich and Kula, 1991, p. 17). The Great Plains supported about half of the total acreage where much of the area was seeded to perennial grasses. By the close of 1969 all of the contracts had expired and approximately 80 percent of the Soil Bank lands were back in cultivation by the mid-1970s (Laycock 1991, p. 3; Heimlich and Kula, 1991, p. 17).

Should similar large-scale loss or reductions in CRP acreages occur, either by reduced enrollments or by conversion back to cultivation upon expiration of existing contracts, the loss of CRP acreage would further diminish the amount of suitable lesser prairie-chicken habitat. This concern is particularly relevant in Kansas where CRP acreages planted to native grass mixtures facilitated an expansion of the area estimated to be occupied lesser prairie-chicken range in that State. In States that planted a predominance of CRP to exotic grasses, loss of CRP in those States would not be as significant. A reduction in CRP acreage could lead to contraction of the estimated occupied range and reduced numbers of lesser prairie-chicken rangewide and poses a threat to existing lesser prairie-chicken populations. While the CRP program has had a beneficial effect on the lesser prairie-chicken by addressing the primary threat of habitat loss and fragmentation, particularly in Kansas, the contracts are of short duration (10 -15 years) and, given current government efforts to reduce the Federal budget deficit, additional significant new enrollments in CRP are not anticipated. However, we anticipate that some CRP grassland acreages would be reenrolled in the program once contracts expire, subject to the established acreage cap.

A recent analysis of CRP by the Natural Resources Conservation Service (Ungerer and Hagen, 2012, pers. comm.) revealed that between 2008 and 2011, approximately 273,160 ha (675,000 ac) of CRP contracts expired within the estimated occupied range, the majority located in Kansas. Many of those expired lands remained in grass. Values varied from a low of 72.4 percent remaining in grass in Colorado to a high of 97.5 percent in New Mexico. Kansas was estimated to have 90.2 percent of the expired acres during this period still in grass. Values for Oklahoma and Texas had not yet been determined. We expect that many of the acreages that remain in grass in New Mexico are likely composed of exotic species of grasses. Despite a small overall loss in CRP acreage, we are encouraged by the relatively high percentage of CRP that remains in grass. However, we remain concerned that the potential for significant loss of CRP acreages remains, particularly considering the lack of financial incentive for Kansas landowner and the survey of prospective land use changes, as previously discussed above. The importance of CRP to lesser prairie-chickens, particularly in Kansas, is high and continued loss of CRP within the estimated occupied range would be detrimental to lesser prairie-chicken conservation.

We also remain concerned about the future value of these grasslands to the lesser prairie-chicken. We assume that many of these CRP grasslands that remain in grass after their contract expires could be influenced by factors addressed elsewhere in this final rule. Encroachment by woody vegetation, fencing, wind power development, and construction of associated transmission lines have the potential to reduce the value of these areas even if they continue to remain in grass. Unless specific efforts are made to target enrollment of CRP in areas important to lesser prairie-chickens, future enrollments likely will do little to reduce fragmentation or enhance connectivity between existing populations. Considering much of the existing CRP in Kansas was identified as supporting large blocks of suitable habitat, as discussed above, fracturing of these blocks into smaller, less suitable parcels by the threats identified in this final rule would reduce the value of these grasslands for lesser prairie-chickens. Additionally, Fuhlendorf *et al*. 2002b, p. 405) estimated that cropland areas that have been restored to native mixed grass prairie may take at least 30 to 50 years to fully recover from the effects of cultivation. The 10-15 year duration of CRP contracts, therefore, may not be long enough to allow the grasslands to recover from previous cultivation, thereby calling into question the long-term value of these grasslands for lesser prairie-chickens.

In summary, we recognize that lands already converted to cultivated agriculture are located throughout the estimated historical and occupied range of the lesser prairie-chicken and are, therefore, perpetuating continuing habitat fragmentation within the range of the lesser prairie-chicken. We expect that CRP will continue to provide a means of temporarily addressing this threat by restoring cropland to grassland cover and provide habitat for lesser prairie-chickens where planting mixtures and maintenance activities are appropriate. However, we expect that, in spite of the temporary benefits provided by CRP, most of the areas already in agricultural production will remain so into the future. While CRP has contributed to the restoration of grassland habitats and has influenced abundance and distribution of lesser prairie-chickens in some areas, we expect these lands to be subject to conversion back to cropland as economic conditions change in the future possibly reducing the overall benefit of the CRP to the lesser prairie-chicken. A similar conservation program, the Soil Bank, was ineffective in securing permanent gains in grassland acres over the long term. While we acknowledge the short-term conservation value of CRP, we do not anticipate that CRP, at current and anticipated funding levels, will cause significant, permanent increases in the extent of native grassland within the range of the lesser prairie-chicken (Coppedge *et al.* 2001, p. 57; Drummond 2007, p. 142). Consequently, CRP grasslands alone are not adequate to provide for the long-term persistence of the species, particularly when the known threats to the lesser prairie-chicken are considered cumulatively.

Livestock Grazing

Habitats used by the lesser prairie-chicken are naturally dominated by a diversity of drought-tolerant perennial grasses and shrubs. Grazing has long been an ecological driving force within the ecosystems of the Great Plains (Stebbins 1981, p. 84), and much of the untilled grasslands within the range of the lesser prairie-chicken continue to be grazed by livestock and other animals. The evolutionary history of the mixed-grass prairie has produced endemic bird species adapted to an ever-changing mosaic of lightly to severely grazed grasslands (Bragg and Steuter 1996, p. 54; Knopf and Samson 1997, pp. 277–279, 283). Historically the interaction of fire, drought, prairie dogs and large ungulate grazers created and maintained distinctively different plant communities in the western Great Plains that resulted in a mosaic of vegetation structure and composition that sustained lesser prairie-chickens and other grassland bird populations (Derner *et al*. 2009, p. 112). As such, grazing by domestic livestock is not inherently detrimental to lesser prairie-chicken management. For example, appropriate grazing levels or stocking rates can help ensure grass cover in brood rearing habitat is not so dense that movements of the chicks are hindered. However, grazing practices that tend to maximize livestock weight gain and production produce habitat conditions that differ in significant ways from the historical mosaic by reducing the amount of habitat in an ungrazed to lightly grazed condition. The more heavily altered conditions are less suitable for the lesser prairie-chicken (Hamerstrom and Hamerstrom 1961, pp. 289–290; Davis *et al.* 1979, pp. 56, 116; Taylor and Guthery 1980a, p. 2; Bidwell and Peoples 1991, pp. 1–2).

Livestock grazing most clearly affects lesser prairie-chickens when it alters the composition and structure of mixed-grass habitats used by the species. Domestic livestock and native ungulates differentially alter native prairie vegetation, in part through different foraging preferences (Steuter and Hidinger 1999, pp. 332–333; Towne *et al.* 2005, p. 1557). Additionally, domestic livestock grazing, particularly when confined to small pastures, often is managed in ways that produce more uniform utilization of forage and greater total utilization of forage, in comparison to conditions produced historically by free-ranging plains bison (*Bison bison*) herds. For example, grazing by domestic livestock tends to be less patchy, particularly when livestock are confined to specific pastures, creating a more uniform grass coverage and height that is not optimal for lesser prairie-chickens. Such management practices and their consequences may actually exceed the effect produced by differences in livestock forage preferences (Towne *et al.* 2005, p. 1558) but, in any case, produce an additive effect on plant community characteristics.

The effects of livestock grazing, particularly overgrazing or overutilization, are most readily observed through changes in plant community composition and other vegetative characteristics (Fleischner 1994, pp. 630–631; Stoddart *et al.* 1975, p. 267). Typical vegetative indicators include changes in the composition and proportion of desired plant species and overall reductions in forage. Plant height and density may decline, particularly when plant regeneration is hindered, and community composition shifts to show increased proportions of less desirable forage species. Stocking rate and weather account for a majority of the variability associated with plant and grazing animal production on rangelands (Briske *et al.* 2008, p. 8). Stocking rate is a function of the number of animals being grazed, land area under grazing management, and time; and, is the most consistent variable land managers have available to influence plant and animal response to grazing (Briske *et al.* 2008, pp. 5–8). Chronic intensive grazing is detrimental to plants and can be addressed by rest and deferment (periodic cessation of grazing), particularly during growing season when plant growth is often rapid. Plants need to recover following defoliation, including that caused by grazing, in order to promote plant growth and sustainability. Low stocking rates tend to promote plant production while higher stocking rates reduce plant production by decreasing leaf area per unit ground area (Briske *et al.* 2008, pp. 8–9). Excessive stocking rates often are unsustainable over time (Briske *et al.* 2008, p. 9).

Grazing management favorable to persistence of the lesser prairie-chicken must ensure that a diversity of plants and cover types, including shrubs, remain on the landscape (Taylor and Guthery 1980a, p. 7; Bell 2005, p. 4), and that utilization levels leave sufficient cover in the spring to ensure that lesser prairie-chicken nests are adequately concealed from predators (Davis *et al.* 1979, p. 49; Wisdom 1980, p. 33; Riley *et al.* 1992, p. 386; Giesen 1994a, p. 98). Under any grazing regime, the canopy cover of preferred grasses should be at least 20 to 30 percent with variable grass heights that average no less than 15 inches (Van Pelt *et al.* 2013, pp. 75–76). Canopy cover of shrubs should be between 10 and 50 percent, depending on whether the dominant shrub is sand sagebrush or shinnery oak and whether the area is being used for nesting or brood-rearing (Van Pelt *et al.* 2013, pp. 75–76). Forb cover that exceeds 10 percent is preferred. Utilization rates (percentage of annual forage production that is harvested by the grazing livestock) will vary depending on a variety of factors but should strive to provide vegetative structure that meets the above criteria. The rangewide plan has more detailed information on appropriate habitat for lesser prairie-chickens and indicates that annual utilization rates of 33 percent or less, on average, under typical range conditions are most beneficial to lesser prairie-chickens (Van Pelt *et al.* 2013, pp. 75–76; 150).

Where grazing regimes leave limited residual cover, as described above, in the spring, protection of lesser prairie-chicken nests may be inadequate and desirable food plants can be scarce (Bent 1932, p. 280; Cannon and Knopf 1980, pp. 73–74; Crawford 1980, p. 3). Because lesser prairie-chickens depend on medium and tall grass species that are preferentially grazed by cattle, in regions of low rainfall, the habitat is easily overgrazed in regard to characteristics (i.e. medium and tall grass species) needed by lesser prairie-chickens (Hamerstrom and Hamerstrom 1961, p. 290). In addition, when grasslands are in a deteriorated condition due to overgrazing and overutilization, the soils have less water-holding capacity, and the availability of succulent vegetation and insects utilized by lesser prairie-chicken chicks is reduced. Many effects of overgrazing and overutilization on habitat quality are similar to effects produced by drought and likely are exacerbated by actual drought conditions (Davis *et al.* 1979, p. 122; Merchant 1982, pp. 31–33) (see separate discussion under “Drought” in “Extreme Weather Events” below).

Fencing is a fundamental tool of livestock management and is often essential to proper herd management. However, fencing, particularly at higher densities, can contribute to structural fragmentation of the landscape and hinder efforts to conserve native grasslands on a landscape scale (Samson *et al*. 2004, p. 11–12). Fencing and related structural fragmentation can be particularly detrimental to the lesser prairie-chicken in areas, such as western Oklahoma, where initial settlement patterns favored larger numbers of smaller parcels for individual settlers (Patten *et al.* 2005b, p. 245). Fencing large numbers of small parcels increases the density of fences on the landscape, increasing opportunities for lesser prairie-chickens to encounter fences during flight. Fencing not only contributes to direct mortality through forceful collisions during flight, but also can indirectly lead to mortality by creating hunting perches used by raptors and by facilitating corridors that may enhance movements of mammalian predators (Wolfe *et al.* 2007, pp. 96–97, 101). In addition, the presence of fence posts can cause general habitat avoidance and displacement in lesser prairie-chickens, which is presumably a behavioral response that serves to limit exposure to predation. However, not all fences present the same mortality risk to lesser prairie-chickens. Mortality risk would appear to be dependent on factors such as fencing design (height, type, number of strands), landscape topography, and proximity to habitats, particularly leks, used by lesser prairie-chickens. Other factors such as the length and density of fences also appear to influence the effects of these structures on lesser prairie-chickens. However, we are not aware of any studies on the impacts of different fencing designs and locations with respect to collision mortality in lesser prairie-chickens. Additional discussion related to impacts of collisions with fences and similar linear features are found in the *Collision Mortality* section below.

Recent rangeland management includes influential elements besides livestock species selection, grazing levels, and fencing, such as applications of fire (usually to promote forage quality for livestock) and water management regimes (usually to provide water supplies for livestock). Current grazing management strategies are commonly implemented in ways that are vastly different and less variable than historical conditions (Knopf and Sampson 1997, pp. 277–79). These practices have contributed to overall changes in the composition and structure of mixed-grass habitats, often making them less suitable for the lesser prairie-chicken. Further, the impacts of grazing are amplified during drought conditions, which limit the ability of plants to recover after being grazed by livestock.

Livestock are known to inadvertently flush lesser prairie-chickens and trample lesser prairie-chicken nests (Toole 2005, p. 27; Pitman *et al*. 2006a, pp. 27–29). This can cause direct mortality to lesser prairie-chicken eggs or chicks or may cause adults to permanently abandon their nests, again resulting in loss of young. For example, Pitman *et al*. (2006a, pp. 27–29) estimated nest loss from trampling by cattle to be about 1.9 percent of known nests. Additionally, even brief flushings of adults from nests can expose eggs and chicks to predation and extreme temperatures. Although documented, the significance of direct livestock effects on the lesser prairie-chicken is largely unknown.

Detailed, rangewide information is lacking on the extent, intensity, and forms of recent grazing, and associated effects on the lesser prairie-chicken. However, livestock grazing is widespread within the five lesser prairie-chicken States and occurs over a large portion of the area currently occupied by lesser prairie-chickens; thus, any habitat degradation resulting from livestock grazing is likely to produce population-level impacts on the lesser prairie-chicken. Kansas, Oklahoma and Texas collectively support 24 percent of all the cattle in the United States; these three States are also within the top five States for cattle numbers as of January 2013 (National Agricultural Statistics Service 2013, p. 5). Where uniform grazing regimes have left inadequate residual cover in the spring, detrimental effects to lesser prairie-chicken populations have been observed (Bent 1932, p. 280; Davis *et al.* 1979, pp. 56, 116; Cannon and Knopf 1980, pp. 73–74; Crawford 1980, p. 3; Bidwell and Peoples 1991, pp. 1–2; Riley *et al.* 1992, p. 387; Giesen 1994a, p. 97). Some studies have shown that overgrazing in specific portions of the lesser prairie-chicken's inhabited range has been detrimental to the species. Taylor and Guthery (1980a, p. 2) believed overgrazing explained the demise of the lesser prairie-chicken in portions of Texas but thought lesser prairie-chickens could maintain low populations in some areas with high-intensity, long-term grazing. In New Mexico, Patten *et al.* (2006, pp. 11, 16) found that grazing did not have an overall influence on where lesser prairie-chickens occurred within their study areas, but there was some evidence that the species did not nest in portions of the study area subjected to cattle grazing. In some areas within lesser prairie-chicken range, long-term high-intensity grazing results in reduced availability of lightly grazed habitat available to support successful nesting (Jackson and DeArment 1963, p. 737; Davis *et al.* 1979, pp. 56, 116; Taylor and Guthery 1980a, p. 12; Davies 1992, pp. 8, 13).

In summary, domestic livestock grazing (including management practices commonly used to benefit livestock production) has altered the composition and structure of mixed-grass habitats historically used by the lesser prairie-chicken. Much of the remaining remnants of mixed-grass prairie and rangeland, while still important to the lesser prairie-chicken, exhibit conditions quite different from those that prevailed prior to EuroAmerican settlement. These changes have considerably reduced the suitability of remnant areas as habitat for lesser prairie-chickens. Where habitats are no longer suitable for lesser prairie-chicken, these areas can contribute to fragmentation within the landscape even though they may remain in native prairie. Where improper livestock grazing has degraded native grasslands and shrublands, we do not expect those areas to significantly contribute to persistence of the lesser prairie-chicken, particularly when considered cumulatively with the influence of the other known threats. However livestock grazing is not entirely detrimental to lesser prairie-chickens, provided grazing management provides habitat that is suitable for lesser prairie-chickens. When appropriately managed, livestock grazing can reduce grass density to facilitate movements of broods and enhance the production and diversity of forbs that provide insects particularly important to the diet of chicks. Thus, we conclude that livestock grazing is not a threat if conducted appropriately such that sufficient residual vegetation remains to provide cover for lesser prairie-chickens. Negative impacts from livestock grazing are also usually reversible, unlike many of the other forms of habitat loss and degradation described herein. Therefore, keeping lands in appropriately managed rangeland is a key component of lesser prairie chicken conservation.

Collision Mortality

Wire fencing is ubiquitous throughout the Great Plains as the primary means of confining livestock to ranches and pastures or excluding them from areas not intended for grazing, such as CRP lands, agricultural fields, and public roads. As a result, thousands of miles of fencing, primarily barbed wire, have been constructed throughout lesser prairie-chicken range. Like most grassland wildlife throughout the Great Plains, the lesser prairie-chicken evolved in open habitats free of vertical structures or flight hazards, such as linear wires. Until recently, unnatural linear features such as fences, power lines, and similar wire structures were seldom perceived as a significant threat at the population level (Wolfe *et al.* 2007, p. 101). Information on the influence of vertical structures is provided elsewhere in this document.

Mortality of prairie grouse caused by collisions with power lines has been occurring for decades, but the overall extent is largely unmonitored. Proximity to power lines has been associated with extirpations of Gunnison and greater sage-grouse due to collisions and predation (Wisdom *et al.* 2011, pp. 467–468). Leopold (1933, p. 353) mentions a two-cable transmission line in Iowa where the landowner would find as many as a dozen dead or injured greater prairie-chickens beneath the line annually. Prompted by recent reports of high collision rates in species of European grouse (Petty 1995, p. 3; Baines and Summers 1997, p. 941; Bevanger and Broseth 2000, p. 124; Bevanger and Broseth 2004, p. 72) and seemingly unnatural rates of mortality in some local populations of lesser prairie-chicken, the Sutton Center began to investigate collision mortality in lesser prairie-chickens. From 1999 to 2004, researchers recovered 322 carcasses of radio-marked lesser prairie-chickens in New Mexico, Oklahoma, and portions of the Texas panhandle. For lesser prairie-chickens in which the cause of death could be determined, 42 percent of mortality in Oklahoma was attributable to collisions with fences, power lines, or automobiles. In New Mexico, only 14 percent of mortality could be traced to collision. The difference in rates of observed collision between States was attributed to differences in the amount of fencing on the landscape resulting from differential land settlement patterns in the two States (Patten *et al.* 2005b, p. 245). In Oklahoma, settlement typically involved smaller areas of land ownership when compared with New Mexico, leading to a higher density of fences per unit area. Higher density of fences contributed to the higher collision rates observed in Oklahoma.

With between 14 and 42 percent of adult lesser prairie-chicken mortality currently attributable to collision with human-induced structures, Wolfe *et al.* (2007, p. 101) assert that fence collisions will negatively influence long-term population viability for lesser prairie-chickens. Precisely quantifying the scope of the impact of fence collisions rangewide is difficult due to a lack of relevant information, such as the extent and density of fencing within the estimated occupied range. However, we presume that hundreds of miles of fences are constructed or replaced annually within the estimated historical and occupied ranges of the lesser prairie-chicken, based on the extent of livestock grazing within these regions. We presume that only rarely are old fences (also see discussion in **Summary of Ongoing and Future Conservation Efforts** section for more information on fence removal). While we are unable to quantify the amount of new fencing being constructed, collision with fences and other linear features, such as power lines, is likely an important source of mortality for lesser prairie-chicken, but primarily in localized areas where the density of these structures on the landscape is high.

Fence collisions are known to be a significant source of mortality in other grouse. Moss (2001, p. 256) modeled the estimated future population of capercaille grouse (*Tetrao urogallus*) in Scotland and found that, by removing fence collision risks, the entire Scotland breeding population would consist of 1,300 females instead of 40 females by 2014. Similarly, recent experiments involving fence marking to increase visibility resulted in a 71 percent overall reduction in grouse collisions in Scotland (Baines and Andrew 2003, p. 174).

As previously discussed, collision and mortality risk appears to be dependent on factors such as fencing design (height, type, number of strands), length, and density, as well as landscape topography and proximity of fences to habitats used by lesser prairie-chickens. Although single-strand, electric fences may be a suitable substitute for multiple strand barbed-wire fences, and possibly lead to reduced fence collisions, we have no information demonstrating such is the case. However, marking the top two strands of barbed-wire fences increases their visibility and may help minimize incidence of collision (Wolfe *et al.* 2009, entire).

In summary, power lines and unmarked wire fences are known to cause injury and mortality of lesser prairie-chickens, although the specific rangewide impact on lesser prairie-chickens is largely unquantified. However, the prevalence of fences and power lines within the species' range and studies showing significant impacts to other grouse species suggest these structures may have at least localized, if not widespread, detrimental effects. While some conservation programs have emphasized removal of unneeded fences, we conclude that, without substantially increased removal efforts, a majority of existing fences will remain on the landscape indefinitely because they are used to manage livestock grazing on many private lands. Existing fences likely operate cumulatively with other mechanisms described in this final rule to diminish the ability of the lesser prairie-chicken to persist, particularly in areas with a high density of fences.

Shrub Control and Eradication

Shrub control and eradication are additional forms of habitat alteration that can influence the availability and suitability of habitat for lesser prairie-chickens (Jackson and DeArment 1963, pp. 736–737). Herbicide applications (primarily 2,4-dichlorophenoxyacetic acid (2,4-D) and tebuthiuron) to reduce or eliminate shrubs from native rangelands is a common ranching practice throughout much of lesser prairie-chicken range, primarily intended to increase forage production for livestock. Through foliar (2,4-D) or pelleted (tebuthiuron) applications, these herbicides are designed to suppress or kill, by repeated defoliation, dicotyledonous plants such as forbs, shrubs, and trees, while causing no significant damage to monocotyledon plants such as grasses.

As defined here, shrub control includes efforts that are designed to have a relatively short-term, temporary effect, generally less than 4 to 5 years, on the target shrub. Eradication consists of efforts intended to have a more long-term or lasting effect on the target shrub. Control and eradication efforts have been applied to both shinnery oak and sand sagebrush dominated habitats, although most shrub control and eradication efforts are primarily focused on shinnery oak. The shinnery oak vegetation type is endemic to the southern Great Plains and is estimated to have historically covered an area of 2.3 million ha (over 5.6 million ac), although its current range has been considerably reduced through eradication (Mayes *et al.* 1998, p. 1609). The distribution of shinnery oak overlaps much of the estimated occupied lesser prairie-chicken range in New Mexico, southwestern Oklahoma, and Texas panhandle region (Peterson and Boyd 1998,

p. 2). Sand sagebrush tends to be the dominant shrub in lesser prairie-chicken range in Kansas and Colorado as well as portions of northwestern Oklahoma, the northeast Texas panhandle, and northeastern New Mexico.

Control or eradication of sand sagebrush occurs within the lesser prairie-chicken range (Rodgers and Sexson 1990, p. 494), but the extent is unknown. Control or eradication of sand sagebrush appears to be more prevalent in other parts of the western United States. Other species of shrubs, such as skunkbush sumac or *Prunus angustifolia* (Chicksaw plum), also have been the target of treatment efforts. The herbicide 2,4-D has been commonly used to control sand sagebrush (Thacker et al. 2012. p. 517). Use of 2,4-D in sand sagebrush communities reduced habitat structure and sand sagebrush density and cover (Thacker *et al.* 2012. p. 518). Application of this herbicide was not found to increase the density of perennial forbs or forb species richness (Thacker *et al.* 2012. p. 518). However annual forb density did increase in pastures that were treated prior to 1985 where time since treatment allowed annual forbs to recover post treatment. Typically use of 2,4-D suppressed sand sagebrush densities for over 20 years, with no increase in the abundance of grasshoppers, an important food item for lesser prairie-chickens (Thacker *et al.* 2012. p. 520). Consequently, Thacker *et al.* (2012, p. 521) cautioned against use of 2,4-D for lesser prairie-chicken habitat management in the absence of research documenting its impacts on lesser prairie-chicken productivity, particularly when nesting cover is limited.

Shinnery oak is toxic to cattle when it first produces leaves in the spring, and it also competes with more palatable grasses and forbs for water and nutrients (Peterson and Boyd 1998, p. 8), which is why it is a common target for control and eradication efforts. In areas where *Gossypium* spp. (cotton) is grown, shinnery oak was managed to control boll weevils (*Anthonomus grandis*), which can destroy cotton crops (Slosser *et al.* 1985, entire). Boll weevils overwinter in areas where large amounts of leaf litter accumulate but tend not to overwinter in areas where grasses predominate (Slosser *et al.* 1985, p. 384). Fire is typically used to remove the leaf litter, and then tebuthiuron, an herbicide, is used to remove shinnery oak (Plains Cotton Growers 1998, pp. 2–3). Prior to the late 1990s, approximately 40,469 ha (100,000 ac) of shinnery oak in New Mexico and 404,685 ha (1,000,000 ac) of shinnery oak in Texas were lost due to the application of tebuthiuron and other herbicides for agriculture and range improvement (Peterson and Boyd 1998, p. 2).

Once shinnery oak is eradicated, it is unlikely to recolonize treated areas. Shinnery oak is a rhizomatous shrub that reproduces very slowly and does not invade previously unoccupied areas (Dhillion *et al.* 1994, p. 52). Shinnery oak rhizomes do not appear to be viable in sites where the plant was previously eradicated, even decades after treatment. While shinnery oak has been germinated successfully in a laboratory setting (Pettit 1986, pp. 1, 3), little documentation exists that shinnery oak acorns successfully germinate in the wild (Wiedeman 1960, p. 22; Dhillion *et al.* 1994, p. 52). In addition, shinnery oak produces an acorn crop in only about 3 of every 10 years (Pettit 1986, p. 1).

While lesser prairie-chickens are found in Colorado and Kansas where preferred habitats lack shinnery oak, the importance of shinnery oak as a component of lesser prairie-chicken habitat has been demonstrated by several studies (Fuhlendorf *et al.* 2002a, pp. 624–626; Bell 2005, pp. 15, 19–25). In a study conducted in west Texas, Haukos and Smith (1989, p. 625) documented strong nesting avoidance by lesser prairie-chickens of rangelands where shinnery oak had been controlled with the herbicide tebuthiuron, demonstrating a preference for habitats with a shinnery oak component. Similar behavior was confirmed by three recent studies, explained below, in New Mexico examining aspects of lesser prairie-chicken habitat use, survival, and reproduction relative to shinnery oak density and herbicide application to control shinnery oak.

First, Bell (2005, pp. 20–21) documented strong thermal selection for and dependency of lesser prairie-chicken broods on dominance of shinnery oak in shrubland habitats. In this study, lesser prairie-chicken hens and broods used sites within the shinnery oak community that had a statistically higher percent cover and greater density of shrubs. Within these sites, microclimate differed statistically between occupied and random sites, and lesser prairie-chicken survival was statistically higher in microhabitat that was cooler, more humid, and less exposed to the wind. Survivorship was statistically higher for lesser prairie-chickens that used sites with greater than 20 percent cover of shrubs than for those choosing 10–20 percent cover; in turn, survivorship was statistically higher for lesser prairie-chickens choosing 10–20 percent cover than for those choosing less than 10 percent cover. Similarly, Copelin (1963, p. 42) stated that he believed the reason lesser prairie-chickens occurred in habitats with shrubby vegetation was due to the need for summer shade.

In a second study, Johnson *et al.* (2004, pp. 338–342) observed that shinnery oak was the most common vegetation type in lesser prairie-chicken hen home ranges. Hens were detected more often than randomly in or near pastures that had not been treated to control shinnery oak. Although hens were detected in both treated and untreated habitats in this study, 13 of 14 nests were located in untreated pastures, and all nests were located in areas dominated by shinnery oak. Areas immediately surrounding nests also had higher shrub composition than the surrounding pastures. This study suggested that treatment of shinnery oak can adversely impact nesting by lesser prairie-chickens.

Finally, a third study showed that over the course of four years and five nesting seasons, lesser prairie-chicken in the core of estimated occupied range in New Mexico distributed themselves non-randomly among shinnery oak rangelands treated and untreated with tebuthiuron (Patten *et al.* 2005a, pp. 1273–1274). Lesser prairie-chickens strongly avoided habitat blocks treated with tebuthiuron but were not statistically influenced by presence of cattle grazing. Further, herbicide treatment explained nearly 90 percent of the variation in occurrence among treated and untreated areas. Over time, radio-collared lesser prairie-chickens spent progressively less time in treated habitat blocks, with almost no use of treated pastures in the fourth year following herbicide application (25 percent in 2001, 16 percent in 2002, 3 percent in 2003, and 1 percent in 2004). Although shinnery oak is an important food source for lesser prairie-chickens, shinnery oak, particularly in the Southern High Plains, may be more important for microclimate and thermal regulation than as a food source (Grisham *et al.* 2013, entire). Grisham *et al.* (2013, p. 7) observed that hens may select shrubby areas over grasses in dry years, possibly because shrubs, such as shinnery oak, are often the first to leaf out and are less dependent on short term precipitation, providing suitable cover for lesser prairie-chicken during short term drought.

In contrast, McCleery *et al*. (2007, pp. 2135–2136) argued that the importance of shinnery oak habitats to lesser prairie-chickens has been overemphasized, primarily based on occurrence of the species in areas outside of shinnery oak dominated habitats. We agree that shinnery oak may not be a rigorously required component of lesser prairie-chicken habitat rangewide. However, we find that shrub cover is an important component of lesser prairie-chicken habitat, and shinnery oak is a key shrub in a large portion of the estimated occupied range of the species. Recently, Timmer (2012, pp. 38, 73–74) found that lesser prairie-chicken lek density peaked when approximately 50 percent of the landscape was composed of shrubland patches consisting of shrubs less than 5 m (16 ft) tall and comprising at least 20 percent of the total vegetation. Shrubs are an important component of suitable habitat and where shinnery oak occurs, lesser prairie-chickens use it both for food and cover. The loss of these habitats likely contributed to observed population declines in lesser prairie-chickens. Mixed-sand sagebrush and shinnery oak rangelands are well documented as preferred lesser prairie-chicken habitat, and long-term stability of shrubland landscapes has been shown to be particularly important to the species (Woodward *et al.* 2001, p. 271).

On BLM-managed lands, where the occurrence of the dunes sagebrush lizard and lesser prairie-chicken overlaps, their Resource Management Plan Amendment (RMPA) states that tebuthiuron may only be used in shinnery oak habitat if there is a 500-m (1,600-ft) buffer around dunes, and that no chemical treatments should occur in suitable or occupied dunes sagebrush lizard habitat (BLM 2008, pp. 4–22). In this RMPA (BLM 2008, pp. 16–17), BLM will allow spraying of shinnery oak in lesser prairie-chicken habitat where it does not overlap with the dunes sagebrush lizard. Additionally, the New Mexico State Lands Office and private land owners continue to use tebuthiuron to remove shinnery oak for cattle grazing and other agricultural purposes (75 FR 77809, December 14, 2010). In the past, the NRCS's herbicide spraying program has treated shinnery oak in at least 39 counties within shinnery oak habitat (Peterson and Boyd 1998, p. 4). Under the Lesser Prairie-chicken Initiative, the NRCS may conduct some thinning of shinnery oak but the specific extent is not enumerated. Thinning of shinnery oak is addressed under the brush management practice. Total acres estimated to be treated under the brush management practice in the shinnery oak ecosystem is 19,230 ha (47,520 ac), however, thinning is expected to be used only in limited circumstances (Shaughnessy 2013, pp. 50, 54).

The BLM, through the Restore New Mexico program, also treats mesquite with herbicides to restore grasslands to a more natural condition by reducing the extent of brush. While some improvement in livestock forage occurs, the areas are rested from grazing for two growing seasons and no increase in stocking rate is allowed. Because mesquite is not readily controlled by fire, herbicides often are necessary to treat its invasion. The BLM has treated approximately 157,018 ha (388,000 ac) and has plans to treat an additional 140,425 ha (347,000 ac) (Watts 2014, pers. comm.). In order to treat encroaching mesquite, BLM aerially treats with a mix of the herbicides Remedy (triclopyr) and Reclaim (clopyralid). Although these chemicals are used to treat the adjacent mesquite, some herbicide drift into shinnery oak habitats can occur during application. Oaks are also included on the list of plants controlled by Remedy, and one use for the herbicide is treatment specifically for sand shinnery oak suppression, as noted on the specimen label (Dow AgroSciences 2008, pp. 5, 7). While Remedy can be used to suppress shinnery oak, depending on the concentration, the anticipated impacts of herbicide drift into non-target areas are expected to be largely short-term due to differences in application rates necessary for the desired treatments. Forbs are also susceptible to Remedy, according to the specimen label, and may be impacted by these treatments, at least temporarily (Dow AgroSciences 2008, p. 2). Typically, shinnery oak and mesquite occurrences do not overlap. Shinnery oak typically occurs in areas with sandy soils while mesquite is more often found in areas where soils have a higher clay content. Depending on the density of mesquite, these areas may or may not be used by lesser prairie-chickens prior to treatment.

Lacking germination of shinnery oak acorns, timely recolonization of treated areas, or any established propagation or restoration method, the application of tebuthiuron at rates approved for use in most States can eliminate high-quality lesser prairie-chicken habitat. Large tracts of shrubland communities are decreasing, and native shrubs drive reproductive output for ground-nesting birds in shinnery oak rangelands (Guthery *et al.* 2001, p. 116).

In summary, we conclude that the long-term to permanent removal of native shrubs such as shinnery oak and sand sagebrush is an ongoing threat to the lesser prairie-chicken throughout the estimated occupied range, but particularly in New Mexico, Oklahoma, and Texas. Habitat, which historically included shrubs, in which the shrubs are permanently removed may fail to continue to meet basic needs of the species, such as foraging, nesting, predator avoidance, and thermoregulation. Nesting habitat typically consists primarily of shrubs and native grasses. In some instances, herbicide use may aid in the restoration of lesser prairie-chicken habitat, particular where dense monocultures of shinnery oak may exist. However, long term to permanent conversion of shinnery oak and sand sagebrush shrubland to other land uses contributes to habitat fragmentation and poses a threat to population persistence.

Pesticides

To our knowledge, no studies have been conducted examining potential effects of agricultural pesticide use on lesser prairie-chicken populations. However, impacts from pesticides to other prairie grouse have been documented. Of approximately 200 greater sage grouse known to be feeding in a block of alfalfa sprayed with dimethoate, 63 were soon found dead, and many others exhibited intoxication and other negative symptoms (Blus *et al.* 1989, p. 1139). Because lesser prairie-chickens are known to selectively feed in alfalfa fields (Hagen *et al.* 2004, p. 72), we find there may be cause for concern that similar impacts could occur when pesticides are applied. Additionally some insect control efforts, such as grasshopper suppression in rangelands by the USDA Animal and Plant Health Inspection Service, treat economically damaging infestations of grasshoppers with insecticides. Treatment could cause reductions in insect populations consumed by lesser prairie-chickens. However, in the absence of more conclusive evidence, we do not currently consider application of insecticides for most agricultural purposes to be a threat to the species.

The use of anticoagulant rodenticides like Rozol® (active ingredient–chlorophacinone) that are used to control black-tailed prairie dogs (*Cynomys ludovicianus*) also may present a hazard to lesser prairie-chickens. Lesser prairie-chickens are known to occasionally use black-tailed prairie dog colonies (Tyler and Shackford 2002, p. 43), typically as lek sites (NRCS 1999b, p. 3; Bidwell et al. 2002, pp.

1–2, 4; NRCS 2011, p. 3). Application of this rodenticide to control black-tailed prairie dogs is registered for use in ten States, including the five States that comprise the estimated occupied range of the lesser prairie-chicken (Vyas *et al*. 2013, p. 97). Typical application involves placement of chorophacinone-treated winter wheat at least 15.24 cm (6 in) inside the burrow from October 1 to March 15th of the following year (Vyas *et al*. 2013, pp. 98-99). Application of the bait inside the burrow would normally make the bait largely unavailable to ground foraging, granivorous birds, like the lesser prairie-chicken. However Vyas *et al*. (2013, p. 100) confirmed that birds can be exposed and ingest the treated bait, at least in some instances. While they raise the concern that impacts could occur on a larger scale even when the rodenticide is applied according to label instructions, the best available information does not confirm that lesser prairie-chickens or other western grouse species have been affected by prairie dog control measures.

Although herbicides are applied within the estimated historical and occupied ranges, to our knowledge no studies have been conducted examining potential effects of herbicide use on the health of lesser prairie-chickens. Typically herbicides are applied as a means of altering vegetation types or structure and can indirectly alter habitat used by lesser prairie-chickens. Information on herbicide application and its effects on lesser prairie-chicken habitat is provided in the previous section on Shrub Control and Eradication above.

Pesticide application, particularly for agricultural uses, occurs within both the estimated historical and occupied ranges of the lesser prairie-chicken. While there are opportunities for individual lesser prairie-chickens to be exposed to pesticides, we are not aware of any specific studies addressing the implications of such application on the individual health of lesser prairie-chickens. In some instances, such as for grasshopper control programs, pesticide applications have the potential to reduce food availability for lesser prairie-chickens but such effects are expected to be localized in nature. While the effects can be negative, we do not believe this stressor will impact the long term stability or persistence of the lesser prairie-chicken rangewide and does not constitute a current threat to the lesser prairie-chicken.

Altered Fire Regimes and Encroachment by Invasive, Woody Plants

Preferred lesser prairie-chicken habitat is characterized by expansive regions of treeless grasslands interspersed with patches of small shrubs (Giesen 1998, pp. 3–4). Prior to extensive EuroAmerican settlement, frequent fires and grazing by large, native ungulates helped confine trees like *Juniperus virginiana* (eastern red cedar) to river and stream drainages and rocky outcroppings. However, settlement of the southern Great Plains altered the historical disturbance regimes and contributed to habitat fragmentation and conversion of native grasslands. The frequency and intensity of these disturbances directly influenced the ecological processes, biological diversity, and patchiness typical of Great Plains grassland ecosystems, which evolved with frequent fire and ungulate herbivory and that provided ideal habitat for lesser prairie-chickens (Collins 1992, pp. 2003–2005; Fuhlendorf and Smeins 1999, pp. 732, 737).

Once these historical fire and grazing regimes were altered, the processes which helped maintain extensive areas of grasslands ceased to operate effectively. Following EuroAmerican settlement, fire suppression allowed trees, such as eastern red cedar, to begin invading or encroaching upon neighboring grasslands. Increasing fire suppression that accompanied settlement, combined with government programs promoting eastern red cedar for windbreaks, erosion control, and wildlife cover, increased availability of eastern red cedar seeds in grassland areas (Owensby *et al.* 1973, p. 256, DeSantis *et al*. 2011, p. 1838). In Oklahoma alone, 1.4 million red cedar seedlings were estimated to have been planted in 3,058 km (1,900 mi) of shelterbelts between 1935 and 1942 (DeSantis *et al.* 2011, p. 1838). Once established, windbreaks and cedar plantings for erosion control contributed to fragmentation of the prairie landscape. Because eastern red cedar is not well adapted to survive most grassland fires due to its thin bark and shallow roots (Briggs *et al.* 2002b, p. 290), the lack of frequent fire greatly facilitated encroachment by eastern red cedar. Once trees began to invade these formerly treeless prairies, the resulting habitat became increasingly unsuitable for lesser prairie-chickens.

Similar to the effects of man-made vertical structures, the presence of trees causes lesser prairie-chickens to cease using areas of otherwise suitable habitat. Woodward *et al.* (2001, pp. 270–271) documented a negative association between landscapes with increased woody cover and lesser prairie-chicken population indices. Similarly, Fuhlendorf *et al.* (2002a, entire) examined the effect of landscape structure and change on population dynamics of lesser prairie-chicken in western Oklahoma and northern Texas. They found that landscapes with declining lesser prairie-chicken populations had significantly greater increases in tree cover types (riparian, windbreaks, and eastern red cedar encroachment) than landscapes with stable or increasing (sustained) lesser prairie-chicken populations (Fuhlendorf *et al.* (2002a, pp. 622, 625).

Tree encroachment into grassland habitats has been occurring for decades, but the extent has been increasing rapidly in recent years (Drake and Todd 2002, p. 24; Zhang and Hiziroglu 2010, p. 1033; Ge and Zou 2013, p. 9094). Based on the estimated rates of encroachment, tree invasion in native grasslands and rangelands has the potential to render significant portions of remaining occupied habitat unsuitable within two to four decades. Once a grassland area has been colonized by eastern red cedar, the trees are mature within 6 to 7 years and provide a plentiful source of seed in which adjacent areas can readily become infested with eastern red cedar. Eastern red cedar cones (fleshy fruit containing seeds) are readily consumed and dispersed by several species of migratory and resident birds, many of which favor vertical structure (Holthuijzen and Sharik 1985, p. 1512, Holthuijzen *et al*. 1987, p. 1092). Some birds may disperse the seeds considerable distances from the seed source (Holthuijzen *et al*. 1987, p. 1094) and passage of the cones through the digestive tract increased seed germination by 1.5 to 3.5 times (Holthuijzen and Sharik 1985, p. 1512). Despite the relatively short viability of the seeds, typically only one growing season, the large cone crop, potentially large seed dispersal ability, and the physiological adaptations of eastern red cedar to open, relatively dry sites help make the species a successful invader of prairie landscapes (Holthuijzen *et al*. 1987, p. 1094). Most trees are relatively long-lived species and, once they become established in grassland areas, will require intensive management to return areas to a grassland state.

Specific information documenting the extent of eastern red cedar infestation within the estimated historical and occupied ranges of the lesser prairie-chicken is limited. Reeves and Mitchell (2012. p. 92) estimated the percent of non-federal rangeland, by state, where invasive cedars were present. Although their analysis did not specifically target the range of the lesser prairie-chicken, the general scope of the impact of eastern red cedar is apparent. An estimated 20.4 percent of non-federal rangeland in Oklahoma has eastern red cedar present. Lesser amounts occur in Kansas (5.1 percent), Texas (2.6 percent) and Colorado (trace amount). New Mexico was the only State not currently experiencing encroachment by eastern red cedar.

Additional information from Oklahoma and portions of Kansas also help demonstrate the significance of this threat to lesser prairie-chicken habitat. In Riley County, Kansas, within the tallgrass prairie region known as the Flint Hills, the amount of eastern red cedar coverage increased over 380 percent within a 21-year period (Price and Grabow 2010, as cited in Beebe *et al.* 2010, p. 2). In another portion of the Flint Hills of Kansas, transition from a tallgrass prairie to a closed canopy (where tree canopy is dense enough for tree crowns to fill or nearly fill the canopy layer so that light cannot reach the floor beneath the trees) eastern red cedar forest occurred in as little as 40 years (Briggs *et al.* 2002a, p. 581). Similarly, the potential for development of a closed canopy (crown closure) in western Oklahoma is very high (Engle and Kulbeth 1992, p. 304), and eastern red cedar encroachment in Oklahoma is occurring at comparable rates. Estimates developed by NRCS in Oklahoma revealed that about 121,406 ha (300,000 ac) a year are being invaded by eastern red cedar (Zhang and Hiziroglu 2010, p. 1033). Stritzke and Bidwell (1989, as cited in Zhang and Hiziroglu 2010, p. 1033) estimated that the area infested by eastern red cedar increased from over 600,000 ha (1.5 million ac) in 1950 to over 1.4 million ha (3.5 million ac) by 1985. By 2002, the NRCS estimated that eastern red cedar had invaded approximately 3.2 million ha (8 million ac) of prairie and cross timbers habitat in Oklahoma (Drake and Todd 2002, p. 24). Zhang and Hiziroglu (2010, p. 1033) estimated that eastern red cedar encroachment in Oklahoma, based on an estimated expansion rate of 308 ha (762 ac) per day, is expected to exceed 5 million ha (12.6 million ac) by 2013 (). At these rates, the area invaded by eastern red cedar could reach almost 6 million ha (14.5 million ac) by the year 2020 if control efforts are not implemented. While the area infested by eastern red cedar in Oklahoma is not restricted to the estimated occupied range of the lesser prairie-chicken, the problem appears to be the worst in northwestern and southwestern Oklahoma, which overlaps with the range of the lesser prairie-chicken (Zhang and Hiziroglu 2010, p. 1032). Considering that southwestern Kansas and the northeastern Texas panhandle have comparable rates of precipitation, fire exclusion, and grazing pressure as western Oklahoma, this rate of infestation is likely occurring in many areas of the estimated occupied lesser prairie-chicken range.

Ge and Zou (2013, p. 9094) hypothesized that encroachment of eastern red cedar will be an important factor affecting suitability of rangelands within the southern Great Plains well into the future. Based on the observed rate of eastern red cedar expansion in northwestern Oklahoma between 1965 to 1995, they projected that woody cover would increase 500 percent by 2015, assuming control efforts are not implemented. At these rates, eastern red cedar would dominate approximately 20 percent of a typical landscape. Similar levels of encroachment are being experienced in Kansas and Texas (Ge and Zou 2013, p. 9094). Schmidt and Wardle (1998, p. 12) predicted that eastern red cedar expansion in the Great Plains would continue into the future because of limitations on the use of prescribed fire and the economic costs of mechanical and chemical treatment of eastern red cedar over large areas.

Eastern red cedar is not the only woody species known to be encroaching in prairies used by lesser prairie-chicken. Within the southern- and western-most portions of the estimated historical and occupied ranges in eastern New Mexico, western Oklahoma, and the Texas Panhandle, mesquite is a common woody invader within these grasslands and can preclude nesting and brood use by lesser prairie-chickens (Riley 1978, p. vii). Other tall, woody plants, such as *Juniperus pinchotii* (redberry or Pinchot juniper), *Robinia pseudoacacia* (black locust), *Elaeagnus angustifolia* (Russian olive), and *Ulmus pumila* (Siberian elm) also can be found in prairie habitats historically and currently used by lesser prairie-chickens and may become invasive in these areas. For example, in some portions of the Texas panhandle, Pinchot juniper distribution increased by about 61 percent over a 50 year period (Ansley et al. 1995, p. 50). All of these woody invaders can provide perch sites for raptors that may prey on lesser prairie-chickens.

Mesquite is a particularly effective woody invader in grassland habitats due to its ability to produce abundant, long-lived seeds that can germinate and establish in a variety of soil types and moisture and light regimes (Archer *et al.* 1988, p. 123). Much of the remaining grasslands and rangelands in the southern portions of the Texas panhandle, including areas within the estimated occupied range, have been invaded by mesquite. Reeves and Mitchell (2012, p. 92) estimated the percent of non-federal rangeland in New Mexico, Oklahoma and Texas that has been invaded by mesquite. Estimates ranged from a low of 7.5 percent in western Oklahoma to a high of 47.6 percent in Texas. Areas that have been invaded by mesquite include portions of the estimated occupied range in these States. Once established, mesquite can alter nutrient cycles and reduce herbaceous cover (Reeves and Mitchell 2012, p. 99). Teague *et al*. (2008, p. 505) reported an average reduction in herbaceous biomass of 1,400 kg/ha (1247.8 lbs/ac) in areas having 100 percent mesquite cover.

Although the precise extent and rate of mesquite invasion is difficult to determine rangewide, the ecological process by which mesquite and related woody species invades these grasslands has been described by Archer *et al.* (1988, pp. 111–127) for the Rio Grande Plains of Texas. In this study, once a single mesquite tree colonized an area of grassland, this plant acted as the focal point for seed dispersal of woody species that previously were restricted to other habitats (Archer *et al.* 1988, p. 124). Once established, factors such as overgrazing, reduced fire frequency, and drought interacted to enable mesquite and other woody plants to increase in density and stature on grasslands (Archer *et al.* 1988, p. 112). On their study site near Alice, Texas, they found that woody plant cover significantly increased from 16 to 36 percent between 1941 and 1983, likely facilitated by heavy grazing (Archer *et al.* 1988, p. 120). The study site had a history of heavy grazing since the late 1800s. However, unlike eastern red cedar, mesquite is not as readily controlled by fire. Wright *et al.* (1976, pp. 469–471) observed that mesquite seedlings older than 1.5 years were difficult to control with fire unless the above ground portions of the trees had first been damaged by an herbicide application, and the researchers observed that survival of 2- to 3-year-old mesquite seedlings was as high as 80 percent even following very hot fires.

Prescribed burning is often the best method to control or preclude tree invasion of native grassland and rangeland. However, burning of native prairie is often perceived to be destructive to rangelands, undesirable for optimizing cattle production, and likely to create wind erosion or “blowouts” in sandy soils. Often, prescribed fire is employed only after significant tree invasion has already occurred and landowners consider forage production for cattle to have diminished. Consequently, fire suppression is common, and relatively little prescribed burning occurs on private land. Additionally, in areas where grazing pressure is heavy and fuel loads are reduced, a typical grassland fire may not be intense enough to eradicate eastern red cedar (Briggs *et al.* 2002a, p. 585; Briggs *et al.* 2002b, pp. 293; Bragg and Hulbert 1976, p. 19). Briggs *et al.* (2002a, p. 582) found that grazing reduced potential fuel loads by 33 percent, and the reduction in fuel load significantly reduced mortality of eastern red cedar post-fire. While establishment of eastern red cedar reduces the abundance of herbaceous grassland vegetation, grasslands have a significant capacity to recover rapidly following cedar control efforts (Pierce and Reich 2010, p. 248). However, both Van Auken (2000, p. 207) and Briggs *et al.* (2005, p. 244) stated that expansion of woody vegetation into grasslands will continue to pose a threat to grasslands well into the future.

In summary, invasion of native grasslands by certain opportunistic woody species like eastern red cedar and mesquite cause otherwise suitable grassland habitats to no longer be used by lesser prairie-chickens and contribute to fragmentation of native grassland habitats. Lesser prairie-chickens are grassland obligates and do not thrive in environments invaded by trees like eastern red cedar and mesquite. We expect that efforts to control invasive, woody species like eastern red cedar and mesquite will continue but that treatment efforts likely will be insufficient to keep pace with rates of expansion, especially when considering the environmental changes resulting from climate change (see discussion below). Therefore, encroachment by invasive, woody plants contributes to further habitat fragmentation and poses a threat to lesser prairie-chicken population persistence.

Climate Change

The effects of ongoing and projected changes in climate are appropriate for consideration in our analyses conducted under the Act. The Intergovernmental Panel on Climate Change (IPCC) has concluded that warming of the climate in recent decades is unequivocal, as evidenced by observations of increases in global average air and ocean temperatures, widespread melting of snow and ice, and rising global sea level (Solomon *et al.* 2007, p.1). The term “climate”, as defined by the IPCC, refers to the mean and variability of different types of weather conditions over time, with 30 years being a typical period for such measurements, although shorter or longer periods also may be used (IPCC 2007a, p. 78). The IPCC defines the term “climate change” to refer to a change in the mean or variability of one or more measures of climate (e.g., temperature or precipitation) that persists for an extended period, typically decades or longer, whether the change is due to natural variability, human activity, or both (IPCC 2007a, p. 78).

Scientific measurements spanning several decades demonstrate that changes in climate are occurring and that the rate of change has been faster since the 1950s. Examples include warming of the global climate system and substantial increases in precipitation in some regions of the world and decreases in other regions. (For these and other examples, see IPCC 2007a, p. 30; and Solomon *et al*. 2007, pp. 35–54, 82–85). Results of scientific analyses presented by the IPCC show that most of the observed increase in global average temperature since the mid-20th century cannot be explained by natural variability in climate, and is “very likely” (defined by the IPCC as 90 percent or higher probability) due to the observed increase in greenhouse gas concentrations in the atmosphere as a result of human activities, particularly carbon dioxide emissions from use of fossil fuels (IPCC 2007a, pp. 5–6 and figures SPM.3 and SPM.4; Solomon *et al*. 2007, pp. 21–35). Further confirmation of the role of greenhouse gasses comes from analyses by Huber and Knutti (2011, p. 4), who concluded it is extremely likely that approximately 75 percent of global warming since 1950 has been caused by human activities.

Scientists use a variety of climate models, which include consideration of natural processes and variability, as well as various scenarios of potential levels and timing of greenhouse gas emissions, to evaluate the causes of changes already observed and to project future changes in temperature and other climate conditions (e.g., Meehl *et al*. 2007, entire; Ganguly *et al*. 2009, pp. 11555, 15558; Prinn *et al*. 2011, pp. 527, 529). All combinations of models and emissions scenarios yield very similar projections of increases in the most common measure of climate change, average global surface temperature (commonly known as global warming), until about 2030. Although projections of the intensity and rate of warming differ after about 2030, the overall trajectory of all the projections is one of increased global warming through the end of this century, even for the projections based on scenarios that assume that greenhouse gas emissions will stabilize or decline. Thus, there is strong scientific support for projections that warming will continue through the 21st century and that the extent and rate of change will be influenced substantially by the extent of greenhouse gas emissions (IPCC 2007a, pp. 44–45; Meehl *et al*. 2007, pp. 760–764 and 797–811; Ganguly *et al*. 2009, pp. 15555–15558; Prinn *et al*. 2011, pp. 527, 529). (See IPCC 2007b, p. 8, for a summary of other global projections of climate-related changes, such as frequency of heat waves and changes in precipitation. Also, see IPCC (2012, entire) for a summary of observations and projections of extreme climate events.)

Various changes in climate may have direct or indirect effects on species. These effects may be positive, neutral, or negative, and they may change over time, depending on the species and other relevant considerations, such as interactions of climate with other variables (*e.g.*, habitat fragmentation) (IPCC 2007a, pp. 8–14, 18–19). Identifying likely effects often involves aspects of climate change vulnerability analysis. Vulnerability refers to the degree to which a species (or system) is susceptible to, and unable to cope with, adverse effects of climate change, including climate variability and extremes. Vulnerability is a function of the type, intensity, and rate of climate change and variation to which a species is exposed, its sensitivity, and its adaptive capacity (IPCC 2007a, p. 89; see also Glick *et al.* 2011, pp. 19–22). There is no single method for conducting such analyses that applies to all situations (Glick *et al.* 2011, p. 3). We use our expert judgment and appropriate analytical approaches to weigh relevant information, including uncertainty, in our consideration of various aspects of climate change.

As is the case with all stressors that we assess, even if we conclude that a species is currently affected or is likely to be affected in a negative way by one or more climate-related impacts, it does not necessarily follow that the species meets the definition of an "endangered species" or a "threatened species" under the Act. If a species is listed as endangered or threatened, knowledge regarding the vulnerability of the species to, and known or anticipated impacts from, climate-associated changes in environmental conditions can be used to help devise appropriate strategies for its recovery.

Some species of grouse have already exhibited significant and measurable negative impacts attributed to climate change. For example, capercaillie grouse in Scotland have been shown to nest earlier than in historical periods in response to warmer springs yet reared fewer chicks (Moss *et al.* 2001, p. 58). The resultant lowered breeding success as a result of the described climactic change was determined to be the major cause of the decline of the Scottish capercaillie (Moss *et al.* 2001, p. 58).

Within the Great Plains, average temperatures have increased and projections indicate this trend will continue over this century (Karl *et al*. 2009, p. 1). Precipitation within the southern portion of the Great Plains is expected to decline, with extreme events such as heat waves, sustained droughts, and heavy rainfall becoming more frequent (Karl *et al*. 2009, pp. 1–2). Seager *et al.* (2007, pp. 1181, 1183–1184) suggests that 'dust bowl' conditions of the 1930s could be the new climatology of the American Southwest, with future droughts being much more extreme than most droughts on record.

As a result of changing conditions, the distribution and abundance of grassland bird species will be affected (Niemuth *et al.* 2008, p. 220). Warmer air and surface soil temperatures and decreased soil moisture near nest sites have been correlated with lower survival and recruitment in some ground-nesting birds such as the bobwhite quail (Guthery *et al.* 2001, pp. 113–115) and the lesser prairie-chicken (Bell 2005, pp. 16, 21). On average, lesser prairie-chickens avoid sites that are hotter, drier, and more exposed to the wind (Patten et al. 2005a, p. 1275). Specific to lesser prairie-chickens, an increased frequency of heavy rainfall events could negatively affect their reproductive success (Lehmann 1941 as cited in Peterson and Silvy 1994, p. 223; Morrow *et al.* 1996, p. 599) although the deleterious effects of increased spring precipitation have been disputed by Peterson and Silvy (1994, pp. 227–228). Peterson and Silvy (1994, pp. 227–228) concluded that spring precipitation does not negatively impact annual breeding success, particularly when the indirect, positive influence of spring precipitation on nesting and brood rearing habitat is considered.

Additionally, more extreme droughts, in combination with existing threats, will have detrimental implications for the lesser prairie-chicken (see Drought discussion in "Extreme Weather Events" below). Boal *et al.* (2010, p. 4) suggests that increased temperatures, as projected by climate models, may lead to egg death or nest abandonment of lesser prairie-chickens. Furthermore, the researchers suggest that if lesser prairie-chickens shift timing of reproduction (to later in the year) to compensate for lower precipitation, then temperature impacts could be exacerbated.

In 2010, we evaluated three different climate change vulnerability models (U.S. Environmental Protection Agency 2009, *draft review*; NatureServe 2010; USDA Rocky Mountain Research Station 2010, *in development*) to determine their usefulness as potential tools for examining the effects of climate change on lesser prairie chickens . Outcomes from our assessment of each of these models for the lesser prairie-chicken suggested that the lesser prairie-chicken is highly vulnerable to, and will be negatively affected by, projected climate change (Service 2010). Factors identified in the models that increase the vulnerability of the lesser prairie-chicken to climate change include, but are not limited to the following: (1) The species' limited distribution and relatively small declining population, (2) the species' physiological sensitivity to temperature and precipitation change, (3) specialized habitat requirements, and (4) the overall limited ability of the habitats occupied by the species to shift at the same rate as the species in response to climate change.

Increasing temperatures, declining precipitation, and extended, severe drought events would be expected to adversely alter habitat conditions, reproductive success, and survival of the lesser prairie-chicken. While populations of lesser prairie-chicken in the southwestern part of the range are likely to be most acutely affected because this area is expected to see significant changes in temperature and precipitation (Grisham *et al,* 2013, entire), populations throughout the entire estimated occupied range, including Colorado and Kansas, likely will be impacted as well. The fragmented nature of the estimated occupied range and habitat losses to date have isolated populations and will increase their susceptibility to climate change. Based on current climate change projections of increased temperatures, decreased rainfall, and an increase of severe events such as drought and rainfall within the southern Great Plains, the lesser prairie-chicken is likely to be adversely impacted by the effects of climate changes, especially when considered in combination with other known threats, such as habitat loss and fragmentation, and the anticipated vulnerability of the species.

Additionally, many climate scientists predict that numerous species will shift their geographical distributions in response to warming of the climate (McLaughlin *et al.* 2002, p. 6070). In mountainous areas, species may shift their range altitudinally, in flatter areas, ranges may shift lattitudinally (Peterson 2003, p. 647). Such shifts may result in localized extinctions over portions of the range, and, in other portions of their distributions, the occupied range may expand, depending upon habitat suitability. Changes in geographical distributions can vary from subtle to more dramatic rearrangements of occupied areas (Peterson 2003, p. 650). Species occupying flatland areas such as the Great Plains generally were expected to undergo more severe range alterations than those in montane areas (Peterson 2003, p. 651). Additionally, populations occurring in fragmented habitats can be more vulnerable to effects of climate change and other threats, particularly for species with limited dispersal abilities (McLaughlin *et al.* 2002, p. 6074). Species inhabiting relatively flat lands will require corridors that allow north-south movements, presuming suitable habitat exists in these areas. Where existing occupied range is bounded by areas of unsuitable habitat, the species' ability to move into suitable areas is reduced and the amount of occupied habitat could shrink accordingly. In some cases, particularly when natural movement has a high probability of failure, assisted migration may be necessary to ensure populations persist ((McLachlan *et al.* 2007, entire).

We do not currently know how the distribution of lesser prairie-chickens may change geographically under anticipated climate change scenarios. Certainly the presence of suitable grassland habitats created under CRP may play a key role in how lesser prairie-chickens respond to the effects of climate change. Additionally, species that are insectivorous throughout all or a portion of their life cycle, like the lesser prairie-chicken, may have increased risks where a phenological mismatch exists between their biological needs and shifts in insect abundance due to vulnerability of insects to changes in thermal regimes (Parmesan 2006, pp. 638, 644, 657; McLachlan *et al.* 2011. p. 5). McLachlan *et al.* (2011, pp. 15, 26) predicted that lesser prairie-chicken carrying capacity would decline over the next 60 years due to climate change, primarily the result of decreased vegetation productivity (reduced biomass); however, they could not specifically quantify the extent of the decline. They estimated the current carrying capacity within the estimated occupied range to be 49,592 lesser prairie-chickens (McLachlan *et al.* 2011, p. 25). Based on their analysis, McLachlan *et al.* (2011, p. 29) predicted that the lesser prairie-chicken may be facing significant challenges to long-term survival over the next 60 years due to climate-related changes in native grassland habitat. We anticipate that climate-induced changes in ecosystems, including grassland ecosystems used by lesser prairie-chickens, coupled with ongoing habitat loss and fragmentation will interact in ways that will amplify the individual negative effects of these and other threats identified in this final rule (Cushman *et al*. 2010, p. 8).

Extreme Weather Events

Weather-related events such as drought, and snow and hail storms influence habitat quality or result in direct mortality of lesser prairie-chicken. Although hail storms typically only have a localized effect, the effects of snow storms and drought can often be more wide-spread and can affect considerable portions of the estimated occupied range.

Drought—Drought is considered a universal ecological driver across the Great Plains (Knopf 1996, p. 147). Annual precipitation within the Great Plains is considered highly variable (Wiens 1974a, p. 391) with prolonged drought capable of causing local extinctions of annual forbs and grasses within stands of perennial species, and recolonization is often slow (Tilman and El Haddi 1992, p. 263). Net primary production in grasslands is strongly influenced by annual precipitation patterns (Sala *et al.* 1988, pp.

42–44; Weltzin *et al.* 2003. p. 944) and drought, in combination with other factors, is thought to limit the extent of shrubby vegetation within grasslands (Briggs *et al.* 2005, p. 245). Grassland bird species, in particular, are impacted by climate extremes such as extended drought, which acts as a bottleneck that allows only a few species to survive through the relatively harsh conditions (Wiens 1974a, pp. 388, 397; Zimmerman 1992, p. 92). Drought also can influence many of the factors previously addressed in this final rule, such as exaggerating and prolonging the effect of fires and overgrazing. Seager *et al.* (2007, pp. 1181, 1183–1184) suggests that conditions experienced during the droughts of the 1930s could become more frequent in the southwestern United States, with future droughts being much more extreme than most droughts on record.

Drought also may exacerbate the impacts of encroachment of woody species, such as eastern red cedar and *Juniperus pinchotii* (redberry or Pinchot juniper). Eastern red cedar, as previously discussed, and Pinchot juniper (McPherson *et al*. 1988, entire) have been rapidly expanding their range and encroaching into grassland communities due to lack of fire and other human activities since EuroAmerican settlement. Pinchot juniper occurs in southwestern Oklahoma through portions of the Texas panhandle and as far south as the Edwards Plateau in southcentral Texas (Willson *et al*. 2008, p. 301). In portions of the Texas panhandle, the extent of Pinchot juniper increased by about 61 percent during the period from 1948 to 1982 (Ansley *et al*. 1995, p. 50) and encroachment continues to occur although the rate of expansion is not known. While a lack of moisture does hinder germination of many juniper species (Smith *et al*. 1975, p.

126), once established, junipers are capable of tolerating conditions typical of most droughts. Although eastern red cedar is one of the least drought tolerant species of junipers, juniper species as a whole, including those native to North America, are considered some of the most drought resistant species in the world (Willson *et al*. 2008, pp. 299, 303). Increased frequency of drought, as might occur under a typical climate change scenario, may slow the initial establishment of eastern red cedar and other junipers but would not be expected to influence their survival in areas that have already been invaded. Their observed tolerance to drought conditions contributes to their ability to invade and multiply, once established, into more xeric (dry) environments (Willson *et al*. 2008, p. 305; DeSantis *et al*. 2011, p. 1838). Due to their known drought tolerance and potential for widespread dispersal by birds, we expect that encroachment by eastern red cedar and other junipers would continue to occur under anticipated climate change scenarios. Such drought tolerance may actually enhance their ability to survive under conditions that are less favorable for other species of plants. Similarly, we do not anticipate that drought conditions would diminish the potential for continued expansion of eastern red cedar and other junipers into regions historically dominated by grasslands.

The Palmer Drought Severity Index (Palmer 1965, entire) is a measure of the balance between moisture demand (evapotranspiration driven by temperature) and moisture supply (precipitation) and is widely used as an indicator of the intensity of drought conditions (Alley 1984, entire). This index is standardized according to local climate (i.e., climate divisions established by the National Oceanic and Atmospheric

Administration) and is most effective in determining magnitude of long-term drought occurring over several months. The index uses zero as normal with drought expressed in terms of negative numbers. Positive numbers imply excess precipitation.

The droughts of the 1930s and 1950s are some of the most severe on record (Schubert *et al.* 2004, p. 485). During these periods, the Palmer Drought Severity Index exceeded negative 4 and 5 in many parts of the Great Plains, which would be classified as extreme to exceptional drought. The drought that impacted much of the estimated occupied lesser prairie-chicken range in 2011 also was classified as severe to extreme, particularly during the months of May through September (National Climatic Data Center 2013). This time period is significant because the period of May through September generally overlaps the lesser prairie-chicken nesting and brood-rearing season. Review of the available records for the Palmer Drought Severity Index during the period from May through September 2011, for the climate divisions that overlap most of the lesser prairie-chicken estimated occupied range, revealed that the index exceeded negative 4 in most of the climate divisions. Climate division 4 in westcentral Kansas was the least impacted by drought in 2011, with a Palmer Drought Severity Index of negative 2.37. The most severe drought conditions, based on the Palmer Index, occurred in the Texas panhandle. Of the eight climate divisions that encompass the majority of the estimated occupied range, drought conditions were ranked the worst on record for the entire 118 year period in four of those climate divisions. Conditions in all but one climate division were ranked within the ten worst droughts over the period of record.

Based on an evaluation of the Palmer Drought Severity Index for May through July of 2012, several of the climate divisions which overlap the estimated occupied range continued to experience extreme to exceptional drought. Colorado, New Mexico, and Texas are experiencing the worst conditions, based on Palmer Index values varying from a low of negative 6.23 in Colorado to a high index value of negative 4.33 in Texas and negative 4.51 in New Mexico. Drought conditions were least severe in Oklahoma, varying from negative 2.15 to negative 4.33. Index values for Kansas remained in the severe range and were all negative 3.23 or worse.

In 2013, conditions improved slightly in Colorado, Texas, New Mexico and portions of Oklahoma and Kansas; however, all but two climate divisions over the majority of the estimated occupied range were ranked within the top 15 worst droughts on record within those climate divisions. Although the drought severity index improved across much of the range, severe drought continued to persist. Persistent drought conditions, such as those observed between 2011 and 2013 will impact vegetative cover for nesting and can reduce insect populations needed by growing chicks. The lesser prairie-chicken estimated population size in 2013 declined considerably; likely in response to degraded habitat conditions cause by the drought conditions that prevailed over most of the estimated occupied range in 2011 and 2012 (see section on "Recent Population Estimates and Trends" for information related to estimated population size).

Existing and ongoing fragmentation of suitable habitat likely contributed to the inability of lesser prairie-chickens to maintain population numbers in response to the drought.

Additionally, drought impacts forage needed by livestock and continued grazing under such conditions can rapidly degrade native rangeland. During times of severe to extreme drought, suitable livestock forage may become unavailable or considerably reduced due to a loss of forage production on existing range and croplands. Through provisions of the CRP, certain lands under existing CRP contract can be used for emergency haying and grazing, provided specific conditions are met, to help relieve the impacts of drought by temporarily providing livestock forage. Typically, emergency haying and grazing is allowed only on those lands where appropriate Conservation Practices (CP), already approved for managed haying and grazing, have been applied to the CRP field. For example, CRP fields planted to either introduced grasses (CP-1) or native grasses (CP-2) are eligible. However, during the widespread, severe drought of 2012 and 2013, eight additional CPs that were not previously eligible to be hayed or grazed were approved for emergency haying and grazing only during 2012. These additional CPs primarily include areas associated with grassed waterways and wetlands. Areas under CP-25, rare and declining habitats, were included and were the most valuable to lesser prairie-chickens of the eight additional practices. Kansas has the most land under CP-25 with about 316,000 ha (781,000 ac) enrolled statewide.

Typically any approved emergency haying or grazing must occur outside of the primary nesting season. The duration of the emergency haying can be no longer than 60 calendar days, and the emergency grazing period cannot extend beyond 90 calendar days, and both must conclude by September 30th of the current growing season. Generally areas that were emergency hayed or grazed in 1 year are not eligible the following 2 years. Other restrictions also may apply.

In most years, the amounts of land that are emergency hayed or grazed are low, typically less than 15 percent of eligible acreage, likely because the producer must take a 25 percent reduction in the annual rental payment, based on the amount of lands that are hayed or grazed. However, during the 2011 drought, requests for emergency haying and grazing were larger than previously experienced. For example, in Oklahoma, more than 103,200 ha (255,000 ac) or roughly 30 percent of the available CRP lands statewide were utilized. Within those counties that encompass the estimated occupied range, almost 55,400 ha (137,000 ac) or roughly 21 percent of the available CRP in those counties were hayed or grazed. In Kansas, there were almost 95,900 ha (237,000 ac) under contract for emergency haying or grazing within the estimated occupied range. The number of contracts for emergency haying and grazing within the estimated occupied range in Kansas is about 18 percent of the total number of contracts within the estimated occupied range. Within New Mexico in 2011, there were approximately 21,442 ha (52,984 ac) under contract for emergency grazing, the entire extent of which were in counties that are either entirely or partially within the estimated occupied range of the lesser prairie-chicken. Texas records do not differentiate between managed CRP grazing and haying and that conducted under emergency provisions. Within the historical range in 2011, 65 counties had CRP areas that were either hayed or grazed. The average percent of areas used was 22 percent. Within the counties that overlap the estimated occupied range, the average percent grazed was the same, 22 percent.

As of the end of July 2012, the entire estimated occupied and historical range of the lesser prairie-chicken was classified as abnormally dry or worse (FSA 2012, p. 14). The abnormally dry category roughly corresponds to a Palmer Drought Index of minus 1.0 to minus 1.9. Based on new provisions announced by USDA on July 23, 2012, the entire estimated historical and occupied ranges of the lesser prairie-chicken were eligible for emergency haying and grazing. Additionally, the reduction in the annual rental payment was reduced from 25 percent to 10 percent. In 2012, New Mexico did not have any areas that were under contract for emergency haying or grazing. Colorado had 1,032 ha (2,550.9 ac) under contract for emergency haying and 30,030 ha (74,206 ac) under contract for emergency grazing within the estimated occupied range of the lesser prairie-chicken (Barbarika 2014). In Kansas, about 34,158 ha (84,405 ac) were under contract for emergency haying and 80,526 ha (198,985 ac) were under contract for emergency grazing within the estimated occupied range of the lesser prairie-chicken (Barbarika 2014). In 2012, Oklahoma had about 2,247 ha (5,552.1 ac) were under contract for emergency haying and 36,736 ha (90,777.7 ac) were under contract for emergency grazing within the estimated occupied range (Barbarika 2014). In Texas, about 3,801 ha

(9,392.3 ac) were under contract for emergency haying and 21,950 ha (54,239.5 ac) were under contract for emergency grazing in 2012 within the estimated occupied range of the lesser prairie-chicken (Barbarika 2014). Combined, about 41,238 ha (101,900.3 ac) were under contract for emergency haying and about 169,122 ha (417,908.2 ac) were under contract for emergency grazing within the estimated occupied range of the lesser prairie-chicken in 2012 (Barbarika 2014). Although the extent of emergency haying and grazing that occurred in 2012 represents only about 3 percent of the total estimated occupied range, the implications become more significant considering this emergency use occurs during drought. Under drought conditions, much of the lands that are not enrolled in CRP are grazed heavily and lands that are enrolled in CRP represent some of the best remaining habitat under drought conditions. When these CRP lands are grazed, the effect is to reduce the amount of usable habitat that is available for lesser prairie-chicken nesting, brood rearing and thermal regulation. In many instances, areas that were previously grazed or hayed under the emergency provisions of 2011 have not recovered due to the influence of the ongoing drought. Additionally, current provisions will allow additional fields to be eligible for emergency haying and grazing that have previously not been eligible, including those classified as rare and declining habitat (CP-25). Conservation Practice 25 provides for very specific habitat components beneficial to ground-nesting birds such as lesser prairie-chickens. The overall extent of relief provided to landowners could result in more widespread implementation of the emergency provisions than has been observed in previous years. The FSA estimated that about 23 percent of the available CRP was emergency hayed or grazed in 2012 (FSA 2014, p. 60).

Widespread haying and grazing of CRP under drought conditions may compromise the ability of these grasslands to provide year-round escape cover and thermal cover during winter, at least until normal precipitation patterns return (see sections **Summary of Ongoing and Future Conservation Actions** and “Conservation Reserve Program” for additional information related to CRP).

Although the lesser prairie-chicken has adapted to drought as a component of its environment, drought and the accompanying harsh, fluctuating conditions have influenced lesser prairie-chicken populations. Following extreme droughts of the 1930s and 1950s, lesser prairie-chicken population levels declined and a decrease in their overall range was observed (Lee 1950, p. 475; Schwilling 1955, pp. 5–6; Hamerstrom and Hamerstrom 1961, p. 289; Copelin 1963, p. 49; Crawford 1980, pp. 2–5; Massey 2001, pp. 5, 12; Hagen and Giessen 2005, unpaginated; Ligon 1953 *as cited in* New Mexico Lesser Prairie Chicken/Sand Dune Lizard Working Group 2005, p. 19). A reduction in lesser prairie-chicken population numbers was documented after drought conditions in 2006 followed by severe winter conditions in 2006 and early 2007. For example, Rodgers (2007b, p. 3) determined that the estimated number of lesser prairie-chickens per unit area, based on lek surveys conducted in Hamilton County, Kansas, declined by nearly 70 percent from 2006 levels and were the lowest on record at that time. In comparison to the 2011 and 2012 drought, the Palmer Drought Severity Index for the May through September period in Kansas during the 2006 drought was minus 2.83 in climate division 4 and minus 1.52 in climate division 7. Based on the Palmer

Drought Severity Index, drought conditions from 2011to 2013 were much more severe than those observed in 2006. The National Weather Service Climate Prediction Center (2014) predicts that through the end of April 2014, drought conditions will persist or intensify over the entire estimated occupied range. Unless the outlook changes, we anticipate that drought conditions will again adversely impact habitat during the nesting and brood rearing season. Such impacts will reduce nesting success and recruitment well into 2014.

Drought impacts the lesser prairie-chicken through several mechanisms. Drought affects seasonal growth of vegetation necessary to provide suitable nesting and roosting cover, food, and opportunity for escape from predators (Copelin 1963, pp. 37, 42; Merchant 1982, pp. 19, 25, 51; Applegate and Riley 1998, p. 15; Peterson and Silvy 1994, p. 228; Morrow *et al.* 1996, pp. 596–597). Lesser prairie-chicken home ranges will temporarily expand during drought years (Copelin 1963, p. 37; Merchant 1982, p. 39) to compensate for scarcity in available resources. During these periods, the adult birds expend more energy searching for food and tend to move into areas with limited cover in order to forage, leaving them more vulnerable to predation and heat stress (Merchant 1982, pp. 34–35; Flanders-Wanner *et al.* 2004, p. 31). Chick survival and recruitment may also be depressed by drought (Merchant 1982, pp. 43–48; Morrow 1986, p. 597; Giesen 1998, p. 11; Massey 2001, p. 12), which likely affects population trends more than annual changes in adult survival (Hagen 2003, pp. 176–177). Drought-induced mechanisms affecting recruitment include decreased physiological condition of breeding females (Merchant 1982, p. 45); heat stress and water loss of chicks (Merchant 1982, p. 46); and effects to hatch success and juvenile survival due to changes in microclimate, temperature, and humidity (Patten *et al.* 2005a, pp. 1274–1275; Bell 2005, pp. 20–21; Boal *et al.* 2010, p. 11). Precipitation, or lack thereof, appears to affect lesser prairie-chicken adult population trends with a potential lag effect (Giesen 2000, p. 145). That is, rain in one year promotes more vegetative cover for eggs and chicks in the following year, which enhances their survival.

Although lesser prairie-chickens have persisted through droughts in the past, the effects of such droughts are exacerbated by 19th–21st century land use practices such as heavy grazing, overutilization, and land cultivation (Merchant 1982, p. 51; Hamerstrom and Hamerstrom 1961, pp. 288–289; Davis *et al.* 1979, p. 122; Taylor and Guthery 1980a, p. 2), which have altered and fragmented existing habitats. In past decades, fragmentation of lesser prairie-chicken habitat likely was less extensive than current conditions, and connectivity between occupied habitats was more prevalent, allowing populations to recover more quickly. As lesser prairie-chicken populations decline and become more fragmented, their ability to rebound from prolonged drought is diminished. This reduced ability to recover from drought is particularly concerning given that future climate projections suggest that droughts will only become more severe. Projections based on an analysis using 19 different climate models revealed that southwestern North America, including the entire estimated historical and occupied range of the lesser prairie-chicken, will consistently become drier throughout the 21st century (Seager *et al.*

2007, p. 1181). Severe droughts should continue into the future, particularly during persistent La Niña events, but they are anticipated to be more severe than most droughts on record (Seager *et al.* 2007, pp. 1182–1183).

Grisham *et al.* (2013, entire) recently evaluated the influence of drought and projected climate change on reproductive ecology of the lesser prairie-chicken in the Southern High Plains (eastern New Mexico and Texas panhandle). They predicted that average daily survival would decrease dramatically under all climatic scenarios they examined. Nest survival from onset of incubation through hatching were predicted to be less than or equal to 10 percent in this region within 40 years. Modeling results indicated that nest survival would fall well below the threshold for population persistence during that time (Grisham *et al.* 2013, p. 8). Although estimates of persistence of lesser prairie-chickens provided by Garton (2012, pp. 15–16) indicated that lesser prairie-chickens in the Shinnery Oak Prairie Region (New Mexico and Texas) had a relatively high likelihood of persisting over the next 30 years, he only examined current information and did not fully consider the implications of projected impacts of climate change in his analysis. Climate change projections provided by Grisham *et al.* (2013, p.8) indicate that the prognosis for persistence of lesser prairie-chickens within this isolated region on the southwestern periphery of the range is considerably worse than previously predicted under projected climate change scenarios.

Storms—Very little published information is available on the effects of certain isolated weather events, like storms, on lesser prairie-chicken. However, hail storms are known to cause mortality of prairie grouse, particularly during the spring nesting season. Fleharty (1995, p. 241) provides an excerpt from the May 1879 Stockton News that describes a large hailstorm near Kirwin, Kansas, as responsible for killing prairie-chickens (likely greater prairie-chicken) and other birds by the hundreds. In May of 2008, a hailstorm killed six lesser prairie-chickens in New Mexico (Beauprez 2009, p. 17; Service 2009, p. 41). Although such phenomena are undoubtedly rare, the effects can be significant, particularly if they occur during the nesting period.

A severe winter snowstorm in 2006, centered over southeastern Colorado, resulted in heavy snowfall, no cover, and little food in southern Kiowa, Prowers, and most of Baca Counties for over 60 days. The storm was so severe that more than 10,000 cattle died in Colorado alone from this event, in spite of the efforts of National Guard and other flight missions that used cargo planes and helicopters to drop hay to stranded cattle (Che *et al.* 2008, pp. 2, 6). Lesser prairie-chicken numbers in Colorado experienced a 75 percent decline from 2006 to 2007, from 296 birds observed to only 74. Active leks also declined from 34 leks in 2006 to 18 leks in 2007 (Verquer 2007, p. 2). Most strikingly, no active leks have been detected since 2008 in Kiowa County, which had six active leks in the several years prior to the storm. The impacts of the severe winter weather, coupled with drought conditions observed in 2006, probably account for the decline in the number of lesser prairie-chickens observed in 2007 in Colorado (Verquer 2007, pp. 2–3). Birds continued to slowly recover following this storm event, with numbers peaking in 2011 (Smith 2013, p.3). Since 2011, numbers of birds have declined and are just slightly above numbers reported in 2007.

In summary, extreme weather events can have a significant impact on individual populations of lesser prairie-chickens. While improving habitat quality and quantity can help stabilize grouse populations and enhance resiliency, it has little influence on stochastic processes like drought and hailstorms that can lead to extinction in local populations (Silvy *et al*. 2004, p. 19). Extreme weather events will continue to occur, as they have in the past, and only where lesser prairie-chickens populations are sufficiently resilient can they be expected to persist. The impact of extreme weather events is especially significant in considering the status of the species as a whole if the impacted population is isolated from individuals in other nearby populations that may be capable of recolonizing or supplementing the impacted population. Droughts, severe storms and other extreme weather events, although recurring, are unpredictable and little can be done to alter or control the occurrence or significance of these events. Such events, and the anticipated impacts, are expected to continue to occur into the future. Drought, in particular, may occur throughout the range of the species, as it did in 2011, 2012, and 2013, and can severely impact persistence of the lesser prairie-chicken. In particular, the persistence of the lesser prairie-chicken in the southwestern portions of the estimated occupied range (New Mexico and Texas) appears to be highly unlikely over the next 30 to 40 years, particularly considering the implications of climate change and recurring droughts (Grisham *et al.* (2013, entire). Loss of these populations would exacerbate the ongoing reduction in occupied range that has been evident over the past century. Extreme weather events, principally drought, are a threat to the lesser prairie-chicken, particularly when considered in light of other threats such as habitat loss, fragmentation and climate change, that reduce resiliency of the species.

Influence of Noise

The timing of displays and frequency of vocalizations in lesser prairie-chickens and other prairie grouse appear to have developed in response to conditions prevalent in prairie habitats and indicates that effective communication, particularly during the lekking season, operates within a fairly narrow set of conditions. Grasslands are considered poor environments for sound transmission because absorption by vegetation and the ground, combined with scattering caused by high winds and thermal turbulence causes the sound intensity to diminish (attenuate) rapidly (Morton 1975, pp. 17, 28; Sparling 1983, p. 40). In a response to this excess attenuation, grassland birds would have to evolve mechanisms that counteract this attenuation in order to communicate effectively over long distances. One primary means of overcoming this barrier would be to produce vocalizations with low carrier frequencies (Sparling 1983, p. 40), as is common in prairie grouse. Activity patterns also may play an important role in facilitating communication in grassland environments (Morton 1975, p. 30). Prairie grouse usually initiate displays on the lekking grounds around sunrise, and occasionally near sunset, corresponding with times of decreased wind and thermal turbulence (Sparling 1983, p. 41). Considering the narrow set of conditions in which communication appears most effective for breeding lesser prairie-chickens, and the importance of communication to successful reproduction, activities that disrupt or alter these conditions likely will have a negative impact on reproductive potential and population growth.

While human activities, such as livestock management, grassland restoration, shrub control and pesticide application, as discussed in the sections above, all cause varying degrees of noise, the impacts of noise on lesser prairie-chickens is more readily apparent and often most persistent (chronic) when it occurs in association with placement of human infrastructure, as discussed in several of the sections below. Almost any anthropogenic feature or related activity that occurs on the landscape can create noise that exceeds the natural background or ambient level. Expansion of transportation networks, urban/suburban development, mineral and other forms of resource extraction and motorized recreation are responsible for most chronic noise exposure in terrestrial environments (Barber *et al*. 2009, p. 1980). In terrestrial systems, the impact of noise may manifest itself in modified behavioral response, physiological stress, and various impacts on communication (Barber *et al*. 2009, p. 181). Noise that results in either physiological stress or impacts communication is likely to then cause a behavioral response. When the behavioral response to noise is avoidance, as it often is for lesser prairie-chickens and other prairie grouse, noise can be a major source of habitat loss or degradation and lead to increased habitat fragmentation.

Several studies have examined the effect of noise on greater sage-grouse. Crompton (2005, p. 10) monitored the installation of a well pad in Utah that was placed within 200 m (656 ft) of a greater sage-grouse lek during 2001. When construction was complete and the pumping unit was operating, noise levels recorded 20 m (66 ft) from the pumping unit were 70 dB and had dropped to 45 dB when measured 200 m (656 ft) from the pumping unit (Crompton 2005, p. 10). Attendance of males at this lek declined dramatically beginning with installation of the well pad and the lek was completely abandoned within 2 years. The following year, the pumping unit was shut down for repairs during April and grouse briefly recolonized the lek. Overall, male lek attendance declined by 44 percent in areas that were developed for coalbed methane production compared with a 15 percent increase in male lek attendance in undeveloped areas (Crompton 2005, p. 10). Annual survival rates for females also were much lower (12.5 percent) in areas developed for coalbed methane than in undeveloped areas (73 percent) (Crompton 2005, p. 19). Consequently, Crompton (2005, p. 22) recommended that noise levels at active leks should be less than 40 dB and no well pad should be located within 1,500 m (0.93 mi) of an active lek. Sound muffling devices were recommended for all existing wells that were within this 1,500 m (0.93 mi) buffer.

Blickley *et al*. (2012a, entire) examined the impact of chronic noise on greater sage-grouse using playback experiments. This study was accomplished by recording noise associated with natural gas drilling rigs and the traffic associated with gas-field roads and then re-playing these recordings near leks. Their results suggest that chronic noise had a negative impact on lek attendance by male greater sage-grouse. Peak male attendance decreased by 73 percent at leks exposed to road noise and 29 percent at leks exposed to noise from gas drilling activity, when compared to paired control leks (Blickley *et al*. 2012a, p. 467). The observed decrease in lek attendance was immediate and sustained throughout the study, although modeling suggested that attendance at the leks rebounded once the noise ceased (Blickley *et al*. 2012a, p. 467). Because the sound volume of the recorded playback was not loud enough to cause direct injury, they concluded that the sounds caused displacement of the males that would normally have attended the leks (Blickley *et al*. 2012a, p. 468). Although higher mortality caused by increased predation was another possible mechanism for the observed decreases in lek attendance, they did not consider increased predation to be a factor due to low observations of predation events at the leks and because predation would result in a gradual decrease in attendance rather than the rapid and sustained decline they observed (Blickley *et al*. 2012a, p. 467). Displacement was likely the result of masking of the male's vocalizations at the lek, reducing ability of females to detect acoustic cues and locate leks in noisy areas (Blickley *et al*. 2012a, p. 469).

Related work by Blickley and Patricelli (2012, entire) examined the potential for noise to mask the sounds used by greater sage-grouse during communication. They stated that most anthropogenic noise is dominated by low frequencies and that birds, such as greater sage-grouse, that produce vocalizations dominated by low frequencies will disproportionately have their vocalizations masked by these developments (Blickley and Patricelli 2012, p. 31). Measurements were taken at various noise sources typically associated with oil and gas operations, including a compressor station, a deep natural gas drilling rig, and at a diesel powered generator (Blickley and Patricelli 2012, p. 27). They also measured the ambient noise associated with an undisturbed lek after lekking had ceased in the morning and expressed the noise produced by each source in relation to the ambient noise levels at various distances. All sounds were recorded at a height of 25 cm (10 in) which roughly corresponds to the height of a typical grouse (Blickley and Patricelli 2012, p. 27). Noise produced by the compressor was 48.9 dB higher than ambient levels at a distance of 75 m (246 ft) from the source and 34.2 dB higher at 400 m (1,312 ft) from the source (Blickley and Patricelli 2012, p. 28). Noise produced by the drilling rig was slightly less than these values at the same distances and noise produced by the generator was 24.9 dB and 18.4 dB higher than ambient levels at these distances. Butler *et al.* (2010. pp. 1160–1161) observed the intensity of booming in lekking lesser prairie-chickens and estimated that sound intensity of booming vocalizations would be less than or equal to 60 dB at 21 m (69 ft), less than or equal to 30 dB at 645 m (2,116 ft) and about 22 dB at 1.6 km (5,240 ft).

The frequency of the sounds produced by these sources at these same distances was 8 kilohertz (kHz) or less. The variety of vocalizations produced by greater sage-grouse peaked at 11.5 kHz or less (Blickley and Patricelli 2012, p. 29). Based on this study, noise produced by typical oil and gas infrastructure can mask grouse vocalizations and compromise the ability of female greater sage-grouse to find active leks when such noise is present (Blickley and Patricelli 2012, p. 32). Although female grouse also use visual cues to assess potential mates on a lek, noisy leks can cause female attendance at these leks to decline. As previously discussed in this section, chronic noise associated with human activity also leads to reduced male attendance at noisy leks. While the effects of masking will decline with distance from the sound source, other communication used by grouse off the lek, such as parent-offspring communication, may continue to be susceptible to masking by noise from human infrastructure (Blickley and Patricelli 2012, p. 33). These findings are particularly important in assessing the impacts of development on grouse activity, especially considering that females use the sounds produced by the males during courtship to locate a lek, then once a lek has been located, to select a mate from the males displaying on that lek. Breeding, reproductive success and ultimately recruitment in areas with human developments could be impaired by inappropriate placement of such developments, impacting survival. Additionally behavioral responses exhibited by grouse when exposed to chronic noise could lead to reductions in the amount of suitable habitat and negatively influence survival and population size in such areas.

During related studies, Blickley *et al*. (2012b, entire) evaluated the implications of chronic noise on the physiological health of lekking male greater sage-grouse through the assessment of glucocorticoid hormone levels. Glucocorticoid hormones are secreted into the blood in response to stress and their metabolites can be measured in fecal samples as an indication of the stress response. In this study, noise associated with roads and drilling activity, as described in Blickley *et al*. (2012a, pp. 464–466), was recorded and replayed at active greater sage-grouse leks. Males exposed to chronic noise had higher (16.7 percent, on average) fecal levels of immunoreactive corticosteroid metabolites than did males from undisturbed leks, confirming chronic noise increased stress levels in male sage grouse that remained on the noisy leks (Blickley *et al*. 2012b, pp. 4–5). However, there was little difference in male response in relation to the type (e.g., road or drilling) of noise. Chronic noise created less desirable habitat for greater sage-grouse than habitat present at undisturbed locations, at least at breeding sites (Blickley *et al*. 2012b, p. 6). The impacts of chronic noise on stress levels in wintering, nesting, and for foraging males are unknown. Noise is likely perceived as a threat by greater sage-grouse and may impact social interactions, including territorial response and recognition of other greater sage grouse (conspecifics), feeding activities and responses to predation, particularly if alarm calls are masked by noise (Blickley *et al*. 2012b, p. 6). Chronic noise may not only reduce the amount of useable space but chronic physiological stress could potentially affect overall health of the organism including disease resistance, survival, and reproductive success.

We anticipate similar behavioral responses by lesser prairie-chickens because their vocalizations are low frequency and vocalization intensity is less than or equal to sound intensity produced by many man-made developments. Blickley *et al*. (2012a, p. 470) believed that noise may be a possible factor in the population declines of other species of lekking grouse in North America, particularly for populations that are exposed to human developments. Like sage grouse, lesser prairie-chicken vocalizations are low frequency, generally less than 4 kHz (Sharpe 1968, p. 111–146; Hagen and Giesen 2005, unpaginated), and subject to being masked by noise from human developments. Butler *et al*. (2010, p. 1161) predicted sound intensity of lesser prairie-chicken booming vocalizations would be 60 dB or less at 21 m (69 ft) and 30 dB or less at 645 m (2,116 ft) from the lek.

Hunt (2004, p. 141) measured sound levels at 33 active and 39 abandoned lesser prairie-chicken leks in New Mexico in an attempt to determine the relationship between noise levels and lek activity. Noise levels from several types of infrastructure associated with oil and gas drilling operations were measured (Hunt 2004, pp. 147–148). Average noise levels of drilling rigs at a distance of 320 m (1,050 ft) was 24 dB above ambient levels measured at active leks and average noise levels for propane and electric powered pumping units at this same distance were 14 and 5.9 dB higher, respectively, than ambient levels at active leks. Although ambient noise levels at abandoned leks were significantly higher (average difference was 4 dB) than ambient noise levels at active leks, he concluded that the observed difference did not, by itself, completely explain why the leks were abandoned (Hunt 2004, p. 142). Other factors associated with petroleum development, such as human activity, presence of power lines and road density, likely contributed to abandonment of the leks they observed (Hunt 2004, p. 142). Abandoned leks had more active wells, more total wells, and greater length of road than active leks, and were more likely than active leks to be near power lines (Hunt 2004, p. iv).

Pitman *et al*. (2005, p. 1264) observed the behavioral responses of nesting lesser prairie-chicken hens to the presence of anthropogenic features, such as wellheads, buildings, roads, transmission lines, and center-pivot irrigation fields, in southwestern Kansas. They reported that the presence of anthropogenic features resulted in the avoidance of 7,114 ha (17,579 ac) of the 13,380 ha (33,063 ac) of nesting habitat available within their study area and concluded that noise associated with these features likely contributed to the behavioral response exhibited by the nesting hens (Pitman *et al*. 2005, p. 1267). They also noted that sound levels, as measured 100 m (328 ft) from the source, ranged from 60-80 dB for center-pivots, 80-100 dB for compressor stations, and over 100 dB for a power plant. Additionally noise associated with transmission lines and heavy traffic from improved roads was audible at a distance over 2 km (1.2 mi) from the source.

In summary, noise can be associated with almost any form of human activity and wildlife often exhibit behavioral and physiological responses to the presence of noise. Vocalizations between individuals of a species are important social cues that can influence habitat use, mate selection, breeding activity, survival and ultimately population size and persistence. In prairie chickens, the “boom” call transmits information about sex, territorial status, mating condition, location, and individual identity of the signaler and thus are important to courtship activity and for long-range advertisement of the display ground (Sparling 1981, p. 484). Chronic noise can interfere with these social interactions by masking important forms of communication between individuals. Opportunities for effective communication on the display ground also occurs under fairly narrow conditions and disturbance during this period may have negative consequences for reproductive success. In lesser prairie-chickens, persistent noise likely causes lek attendance to decline, disrupts courtship and breeding activity, impairs habitat quality and reduces reproductive success. Noise causes abandonment of otherwise suitable habitats and contributes to habitat loss and degradation. Many of the development activities discussed in the sections below, particularly energy development, emit noises that likely cause specific behavioral responses by lesser prairie-chickens. As these types of developments continue to increase within the estimated occupied range, as expected, the impacts of noise from these activities likely will be amplified and will be detrimental to the persistence of the lesser prairie-chicken, particularly at the local level.

Wind Power and Energy Transmission Operation and Development

Wind power is a form of renewable energy that is increasingly being used to meet electricity demands in the United States. The U.S. Energy Information Administration has estimated that the demand for electricity in the United States will grow by 39 percent between 2005 and 2030 (U.S. Department of Energy (DOE) 2008, p. 1). Wind energy, under one scenario, would provide 20 percent of the United States' estimated electricity needs by 2030 and require at least 250 gigawatts of additional land-based wind power capacity to achieve predicted levels (DOE 2008, pp. 1, 7, 10). The forecasted increase in production would require about 125,000 turbines based on the existing technology and equipment in use and assuming a turbine has a generating capacity of 2 megawatts (MW). Achieving these levels also would require expansion of the current electrical transmission system. Most of the wind power development needed to meet these anticipated demands is likely to come from the Great Plains States because they have high wind resource potential, which exerts a strong, positive influence on the amount of wind power developed within a particular State (Staid and Guikema 2013, p. 384).

All 5 lesser prairie-chicken States are within the top 12 States nationally for potential wind capacity, with Texas ranking second for potential wind energy capacity and Kansas ranking third (American Wind Energy Association 2012b, entire). The potential for wind development within the estimated historical and occupied ranges of the lesser prairie-chicken is apparent from the wind potential estimates developed by the DOE's National Renewable Energy Laboratory and AWS Truewind (DOE National Renewable Energy Laboratory 2010b, p. 1). These estimates present the predicted mean annual wind speeds at a height of 80 m (262 ft). Areas with an average wind speed of 6.5 m/s (21.3 ft/s) and greater at a height of 80 m (262 ft) are generally considered to have a suitable wind resource for large scale development. All of the estimated historical and occupied range of the lesser prairie-chicken occurs in areas determined to have 6.5 m/s (21.3 ft/s) or higher average windspeed (DOE National Renewable Energy Laboratory 2010b, p. 1). The vast majority of the estimated occupied range lies within areas having wind speeds of 7.5 m/s (24.6 ft/s) or higher. These wind speeds provide good to excellent potential for wind energy production and represent the highest potential areas for wind energy development.

Numerous financial incentives, including grants, production incentives and tax relief, already are available to help encourage and promote development of renewable energy sources. Four (Colorado, Kansas, New Mexico and Texas) of the five states that encompass the range of the lesser prairie-chicken have renewable portfolio standards (Hitaj 2013, pp. 408–409). Renewable portfolio standards require that utilities obtain a certain percentage of their electricity from renewable energy sources and there may be substantial financial penalties for noncompliance. The percentage of renewable energy in each portfolio varies from a low of 4.4 percent in Texas to a high of 27 percent in Colorado (Hitaj 2013, pp. 408–409). With the exception of Texas, which was extended to 2025, all of the renewable portfolio standards that have been established within the lesser prairie-chicken States have an established target date of 2020. Only Oklahoma does not have a renewable portfolio standard. Evaluation of the effects of renewable portfolio standards have concluded that these standards have had a significant, positive impact on the development of wind power within those States with existing renewable portfolio standards (Yin and Powers 2010, p. 1149). Oklahoma and New Mexico offer production incentives, and Colorado, Kansas and Texas provide property tax incentives. Texas also provides a corporate tax credit on equipment and installation costs (Hitaj 2013, p. 409).

At the National level, wind power development has been incentivized by the Federal renewable energy production tax credit, most recently 2.3 cents per kilowatt-hour. The credit typically applies to the first 10 years of operation but unused credits may be carried forward for up to 20 years. This credit first became available in 1992 and has had an important effect on investment and development by the wind power industry (Hitaj 2013, p. 404; Staid and Guikema 2013, p. 378). Development has slowed during periods when the availability of the Federal production tax credit was uncertain (Bird *et al*. 2005, p. 1398; Staid and Guikema 2013, p. 378). The production tax credit expired in 2012 but was extended in January of 2013 through the end of the calendar year. The Federal production tax credit has since expired and its future is currently unknown. Typically, for years in which the production tax credit has not been in place development has slowed and the years prior to expiration have shown a boom in wind power development (Blair 2012, p. 10).

Wind farm development begins with site monitoring and collection of meteorological data to characterize the available wind regime. Turbines are installed after the meteorological data indicate appropriate siting and spacing. The tubular towers of most commercial, utility-scale onshore wind turbines are between 65 m (213 ft) and 100 m (328 ft) tall. The most common system uses three rotor blades and can have a diameter of as much as 100 m (328 ft). The total height of the system is measured when a turbine blade is in the 12 o'clock position and will vary depending on the length of the blade. With blades in place, a typical system will exceed 100 m (328 ft) in height. A wind farm will vary in size depending on the size of the turbines and amount of land available. Typical wind farm arrays consist of 30 to 150 towers each supporting a single turbine. The individual permanent footprint of a single turbine unit, about 0.3 to 0.4 ha (0.75 to 1 ac), is relatively small in comparison with the overall footprint of the entire array (DOE 2008, pp. 110–111). Spacing between each turbine is usually 5 to 10 rotor diameters to avoid interference between turbines. Roads are necessary to access the turbine sites for installation and maintenance. One or more substations, where the generated electricity is collected and transmitted, also may be built depending on the size of the wind farm. Considering the initial capital investment, and that the service life of a single turbine is at least 20 years (DOE 2008, p. 16), we expect most wind power developments to be in place for at least 20 years.

Siting of commercially viable wind energy developments is largely based on wind intensity (speed) and consistency, and requires the ability to transmit generated power to the users. Any discussion of the effects of wind energy development on the lesser prairie-chicken also must take into consideration the influence of the transmission lines critical to distribution of the energy generated by wind turbines. Transmission lines can traverse long distances across the landscape and can be both above ground and underground, although the vast majority of transmission lines are erected above ground. Most of the impacts to lesser prairie-chicken associated with transmission lines are with the aboveground systems. Support structures vary in height depending on the size of the line. Most high-voltage powerline towers are 30 to 38 m (98 to 125 ft) high but can be higher if the need arises. Local distribution lines are usually much shorter in height but can still contribute to fragmentation of the landscape. Local distribution lines, while more often are erected above ground, can be placed below ground. Financial investment in the transmission of electrical power has been steadily climbing since the late 1990s and includes not only the cost of maintaining the existing system but also includes costs associated with increasing reliability and development of new transmission lines (DOE 2008, p. 94). Manville (2005, p. 1052) reported that there are at least 804,500 km (500,000 mi) of transmission lines (lines carrying greater than 115 kilovolts (kV)) within the United States. Recent transmission-related activities within the estimated historical and occupied ranges include the creation of Competitive Renewable Energy Zones in Texas and the “X plan” under consideration by the Southwest Power Pool, which are discussed in more detail below.

Wind energy developments already exist within the estimated historical range of the lesser prairie-chicken, some of which have impacted occupied habitat. The 5 lesser prairie-chicken States are all within the top 20 States nationally for installed wind capacity (American Wind Energy Association 2012a, p. 6). By the close of 1999, the installed capacity, in MW, of wind power facilities within the five lesser prairie-chicken States was 209 MW; the majority, 184 MW, was provided by the State of Texas (DOE National Renewable Energy Laboratory 2010a, p. 1). At the close of 2012, the installed capacity within the five lesser prairie-chicken States had grown to 21,140 MW (Wiser and Bollinger 2013, p. 9). Although not all of this installed capacity is located within the estimated historical or occupied ranges of the lesser prairie-chicken, and includes any offshore wind projects in Texas (one non-commercial tower at close of 2013), there is considerable overlap between the estimated historical and occupied ranges and those areas having good to excellent wind potential, as determined by the DOE's National Renewable Energy Laboratory (DOE National Renewable Energy Laboratory 2010b, p. 1). Areas having good to excellent wind potential represent the highest priority sites for wind power development, particularly where projects have access to transmission systems with available capability.

Within the estimated occupied range in Colorado, existing wind projects are located in Baca, Bent, and Prowers Counties. Colorado's installed wind capacity grew by 39 percent in 2011 (American Wind Energy Association 2012b, entire). In Kansas, Barber, Ford, Gray, Kiowa, and Wichita Counties have existing wind projects. Kansas is expected to double their existing capacity in 2012 and leads the United States with the most wind power under construction (American Wind Energy Association 2012b, entire). By the close of 2012, Kansas had installed the most capacity (1,441 MW) of any State (Wiser and Bollinger 2013, p. 9). Curry, Roosevelt, and Quay Counties in the New

Mexico portion of the estimated occupied range currently have operating wind projects. There are 14,136 MW (roughly 5,654 2.5 MW turbines) in the queue awaiting construction (American Wind Energy Association 2012b, entire). In Oklahoma, Custer, Dewey, Harper, Roger Mills, and Woodward Counties have existing wind farms. Approximately 393 MW are under construction and there is another 14,667 MW in the queue awaiting construction. In Texas, Carson, Moore, Oldham and Randall counties have existing wind farms. Wiser and Bollinger (2013, p. 12) reported that nationwide, by the end of 2012, there were about 125 GW of wind power projects within the interconnection queues awaiting development. This figure represents more than double the existing developed wind capacity in the United States with Texas (Electric Reliability Council of Texas) and the Southwest Power Pool having almost 32 percent of the total capacity in the interconnection queues (Wiser and Bollinger 2013, pp. 12–13). These two transmission system operators encompass almost all of the estimated occupied range of the lesser prairie-chicken in Kansas, New Mexico, Oklahoma and Texas.

Most published literature on the effects of wind development on birds focuses on the risks of collision with towers or turbine blades. Until recently, there was very little published research specific to the effects of wind turbines and transmission lines on prairie grouse and much of that focuses on avoidance of the infrastructure associated with renewable energy development (see previous discussion on vertical structures in the "Causes of Habitat Fragmentation within Lesser Prairie-Chicken Range" section above and discussion that follows). We find that many wind power facilities are not monitored consistently enough to detect collision mortalities and the observed avoidance of and displacement influenced by the vertical infrastructure observed in prairie grouse likely minimizes the opportunity for such collisions to occur. However, Vodenhal *et al.* (2011, unpaginated) has observed both greater prairie-chickens and plains sharp-tailed grouse (*Tympanuchus phasianellus jamesi*) lekking near the Ainsworth Wind Energy Facility in Nebraska since 2006. The average distance of the observed display grounds to the nearest wind turbine tower was 1,430 m (4,689 ft) for greater prairie-chickens and 1,178 m (3,864 ft) for sharp-tailed grouse.

Greater prairie-chickens also were observed within a wind power development in Kansas, indicating that strong avoidance of such developments by prairie grouse is not always evident and, under some conditions, the impacts may occasionally be beneficial. Winder *et al.* (2013, entire), as part of a larger study that examined the environmental impacts of the Meridian Way wind power project in northcentral Kansas, examined the effects of wind energy development on survival of female greater prairie-chickens. The study site was located in an area that was considerably fragmented, having a relatively high density of roads and moderately high incidence of row crop agriculture (35 percent) for a primarily grassland landscape (Winder *et al.* 2013, p. 3). They concluded that development of this wind power facility did not negatively impact survival of female greater prairie-chickens. In fact, survival increased significantly post construction (Winder *et al.* 2013, p. 5), perhaps in response to changes in predator behavior following completion of construction in 2008. Prior to construction, they observed that the majority of greater prairie-chicken mortality was due to predation, principally during the lekking season (Winder *et al.* 2013, p. 6). Post construction, they speculated that the presence of the wind farm altered predator activity on the study area although they did not specifically record information on numbers of predators before and after construction (Winder *et al.* 2013, p. 7).

Because Winder *et al.* (2013, entire) only provided information on adult survival associated with wind farm development; we lack information on recruitment and the long-term persistence of greater prairie-chickens at this site. While adult survival is one of several demographic factors that influence population growth, it is rarely as important as nest and brood survival in prairie grouse, particularly lesser prairie-chickens (Pitman *et al*. 2006b, p. 679; Hagen *et al*. 2009, pp. 1329–1330; Grisham 2012, p. 153; Hagen *et al.* 2013, p. 750). The lack of information on nest and brood survival, thus recruitment, could result in misrepresentation of the impacts of the wind farm. For example, female survival may have been demonstrated to increase post construction, but we do not know from this study if the females nested or the fate of those nests and of any broods that might have been produced. Previous studies on lesser prairie-chickens demonstrated that females would not nest within specific distances of certain vertical structures (Pitman *et al.* 2005, pp. 1267–1268). Additionally, Winder *et al.* (2013, entire) did not provide any information on habitat selectivity by the adults or persistence of leks at the study site. Consequently, we do not know whether the birds actively chose to remain at that location, or simply continued to use the only remaining usable habitat and are unable to persist long term. While they did report that over 75 percent of the leks were located within 8 km (5 mi) of a turbine, the fate of those leks post construction were not reported (Winder *et al.* 2013, p. 3).

However, additional information regarding this study is available that provides more insight into some aspects of the effects of wind power development on greater prairie-chickens and helps address some of the concerns presented above (Sandercock *et al.* 2012, entire). With respect to lek persistence, the distance from a wind turbine was not shown to have a statistically significant effect on the probability of lek persistence (Sandercock *et al.* 2012, p. 11). However, lek sites located less than 5 km (3.1 mi) from a turbine had a lower probability of persistence than leks that were located larger distances from a turbine, leading the authors to conclude that wind energy development negatively impacted lek persistence (Sandercock *et al.* 2012, p. 11). Females were not observed to select nest sites at random; instead they preferred to nest in native grasslands (Sandercock *et al.* 2012, p. 25). Although females may have remained at the site post construction due to the continued presence of suitable grassland habitat, Sandercock *et al.* (2012, p. 3) did not observe any impacts of wind power development on nest site selection, nesting success, or female reproductive effort. However, they did report weak evidence for avoidance of wind turbines by female greater prairie-chickens that were not attending nests or broods during the breeding season (Sandercock *et al.* 2012, p. 25). Prior to construction, some 20 percent of the observed movements would have crossed the location of the proposed wind farm but post construction only 11 percent of the observed movements crossed the area where actual wind energy infrastructure existed. They concluded that females were more likely to move away from wind power infrastructure and may lead to fragmentation of existing populations post construction (Sandercock *et al.* 2012, p. 25).

When male fitness was examined, they observed that the residual body mass of male greater prairie-chickens at lek sites near turbines declined post construction and may have negatively impacted individual survival or reproductive performance (Sandercock *et al.* 2012, p. 53). Reduced body condition also may impact flight performance and increase predation risk in males displaying on leks. Based on counts of males at leks, Sandercock *et al.* (2012, p. 61), did not find that greater prairie-chicken population size was negatively impacted by wind power development. However, following construction, they observed that the number of males declined over the next 3 years of the study and resulted in finite rates of population change indicative of a declining population (Sandercock *et al.* (2012, p. 61). They also observed that wind power development did appear to reduce dispersal rates or change settlement patterns in greater prairie-chickens, leading to higher rates of relatedness among males.

As evident from the study of the Meridian Way Wind Power Development, under some conditions, and with some species of grouse, the displacement effects of wind power projects may not be as strong as observed with other types of developments. In the instance of female survival, the presence of wind turbines may enhance survival, particularly if the presence of the turbines leads to reduced rates of predation. However, at least in this study, the presence of the wind power development was not entirely benign and the fragmented nature of the landscape surrounding the study site may have exerted a stronger influence on the observed behavior of greater prairie-chickens than did the presence of the wind turbines over the three year period examined in this study. Under these conditions, the birds may have perceived the wind project site as more suitable than the surrounding landscape.

These studies also appear to indicate that greater prairie-chickens may be more tolerant of wind turbine towers than other species of prairie grouse (Winder *et al.* (2013, p. 9). Hagen (2004, p. 101) cautions that occurrence near such structures may be due to strong site fidelity or continued use of suitable habitat remnants and that these populations actually may not be able to sustain themselves without immigration from surrounding populations (i.e., population sink). If greater prairie-chickens are less sensitive to wind energy development, this may, at least partially explain why greater prairie-chickens also continue to utilize grassland habitats at the Ainsworth Wind Energy Facility in Nebraska.

Currently, we have no documentation of any collision-related mortality in wind farms for lesser prairie-chickens. In Kansas, Winder *et al.* (2013, p. 8) did observe collision mortality before and after construction of a wind farm but those mortalities were due to fences or power lines and not the turbines themselves. Similarly, no deaths of gallinaceous birds (upland game birds) were reported in a comprehensive review of avian collisions and wind farms in the United States; the authors hypothesized that the average tower height and flight height of grouse minimized the risk of collision (Erickson *et al*. 2001, pp. 8, 11, 14, 15). However, Johnson and Erickson (2011, p. 17) monitored commercial scale wind farms in the Columbia Plateau of Washington and Oregon and observed that about 13 percent of the observed collision mortalities were nonnative upland game birds: ring-necked pheasant, gray partridge (*Perdix perdix*), and chukar (*Alectoris chukar*). Although the risk of collision with individual wind turbines appears low, commercial wind energy developments can directly alter existing habitat, contribute to habitat and population fragmentation, and cause more subtle alterations that influence how species use habitats in proximity to these developments (National Research Council 2007, pp. 72–84).

Wind turbines can generate significant levels of noise. Estimates of the noise created by wind turbines vary depending on a variety of factors. Cummins (2012, p. 12-15) summarizes information on wind turbine noise, including use of sound contour maps to explain how turbine noise changes with distance, topography, and turbine layout. Generally, the wind energy industry expects that turbine noise will average 35 to 45 dB at 350 m (1,150 ft) from an operating turbine but in some instances the sound may continue to exceed 45 dB as far as 0.8 km (0.5 mi) from the sound source (Cummings 2012, p. 13). Noise levels obviously could peak at levels higher than the average. Most noise produced by wind turbines also is low frequency, typically 0.25 kHz or less (Cummings 2012, p. 40). Noise levels of this magnitude and frequency may generate a behavioral response in lesser prairie-chickens and may result in avoidance of areas of otherwise suitable habitat.

Electrical transmission lines can directly affect prairie grouse by posing a collision hazard (Leopold 1933, p. 353; Connelly *et al.* 2000, p. 974; Patten *et al.* 2005b, pp. 240, 242) and can indirectly lead to decreased lek recruitment, increased predation, and facilitate invasion by nonnative plants. The physical footprint of the actual project is typically much smaller than the actual impact of the transmission line itself. Lesser prairie-chickens exhibit strong avoidance of tall vertical features such as utility transmission lines (Pitman *et al.* 2005, pp. 1267–1268). In typical lesser prairie-chicken habitat where vegetation is low and the terrain is relatively flat, power lines and power poles provide attractive hunting, loafing, and roosting perches for many species of raptors (Steenhof *et al.* 1993, p. 27). The elevated advantage of transmission lines and power poles serve to increase a raptor's range of vision, allow for greater speed during attacks on prey, and serve as territorial markers. Raptors actively seek out power lines and poles in extensive grassland areas where natural perches are limited. While the effect of this predation on lesser prairie-chickens undoubtedly depends on raptor densities, as the number of perches or nesting features increase, the impact of avian predation will increase. Additional discussion concerning the influence of vertical structures on predation of lesser prairie-chickens can be found in the "Causes of Habitat Fragmentation Within Lesser Prairie-Chicken Range" section above, and additional information on predation is provided in a separate discussion under "*Predation*" below.

Transmission lines, particularly due to their length, can be a significant barrier to dispersal of prairie grouse, disrupting movements to feeding, breeding, and roosting areas. Both lesser and greater prairie-chickens avoided otherwise suitable habitat near transmission lines and crossed these power lines much less often than nearby roads, suggesting that power lines are a particularly strong barrier to movement (Pruett *et al.* 2009a, pp. 1255–1257). Because lesser prairie-chickens avoid tall vertical structures like transmission lines and because transmission lines can increase predation rates, leks located in the vicinity of these structures may see reduced recruitment of new males to the lek (Braun *et al.* 2002, pp. 339–340, 343–344). Lacking recruitment, leks may disappear as the number of older males decline due to death or emigration. Linear corridors such as road networks, pipelines, and transmission line rights-of-way can create soil conditions conducive to the spread of invasive plant species, at least in semiarid sagebrush habitats (Knick *et al.* 2003, p. 619; Gelbard and Belnap 2003, pp. 424–425), but the scope of this impact within the range of the lesser prairie-chicken is unknown. Spread of invasive plants is most critical where established populations of invasive plants begin invading areas of native grassland vegetation.

Electromagnetic fields associated with transmission lines alter the behavior, physiology, endocrine systems, and immune function in birds, with negative consequences on reproduction and development (Fernie and Reynolds 2005, p. 135). Birds are diverse in their sensitivities to electromagnetic field exposure with domestic chickens known to be very sensitive. Although many raptor species are less affected by these fields (Fernie and Reynolds 2005, p. 135), no specific studies have been conducted on lesser prairie-chickens. However electromagnetic fields associated with powerlines and telecommunication towers may explain, at least in part, avoidance of such structures by sage grouse (Wisdom *et al.* 2011, pp. 467–468).

Identification of the actual number of proposed wind energy projects that will be built within the range of the lesser prairie-chicken in any future timeframe is difficult to accurately discern, particularly at smaller scales. Nationally, during the period from 1997 to 2002, the average annual growth rate in wind power was 24 percent (Bird *et al*. 2005, p. 1397). An analysis of the Federal Aviation Administration’s Daily Digital Obstruction File (obstacle database) can provide some insight into the number of existing and proposed wind generation towers. The Federal Aviation Administration is responsible for ensuring wind towers and other vertical structures are constructed in a manner that ensures the safety and efficient use of the navigable airspace. In accomplishing this mission, they evaluate applications submitted by the party responsible for the proposed construction and alteration of these structures. Included in the application is information on the precise location of the proposed structure. This information can be used, in conjunction with other databases, to determine the number of existing and proposed wind generation towers within the estimated historical and occupied ranges of the lesser prairie-chicken.

Analysis of the information contained in the obstacle database, as available in April 2010, revealed that 6,279 vertical structures, such as wind turbines, telecommunication towers, radio towers, meteorological towers and similar vertical structures, were located within the estimated historical range of the lesser prairie-chicken at that time. An additional estimated 8,501 vertical structures had been cleared for construction, and another 1,693 vertical structures were pending approval within the estimated historical range of the lesser prairie-chicken. While not all of these structures are wind generation towers, the vast majority are. A similar analysis was conducted on lesser prairie-chicken estimated occupied range. As of April 2010, the estimated occupied range included 173 vertical structures. Approximately 1,950 vertical structures had been cleared for construction, and another 250 vertical structures were awaiting approval. In January of 2012, an analysis of the Federal Aviation Administration's obstacle database showed that there were 405 existing wind turbines in or within 1.6 km (1 mi) of the estimated occupied range. In March of 2012, there were 4,887 wind turbines awaiting construction, based on the Federal Aviation Administration's obstruction evaluation database.

For this final rule, we conducted a more complete analysis of vertical structures in an effort to update the analysis we conducted in 2010, as explained above. As before, we used the Federal Aviation Administration's Daily Digital Obstruction File, current as of November 2013 to identify the vertical structures that were built and remain operational between 1974 and 2013. Generally these are vertical structures, such as wind towers and communication towers, that are at least 60.6 m (199 ft) above ground level or otherwise have been deemed a hazard to aviation. Within the historical range of the lesser prairie-chicken, there were a total of 17,800 vertical structures identified, of which 9,109 were classified as windmill type (wind turbine) structures. Of those windmill structures 1,074 had been approved after December 12, 2012, the date of our proposed rule. Within the EOR +10, as previously described, there were 3,714 vertical structures identified in the database of which about 1,398 vertical structures were classified by the Federal Aviation Administration (FAA) as windmill type structures. Of those structures, 405 were approved after December 12, 2012, the date of our proposed rule.

Similarly, we used a portion of the FAA's Obstruction Evaluation/Airport Airspace Analysis database, current as of December 2013, to estimate the number of wind turbines and meteorological towers that are awaiting construction or alteration, pending approval from the FAA. We included meteorological towers because their presence is often a good first indication that an area is being studied for wind development or as a means of monitoring wind and related data within an existing wind farm. These structures/features are grouped into four classes: determined hazard–structure has been given a hazard determination by FAA; determined with no build date–evaluation by FAA is complete, structure is not a hazard but no completion date has been provided; determined with build date–evaluation by FAA is complete, structure is not a hazard and a completion date has been provided; not yet determined–all structures proposed to be built and have submitted the Form 7460-1 but for which FAA has not yet made a determination as to whether the structure poses a hazard to air navigation. Our analysis of the historical range revealed that 36,197 wind and meteorological tower features have been proposed for development. Of that total number of features, 12,020 windmill features and 169 meteorological towers have been proposed for development within the EOR +10. Within the EOR +10, 1,513 windmill features and 37 meteorological towers were submitted for approval by FAA after the date of publication of our proposed listing rule on December 12, 2012.

Additionally, the Southwest Power Pool provides public access to its Generation Interconnection Queue (*https://studies.spp.org/GenInterHomePage.cfm*), which provides all of the active requests for connection from new energy generation sources requiring Southwest Power Pool approval prior to connecting with the transmission grid. The Southwest Power Pool is a regional transmission organization which overlaps all or portions of nine States, including Kansas, New Mexico, Oklahoma, and Texas, and functions to ensure reliable supplies of power, adequate transmission infrastructure, and competitive wholesale prices of electricity exist. The Southwest Power Pool's jurisdiction in Kansas, New Mexico, Oklahoma, and Texas does not include all of the historical or estimated occupied range of the lesser prairie-chicken but serves as a very conservative indicator of the amount of interest in wind power development in these four States. In 2010, within the Southwest Power Pool portion of Kansas, New Mexico, Oklahoma, and Texas, there were 177 wind generation interconnection study requests totaling 31,883 MW awaiting approval. A maximum development scenario, assuming all of these projects are built and they install all 2.0 MW wind turbines, would result in approximately 15,941 wind turbines being erected in these four States. Recently we conducted an additional analysis of the current information, as of January 28, 2014, within the Southwest Power Pool's Generation Interconnection Queue. We conducted this analysis to obtain a more recent evaluation of existing and proposed wind power development within the Southwest Power Pool's jurisdiction in portions of Kansas, New Mexico, Oklahoma, and Texas. There were a total of 74 projects in the queue within the counties encompassed by the EOR +10. Thirty-one of those projects were in commercial operation, thirty-eight were identified as being in planning or development and five projects were suspended and not currently moving forward. Fifteen of those thirty-eight projects, totaling 3,208.3 MW of power, that were identified as being in active planning or development were submitted for consideration after publication of our proposed rule on December 12, 2012. The total planned power production, in MW, for the projects in operation and in planning or development were 4,706.5 and 9,324.3, respectively. If we assume a typical turbine size of 2.0 MW, an estimated 7,015 turbines have been built or are in planning and development at this time within the counties encompassed by the EOR +10 within the Southwest Power Pool jurisdiction. These estimated values do not include development and planning within the Electric Reliability Council of Texas whose jurisdiction extends over most of the Texas Panhandle.

The possible scope of this anticipated wind energy development on the status of the lesser prairie-chicken can readily be seen in Oklahoma where the locations of many of the current and historically occupied leks are known. Most remaining large tracts of untilled native rangeland, and hence lesser prairie-chicken habitat, occur on topographic ridges. Leks, the traditional mating grounds of prairie grouse, are consistently located on elevated grassland sites with few vertical obstructions (Flock 2002, p. 35). Because of the increased elevation, these ridges also are prime sites for wind turbine development. In cooperation with ODWC, Service personnel in 2005 quantified the potential degree of wind energy development in relation to existing populations of lesser prairie-chicken in Oklahoma. All active and historically occupied lesser prairie-chicken lek locations in Oklahoma, as of the mid 1990s (n = 96), and the estimated occupied range, were compared with the Oklahoma Neural Net Wind Power Development Potential Model map created by the Oklahoma Wind Power Assessment project. The mapping analysis revealed that 35 percent of the estimated occupied range in Oklahoma is within areas designated by the Oklahoma Wind Power Assessment as "excellent" for wind energy development. When both the "excellent" and "good" wind energy development classes are combined, about 55 percent of the lesser prairie-chicken's occupied range in Oklahoma lies within those two classes.

When leks were examined, the analysis revealed a nearly complete overlap on all known active and historically occupied lek locations, based on the known active leks during the mid 1990s. Roughly 91 percent of the known lesser prairie-chicken lek sites in Oklahoma are within 8 km (5 mi) of land classified as "excellent" for wind development (O'Meilia 2005). Over half (53 percent) of all known lek sites in Oklahoma occur within 1.6 km (1 mi) of lands classified as “excellent” for commercial wind energy development. This second metric is particularly relevant considering a majority of lesser prairie-chicken nesting generally occurs, on average, within 3.4 km (2.1 mi) of active leks (Hagen and Giesen 2005, p. 2). Robel (2002, p. 23) estimated that habitat within 1.6 km (1.0 mi) or more of a single commercial-scale wind turbine is rendered unsuitable for greater prairie chickens due to their tendency to avoid tall structures. Using Robel’s (2002, p. 23) estimate of this zone of avoidance (1.6 km or 1.0 mi) for a single commercial-scale wind turbine, development of commercial wind farms, which would consist of multiple turbines spaced over a large area (typical wind farm arrays consist of 30 to 150 towers each supporting a single turbine), likely will have a significant adverse influence on reproduction of the lesser prairie-chicken, provided lesser prairie-chickens consistently avoid nesting within 1.6 km (1 mi) of each turbine.

Unfortunately, a similar analysis of active and historically occupied leks is not available for the other States due to a lack of comparable information on the location of lek sites. Considering western Kansas currently supports the largest number and distribution of lesser prairie-chickens of all five States, the influence of wind energy development on the lesser prairie-chicken in Kansas would likely be equally, if not more, significant. As previously discussed in this section, wind power development in Kansas is expanding (Wiser and Bollinger 2013, p. 9) and the industry is seeking to continue development of additional wind farms. In 2006, the Governor of Kansas initiated the Governor’s 2015 Renewable Energy Challenge, an objective of which is to have 1,000

MW of renewable energy capacity in Kansas by 2015 (Cita *et al.* 2008, p. 1). A cost-benefit study (Cita *et al.* 2008, Appendix B) found that wind power was the most likely and most cost effective form of renewable energy resource for Kansas. Modestly assuming an average of 2 MW per turbine—most commercial scale turbines are between 1.5 and 2.5 MW—an estimated 500 turbines would have to be erected in Kansas if this goal is to be met.

While not all of those turbines would be placed in occupied habitat, and some overlap in avoidance would occur if turbines were oriented in a typical wind farm array, the potential impact could be significant. First, the best wind potential in Kansas occurs in the western two-thirds of the State and largely overlaps the estimated occupied lesser prairie-chicken range (DOE, National Renewable energy Laboratory 2010b, p. 1). Additionally, Kansas has a voluntary moratorium on the development of wind power in the Flint Hills of eastern Kansas, which likely will shift the focus of development into the central and western portions of the State. Taking these two factors into consideration, construction of much of the new wind power anticipated in the Governor's 2015 Renewable Energy Challenge likely would occur in the western two-thirds of Kansas. If we assume that even one-half of the estimated 500 turbines are placed in lesser prairie-chicken range, 250 turbines would individually impact over 101,000 ha (250,000 ac), based on an avoidance distance of 1.6 km (1 mi). The habitat loss resulting from the above scenario would further reduce the extent of large, unfragmented parcels and influence connectivity between remaining occupied blocks of habitat, reducing the amount of suitable habitat available to the lesser prairie-chicken. Consequently, siting of wind energy arrays and associated facilities, including electrical transmission lines, appears to be a serious threat to lesser prairie-chickens in western Kansas within the near future (Rodgers 2007a).

In Colorado, the DOE, National Renewable Energy Laboratory (2010b, p. 1) rated the southeastern corner of Colorado as having good wind resources, the largest area of Colorado with that ranking. The area almost completely overlaps the estimated occupied range of the lesser prairie-chicken in Colorado. Colorado currently ranks 10th in both total installed capacity and number of commercial scale wind turbines in operation (AWEA 2014). The 162 MW Green Wind Power Project and 75 MW Twin Buttes Wind Project are located with Prowers County which includes portions of the estimated occupied range. The CPW reported that commercial wind development is occurring in Colorado, but that most of the effort is currently centered north of the estimated occupied range of lesser prairie-chicken in southeastern Colorado.

Wind energy development in New Mexico is less likely than in other States within the range of the lesser prairie-chicken because the suitability for wind energy development in the estimated occupied range of the lesser prairie-chicken in New Mexico is only rated as fair (DOE, National Renewable Energy Laboratory 2010b, p. 1). However, some parts of northeastern New Mexico within lesser prairie-chicken historical range have been rated as excellent. Northeastern New Mexico is important to lesser prairie-chicken conservation because this area is vital to efforts to reestablish or reconnect the New Mexico lesser prairie-chicken population to those in Colorado and the Texas panhandle.

In Texas, the Public Utility Commission recently directed the Electric Reliability Council of Texas (ERCOT) to develop transmission plans for wind capacity to accommodate between 10,000 and 25,000 MW of power (American Wind Energy Association 2007b, pp. 2–3). ERCOT is a regional transmission organization with jurisdiction over most of Texas. The remainder of Texas, largely the Texas panhandle, lies within the jurisdiction of the Southwest Power Pool. A recent assessment from ERCOT identified more than 130,000 MW of high-quality wind sites in Texas, more electricity than the entire State currently uses. The establishment of Competitive Renewable Energy Zones by ERCOT within the State of Texas will facilitate wind energy development throughout western Texas. Based on the development priority of each zone, the top four Competitive Renewable Energy Zones, which are designated for future wind energy development in the Texas panhandle, are located within occupied and historical lesser prairie-chicken habitat in the Texas panhandle. .

Wind energy and associated transmission line development in the Texas panhandle and portions of west Texas represent a threat to extant lesser prairie-chicken populations in the State. Once established, wind farms and associated transmission features would severely hamper future efforts to restore population connectivity and gene flow (transfer of genetic information from one population to another) between existing populations that are currently separated by incompatible land uses in the Texas panhandle.

Development of high-capacity transmission lines is critical to the development of the anticipated wind energy resources in ensuring that the generated power can be delivered to the consumer. According to ERCOT (American Wind Energy Association 2007a, p. 9), every $1 billion invested in new transmission capacity enables the construction of $6 billion of new wind farms. We estimate, based on a spatial analysis prepared by The Nature Conservancy in 2011 under their license agreement with Ventyx Energy Corporation, that there are 35,220 km (21,885 mi) of transmission lines, having a capacity of 69 kilovolts (kV) or larger, in service within the historical range of the lesser prairie-chicken. Within the estimated currently occupied range, this analysis estimated that about 3,610 km (2,243 mi) of transmission lines with a capacity of 69kV and larger are currently in service. Within the estimated occupied range, this same analysis revealed that an additional 856 km (532 mi) of 69kV or higher transmission line is anticipated to be in service within the near future.

Because we did not have access to the same commercially available dataset used by The Nature Conservancy, but we wanted to provide an updated analysis of the scope of transmission line development within the range of the lesser prairie-chicken, we used transmission line data maintained by the Southwest Power Pool. This dataset has some limitations, particularly for Texas and New Mexico which are largely outside of the jurisdiction of the Southwest Power Pool. However the data can be used to get a sense of the scope of existing development within portions of the range. Our analysis revealed that 9,153 km (5,687.4 mi) of transmission lines having a capacity of 69kV or higher exist within those portions of the estimated occupied range that lie within the jurisdiction of the Southwest Power Pool. Although the analysis performed by The Nature Conservancy using the Ventyx Energy Corporation dataset has not been updated since 2011, we can use that analysis to derive the density of transmission lines in existence at that time within the estimated occupied range. Assuming all of the 69 kV or larger transmission lines in service at the time of that analysis (about 3,610 km (2,243 mi) of transmission lines) are still in service, the density of these transmission lines would be 0.04 km/sq km (0.07 mi/sq mi). Although similar information for lesser prairie-chickens is not available, transmission line densities were particularly important in assessing the value of habitat for greater sage grouse. Habitat suitability for sage grouse was the highest when densities of transmission lines were below 0.06 km/sq km (Knick 2013 *et al.*, p. 6). Leks were absent from areas where transmission line densities exceeded 0.20 km/sq km (Knick 2013 *et al.*, p. 6).

The Southwest Power Pool also has information about several proposed electric transmission line upgrades. This organization identified approximately 423 km (263 mi) of proposed new transmission lines, commonly referred to as the “X Plan”, that were being evaluated during the transmission planning process. Transmission planning continues to move forward, and numerous alternatives are being evaluated, many of which will increase transmission capacity throughout all or portions of the estimated occupied lesser prairie-chicken range and serve to catalyze extensive wind energy development throughout much of the remaining estimated occupied lesser prairie-chicken range in Kansas, Oklahoma, and Texas. Additionally, Clean Line Energy is planning to build a high voltage direct current transmission line (Plains and Eastern Clean Line) that would originate within Texas County of the Oklahoma panhandle, travel the length of the panhandle region, and then drop south to near Woodward, Oklahoma, before continuing eastward across Oklahoma, Arkansas and western Tennessee. The Plains and Eastern Clean Line project would deliver a maximum of 3,500 MW of electric power. Increased transmission capacity provided by the Clean Line project will facilitate development of additional wind power. Additionally, the fragmenting effect of this transmission line is a significant concern. Corman (2011, pp. 151–152) concluded that the northeast Texas population of lesser prairie-chickens was too small to retain high amounts of genetic diversity over the long term. He thought connectivity between the Oklahoma and Kansas lesser prairie-chicken populations was crucial to maintaining persistence in the northeast Texas population. Should lesser prairie-chickens avoid areas adjacent to this high voltage transmission line, as demonstrated with a comparable high voltage transmission line (Pruett 2009a, pp. 1255–1257), movement between populations across the line will diminish significantly. A draft Environmental Impact Statement on this project is anticipated in the fall of 2014; the project cannot proceed until that analysis is complete and the potential route approved. The project is expected to commence commercial operation now earlier than 2018.

Another similar high voltage direct current transmission line proposed by Clean Line Energy Partners, known as the Grain Belt Express, is planned for Kansas. The line would originate in west-central Kansas and continue to its endpoint in the upper Midwestern United States. Very little opportunity to interconnect with these direct current lines exists due to the anticipated high cost associated with development of an appropriate interconnecting substation. Consequently, most of the anticipated wind power that will be transmitted across the Oklahoma and Kansas projects likely will occur near the western terminals associated with these two Clean Line projects. Assuming a fairly realistic build-out scenario for these transmission lines, in which wind power projects would most likely be constructed within 64 km (40 mi) of the western end points of each line (77 FR 75624), much of the estimated occupied range in Colorado, Kansas, Oklahoma, and northeast Texas falls within the anticipated development zone. Although both of these projects are still relatively early in the planning process, and the specific environmental impacts have yet to be determined, a reasonably likely wind power development scenario would place much of the estimated occupied range at risk of wind power development.

In summary, wind energy and associated infrastructure development is occurring now and is expected to continue into the future within occupied portions of lesser prairie-chicken habitat. Proposed transmission line improvements, such as the proposed Plains and Eastern Clean Line project, will serve to facilitate further development of additional wind energy resources but will take several years to commence operations. Future wind energy developments, based on the known locations of areas with excellent to good wind energy development potential, likely will have substantial overlap with known lesser prairie-chicken populations. There is little published information on the specific effects of wind power development on lesser prairie-chickens. Most published reports on the effects of wind power development on birds focus on the risks of collision with towers or turbine blades. However, we do not expect that significant numbers of collisions with spinning blades would be likely to occur due to avoidance of the wind towers and associated transmission lines by lesser prairie-chickens. The most significant impact of wind energy development on lesser prairie-chickens is caused by the avoidance of useable space due the presence of vertical structures (turbine towers and transmission lines) within suitable habitat. The noise produced by wind turbines also is anticipated to contribute to behavioral avoidance of these structures. Avoidance of these vertical structures by lesser prairie-chickens can be as much as 1.6 km (1 mi), resulting in large areas (814 ha (2,011 ac) for a single turbine) of unsuitable habitat relative to the overall footprint of a single turbine. Where such development has occurred or is likely to occur, these areas are no longer suitable for lesser prairie-chicken even though many of the typical habitat components used by lesser prairie-chicken remain. Therefore, considering the scale of current and future wind development that is likely within the range of the lesser prairie-chicken and the significant avoidance response of the species to these developments, we conclude that wind energy development is a threat to the species, especially when considered in combination with other habitat fragmenting activities.

Roads and Other Similar Linear Features

Similar to transmission lines, roads are a linear feature on the landscape that can contribute to loss and fragmentation of habitat suitable for the species and can fragment populations as a result of behavioral avoidance. The observed behavioral avoidance associated with roads is likely due to noise, visual disturbance, and increased predator movements paralleling roads. For example, roads are known to contribute to lek abandonment when they disrupt the important habitat features associated with lek sites (Crawford and Bolen 1976b, p. 239). The presence of roads allows human encroachment into habitats used by lesser prairie-chickens, further causing fragmentation of suitable habitat patches. Some mammalian species known to prey on lesser prairie-chickens, such as red fox, raccoons, and striped skunks, have greatly increased their distribution by dispersing along roads (Forman and Alexander 1998, p. 212; Forman 2000, p. 33; Frey and Conover 2006, pp. 1114–1115).

Traffic noise from roads may indirectly impact lesser prairie-chickens. Because lesser prairie-chickens depend on acoustical signals to attract females to leks, noise from roads, oil and gas development, wind turbines, and similar human activity may interfere with mating displays, influencing female attendance at lek sites and causing young males not to be drawn to the leks. Within a relatively short period, leks can become inactive due to a lack of recruitment of new males to the display grounds.

Roads also may influence lesser prairie-chicken dispersal, likely dependent upon the volume of traffic, and thus disturbance, associated with the road. However, roads generally do not constitute a significant barrier to dispersal unless they are large, multiple-land roads. Lesser prairie-chickens have been shown to avoid areas of suitable habitat near larger, multiple-lane, paved roads (Pruett *et al.* 2009a, pp. 1256, 1258). Generally, roads were between 4.1 and 5.3 times less likely to occur in areas used by lesser prairie-chickens than areas that were not used and can influence habitat and nest site selection (Hagen et al. 2011, pp. 68, 71-72). Lesser prairie-chickens are thought to avoid major roads due to disturbance caused by traffic volume and, perhaps behaviorally, to avoid exposure to predators that may use roads as travel corridors. Similar behavior has been documented in sage grouse (Oyler-McCance *et al*. 2001, p. 330). Wisdom *et al.* (2011, p. 467) examined factors believed to have contributed to extirpation of sage grouse in areas scattered throughout the entire species' historical range and found that extirpated range contained almost 27 times the human density, was 60 percent closer to highways, and had 25 percent higher density of roads, in contrast to occupied range.

Roads also can cause direct mortality due to collisions with automobiles and possibly increased predation. Although individual mortality resulting from collisions with moving vehicles does occur, the mortalities typically are not monitored or recorded.

Therefore we cannot determine the importance of direct mortality from roads on lesser prairie-chicken populations.

Using the data layers provided in StreetMap USA, a product of ESRI Corporation and intended for use with ArcGIS, we estimated the scope of the impact of roads on lesser prairie-chickens. Within the entire historical range, there are 622,061 km (386,581 mi) of roads. This figure includes major Federal and state highways as well as county highways and smaller roads. Within the estimated occupied range, approximately 81,874 km (50,874 mi) of roads have been constructed. We also used topographically integrated geographic encoding and referencing (TIGER) files available from the U.S. Census Bureau to conduct a similar analysis of the impact of roads. These files, dated 2007, are more current than the information provided in StreetMap USA. Within the historical range in 2007 there was a total of 642,860 km (399,454.8 mi) of roads within the historical range. Of these roads, about 84,531 km (52,525.3 mi) were located within the estimated occupied range. More detailed examination of the roads in the estimated occupied range revealed there were about 2,386 km (1,482.8 mi) of primary roads, 2,002 km (1,244.3 mi) of secondary roads, and 80,142 km (49,798.2 mi) of local or rural roads. Density (number per unit area) of roads within the estimated occupied range was 1.04 km of road per square km (1.68 mi of road per sq mi). The density of primary roads was 0.03 km of road per square km (0.05 mi of road per sq mi) and for secondary roads was 0.02 km of road per square km (0.04 mi of road per sq mi). The density of local and rural roads was highest at 0.99 km of road per square km (1.59 mi of road per sq mi).

Although we do not have similar information for lesser prairie-chickens, Knick *et al.* (2013, entire) found that road densities were particularly important in assessing the value of habitat for greater sage grouse. The most valuable sage grouse habitats had densities of secondary roads that were below 1.0 km per sq km, highway densities below 0.05 km per sq km, and interstate highway densities at or below 0.01 km per sq km (Knick *et al.* 2013, p. 1544). Ninety-three percent of the active leks were located in areas where interstate highway densities were less than 0.01 km/sq km (Knick *et al.* 2013, p. 1544).

While we do not anticipate significant expansion of the number or distance of existing roads in the near or longterm, these roads have already contributed to significant habitat fragmentation within both the estimated historical and occupied range of the lesser prairie-chicken. Assigning buffer values, as described in the rangewide plan (Van Pelt *et al.* 2013, p. 95), to the existing roads within the estimated occupied range provides an estimate of the amount of habitat that has been lost to the lesser prairie-chicken, either by construction, displacement or both. These buffer distances are 500 m (1,640 ft) for primary roads, 67 m (220 ft) for secondary roads, and 10 m (33 ft) for local, rural roads. The total habitat impacted by all types of roads within the estimated occupied range is 402,739.4 ha (995,189.3 ac). The fragmentation caused by roads in combination with other causes of fragmentation described in this final listing rule contributes to the further reduction of usable habitat available to support lesser prairie-chicken populations. The resultant fragmentation is detrimental to lesser prairie-chickens because they rely on large, expansive areas of contiguous rangeland and grassland to complete their life cycle.

Although the best available information does not allow us to predict the number or distance of new roads that will exist into the future, we do not anticipate that the number or distance of primary and secondary roads will increase significantly in the future. However, we do anticipate that increasing human populations within the estimated occupied range, as discussed previously, will lead to increased traffic and road noise on the roads that do exist. Consequently, roads that are already being avoided by lesser prairie-chickens will continue to be barriers, and increasing traffic volumes will lead to additional roads being avoided, further fragmenting an already highly fragmented landscape. Additionally, Pitman *et al.* (2005, p. 1267) believes roads served as travel corridors for predators and may increase the impact of predation on lesser prairie-chickens (see section on *Predation* below).

In summary, roads occur throughout the range of the lesser prairie-chicken and contribute to the threat of cumulative habitat fragmentation to the species.

Petroleum Production

Petroleum production, primarily oil and gas development, is occurring over much of the estimated historical and occupied range of the lesser prairie-chicken. Oil and gas development involves activities such as surface exploration, exploratory drilling, field development, facility construction, and operation and maintenance. Ancillary facilities can include compressor stations, pumping stations, and electrical generators. Activities such as well pad construction, seismic surveys, access road development, power line construction, and pipeline corridors can directly impact lesser prairie-chicken habitat. Indirect impacts from noise, gaseous emissions, and human presence also influence habitat quality in oil and gas development areas. These activities affect lesser prairie-chickens by disrupting reproductive behavior (Hunt and Best 2004, p. 41) and through habitat fragmentation and conversion (Hunt and Best 2004, p. 92). Smith *et al.* (1998, p. 3) observed that almost one-half, 13 of 29, of the abandoned leks examined in southeastern New Mexico in an area of intensive oil and gas development had a moderate to high level of noise. Hunt and Best (2004, p. 92) found that abandoned leks in southeastern New Mexico had more active wells, more total wells, and greater length of access road than active leks. They concluded that petroleum development at intensive levels, with large numbers of wells in close proximity to each other necessitating large road networks and an increase in the number of power lines, is likely not compatible with life-history requirements of lesser prairie-chickens (Hunt and Best 2004, p. 92)

Impacts from oil and gas development and exploration is thought to be the primary reason responsible for the species' near absence throughout previously occupied portions of the Carlsbad BLM unit in southeastern New Mexico (Belinda 2003, p. 3). This conclusion is supported by research examining lesser prairie-chicken losses over the past 20 years on Carlsbad BLM lands (Hunt and Best 2004, pp. 114–115). Those variables associated with oil and gas development explained 32 percent of observed lek abandonment (Hunt and Best 2004) and the consequent population extirpation.

Colorado currently ranks within the top ten States in both crude oil and natural gas production. Oil and gas development began in Colorado the late 1800s. Much of the development within the estimated historical and occupied range of the lesser prairie-chicken occurs within the Hugoton and Denver Basin fields. Since 1995 the number of drilling permits issued annually has steadily grown from 1,002 in 1995 to 8,027 in 2008 (Dennison 2009). However, 84 percent of that activity is located in only six counties that lie outside of the estimated occupied range. Some development is anticipated in Baca County, Colorado, although the timeframe for initiation of those activities is uncertain (CPW 2007, p. 2). The State of Colorado, Oil and Gas Conservation Commission also has established rules that provide some protection to the lesser prairie-chicken from oil and gas development in this State. A full list of those measures are provided in the rangewide plan (Van Pelt *et al*. 2013, pp. 6–8) and include a requirement to solicit review by the CPW prior to development in an effort to avoid and minimize impacts to the lesser prairie-chicken. Other measures include timing and distance stipulations, including a provision to avoid development within 3.5 km (2.2 mi) of an active lek.

Kansas is one of the top ten oil producing States in the Nation and is within the top 12 States in Natural gas production. Between 1995 and 2010, over 37.2 million barrels of oil were produced in Kansas (Circle Star Energy 2014). The major oil and gas fields (Hugoton and Panoma) in Kansas primarily occur in the southwestern corner and central regions of the State, overlapping large portions of the estimated historic and occupied ranges of the lesser prairie-chicken. Gas development is the primary activity in the southwestern corner with oil being primary in the central region. In the central region of Kansas, development of the Mississippian Lime Play using hydraulic fracturing techniques has revived oil and gas development in the region. The Kansas Department of Commerce has stated that potentially hundreds of wells could be drilled in this region in the next 20 to 30 years (Kansas Department of Commerce 2014). Some gas development also occurs in the central region of the State.

New Mexico currently ranks in the top ten States in the Nation for production of both crude oil and natural gas (U.S. Energy Information Administration 2014). Within the range of the lesser prairie-chicken, much of the oil and gas development occurs on lands administered by the BLM. In the BLM's Special Status Species Record of Decision and approved Resource Management Plan Amendment (RMPA), some protections for the lesser prairie-chicken on BLM lands in New Mexico are provided by reducing the number of drilling locations, decreasing the size of well pads, reducing the number and length of roads, reducing the number of powerlines and pipelines, and implementing best management practices for development and reclamation (BLM 2008, pp. 5–31). The RMPA provides guidance for management of approximately 344,000 ha (850,000 ac) of public land and 121,000 ha (300,000 ac) of Federal minerals below private or state lands in Chaves, Eddy, Lea, and Roosevelt Counties in New Mexico.

Implementation of these restrictions, particularly curtailment of new mineral leases, is concentrated in the Core Management and Primary Population Areas (BLM 2008, pp. 9–11). The Core Management and Primary Population Areas are located in the core of the lesser prairie-chicken estimated occupied range in New Mexico. The effect of these best management practices on the population of the lesser prairie-chicken is unknown, particularly considering about 33,184 ha (82,000 ac) have already been leased in those areas (BLM 2008, p. 8). The plan stipulates that measures designed to protect the lesser prairie-chicken and dunes sagebrush lizard may not allow approval of all spacing unit locations or full development of the lease (BLM 2008, p. 8).

Oklahoma currently ranks in the top five States in the Nation for production of both crude oil and natural gas (U.S. Energy Information Administration 2014). In Oklahoma, oil and gas exploration statewide continues at a high level. Since 2002, the average number of active drilling rigs in Oklahoma has steadily risen (Boyd 2009, p. 1). Since 2004, the number of active drilling rigs has remained above 150, reflecting the highest level of sustained activity since the 'boom' years from the late 1970s through the mid-1980s in Oklahoma (Boyd 2007, p. 1). The Oklahoma Department of Wildlife Conservation worked with the Oklahoma Independent Petroleum Association to address potential impacts of oil and gas development on the lesser prairie-chicken. Through this effort, a set of voluntary best management practices, such as minimizing surface disturbance and removal of unneeded equipment, have been developed (Van Pelt *et al.* 2013, p. 60).

Texas currently ranks as the top State in the Nation for production of both crude oil and natural gas (U.S. Energy Information Administration 2014). In some areas within the estimated occupied range, the scope of development has increased significantly. For example, the amount of habitat fragmentation due to oil and gas extraction in the Texas panhandle and western Oklahoma associated with the Buffalo Wallow oil and gas field within the Granite Wash formation of the Anadarko Basin has steadily increased over time. In 1982, the rules for the Buffalo Wallow field in Hemphill and Wheeler counties, Texas allowed one well per 130 ha (320 ac). In late 2004, the Texas Railroad Commission changed the field rule regulations for the Buffalo Wallow oil and gas field to allow oil and gas well spacing to a maximum density of one well per 8 ha (20 ac) (Rothkopf *et al.* 2011, p. 1). When fully developed at this density, this region of the Texas panhandle, which overlaps portions of the estimated occupied range, will have experienced a 16-fold increase in habitat fragmentation in comparison with the rates allowed prior to 2004.

Oil and gas development and exploration is ongoing in all five lesser prairie-chicken States. Based on the information available to us, none of the States, with the exception of Colorado, has implemented specific regulatory measures to address impacts of oil and gas development on the lesser prairie-chicken. In New Mexico, much of the oil and gas development within the estimated historic and occupied range is regulated by the BLM. Where Federal minerals occur outside of New Mexico and within the estimated occupied range, BLM has implemented timing, noise, and distance stipulations that primarily provide protections during the lekking season but do little to protect nesting hens and the broods. We attempted to assess the extent of oil and gas development using available information from the State oil and gas regulatory agencies within the five State range of the lesser prairie-chicken. Although we do not have access to information on oil and gas activity beyond 2008, the data provide a fairly good assessment of development activity before 2008. We identified 670,509 existing oil and gas wells within the historical range and of those wells, 53,205 oil and gas wells existed within the estimated occupied range. The rangewide plan (Van Pelt *et al*. 2013, pp. 132–134) estimated 68,716 active wells exist within the EOR +10, based on data from 2010 to 2013.

If we apply a 200 m buffer to those wells, as used in the rangewide plan (Van Pelt *et al.* 2013, p. 95), and remove any overlap from our analysis, an estimated 516,000 ha (1.27 million ac) of habitat within the estimated occupied range was impacted by oil and gas development by 2008. The buffers established in the rangewide plan were based on the best available science and the professional judgment of the members of the Interstate Working Group Science team, which included representation from the Service, U.S. Geological Survey, Natural Resources Conservation Service, State Fish and Wildlife Agencies, public universities, private conservation organizations and private consultants.

We lacked data from which we could independently project oil and gas development into the future. However, the rangewide plan (Van Pelt *et al*. 2013, pp. 138) provided a high and low projection of oil and gas development within the EOR +10 for 10, 20 and 30 years into the future. Within 30 years, they estimate that about 122,639 new wells under a low price scenario and 179,416 new wells under a high price scenario could be developed within the EOR +10.

Wastewater pits associated with energy development are not anticipated to be a major threat to lesser prairie-chickens primarily due to the presence of infrastructure and the lack of suitable cover near these pits. In formations with high levels of hydrogen sulfide gas, the presence of this gas can cause mortality.

In summary, infrastructure associated with current petroleum production contributes to the ongoing habitat fragmentation within the estimated occupied range of the lesser prairie-chicken. Reliable information about future trends for petroleum production indicates that this impact will continue into the future. Habitat impacts, based on our estimates, as provided above, and those of WAFWA (Van Pelt *et al*. 2013, p. 95), could be in excess of a million of acres throughout the estimated occupied range.

Predation

Lesser prairie-chickens have coevolved with a variety of predators, but none are lesser prairie-chicken specialists. Prairie falcon (*Falco mexicanus*), northern harrier (*Circus cyaneus*), Cooper's hawk (*Accipiter cooperii*), great-horned owl (*Bubo* *virginianus*), other unspecified birds of prey (raptors), and coyote (*Canis latrans*) have been identified as predators of lesser prairie-chicken adults and chicks (Davis *et al.* 1979, pp. 84–85; Merchant 1982, p. 49; Haukos and Broda 1989, pp. 182–183; Giesen 1994a, p. 96). Predators of nests and eggs also include Chihuahuan raven (*Corvus cryptoleucus*), striped skunk (*Mephitis mephitis*), ground squirrels (*Spermophilus* spp.), and bullsnakes (*Pituophis melanoleucus*), as well as coyotes and badgers (*Taxidea taxus*) (Davis *et al.* 1979, p. 51; Haukos 1988, p. 9; Giesen 1998, p. 8).

Lesser prairie-chicken predation varies in both form and frequency throughout the year. In Kansas, Hagen *et al.* (2007, p. 522) attributed about 59 percent of the observed mortality of female lesser prairie-chickens to mammalian predators and between 11 and 15 percent, depending on season, to raptors. Coyotes were reported to be responsible for 64 percent of the nest depredations observed in Kansas (Pitman *et al.* 2006a, p. 27). Observed mortality of male and female lesser prairie-chickens associated with raptor predation reached 53 percent in Oklahoma and 56 percent in New Mexico (Wolfe *et al.* 2007, p. 100). Predation by mammals was reported to be 47 percent in Oklahoma and 44 percent in New Mexico (Wolfe *et al.* 2007, p. 100). In Texas, over the course of three nonbreeding seasons, Boal and Pirius (2012, p. 8) assessed cause-specific mortality for 13 lesser prairie-chickens. Avian predation was identified as the cause of death in 10 of those individuals, and mammalian predation was responsible for 2 deaths. The cause of death could not be identified in one of those individuals. Behney *et al.* (2012, p. 294) suspected that mammalian and reptilian predators had a greater influence on lesser prairie-chicken mortality during the breeding season than raptors.

Predation is a naturally occurring phenomenon and generally does not pose a risk to wildlife populations, including the lesser prairie-chicken, unless the populations are extremely small or have an abnormal level of vulnerability to predation. The lesser prairie-chicken's cryptic plumage and behavioral adaptations allow the species to persist under normal predation pressures. Birds may be most susceptible to predation while on the lek when birds are more conspicuous. Both Patten *et al.* (2005b, p. 240) and Wolfe *et al.* (2007, p. 100) reported that raptor predation increased coincident with lek attendance. Patten *et al.* (2005b, p. 240) stated that male lesser prairie-chickens are more vulnerable to predation when exposed during lek displays than they are at other times of the year and that male lesser prairie-chicken mortality was chiefly associated with predation. However, during 650 hours of lek observations in Texas, raptor predation at leks was considered to be uncommon and an unlikely factor responsible for declines in lesser prairie-chicken populations (Behney *et al.* 2011, pp. 336–337). But Behney *et al.* (2012, p. 294) observed that the timing of lekking activities in their study area corresponded with the lowest observed densities of raptors and that lesser prairie-chickens contend with a more abundant and diverse assemblage of raptors in other seasons.

Predation and related disturbance of mating activities by predators may impact reproduction in lesser prairie-chickens. For females, predation during the nesting season likely would have the most significant impact on lesser prairie-chicken populations, particularly if that predation resulted in total loss of a particular brood. Predation on lesser prairie-chicken may be especially significant relative to nest success. Nest success and brood survival of greater prairie-chickens accounted for most of the variation in population finite rate of increase (Wisdom and Mills 1997, p. 308). Bergerud (1988, pp. 646, 681, 685) concluded that population changes in many grouse species are driven by changes in breeding success. An analysis of Attwater's prairie-chicken supported this conclusion (Peterson and Silvy 1994, p. 227). Demographic research on lesser prairie-chicken in southwestern Kansas confirmed that changes in nest success and chick survival, two factors closely associated with vegetation structure, have the largest impact on population growth rates and viability (Hagen *et al.* 2009, p. 1329).

Rates of predation on lesser prairie-chicken likely are influenced by certain aspects of habitat quality such as fragmentation or other forms of habitat degradation (Robb and Schroeder 2005, p. 36). As habitat fragmentation increases, suitable habitats become more spatially restricted and the effects of terrestrial nest predators on grouse populations may increase (Braun *et al.* 1978, p. 316). In a study on Attwater's prairie-chicken, Horkel *et al*. (1978, p. 239) observed that artificial nests located within 46 m (150 ft) of a road or mown pipeline rights-of-way were less successful than artificial nests located further away from these features. They concluded that these fragmenting features served as activity centers and travel lanes for predators and contributed to increased predator activity and decreased nest success in proximity to these features (Horkel *et al*.

1978, p. 240). Nest predators typically have a positive response (e.g., increased abundance, increased activity, and increased species richness) to fragmentation, although the effects are expressed primarily at the landscape scale (Stephens *et al*. 2003, p. 4). Similarly, as habitat quality decreases through reduction in vegetative cover due to grazing or herbicide application, predation of lesser prairie-chicken nests, juveniles, and adults are all expected to increase. For this reason, ensuring adequate shrub cover and removing raptor perches such as trees, power poles, and fence posts may lower predation more than any conventional predator removal methods (Wolfe *et al.* 2007, p. 101). As discussed at several locations within this document, existing and future development of transmission lines, fences, and vertical structures will either contribute to additional predation on lesser prairie-chickens or cause areas of suitable habitat to be abandoned due to behavior avoidance by lesser prairie-chickens. Increases in the encroachment of trees into the native prairies also will contribute to increased incidence of predation by providing additional perches for avian predators. Because predation has a strong relationship with certain anthropogenic factors, such as fragmentation, vertical structures, and roads, continued development is likely to increase the effects of predation on lesser prairie-chickens beyond natural levels. As a result, predation is likely to contribute to the declining population of the species.

Disease

Giesen (1998, p. 10) provided no information on ectoparasites or infectious diseases in lesser prairie-chicken, although several endoparasites, including nematodes and cestodes, are known to infect the species. In Oklahoma, Emerson (1951, p. 195) documented the presence of the external parasites (biting lice-Order Mallophaga) *Goniodes cupido* and *Lagopoecus* sp. in an undisclosed number of lesser prairie-chickens. Between 1997 and 1999, Robel *et al.* (2003, p. 342) conducted a study of helminth parasites in lesser prairie-chickens from southwestern Kansas. Of the carcasses examined, 95 percent had eye worm (*Oxyspirura petrowi*), 92 percent had stomach worm (*Tetrameres* sp.), and 59 percent had cecal worm (*Subulura* sp.) (Robel *et al.* 2003, p. 341). No adverse impacts to the lesser prairie-chicken population they studied were evident as a result of the observed parasite burden. Addison and Anderson (1969, p. 1223) also found eyeworm (*O. petrowi*) from a limited sample of lesser prairie-chickens in Oklahoma. The eyeworm also has been reported from lesser prairie-chickens in Texas (Pence and Sell 1979, p. 145). Pence and Sell (1979, p. 145) also observed the roundworm *Heterakis isolonche* and the tapeworm *Rhabdometra odiosa* from lesser prairie-chickens in Texas. Smith *et al.* (2003, p. 347) reported on the occurrence of blood and fecal parasites in lesser prairie-chickens in eastern New Mexico. Eight percent of the examined birds were infected with *Eimeria tympanuchi*, an intestinal parasite, and 13 percent were infected with *Plasmodium pedioecetii*, a hematozoan. Stabler (1978, p. 1126) first reported *Plasmodium pedioecetii* in the lesser prairie-chicken from samples collected from New Mexico and Texas. In the spring of 1997, a sample of 12 lesser prairie-chickens from Hemphill County, Texas, were tested for the presence of disease and parasites. No evidence of viral or bacterial diseases, hemoparasites, parasitic helminths, or ectoparasites was found (Hughes 1997, p. 2).

In southwestern Kansas, Hagen *et al*. (2002 entire) tested for the presence of mycoplasmosis, a respiratory infection, in lesser prairie-chickens. Although some birds tested positive for antibodies to *Mycoplasma meleagridis, M. synoviae,* and *M. gallisepticum,* all were at rates less than 10 percent and no infection was confirmed (Hagen *et al*. 2002, p. 708). However, lesser prairie-chickens testing positive should be considered potential carriers of mycoplasmosis (Hagen *et al*., 2002, p. 710). Infections may be transmitted most commonly during winter and spring when lesser prairie-chickens are likely to be grouped together to forage or conduct breeding activity.

Peterson *et al.* (2002, p. 835) reported on an examination of 24 lesser prairie-chickens from Hemphill County, Texas, for several disease agents. Lesser prairie-chickens were seropositive for both the Massachusetts and Arkansas serotypes of avian infectious bronchitis, a type of coronavirus. All other tests were negative.

Reticuloendotheliosis is a viral disease of poultry that has been found to cause mortality in captive Attwater's prairie-chickens and greater prairie-chickens (Drew *et al.* 1998, entire). Symptoms include immunosuppression, reduced body size and tumors that can result in significant morbidity and mortality (Bohls et al. 2006a, p. 613). Researchers surveyed blood samples from 184 lesser prairie-chickens from three States during 1999 and 2000, for the presence of reticuloendotheliosis. All samples were negative, suggesting that reticuloendotheliosis may not be a serious problem for most wild populations of lesser prairie-chicken (Wiedenfeld *et al.* 2002, p. 143). A vaccine has recently been developed that, while not preventing infection, provided partial protection from reticuloendotheliosis in captive Attwater's prairie-chicken (Drechsler et al. 2013, pp. 258–259). This vaccine has not yet been tested on lesser prairie-chickens to our knowledge.

The impact of West Nile virus on lesser prairie-chickens is unknown. Recently scientists at Texas Tech University detected West Nile virus in a small percentage (1.3 percent) of the lesser prairie-chicken blood samples they analyzed. Other grouse, such as ruffed grouse (*Bonasa umbellus*), have been documented to harbor West Nile virus infection rates similar to some corvids (crows, jays, and ravens). For 130 ruffed grouse tested in 2000, all distant from known West Nile virus epicenters, 21 percent tested positive. This was remarkably similar to American crows (*Corvus brachyrhynchos*) and blue jays (*Cyanocitta cristata*) (23 percent for each species), species with known susceptibility to West Nile virus (Bernard *et al.* 2001, p. 681). The IPCC (2007, p. 51) suggests that the distribution of some disease vectors, such as mosquitos (*Culex* spp.) that carry West Nile virus, may change as a result of climate change. Mosquitoes are also known to transmit the reticuloendotheliosis virus (Bohls *et al*. 2006b, p. 193). However, we have no specific information suggesting that West Nile virus or any known disease may become problematic for the lesser prairie-chicken as a result of climate change.

Although parasites and diseases have the potential to influence population dynamics, the incidence of disease or parasite infestations in regulating populations of the lesser prairie-chicken is unknown. The Lesser Prairie-Chicken Interstate Working Group (Mote *et al.* 1999, p. 12) concluded that, while density-dependent transmission of disease was unlikely to have a significant effect on lesser prairie-chicken populations, a disease that was transmitted independently of density could have drastic effects. Further research is needed to establish whether parasites limit prairie grouse populations. Peterson (2004, p. 35) urged natural resource decisionmakers to be aware that macro- and micro-parasites cannot be safely ignored as populations of species such as the lesser prairie-chicken become smaller, more fragmented, and increasingly vulnerable to the effects of disease. A recent analysis of the degree of threat to prairie grouse from parasites and infectious disease concluded that microparasitic infections that cause high mortality across a broad range of galliform (wildfowl species such as turkeys and grouse) hosts have the potential to extirpate small, isolated prairie grouse populations (Peterson 2004, p. 35).

Some degree of impact from parasites and disease is a naturally occurring phenomenon for most wildlife species and is one element of compensatory mortality (the phenomenon that various causes of mortality in wildlife tend to balance each other, allowing the total mortality rate to remain constant) that operates among many species. However, there is no information that indicates parasites or disease are causing, or contributing to, the decline of any lesser prairie-chicken populations, and, at this time, we have no basis for concluding that disease or parasite loads are a threat to any lesser prairie-chicken populations. Consequently, we do not consider disease or parasite infections to be a significant factor in the decline of the lesser prairie-chicken. However, should populations continue to decline or become more isolated by fragmentation, even small changes in habitat abundance or quality could have a more significant influence on the impact of parasites and diseases to the lesser prairie-chicken.

Hunting and Other Forms of Recreational, Educational, or Scientific Use

In the late 19th century, lesser prairie-chickens were subject to market hunting (Jackson and DeArment 1963, p. 733; Fleharty 1995, pp. 38–45; Jensen *et al.* 2000, p. 170). Harvest throughout the species' estimated historical range has been regulated since approximately the turn of the 20th century (Crawford 1980, pp. 3–4). Currently, the lesser prairie-chicken is classified as a game species in Kansas, New Mexico, Oklahoma, and Texas, although authorized harvest is allowed only in Kansas. The lesser prairie-chicken has been listed as a threatened species in Colorado, eliminating harvest of the species under the State's Nongame and Endangered or Threatened Species Conservation Act since 1973. In March of 2009, Texas adopted a temporary, indefinite suspension of their current 2-day season until lesser prairie-chicken populations recover to huntable levels. Previously in Texas, lesser prairie-chicken harvest was not allowed except on properties with an approved wildlife management plan specifically addressing the lesser prairie-chicken. When both Kansas and Texas allowed lesser prairie-chicken harvest, the total annual harvest for both States was fewer than 1,000 birds annually.

In New Mexico, the lesser prairie-chicken was legally hunted until 1996 (Hunt 2004, p. 39). The annual harvest in the 1960s averaged about 1,000 birds, but harvest declined to only 130 birds in 1979. Harvest rebounded a few years later peaking in 1987 and 1988 when average harvest was about 4,000 birds (Hunt 2004, p. 39). Harvest subsequently declined through the early 1990s.

In Kansas, the current bag limit is one lesser prairie-chicken daily south of Interstate 70 and two lesser prairie-chickens north of Interstate 70. The season typically begins in early November and runs through the end of December in southwestern Kansas. In the northwestern portion of the State, the season typically extends through the end of January. During the 2006 season, hunters in Kansas expended 2,020 hunter-days and harvested approximately 340 lesser prairie-chickens. In 2010, 2,863 hunter-days were expended and an estimated 633 lesser prairie-chickens were harvested in Kansas (Pitman 2012a). Given the low number of lesser prairie-chickens harvested per year in Kansas relative to the population size of lesser prairie-chickens, the statewide harvest is probably insignificant at the population level. There are no recent records of unauthorized harvest of lesser prairie-chickens in Kansas (Pitman 2012b).

Two primary hypotheses exist regarding the influence of hunting on harvested populations—hunting mortality is either additive to other sources of mortality or nonhunting mortality compensates for hunting mortality, up to some threshold level. The compensatory hypothesis essentially implies that harvest by hunting removes only surplus individuals, and individuals that escape hunting mortality will have a higher survival rate until the next reproductive season. Both Hunt and Best (2004, p. 93) and Giesen (1998, p. 11) do not believe hunting has an additive mortality on lesser prairie-chickens, although, in the past, hunting during periods of low population cycles may have accelerated declines (Taylor and Guthery 1980b, p. 2). However, because most remaining lesser prairie-chicken populations are now very small and isolated, and because they naturally exhibit a clumped distribution on the landscape, they are likely vulnerable to local extirpations through many mechanisms, including harvest by humans. Braun *et al.* (1994, p. 435) called for definitive experiments that evaluate the extent to which hunting is additive at different harvest rates and in different patch sizes. They suggested conservative harvest regimes for small or fragmented grouse populations because fragmentation likely decreases the resilience of populations to harvest. Sufficient information to determine the rate of localized harvest pressure is unavailable and, therefore, the Service cannot determine whether such harvest contributes to local population declines. We do not consider hunting to be a threat to the species at this time. However, as populations of lesser prairie-chickens become smaller and more isolated by habitat fragmentation, their resiliency to the influence of hunting pressure will decline, likely increasing the degree of threat that hunting may pose to the species.

An additional activity that has the potential to negatively affect individual breeding aggregations of lesser prairie-chickens is the growing occurrence of public and guided bird watching tours of leks during the breeding season. The site-specific impact of recreational observations of lesser prairie-chicken at leks is currently unknown but daily human disturbance could reduce mating activities, possibly leading to a reduction in total production. However, disturbance effects are likely to be minimal at the population level if disturbance is avoided by observers remaining in vehicles or blinds until lesser prairie-chickens naturally disperse from the lek and observations are confined to a limited number of days and leks. Solitary leks comprising fewer than ten males are most likely to be affected by repeated recreational disturbance. Suminski (1977, p. 70) strongly encouraged avoidance of activities that could disrupt nesting activities. Research is needed to quantify this potential threat to local populations of lesser prairie-chickens.

Research activities, such as roadside surveys and flush counts, that generally tend to rely on passive sampling rather than active handling of the birds are not likely to substantially impact the lesser prairie-chicken. When birds are flushed, some increased energy expenditure or exposure to predation may occur, but the impacts are anticipated to be minor and of short duration. Studies that involve handling of adults, chicks and eggs, particularly those involving the use of radio transmitters, also may cause increased energy expenditure, predation exposure or otherwise impact individual birds. However such studies typically occur at a relatively small, localized scale and are not likely to cause a direct impact to the population as a whole. Such studies are usually of short duration, lasting no more than a few years.

In summary, it is possible that harvest of lesser prairie-chickens through sport hunting might be contributing to a decline of some populations, but the best available information does not show whether this is actually occurring and we have no basis on which to estimate whether hunting is contributing to decline in some areas. However, as populations continue to decline and become more fragmented, the influence of sport harvest likely will increase and could become a threat in the future. Public viewing of leks tends to be limited, primarily due to a general lack of public knowledge of lek locations and difficulty accessing leks located on private lands. Observations by bird watchers are likely to be very limited in extent and bird watchers, as a group, generally tend to minimize disturbance to birds as they conduct their activities. We expect the range States will continue to conduct annual lek counts, which contributes to a temporary disturbance when the birds are flushed during attempts to count birds attending the leks. However these disturbances are intermittent and do not occur repeatedly throughout the lekking period. Research on lesser prairie-chickens may result in some capture and handling of the species. Capture-induced stress may occur and could lead to isolated instances of mortality or injury to individual birds. But such research is not widespread and likely does not cause significant population-level impacts. Research is not anticipated to result in loss of habitat and is therefore not likely to lead to impacts from habitat fragmentation. We are not aware of any other forms of utilization that are negatively impacting lesser prairie-chicken populations. There is currently no known, imminent threat of take attributed to collection or illegal harvest for this species, consequently, we conclude that overutilization at current population and harvest levels does not pose a threat to the species.

Other Factors

A number of other factors, although they do not directly contribute to habitat loss or fragmentation, can influence the survival of the lesser prairie-chicken. These factors, in combination with habitat loss and fragmentation, are likely to negatively influence the persistence of the species.

Nest Parasitism and Competition by Exotic Species

Ring-necked pheasants (*Phasianus colchicus*) are nonnative species that overlap the estimated occupied range of the lesser prairie-chicken in Kansas and portions of Colorado, Oklahoma, Texas (Johnsgard 1979, p. 121), and New Mexico (Allen 1950, p. 106). Hen pheasants have been documented to lay eggs in the nests of several bird species, including lesser prairie-chicken and greater prairie-chicken (Hagen *et al.* 2002, pp. 522–524; Vance and Westemeier 1979, p. 223; Kimmel 1987, p. 257; Westemeier *et al.* 1989, pp. 640–641; Westemeier *et al.* 1998, 857–858). Consequences of nest parasitism vary, and may include abandonment of the host nest, reduction in number of host eggs, lower hatching success, and parasitic broods (Kimmel 1987, p. 255). Because pheasant eggs hatch in about 23 days, the potential exists for lesser prairie-chicken hens to cease incubation, begin brooding, and abandon the nest soon after the first pheasant egg hatches. Nests of greater prairie-chickens parasitized by pheasants have been shown to have lower egg success and higher abandonment than unparasitized nests, suggesting that recruitment and abundance may be impacted (Westemeier *et al.* 1998, pp. 860–861). Predation rates also may increase with incidence of nest parasitism (Vance and Westemeier 1979, p. 224). Further consequences are hypothesized to include the imprinting of the pheasant young from the parasitized nest to the host species, and later attempts by male pheasants to court females of the host species (Kimmel 1987, pp. 256–257). Male pheasants have been observed disrupting the breeding behavior of greater prairie-chickens on leks (Sharp 1957, pp. 242–243; Follen 1966, pp. 16–17; Vance and Westemeier 1979, p. 222). In addition, pheasant displays toward female prairie-chickens almost always cause the female to leave the lek (Vance and Westemeier 1979, p. 222). Thus, an attempt by a male pheasant to display on a prairie-chicken lek could disrupt the normal courtship activities of prairie-chickens.

Few published accounts of lesser prairie-chicken nest parasitism by pheasants exist (Hagen *et al.* 2002, pp. 522–524), although biologists from KPWD, ODWC, Sutton Center, TPWD, and the Oklahoma Cooperative Fish and Wildlife Research Unit have given more than 10 unpublished accounts of such occurrences. Westemeier *et al.* (1998, p. 858) documented statistically that for a small, isolated population of greater prairie-chickens in Illinois, nest parasitism by pheasants significantly reduced the hatchability of nests. They concluded that, in areas with high pheasant populations, the survival of isolated, remnant flocks of prairie-chicken may be enhanced by management intervention to reduce nest parasitism by pheasants (Westemeier *et al.* 1998, p. 861). While Hagen *et al.* (2002, p. 523) documented a rate of only 4 percent parasitism (3 of 75 nests) of lesser prairie-chicken nests in Kansas, the sample size was small and may not reflect actual impacts across larger time and geographic scales, and precipitation gradients. Competition with and parasitism by pheasants may be a potential factor that could negatively affect vulnerable lesser prairie-chicken populations at the local level, particularly if remaining native rangelands become increasingly fragmented (Hagen *et al.* 2002, p. 524). More research is needed to understand and quantify impacts of pheasants on lesser prairie-chicken populations range wide.

Hybridization

The sympatric (overlapping) occupation of habitat and leks by greater prairie-chickens and lesser prairie-chickens in a small 250,000 ha (617,000 ac) portion of central and northwestern Kansas may pose a potential, but limited threat to the species in that region. Hybridization between the two species could lead to introgression (infiltration of the genes of one species into the gene pool of another through repeated backcrossing) and reduced reproductive potential. Hybrid crosses between greater and lesser prairie-chickens have been produced in captivity and the first generation of offspring are fertile;

however, mating of second-generation hybrids produced a clutch of 26 eggs, but only 11 eggs were fertile and only four of those eggs hatched (Crawford 1978, p. 592). All four of those chicks died within one week of unknown causes.

Prior to EuroAmerican settlement of the Great Plains, the distributions of the greater and lesser prairie-chicken likely did not overlap, although it is impossible to precisely determine their presettlement distribution patterns (Johnsgard and Wood 1968, p. 174). Following human settlement and initial cultivation of the prairies, the distribution of the greater and lesser prairie-chicken expanded, at least until the amount of cultivation was so extensive that some populations could not persist due to inadequate amounts of native grassland intermingled with cultivation (Johnsgard and Wood 1968, p. 177). As indicated by Sharpe (1968, pp. 51, 174), the historical occurrence of lesser prairie-chickens in Nebraska was considered be the result of a short-lived range expansion facilitated by human settlement and cultivation of grain crops. As their ranges expanded, some overlap of lesser and greater prairie-chickens occurred, primarily in northwestern Kansas and southwestern Nebraska. Where the two species came into contact, some natural hybridization likely occurred but the frequency is unknown. As the range of the lesser prairie-chicken shrank in response to expanding conversion of the prairie, the ranges of lesser and greater prairie-chickens ceased to overlap, at least until recently. Habitat restoration in northwestern Kansas, assisted by successful planting of native grassland CRP since 1985, likely facilitated the co-occupation of portions of their ranges. The ranges of greater and lesser prairie-chickens now overlap within a seven county region in Kansas (Bain and Farley 2002, p. 684).

In this seven county area, Bain and Farley (2002, p. 684) observed 12 birds from nine mixed leks containing both greater and lesser prairie-chickens that appeared to be hybrids. These birds displayed external characteristics, courtship behaviors and vocalizations that were intermediate between the two species but they were unable to confirm that these birds were actually hybrids (Bain and Farley 2002, pp. 684–686).

Currently, the incidence of hybridization between greater prairie-chickens and lesser prairie-chickens appears very low, less than 1 percent (309 individuals) of the estimated total population (MacDonald *et al*. 2012, p. 21). The occurrence of hybridization also is restricted to a small portion, about 250,000 ha (617,000 ac), of the overall current range (Bain and Farley 2002, p. 684). Although the density of leks within the area north of the Arkansas River in Kansas are high, the density of mixed leks is much lower (MacDonald *et al.* 2012, p. 21). These populations are largely dependent on fragmented tracts of CRP lands, and lesser prairie-chicken populations may continue to expand within this region depending on implementation of CRP projects and stochastic environmental factors. Should greater prairie-chicken populations in this region expand, increasing the extent of overlap in their distributions, the incidence of hybridization also may increase. Currently we are unable to predict how the incidence of hybridization may change into the future. Additionally, the zone of hybridization may decrease in size or cease to exist entirely if the extent of cropland or suitable habitat changes in response to CRP. The zone of overlap could increase with time if the lesser prairie-chicken occupied range shifts northward, particularly in light of climate changes that may occur within the next 100 years. If the zone of overlap expands, the extent of hybridization may increase.

Currently, we have no information on how these apparent hybrid individuals interact and compete in breeding on the lek. If the second generation hybrids truly are not viable, as reported by Crawford (1978, p. 592), the risk of introgression, should they be successful in competing for mates, is low. However, the fertility of first and second generation hybrid individuals has not been rigorously tested. Theoretically, natural isolating mechanisms, such as appearance, vocalization and courtship behavior would serve to minimize the incidence of hybridization. However, as discussed in the "Taxonomy" section, speciation in lesser and greater prairie-chickens may be incomplete and natural isolating mechanisms may not operate effectively. Noise from human developments that may mask vocalizations in lesser prairie-chickens, as previously discussed in the section on influence of noise, also may impact the ability of females to detect differences in vocalizations between lesser prairie-chickens and their hybrids. Additionally, low population density may increase the susceptibility of lesser prairie-chickens to hybridization, primarily within the zone of overlap, and could exacerbate the potentially negative effects of hybridization. Hybridization is a particularly important issue for species that are rare and both fragmentation and habitat modification are significant factors that can contribute to increased rates of hybridization in some species (Rhymer and Simberloff 1996, pp. 83, 103; Allendorf *et al*. 2001, p. 613).

Presently, the immediate and long-term influence of hybridization on the species is unknown, although Johnsgard (2002, p. 32) did not consider current levels of hybridization to be genetically significant. Similarly, Johnson (2008, pp. 170–171) estimated that the rate of gene flow between lesser and greater prairie chickens was very low. Because the current extent, both numerically and areally, of hybridization appears very small, we currently do not consider hybridization to be a threat. Interbreeding on the mixed leks could result in some wasted reproductive effort but significant demographic effects are not expected at current levels. However, continued monitoring and additional investigation of hybridization between greater and lesser prairie-chickens is encouraged. Should the zone of overlap continue to expand, hybridization could become a threat with a significant impact on the lesser prairie-chicken.

Genetic Risks, Small Population Size and Lek Mating System

Anthropogenic habitat deterioration and fragmentation, as previously discussed in this rule, not only drives range contractions and population extinctions but also may have significant genetic and, thus, evolutionary consequences for the surviving populations. Genetic risks, such as reduced reproductive success, are an important concern for lesser prairie-chickens, particularly considering the extensive reduction in abundance and occupied range that has occurred since EuroAmerican settlement of the Great Plains, and such risks often impact species well before they are driven to extinction (Spielman *et al*. 2004, p. 15264; Frankham 2005, pp. 134–135). Although we lack precise estimates of lesser prairie-chicken abundance and distribution prior to human settlement, we can infer from the estimates provided in the literature (previously discussed in section on Historical Range and Distribution) that populations were considerably larger and more widely distributed than they are at present. Typically, these larger populations have more genetic diversity and are less vulnerable to extinction than smaller populations (Frankham 1996, pp. 1503‑1507; Spielman *et al*. 2004, p. 15261; Frankham 2005, p. 132; Willi *et al*. 2006, entire).

As surviving populations become more isolated due to fragmentation and habitat loss, the movement of genetic information (gene flow) between those populations declines, leading to loss of genetic diversity and variability. Pruett *et al.* (2009b, p. 258) concluded that lesser prairie-chicken populations were historically connected, as evidenced by the lack of morphological variation across the range and availability of genetic information which suggests that the populations were contiguous and gene flow occurred among the extant populations. Considering increased levels of fragmentation can constrain dispersal in lesser prairie-chickens, low levels of dispersal may contribute to increased relatedness in both males and females at some lek sites. However, an analysis of genetic data collected in the early 2000s from Colorado, Kansas, New Mexico and Oklahoma did not indicate that population declines and habitat fragmentation apparent at that time had created any barriers to lesser prairie-chicken dispersal (Hagen *et al*. 2010, p. 35).

A number of harmful effects, such as reduced reproductive success or disease resistance, can have a genetic link and, over time, the loss of genetic variation and diversity allows these deleterious effects to become more prevalent as population sizes decline or isolation increases. Inbreeding occurs when the number of mates from which to choose become limited, increasing relatedness among individuals and contributing to a reduction in genetic variability. Inbreeding can reduce reproductive fitness and survival and increase extinction risk (Spielman *et al*. 2004, pp. 15261, 15263; Frankham 2005, pp. 132–133, 136). Other genetic factors such as mutation and genetic drift (change in the genetic composition of a population due to chance events) also can influence genetic diversity and may contribute to increased extinction risk over long time spans. A loss of genetic diversity also may reduce the ability of individuals and populations to respond, or adapt, to changing environmental conditions, potentially impacting long-term stability and viability (Willi *et al*. 2006, pp. 447–450; Hughes *et al*. 2008, pp. 615–617, 620; Frankham 2005, p. 135). As populations decline, they become more sensitive to random demographic, environmental, and catastrophic (non-genetic) events. Factors such as drought, disease or predation can exert a more substantial influence over small populations. Even small populations that are growing can succumb to random changes in birth or survival rates that may drive a population to extinction. The small, fragmented lesser prairie-chicken populations that currently exist over portions of the estimated occupied range have an increased likelihood that such harmful effects already may be, or soon will be, occurring.

These genetic risks, and their suite of associated harmful effects, may be amplified by the lek mating system characteristic of prairie grouse (Corman 2011, pp. 34–35). When male prairie chickens select a site for displaying, several factors such as high visibility, good auditory projection, and a lack of ambient noise are known to influence selection of lek sites by prairie chickens, and these same factors likely help aid females in locating the mating grounds (Gregory *et al*. 2011, p. 29). Johnsgard (2002, p. 129) stressed that the mating system used by prairie grouse works most effectively when populations are dense enough to provide the visual and acoustic stimuli necessary to attract prebreeding females to the lek. Once established, the lek must then be large enough to assure that the matings will be performed by the most physically and genetically fit males. Lek breeding, where relatively few males sire offspring, tends to promote inbreeding (Bouzat and Johnson 2004, p. 503).

Therefore, as populations decline, several events begin to exert influence on the viability of the affected population. As populations decline, and the number of males attending a particular lek decline, the probability that a lek will persistence also declines (Sandercock et al. 2012, p. 11). Females may have difficulty locating leks as the number of leks decline. Females also may not be attracted to an existing lek as male lek attendance declines and the corresponding collective visual and auditory display diminishes. Relatedly, as the number of male birds attending a particular lek declines, females will have fewer and fewer choices from which to select a mate, reducing the likelihood that females will select the most fit male. Because male lesser prairie-chickens have high site fidelity and consistently return to a particular lek site (Copelin 1963, pp. 29–30; Hoffman 1963, p. 731; Campbell 1972, pp. 698–699), the same dominant, but perhaps less fit, male may conduct the majority of the matings. As this continues over several successive years, the potential for inbreeding becomes more prevalent and the risk of impacts from harmful genetic effects rises. Although an obvious oversimplification of the process, the likelihood that lesser prairie-chickens will experience detrimental genetic effects, such as inbreeding, is high and will only increase as population sizes decline and become more fragmented over time. The potential for possible genetic effects is amplified by the lek mating system, where mating is performed by relatively few males (highly male skewed) (Oyler-McCance *et al.* 2010, p. 121).

However, the tendency of female lesser prairie-chickens and other prairie grouse to typically nest near a lek other than the one on which they mated is an innate mechanism that can help enhance genetic mixing and reduce the potential for of inbreeding to occur. Bouzat and Johnson (2004, p. 504) believed that site fidelity in female lesser prairie-chickens was lower than that for males and may help ensure low relatedness in reproductive females at leks.

Johnson (2008, p. 171) reported that gene flow is currently restricted between lesser prairie-chicken populations in New Mexico and those in Oklahoma and expressed concern that genetic variability may decline due to reduced population sizes. Hagen *et al.* (2010, p. 34) also reported that the New Mexico population was significantly different from populations in other States due to a lack of gene flow. An isolated population of lesser prairie-chicken in New Mexico and southwest Texas was reported to have lost genetic diversity due to separation from the main population, and this separation may have occurred since the 1800s (Corman 2011, p. 114).

These findings are not unexpected given information on lesser prairie-chicken movements. Pruett *et al.* (2009b, p. 258) report findings by the Sutton Center that lesser prairie-chickens in Oklahoma were observed to move as much as 20 to 30 km (12 to 19 mi), but the extant lesser prairie-chicken populations in New Mexico and Oklahoma are separated by more than 200 km (124 mi). Given the limited movements of individual lesser prairie-chickens and the distance between these two populations, Pruett *et al.* (2009b, p. 258) considered interaction between these populations to be highly unlikely. Johnson (2008, p. 171) speculated that the observed estimate of gene flow between the New Mexico and Oklahoma populations could be due to effects of recent genetic drift as habitat fragmentation and isolation developed between the New Mexico and Oklahoma populations. Corman (2011, p. 116) stated that prolonged separation by an isolated population in southwest Texas and eastern New Mexico may have contributed to reduced variability in mitochondrial Deoxyribonucleic acid (mtDNA, genetic material). Further examination of the viability of existing lesser prairie-chicken populations will be needed to thoroughly describe the effects of small population size and isolation on persistence of the lesser prairie-chicken.

Dispersal is an important demographic factor that contributes to genetically viable populations (Johnson 2003, p. 62). Fragmentation that restricts dispersal capabilities can have dramatic impacts on the level of genetic variability and thus evolutionary potential of surviving populations (Johnson 2003, p. 62). Populations, such as the lesser prairie-chicken, that have undergone large decreases in population size are likely to lose genetic variation (Nei et al. 1975, Maruyama and Fuerst 1985). Resistance to disease and ability of populations to respond to environmental disturbances may also decrease with the loss of genetic variation (Lacy 1997).

We have determined that genetic risks related to small population size and the lek mating system, while not a significant concern at current population levels, could begin to substantially impact lesser prairie-chickens in the future, should populations continue to decline or become more isolated by habitat fragmentation. The population in Deaf Smith County, Texas is already showing signs of inbreeding due to isolation (see discussion in section on Conservation Genetics). Additionally, genetic examination of the northeast Texas population revealed a dependence upon gene flow from Oklahoma and Kansas to maintain adequate levels of genetic diversity. If this gene flow is disrupted by habitat fragmentation , the northeast Texas population also could be impacted by the effects of inbreeding. Considering Corman (2011, pp. 49–50) observed that both the Deaf Smith and the Gray-Donley County populations were intermediate between the New Mexico-southwest Texas population and lesser prairie-chicken populations throughout the remainder of the range, existing and anticipated genetic impacts to these populations would further isolate the New Mexico-southwest Texas population from the rest of the range. Further isolation could impact the viability of the New Mexico-southwest Texas population. Continued loss of genetic variation may negatively impact the long-term viability of some lesser prairie-chicken populations.

Surface Water Impoundments

Dams have been constructed on streams within the range of the lesser prairie-chicken to produce impoundments for flood control, water supply, and other purposes. The impounded waters flood not only affected stream segments and riparian areas, but also adjacent areas of grassland and shrubland habitats that potentially provided usable space for lesser prairie-chickens. Although lesser prairie-chickens may make use of free-standing water, as is retained in surface impoundments, its availability is not critical for survival of the birds (Giesen 1998, p. 4).

The historical range of the lesser prairie-chicken contains approximately 25 large impoundments with a surface area greater than 1,618 ha (4,000 ac), the largest 20 of these (and their normal surface acreage) are listed from largest to smallest in Table 5, below.

TABLE 5.—Impoundments with surface acreage greater than 1,618 ha (4,000 ac) within the historical range of the lesser prairie-chicken.

Impoundment	Surface Acreage	State
John Martin Reservoir	8,302 ha (20,515 ac)	Colorado
O. H. Ivie Lake	7,749 ha (19,149 ac)	Texas
Lake Meredith	6,641 ha (16,411 ac)	Texas
Lake Kemp	6,309 ha (15,590 ac)	Texas
Lake Arrowhead	6,057 ha (14,969 ac)	Texas
E. V. Spence Reservoir	6,050 ha (14,950 ac)	Texas
Hubbard Creek Reservoir	6,038 ha (14,922 ac)	Texas
Twin Buttes Reservoir	3,965 ha (9,800 ac)	Texas
Cheney Reservoir	3,859 ha (9,537 ac)	Kansas
Wilson Lake	3,642 ha (9,000 ac)	Kansas
Foss Lake	3,561 ha (8,800 ac)	Oklahoma
Great Salt Plains Lake	3,516 ha (8,690 ac)	Oklahoma
Ute Reservoir	3,318 ha (8,200 ac)	New Mexico
Canton Lake	3,201 ha (7,910 ac)	Oklahoma
J. B. Thomas Reservoir	2,947 ha (7,282 ac)	Texas
Cedar Bluff Reservoir	2,779 ha (6,869 ac)	Kansas

Lake Brownwood	2,626 ha (6,490 ac)	Texas
Tom Steed Lake	2,590 ha (6,400 ac)	Oklahoma
Lake Altus-Lugert	2,533 ha (6,260 ac)	Oklahoma
Lake Kickapoo	2,439 ha (6,028 ac)	Texas
Total	88,129 ha (217,772 ac)	

(Sources: Kansas Water Office 2012, New Mexico State Parks 2012, Texas Parks and Wildlife Department 2012, Texas State Historical Association 2012, U.S. Army Corps of Engineers 2012, U.S. Bureau of Reclamation 2012)

In addition, the historical range of the lesser prairie-chicken contains many smaller impoundments, such as municipal reservoirs and upstream flood control projects. For example, beginning in the mid-1900s, the USDA constructed hundreds of small impoundments (floodwater retarding structures) within the historical range of the lesser prairie-chicken, through the Watershed Protection and Flood Prevention Program. The program was implemented to its greatest extent in Oklahoma (Oklahoma Conservation Commission 2005), and, within the portion of the lesser prairie-chicken's historical range in that State, the USDA constructed 574 floodwater retarding structures, totaling 6,070 ha (15,001 ac) (Elsener 2012). Similarly, within the portion of the lesser prairie-chicken's historical range in Texas, the USDA constructed 276 floodwater retarding structures, totaling 8,293 surface acres (Bednarz 2012). In Kansas, considerably fewer floodwater retarding structures were constructed within the historical range, totaling 857 ha (2,118 ac) (Gross 2012). Even fewer such structures were constructed in Colorado and New Mexico.

Cumulatively, the total area of historical lesser prairie-chicken range lost due to construction of large, medium, and small impoundments is about 98,413 ha (243,184 ac), or roughly 0.2 percent of the historical range, and is much less than the amount of habitat lost or degraded by other factors discussed in this rule (e.g., conversion of rangeland to cropland and overgrazing). The Service expects a large majority of existing reservoirs to be maintained over the long term. Therefore, these structures will continue to displace former areas of lesser prairie-chicken habitat, as well as fragment surrounding lands as habitat for the lesser prairie-chicken, but the overall habitat loss is relatively minor. Because extensive new dam construction is not anticipated within the lesser prairie-chicken's range, the Service considers it unlikely that reservoir construction will significantly impact lesser prairie-chickens in the future.

In summary, several other natural or manmade factors are affecting the continued existence of the lesser prairie-chicken. Parasitism of lesser prairie-chicken nests by pheasants and hybridization with greater prairie chickens have been documented but the incidence is low. The impact is not significant at current levels. Hybridization is occurring in a small portion of the estimated occupied range but the immediate and long-term influence of hybridization on the species is unknown. The incidence of hybridization is low, typically about 1 percent of the estimated total population.

However, should the zone of overlap between lesser and greater prairie-chickens expand, hybridization could become a more significant stressor in the future. As lesser prairie-chicken populations decline, number of potential genetic factors associated with reduced population size may begin to become more prevalent, particularly as populations become more isolated. Although genetic risks related to small population size and the lek mating system are not a significant concern at current population levels, they could begin to substantially impact lesser prairie-chickens in the future, Although past construction of surface water impoundments within the historical range have eliminated potential habitat, and continue to displace former areas of lesser prairie-chicken habitat, including small areas within the estimated occupied range, construction of large impoundments has slowed considerably over the past several decades. Habitat losses from reservoir construction are small, constituting roughly 0.2 percent of the historical range. However, considering low population density can increase the susceptibility of lesser prairie-chicken to possible genetic effects and increase the negative effects of hybridization, nest parasitism, and competition, we consider the effects of these natural and manmade factors to be a threat to the lesser prairie-chicken.

Adequacy of Existing Regulatory Mechanisms

Regulatory mechanisms, such as Federal, state, and local land use regulations or laws, may provide protection from some threats provided those regulations and laws are not discretionary and are enforceable.

In 1973, the lesser prairie-chicken was listed as a threatened species in Colorado under the State's Nongame and Endangered or Threatened Species Conservation Act. While this designation prohibits unauthorized take, possession, and transport, that adequately protects the species from direct purposeful mortality by humans, no protections are provided for destruction or alteration of lesser prairie-chicken habitat. In the remaining States, the lesser prairie-chicken is classified as a game species, although the legal harvest is now closed in New Mexico, Oklahoma, and Texas. Accordingly, the State conservation agencies have the authority to regulate possession of the lesser prairie-chicken, set hunting seasons, and issue citations for poaching. For example, Texas Statute (Parks and Wildlife Code Section 64.003) prohibits the destruction of nests or eggs of game birds such as the lesser prairie-chicken. These authorities provide lesser prairie-chickens with protection from direct mortality caused by hunting and prohibit some forms of unauthorized take, and have been adequate to address any concerns of overhunting, as evidenced by the fact that these states have closed harvest in response to low population levels. Alternatively, these authorities do not provide protection for destruction or alteration of the species' habitat.

In July of 1997, the NMDGF received a formal request to commence an investigation into the status of the lesser prairie-chicken within New Mexico. This request began the process for potential listing of the lesser prairie-chicken under New Mexico's Wildlife Conservation Act. In 1999, the recommendation to list the lesser prairie-chicken as a threatened species under the Wildlife Conservation Act was withdrawn until more information was collected from landowners, lessees, and land resource managers who may be affected by the listing or who may have information pertinent to the investigation. In late 2006, the New Mexico State Game Commission determined that the lesser prairie-chicken would not be State-listed in New Mexico. New Mexico's Wildlife Conservation Act, under which the lesser prairie-chicken could have been listed, offers little opportunity to prevent otherwise lawful activities.

Regardless of each State's listing status, most occupied lesser prairie-chicken habitat throughout its estimated occupied range occurs on private land (Taylor and Guthery 1980b, p. 6), where State conservation agencies have little authority to protect or direct management of the species' habitat. All five States in the estimated occupied range have incorporated the lesser prairie-chicken as a species of conservation concern and management priority in their respective State Wildlife Action Plans. While identification of the lesser prairie-chicken as a species of conservation concern does help heighten public awareness, this designation provides no protection from direct take or habitat destruction or alteration.

Some States, such as Oklahoma, have laws and regulations that address use of State school lands, primarily based on maximizing financial return from operation of these lands. However, the scattered nature of these lands and requirement to maximize financial returns minimize the likelihood that these lands will be managed to reduce degradation and fragmentation of habitat and ensure the conservation of the species.

Lesser prairie-chickens are not covered or managed under the provisions of the Migratory Bird Treaty Act (16 U.S.C. 703–712) because they are considered resident game species. The lesser prairie-chicken has an International Union for Conservation of Nature (IUCN) Red List Category of “vulnerable” (BirdLife International 2008), and NatureServe currently ranks the lesser prairie-chicken as G3—Vulnerable (NatureServe 2011, entire). The lesser prairie-chicken also is on the National Audubon Society’s WatchList 2007 Red Category, which is “for species that are declining rapidly or have very small populations or limited ranges, and face major conservation threats.” However, none of these designations provide any regulatory protection.

There are six National Grasslands located within the estimated historical range of the lesser prairie-chicken. Two of the six, the Comanche National Grassland in Colorado and the Cimarron National Grassland in Kansas, occur within the estimated occupied range. The remaining four occur within or adjacent to counties that are occupied with lesser prairie-chickens, but the National Grasslands themselves are not within the delineation of the estimated occupied range. The National Grasslands are managed by the USFS, have been under Federal ownership since the late 1930s, and were officially designated as National Grasslands in 1960. The Kiowa, Rita Blanca, Black Kettle, and McClellan Creek National Grasslands are administered by the Cibola National Forest.

The Kiowa National Grassland covers 55,659 ha (137,537 ac) and is located within Mora, Harding, Union, and Colfax Counties, New Mexico. The Rita Blanca National Grassland covers 37,631 ha (92,989 ac) and is located within Dallam County, Texas, and Cimarron County, Oklahoma. The Black Kettle National Grassland covers 12,661 ha (31,286 ac) and is located within Roger Mills County, Oklahoma, and Hemphill County, Texas. The McClellan Creek National Grassland covers 586 ha (1,449 ac) and is located in Gray County, Texas. No breeding populations of lesser prairie-chickens are known to occur on these holdings.

The Comanche and Cimarron National Grasslands are under the administration of the Pike and San Isabel National Forest. The Comanche National Grassland covers 179,586 ha (443,765 ac) and is located within Baca, Las Animas, and Otero Counties, Colorado. The Cimarron National Grassland covers 43,777 ha (108,175 ac) and is located in Morton and Stevens Counties, Kansas. Both of these areas are known to support breeding lesser prairie-chickens. The National Forest Management Act of 1976 and the associated planning rule in effect at the time of planning initiation are the principal law and regulation governing the planning and management of National Forests and National Grasslands by the USFS.

Planning for the Kiowa, Rita Blanca, Black Kettle, and McClellan Creek National Grasslands was well underway when the 2008 National Forest System Land Management Planning Rule was enjoined on June 30, 2009, by the United States District Court for the

Northern District of California (*Citizens for Better Forestry v. United States Department of Agriculture*, 632 F. Supp. 2d 968 (N.D. Cal. June 30, 2009)). A new planning rule was finalized in 2012 (77 FR 67059) and became effective on May 9, 2012. The transition provisions of the 2012 planning rule (36 CFR 219.17(b)(3)) allow those National Forest System lands that had initiated plan development, plan amendments, or plan revisions prior to May 9, 2012, to continue using the provisions of the prior planning regulation. The Cibola National Forest and Grasslands used the guidance of the 2012 Planning Rule transition language allowing the provisions of the 1982 Planning Rule, including the requirement to prepare an Environmental Impact Statement, to complete the new plan for these National Grasslands. The management strategies for management of these National Grasslands provide a strategic, outcome-oriented, programmatic framework for future activities and will be implemented at the District level through the application of certain Desired Conditions, Objectives, Standards, and Guidelines. The Environmental Impact Statement highlights that the new plan will allow for enhancement of lesser prairie-chicken habitat by moving vegetation types toward the species' desired vegetation structures and species composition, in addition to reducing mortality caused by fence collision. As explained above, the transition provisions (36 CFR 219.17(b)(3)) of the 2012 planning rule allow the use of the provisions of the 1982 planning rule, including the requirement that management indicator species be identified as part of the plan. Management indicator species serve multiple functions in forest planning: focusing management direction developed in the alternatives, providing a means to analyze effects on biological diversity, and serving as a reliable feedback mechanism during plan implementation. The latter often is accomplished by monitoring population trends in relationship to habitat changes. Although suitable habitat is present, no breeding populations of lesser prairie-chickens are known from the Kiowa, Rita Blanca, Black Kettle, and McClellan Creek National Grasslands. Consequently, the lesser prairie-chicken is not designated as a management indicator species in the plan. Instead the lesser prairie-chicken is included on the Regional Forester's sensitive species list and as an At-Risk species.

In 2008, a new National Forest System Land Management Planning Rule (36 CFR Part 219) took effect and was used to guide the development of a Land and Resource Management Plan for the Comanche and Cimarron National Grasslands. That plan was one of the first plans developed and released under the 2008 planning rule. The predecisional review version of the Cimarron and Comanche National Grasslands Land Management Plan was made available to the public on October 17, 2008. The lesser prairie-chicken was included as a species-of-concern in accordance with guidance available in the existing planning rule (USFS 2008, p. 35). As defined in the 2008 planning rule, species-of-concern are species for which the Responsible Official determines that management actions may be necessary to prevent listing under the Endangered Species Act (36 CFR 219.16). Identification of the lesser prairie-chicken as a species-of-concern in the Cimarron and Comanche National Grasslands Land Management Plan led to inclusion of planning objectives targeting improvement of the species' habitat, as described below.

The Comanche and Cimarron National Grasslands currently manage the Comanche Lesser Prairie-chicken Habitat Zoological Area, now designated as a Colorado Natural Area, which encompasses an area of 4,118 ha (10,177 ac) that is managed to benefit the lesser prairie-chicken. Current conditions on this area include existing oil and gas leases, two-track roads, utility corridors, and livestock grazing. Wildfires on the area have been suppressed over the last 30 years. The area provides a special viewing area for the lesser prairie-chicken, which has been closed to protect lekking activities. The 1984 plan specifies that the condition of the area should meet the special habitat needs of the lesser prairie-chicken, specifically protection of leks from all surface disturbance, protection of nesting habitat from surface disturbance during the nesting period (April 15 to June 30) and limiting forage use by livestock and wild herbivores to no more than 40 percent.

The USFS contracted with lesser prairie-chicken experts to prepare the lesser prairie-chicken technical conservation assessment, which is a succinct evaluation of species of potential viability concern, (Robb and Schroeder 2005, entire). The conservation assessment addresses the biology, ecology, conservation, and management of the species throughout its range, but it primarily focuses on Colorado and Kansas (Forest Service Region 2) (Robb and Schroeder 2005, p. 7). Species conservation assessments produced as part of the Species Conservation Project are designed to provide land managers, biologists, and the public with a thorough discussion of the biology, ecology, conservation, and management of the lesser prairie-chicken based on existing scientific knowledge and to provide the ecological background upon which management should be based, focusing on the consequences of changes in the environment that result from management (Robb and Schroeder 2005, p. 7). This conservation assessment for the lesser prairie-chicken was completed in 2005 and affirmed the need for the USFS to retain sensitive species status designation for the lesser prairie-chicken. The criteria evaluated for inclusion on the sensitive species list include distribution, dispersal capability, abundance, population trend, habitat trend, habitat vulnerability or modification, and life history and demographics. The sensitive species recommendation form for the lesser prairie-chicken states that the species clearly warrants sensitive species designation because habitat loss, fragmentation and degradation are still significant risk factors on both USFS and surrounding private lands.. Management activities on the National Grasslands throughout the range of the lesser prairie-chicken may be guided by the technical conservation assessment; however, the document only provides summaries of existing scientific knowledge, discussion of broad implications of that knowledge, and outlines of information needs. The technical conservation assessment does not seek to develop specific prescriptions for management of populations and habitats. Instead, it is intended to provide the ecological background upon which management should be based and focuses on the consequences of changes in the environment that result from management (i.e., management implications). This document can be found at

http://www.fs.fed.us/r2/projects/scp/assessments/lesserprairiechicken.pdf.

The other primary Federal surface ownership of lands occupied by the lesser prairie-chicken is administered by the BLM in New Mexico. In New Mexico, roughly 41 percent of the known historical and most of the estimated occupied lesser prairie-chicken range occurs on BLM land. The BLM currently manages approximately 342,969 surface ha (847,491 ac) within lesser prairie-chicken range in eastern New Mexico. They also oversee another 120,529 ha (297,832 ac) of Federal minerals below private surface ownership. The core of currently occupied lesser prairie-chicken habitat in New Mexico is within the Roswell BLM Resource Area. However, the Carlsbad BLM Resource Area comprised much of the historical southern periphery of the species' range in New Mexico.

The BLM established the 23,278-ha (57,522-ac) Lesser Prairie-Chicken Habitat Preservation Area of Critical Environmental Concern (ACEC) upon completion of the RMPA in 2008; the purpose of the ACEC is to maintain and enhance habitat for the lesser prairie-chicken and the dunes sagebrush lizard (*Sceloporus arenicolus)* (BLM 2008, p. 1). The management goal for the ACEC is to protect the biological qualities of the area, with emphasis on the preservation of the shinnery oak-dune community to enhance the biodiversity of the ecosystem, particularly habitats for the lesser prairie-chicken and the dunes sagebrush lizard. The ACEC not only includes 20,943 ha (51,751 ac) public land surface acres, in addition to State trust land and private land, but also includes 18,981 ha (46,902 ac) of Federal mineral estate (BLM 2008, p. 30). Upon designation, the ACEC was closed to future oil and gas leasing, and existing leases would be developed in accordance with prescriptions applicable to the Core Management Area as described below (BLM 2008, p. 30). Additional management prescriptions for the ACEC include designation as a right-of-way exclusion area, vegetation management to meet the stated management goal of the area, and limiting the area to existing roads and trails for off-highway vehicle use (BLM 2008, p. 31). All acres of the ACEC have been closed to grazing through relinquishment of the permits except for one 1393 ha (3,442 ac) allotment.

The BLM’s amended RMPA (BLM 2008, pp. 5–31) provides some limited protections for the lesser prairie-chicken in New Mexico by reducing the number of drilling locations, decreasing the size of well pads, reducing the number and length of roads, reducing the number of powerlines and pipelines, and implementing best management practices for development and reclamation. Implementation of these protective measures, particularly curtailment of new mineral leases, would be greatest in the Core Management Area and the Primary Population Area habitat management units (BLM 2008, pp. 9–11). The Core Management and Primary Population Areas are located in the core of the lesser prairie-chicken estimated occupied range in New Mexico. The effect of these best management practices on the status of the lesser prairie-chicken is unknown, particularly considering about 33,184 ha (82,000 ac) have already been leased in those areas (BLM 2008, p. 8). The effectiveness of the amended RMPA is hampered by a lack of explicit measures designed to improve the status of the lesser prairie-chicken, limited certainty that resources will be available to carry out the management plan, limited regulatory or procedural mechanisms in place to carry out the efforts, lack of monitoring efforts, and provision for exceptions to the best management practices under certain conditions, which could negate the benefit of the conservation measures.

The amended RMPA stipulates that implementation of measures designed to protect the lesser prairie-chicken and dunes sagebrush lizard may not allow approval of all spacing unit locations or full development of a lease (BLM 2008, p. 8). In addition, the RMPA prohibits drilling and exploration in lesser prairie-chicken habitat between March 1 and June 15 of each year (BLM 2008, p. 8). No new mineral leases will be issued on approximately 32 percent of Federal mineral acreage within the RMPA planning area (BLM 2008, p. 8), although some exceptions are allowed on a case-by-case basis (BLM 2008, pp. 9–11). Within the Core Management Area and Primary Population Area, new leases will be restricted in occupied and suitable habitat; however, if there is an overall increase in reclaimed to disturbed acres over a 5-year period, new leases in these areas will be allowed (BLM 2008, p. 11). Considering Hunt and Best (2004, p. 92) concluded that petroleum development at intensive levels likely is not compatible with populations of lesser prairie-chicken, additional development in the Core Management Area and Primary Population Area habitat management units may hinder long-term conservation of the species in New Mexico. The RMPA allows lease applicants to voluntarily participate in a power line removal credit to encourage removal of idle power lines (BLM 2008, pp. 2–41). In the southernmost habitat management units, the Sparse and Scattered Population Area and the Isolated Population Area, where lesser prairie-chickens are now far less common than in previous decades (Hunt and Best 2004), new leases will not be allowed within 2.4 km (1.5 mi) of a lek (BLM 2008, p. 11).

The overall ineffectiveness of certain imposed energy development stipulations near leks for the purpose of protecting grouse on Federal lands has been confirmed for sage grouse. Holloran (2005, p. 57) and Naugle *et al.* (2006a, p. 3) documented that sage grouse avoid energy development (coalbed methane) not only in breeding and nesting habitats, but also in wintering habitats. They assert that current best management practices in use by Federal land management agencies that place timing stipulations or limit surface occupancy near greater sage-grouse leks result in a human footprint that far exceeds the tolerance limits of sage grouse. Ultimately, they recommended that effective conservation strategies for grouse must limit the cumulative impact of habitat disturbance, modification, and destruction in all habitats and at all times of the year (Holloran 2005, p. 58; Naugle *et al.* 2006b, p. 12). Additional research on the effect of petroleum development on lesser prairie-chicken is needed. However, available information on the lesser prairie-chicken (Suminski 1977, p. 70; Hagen *et al.* 2004, pp. 74–75; Hunt and Best 2004, p. 92; Pitman *et al.* 2005, pp. 1267–1268) indicates that the effect of petroleum development is often detrimental, particularly during the breeding season.

Because only about 4 percent of the species' overall range occurs on Federal lands, the Service recognizes that the lesser prairie-chicken cannot be fully recovered on Federal lands alone. However, no laws or regulations currently protect lesser prairie-chicken habitat on private land, aside from State harvest restrictions. Therefore, the Service views decisions regarding the management and leasing of Federal lands and minerals within existing lesser prairie-chicken range as important to the future conservation and persistence of the species.

Since 2004, the construction of commercial wind energy projects near and within estimated occupied lesser prairie-chicken habitat has raised concerns about the potential negative effects such projects may have on the species, if constructed at large scales in occupied range. As discussed previously, a rapid expansion of transmission lines and associated wind energy development throughout large portions of occupied lesser prairie-chicken range is occurring. Because most wind development activities are privately funded and are occurring on private land, wind energy siting, development, and operation falls outside the purview of the National Environmental Policy Act of 1969 (NEPA) and, within the range of the lesser prairie-chicken, other Federal conservation statues and regulatory processes. As a result, Federal law and policy does not generally regulate the wind development activities in regard to the lesser prairie-chicken

The current lack of regulatory oversight and public notice requirements for the construction of wind generation and related transmission facilities is a concern. Specifically, the Service is unaware of any state or Federal mechanisms that require potential wind energy producers to disclose the location, size, and anticipated construction date for pending projects on non-Federal lands or require analysis under the provisions of the NEPA. Lacking the ability to obtain pertinent siting information or analyze alternative siting locations, neither the Service nor State conservation agencies currently have the ability to accurately influence the size or timing of wind generation construction activities within occupied lesser prairie-chicken habitat.

In summary, most occupied lesser prairie-chicken habitat occurs on private land, where State conservation agencies currently have little authority to protect lesser prairie-chicken or facilitate and monitor management of lesser prairie-chicken habitat beyond regulating recreational harvest. Because most lesser prairie-chicken habitat destruction and modification on private land occurs through otherwise lawful activities such as agricultural conversion, livestock grazing, energy development, and fire exclusion, few (if any) regulatory mechanisms are in place to substantially alter human land uses at a sufficient scale to protect lesser prairie-chicken populations and their habitat. While almost no regulatory protection is in place for the species, regulatory incentives, in the form of county, state, and national legislative actions, have been created to facilitate the expansion of activities that result in fragmentation of occupied lesser prairie-chicken habitat, such as that resulting from oil, gas, and wind energy development. For the remaining 4 percent of occupied habitat currently under Federal management, habitat quality depends primarily on factors related to multiple use mandates, such as livestock grazing and oil, gas, and wind power development activities. Because prior leasing commitments and management decisions on the majority of occupied parcels of Federal land offer little flexibility for reversal, any new regulatory protection for uncommitted land units are important and will take time to achieve substantial benefits for the species in the long term.

We note that the existing regulatory mechanisms at the Federal and State level have not been sufficient to halt the decline of the species. Further, the best available information does not show any existing regulatory mechanisms at the local level that address the identified threats to the species. In spite of the existing regulatory mechanisms, the current and projected threat from the loss and fragmentation of lesser prairie-chicken habitat and range is still ongoing. The existing regulatory mechanisms have not been effective at removing all of the impacts to lesser prairie-chickens and their habitat.

Determination

Section 4 of the Act (16 U.S.C. 1533), and its implementing regulations at 50 CFR part 424, set forth the procedures for adding species to the Federal Lists of Endangered and Threatened Wildlife and Plants. Under section 4(a)(1) of the Act, we may list a species based on (A) The present or threatened destruction, modification, or curtailment of its habitat or range; (B) overutilization for commercial, recreational, scientific, or educational purposes; (C) disease or predation; (D) the inadequacy of existing regulatory mechanisms; or (E) other natural or manmade factors affecting its continued existence. Listing actions may be warranted based on any of the above threat factors, singly or in combination.

As required by the Act, we considered the five factors in assessing whether the lesser prairie-chicken meets the definition of an endangered or a threatened species. We examined the best scientific and commercial information available regarding the past, present, and future threats faced by the lesser prairie-chicken. Based on our review of the best available scientific and commercial information, we find the lesser prairie-chicken is likely to become in danger of extinction in the foreseeable future and, therefore, meets the definition of a threatened species.

The life history and ecology of the lesser prairie-chicken make it exceptionally vulnerable to changes on the landscape, especially at its currently reduced numbers. As discussed above, this vulnerability to habitat impacts results from the species' lek breeding system, which requires males and females to be able to hear and see each other over relatively wide distances; the need for large patches of habitat that include several types of microhabitats; and the behavioral avoidance of vertical structures. Specifically, the lesser prairie-chicken's behavioral avoidance of vertical structures causes its habitat to be more functionally fragmented than another species' habitat would be. For example, a snake likely would continue to use habitat underneath a wind turbine, but the lesser prairie-chicken's predator avoidance behavior causes it to avoid a large area (estimated to be 1 mile) around a tall vertical object. The habitat within that 1.6-km (1-mi) buffer continues to be otherwise suitable for lesser prairie-chickens, but the entire area is avoided because of the vertical structure. As a result, the impact of any individual fragmenting feature is of higher magnitude than the physical footprint of that structure would suggest it should be.

The ongoing and future impacts of cumulative habitat loss and fragmentation to the lesser prairie-chicken are widespread and of high magnitude. Most importantly, the probable future negative impacts to the species and its habitat are the result of conversion of grasslands to agricultural uses; encroachment by invasive, woody plants; wind energy development; petroleum production; roads; and presence of manmade vertical structures, including towers, utility lines, fences, turbines, wells, and buildings. The historical and current impact of these fragmenting factors has reduced the status of the species to the point that individual populations are vulnerable to extirpation as a result of stochastic events such as extreme weather events. Additionally, these populations are more vulnerable to the effects of climate change, disease, and predation than they would have been at historical population levels. These threats are currently impacting lesser prairie-chickens throughout their range and, as detailed individually above, are projected to increase in severity into the foreseeable future.

The range of the lesser prairie-chicken has been reduced by an estimated 84 percent since pre-European settlement. The vulnerability of lesser prairie-chickens to changes on the landscape is magnified compared to historical times due to the species' reduced population numbers, prevalence of isolated populations, and reduced range. There are few areas of large patches of unfragmented, suitable grassland remaining. Based on our analysis presented earlier, approximately 98.96 percent of the remaining suitable habitat patches were less than 486 ha (1,200 ac) in size. In addition, 99.97 percent of the remaining suitable habitat patches were less than 6,475 ha (16,000 ac) in size. In order to thrive and colonize unoccupied areas, lesser prairie-chickens require large patches of functionally unfragmented habitat that include a variety of microhabitats needed to support lekking, nesting, brood rearing, feeding for young, and feeding for adults, among other things. Habitat patches that do not contain all of these microhabitats may support population persistence but may not support thriving populations that can produce surplus males capable of colonizing new areas or recolonizing previously extirpated areas.

The species has a reduced population size and faces ongoing habitat loss and degradation. The species will lack sufficient redundancy and resiliency to ensure its viability from present and future threats. As a result, the status of the species has been reduced to the point that individual populations are vulnerable to extirpation due to a variety of stochastic events (e.g., drought, winter storms). These extirpations are especially significant because, in many places, there are no nearby, connected populations with robust numbers that can rescue the extirpated populations (i.e., be a source for recolonization). Stochastic events will not affect all populations equally such all of the remaining populations are not likely to be extirpated at once; however, without intervention, population numbers will continue to decline and the range of the species will continue to contract.

There are numerous ongoing conservation efforts throughout the range of the species that are working to reduce or remove many of the threats affecting the lesser prairie-chicken. However, those existing efforts are largely focused on just one or two of the threats that the lesser prairie-chicken is facing, and, in total, those efforts largely do not address two of the more significant threats to the lesser prairie-chicken into the future, namely oil and gas development and wind energy development. Additionally, despite those ongoing efforts, the status of the species has continued to decline, presumably as a result of the effects of drought. The WAFWA recently finalized their rangewide plan, a landmark conservation effort that is intended to address, in part, those threat sources that are not covered elsewhere. While we have determined that the rangewide plan will provide a net conservation benefit to the species, the positive benefits of that effort are expected to occur in the future rather than now at the time of listing.

In summary, because of the reduction in the numbers and range of lesser prairie-chickens resulting from cumulative ongoing habitat fragmentation, combined with the lack of sufficient redundancy and resiliency of current populations, we conclude that the lesser prairie-chicken is currently at risk of extinction or is likely to be in danger of extinction in the foreseeable future.

We must then assess whether the species is in danger of extinction now (i.e., an endangered species) or is likely to become in danger of extinction in the foreseeable future (i.e., a threatened species). In assessing the status of the lesser prairie-chicken, we applied the general understanding of “in danger of extinction” as discussed in the December 22, 2010, memo to the polar bear listing determination file, “Supplemental Explanation for the Legal Basis of the Department’s May 15, 2008, Determination of Threatened Status for the Polar Bear,” signed by then Acting Director Dan Ashe (hereafter referred to as Polar Bear Memo). As discussed in the Polar Bear Memo, a key statutory difference between an endangered species and a threatened species is the timing of when a species may be in danger of extinction (i.e., currently on the brink of extinction), either now (endangered species) or in the foreseeable future (threatened species).

As discussed in the Polar Bear Memo, because of the fact-specific nature of listing determinations, there is no single metric for determining if a species is “in danger of extinction" now. Nonetheless, the practice of the Service over the past four decades has been consistent. Species that the Service has determined to be in danger of extinction now, and therefore appropriately listed as an endangered species, generally fall into four basic categories:

(1) Species facing a catastrophic threat from which the risk of extinction is imminent and certain.

(2) Narrowly restricted endemics that, as a result of their limited range or population size are vulnerable to extinction from elevated threats.

(3) Species formally more widespread that have been reduced to such critically low numbers or restricted ranges that they are at a high risk of extinction due to threats that would not otherwise imperil the species.

(4) Species with still relatively widespread distribution that have nevertheless suffered ongoing major reductions in their numbers, range, or both, as a result of factors that have not been abated.

The best scientific and commercial data available indicate that the lesser prairie-chicken could fit into the fourth category. However, as noted in the Polar Bear Memo, threatened species share some characteristics with this category of endangered species where the recent decline in population, range, or both, is to a less severe extent. The Polar Bear Memo indicates that "[w]hether a species in this situation is ultimately an endangered species or threatened species depends on the specific life history and ecology of the species, the natures of the threats, and population numbers and trends." The Polar

Bear Memo provides examples of species that suffered fairly substantial declines in numbers or range and were appropriately listed as threatened because the species as a whole was not in danger of extinction, although the Service could foresee the species reaching the brink of extinction.

As discussed above, the foreseeable future refers to the extent to which the Secretary can reasonably rely on predictions about the future in making determinations about the future conservation status of the species. For the lesser prairie-chicken, information about the primary ongoing and future threats is reasonably well-known and reliable. Thus, we used the best scientific and commercial data available to analyze and identify the primary ongoing and future threats to the lesser prairie-chicken. As discussed in the Polar Bear Memo, species like the lesser prairie-chicken that have suffered ongoing, major reductions in numbers or range (or both) due to factors that have not been abated may be classified as threatened species if some populations appear stable, which would indicate that the entity as a whole was not in danger of extinction now (i.e., not an endangered species). In the case of the lesser prairie-chicken, the best available information indicates that, while there have been major range reductions (84 percent) as a result of factors that have not been abated (cumulative habitat fragmentation and drought), there are sufficient stable populations such that the species is not on the brink of extinction. Specifically, in the Short-Grass/CRP mosaic ecoregion of northwestern Kansas, the lesser prairie-chicken has reoccupied parts of its former range after landowners enrolled in CRP, creating large blocks of high-quality habitat beneficial to the species. This population is considered relatively secure in the near term, as it is primarily comprised of CRP lands that are in 10- to 15-year contracts. Further, lesser prairie-chicken populations are spread over a large geographical area, and the current range of the species includes populations that represent the known diversity of ecological settings for the lesser prairie-chicken. As a result, it is unlikely that a single stochastic event (e.g., drought, winter storm) will affect all known extant populations equally or simultaneously; therefore, it would require several stochastic events over a number of years to bring the lesser prairie-chicken to the brink of extinction due to those factors alone. In addition, the current and ongoing threats of conversion of grasslands to agricultural uses; encroachment by invasive, woody plants; wind energy development; and petroleum production are not likely to impact all remaining populations significantly in the near term because these activities either move slowly across the landscape or take several years to plan and implement. These threats are also less likely to significantly impact the Kansas lesser prairie-chicken population in the near term because of its relative security (e.g., land use is unlikely to change through the term of the CRP contracts), as described above. Therefore, there are sufficient populations to allow the lesser prairie-chicken to persist into the near future, it is not in danger of extinction throughout all of its range now. However, because of the nature of the ongoing threats to the species, the Service can foresee the species reaching the brink of extinction, and the species, therefore, appropriately meets the definition of a threatened species (i.e., likely to become in danger of extinction in the foreseeable future).

In conclusion, as described above, the lesser prairie-chicken has experienced significant reductions in range and population numbers, is especially vulnerable to impacts due to its life history and ecology, and is subject to significant current and future threats. We conclude that there are sufficient populations to allow the species to persist into the near future. Therefore, after a review of the best available scientific information as it relates to the status of the species and the five listing factors, we find the lesser prairie-chicken is likely to become in danger of extinction in the foreseeable future throughout its range. Therefore, we are listing the lesser prairie-chicken as a threatened species.

Available Conservation Measures

Conservation measures provided to species listed as endangered or threatened under the Act include recognition, recovery actions, requirements for Federal protection, and prohibitions against certain practices. Recognition through listing often results in public awareness and facilitates conservation by Federal, State, Tribal, and local agencies; private organizations; and individuals. The Act encourages cooperation with the States and requires that recovery actions be carried out for all listed species. The protection required by Federal agencies and the prohibitions against certain activities involving listed species are discussed, in part, below.

Recovery Planning

The primary purpose of the Act is the conservation of endangered and threatened species and the ecosystems upon which they depend. The ultimate goal of such conservation efforts is the recovery of these listed species, so that they no longer need the protective measures of the Act. Subsection 4(f) of the Act requires the Service to develop and implement recovery plans for the conservation of endangered and threatened species. The recovery planning process involves the identification of actions that are necessary to halt or reverse the species' decline by addressing the threats to its survival and recovery. The goal of this process is to restore listed species to a point where they are secure, self-sustaining, and functioning components of their ecosystems.

Recovery planning includes the development of a recovery outline soon after a species is listed, preparation of a draft and final recovery plan, and periodic revisions to the plan as significant new information becomes available. The recovery outline guides the immediate implementation of urgently needed recovery actions and describes the process to be used to develop a recovery plan. The recovery plan identifies site-specific management actions that, when implemented, will achieve recovery of the species, measurable criteria that determine when a species may be downlisted or delisted, and methods for monitoring recovery progress. Recovery plans also establish a framework for agencies to coordinate their recovery efforts and provide estimates of the cost of implementing recovery tasks. Recovery teams (comprised of species experts, Federal and State agencies, nongovernment organizations, and stakeholders) are often established to develop recovery plans. When completed, the recovery outline, draft recovery plan, and the final recovery plan will be available on our website (*http://www.fws.gov/endangered*), or from our Oklahoma Ecological Services Field Office (see **FOR FURTHER INFORMATION CONTACT**).

Implementation of recovery actions generally requires the participation of a broad range of partners, including other Federal agencies, States, Tribal and nongovernmental organizations, businesses, and private landowners. Examples of recovery actions include habitat restoration (e.g., restoration of native vegetation), research and monitoring, captive propagation and reintroduction, and outreach and education. Although land acquisition is an example of a type of recovery action, the recovery of many listed species cannot be accomplished solely on Federal lands because their range may occur primarily or solely on non-federal lands. Consequently, recovery of these species will require cooperative conservation efforts involving private, State, and possibly Tribal lands.

Once this species is listed, funding for recovery actions will be available from a variety of sources, including Federal budgets, State programs, and cost share grants for non-federal landowners, the academic community, and nongovernmental organizations. In addition, under section 6 of the Act, the States of Colorado, Kansas, New Mexico, Oklahoma, and Texas will be eligible for Federal funds to implement management actions that promote the protection and recovery of the lesser prairie-chicken.

Information on our grant programs that are available to aid species recovery can be found at: *http://www.fws.gov/grants*.

Please let us know if you are interested in participating in recovery efforts for the lesser prairie-chicken. Additionally, we invite you to submit any new information on this species whenever it becomes available and any information you may have for recovery planning purposes (see **FOR FURTHER INFORMATION CONTACT**).

Federal Agency Consultation

Section 7(a) of the Act, as amended, requires Federal agencies to evaluate their actions with respect to any species that is proposed or listed as endangered or threatened and with respect to its critical habitat, if any is designated. Regulations implementing this interagency cooperation provision of the Act are codified at 50 CFR part 402. Section 7(a)(4) requires Federal agencies to confer with the Service on any action that is likely to jeopardize the continued existence of a species proposed for listing or result in destruction or adverse modification of proposed critical habitat. If a species is listed subsequently, section 7(a)(2) of the Act requires Federal agencies to ensure that activities they authorize, fund, or carry out are not likely to jeopardize the continued existence of the species or destroy or adversely modify its critical habitat. If a Federal action may adversely affect a listed species or its critical habitat, the responsible Federal agency must enter into formal consultation with the Service.

Some examples of Federal agency actions within the species' habitat that may require conference or consultation, or both, as described in the preceding paragraph include landscape-altering activities on Federal lands; provision of Federal funds to State and private entities through Service programs, such as the PFW Program, State Wildlife Grant Program, and Federal Aid in Wildlife Restoration program; construction and operation of communication, radio, and similar towers by the Federal Communications Commission or Federal Aviation Administration; issuance of section 404 Clean Water Act permits by the U.S. Army Corps of Engineers; construction and management of petroleum pipeline and power line rights-of-way by the Federal Energy Regulatory Commission; construction and maintenance of roads or highways by the Federal Highway Administration; implementation of certain USDA agricultural assistance programs; Federal grant, loan, and insurance programs; Federal habitat restoration programs such as EQIP; and development of Federal minerals, such as oil and gas.

Prohibitions and Exceptions

The purposes of the Act are to provide a means whereby the ecosystems upon which endangered species and threatened species depend may be conserved, to provide a program for the conservation of such endangered species and threatened species, and to take such steps as may be appropriate to achieve the purposes of the treaties and conventions set forth in the Act. The Act is implemented through regulations found in the Code of Federal Regulations (CFR). When a species is listed as endangered, certain actions are prohibited under section 9 of the Act, as specified in 50 CFR 17.21. These prohibitions, which will be discussed further below, include, among others, take within the United States, within the territorial seas of the United States, or upon the high seas; import; export; and shipment in interstate or foreign commerce in the course of a commercial activity.

The Act does not specify particular prohibitions, or exceptions to those prohibitions, for threatened species. Instead, under section 4(d) of the Act, the Secretary of the Interior was given the discretion to issue such regulations as he deems necessary and advisable to provide for the conservation of such species. The Secretary also has the discretion to prohibit by regulation with respect to any threatened species, any act prohibited under section 9(a)(1) of the Act. Exercising this discretion, the Service has developed general prohibitions (50 CFR 17.31) and exceptions to those prohibitions (50 CFR 17.32) under the Act that apply to most threatened species. Under 50 CFR 17.32, permits may be issued to allow persons to engage in otherwise prohibited acts. Alternately, for threatened species, the Service may develop specific prohibitions and exceptions that are tailored to the specific conservation needs of the species. In such cases, some of the prohibitions and authorizations under 50 CFR 17.31 and 17.32 may be appropriate for the species and incorporated into a special rule under section 4(d) of the Act, but the 4(d) special rule will also include provisions that are tailored to the specific conservation needs of the threatened species and which may be more or less restrictive than the general provisions at 50 CFR 17.31. Elsewhere in today's **Federal Register**, we published a final 4(d) special rule that provides measures that are necessary and advisable to provide for the conservation of the lesser prairie-chicken.

We may issue permits to carry out otherwise prohibited activities involving endangered and threatened wildlife species under certain circumstances. Regulations governing permits are codified at 50 CFR 17.32 for threatened species. A permit must be issued for the following purposes: for scientific purposes, to enhance the propagation or survival of the species, and for incidental take in connection with otherwise lawful activities. We anticipate that we would receive requests for all three types of permits, particularly as they relate to development of wind power facilities or implementation of safe harbor agreements. Requests for copies of the regulations regarding listed species and inquiries about prohibitions and permits may be addressed to the Field Supervisor at the address in the **FOR FURTHER INFORMATION CONTACT** section.

It is our policy, as published in the **Federal Register** on July 1, 1994 (59 FR 34272), to identify to the maximum extent practicable at the time a species is listed, those activities that would or would not constitute a violation of section 9 of the Act. The intent of this policy is to increase public awareness of the effect of a proposed listing on proposed and ongoing activities within the range of the newly listed species. The following activities could potentially result in a violation of section 9 of the Act; this list is not comprehensive:

(1) Unauthorized collecting, handling, possessing, selling, delivering, carrying, or transporting of the species, including import or export across State lines and international boundaries, except for properly documented antique specimens of these taxa at least 100 years old, as defined by section 10(h)(1) of the Act.

(2) Actions that would result in the unauthorized destruction or alteration of the species' occupied habitat, as described in this rule. Such activities could include, but are not limited to, the removal of native shrub or herbaceous vegetation by any means for any infrastructure construction project or direct conversion of native shrub or herbaceous vegetation to another land use.

(3) Actions that would result in the long-term (e.g., greater than 3 years) alteration of preferred vegetative characteristics of lesser prairie-chicken habitat, as described in this rule, particularly those actions that would cause a reduction or loss in the native invertebrate community within those habitats. Such activities could include, but are not limited to, inappropriate livestock grazing, the application of herbicides or insecticides, and seeding of nonnative plant species that would compete with native vegetation for water, nutrients, and space.

(4) Actions that would result in lesser prairie-chicken avoidance of an area during one or more seasonal periods. Such activities could include, but are not limited to, the

construction of vertical structures such as power lines, fences, communication towers, and buildings; motorized and nonmotorized recreational use; and activities such as well drilling, operation, and maintenance, which would entail significant human presence, noise, and infrastructure.

(5) Actions, intentional or otherwise, that would result in the destruction of eggs or active nests or cause mortality or injury to chicks, juveniles, or adult lesser prairie-chickens.

Questions regarding whether specific activities would constitute a violation of section 9 of the Act should be directed to the Oklahoma Ecological Services Field Office (see **FOR FURTHER INFORMATION CONTACT**).

Critical Habitat Designation for Lesser Prairie-chicken

Background

Critical habitat is defined in section 3 of the Act as:

(i) The specific areas within the geographical area occupied by the species, at the time it is listed in accordance with the Act, on which are found those physical or biological features:

(I) Essential to the conservation of the species, and

(II) Which may require special management considerations or protection; and

(ii) Specific areas outside the geographical area occupied by the species at the time it is listed, upon a determination that such areas are essential for the conservation of the species.

Conservation, as defined under section 3 of the Act, means using all methods and procedures deemed necessary to bring an endangered or threatened species to the point at which the measures provided pursuant to the Act are no longer necessary. Such methods and procedures include, but are not limited to, all activities associated with scientific resources management such as research, census, law enforcement, habitat acquisition and maintenance, propagation, live trapping, and transplantation, and, in the extraordinary case where population pressures within a given ecosystem cannot be relieved otherwise, may include regulated taking.

Critical habitat receives protection under section 7(a)(2) of the Act through the requirement that Federal agencies insure, in consultation with the Service, that any action they authorize, fund, or carry out is not likely to result in the destruction or adverse modification of critical habitat. The designation of critical habitat does not alter land ownership or establish a refuge, wilderness, reserve, preserve, or other conservation area. Such designation does not allow the government or public to access private lands. Such designation does not require implementation of restoration, recovery, or enhancement measures by non-Federal landowners. Instead, where a landowner seeks or requests

Federal agency funding or authorization for an action that may affect a listed species or critical habitat, the consultation requirements of section 7(a)(2) would apply, but even in the event of a destruction or adverse modification finding, the obligation of the Federal action agency and the applicant is not to restore or recover the species, but to implement reasonable and prudent alternatives to avoid destruction or adverse modification of critical habitat.

Under the first prong of the Act's definition of critical habitat, areas within the geographical area occupied by the species at the time it was listed are included in a critical habitat designation if they contain physical or biological features (1) which are essential to the conservation of the species and (2) which may require special management considerations or protection. For these areas, critical habitat designations identify, to the extent known using the best scientific and commercial data available, those physical or biological features that are essential to the conservation of the species (such as space, food, cover, and protected habitat). In identifying those physical and biological features within an area, we focus on the principal biological or physical constituent elements (primary constituent elements such as roost sites, nesting grounds, seasonal wetlands, water quality, tide, soil type) that are essential to the conservation of the species. Primary constituent elements are the elements of physical or biological features that are the specific components that provide for a species' life-history processes, and are essential to the conservation of the species.

Under the second prong of the Act's definition of critical habitat, we can designate critical habitat in areas outside the geographical area occupied by the species at the time it is listed, upon a determination that such areas are essential for the conservation of the species. For example, an area formerly occupied by the species but that was not occupied at the time of listing may be essential to the conservation of the species and may be included in a critical habitat designation. We designate critical habitat in areas outside the geographical area occupied by a species only when a designation limited to its current occupied range would be inadequate to ensure the conservation of the species.

Section 4 of the Act requires that we designate critical habitat on the basis of the best scientific and commercial data available. Further, our Policy on Information Standards Under the Endangered Species Act (published in the **Federal Register** on July 1, 1994 (59 FR 34271)), the Information Quality Act (section 515 of the Treasury and General Government Appropriations Act for Fiscal Year 2001 (Pub. L. 106–554; H.R. 5658)), and our associated Information Quality Guidelines, provide criteria, establish procedures, and provide guidance to ensure that our decisions are based on the best scientific data available. They require our biologists, to the extent consistent with the Act and with the use of the best scientific data available, to use primary and original sources of information as the basis for recommendations to designate critical habitat.

When we are determining which areas we should designate as critical habitat, our primary source of information is generally the information developed during the listing process for the species. Additional information sources may include articles published in peer-reviewed journals, conservation plans developed by States and Counties, scientific status surveys and studies, biological assessments, or other unpublished materials and expert opinion or personal knowledge.

Habitat is often dynamic, and species may move from one area to another over time. Furthermore, we recognize that critical habitat designated at a particular point in time may not include all of the habitat areas that we may later determine are necessary for the recovery of the species, considering additional scientific information may become available in the future. For these reasons, a critical habitat designation does not signal that habitat outside the designated area is unimportant or may not be needed for recovery of the species. Areas that are important to the conservation of the species, both inside and outside the critical habitat designation, will continue to be subject to: (1) Conservation actions implemented under section 7(a)(1) of the Act; (2) regulatory protections afforded by the requirement in section 7(a)(2) of the Act for Federal agencies to insure their actions are not likely to jeopardize the continued existence of any endangered or threatened species; and (3) the prohibitions of section 9 of the Act if actions occurring in these areas may result in take of the species. Federally funded or permitted projects affecting listed species outside their designated critical habitat areas may still result in jeopardy findings in some cases. These protections and conservation tools will continue to contribute to recovery of this species. Similarly, critical habitat designations made on the basis of the best available information at the time of designation will not control the direction and substance of future recovery plans, HCPs, or other species conservation planning efforts if new information available at the time of these planning efforts calls for a different outcome.

Prudency Determination

Section 4(a)(3) of the Act, as amended, and implementing regulations (50 CFR 424.12), require that, to the maximum extent prudent and determinable, the Secretary designate critical habitat at the time a species is determined to be an endangered or threatened species. Our regulations (50 CFR 424.12(a)(1)) state that the designation of critical habitat is not prudent when one or both of the following situations exist: (1) The species is threatened by taking or other human activity, and the identification of critical habitat can be expected to increase the degree of threat to the species, or (2) such designation of critical habitat would not be beneficial to the species.

There is currently no operative threat to lesser prairie-chickens attributed to unauthorized collection or vandalism, and identification and mapping of critical habitat is not expected to initiate any such threat. Thus, we conclude designating critical habitat for the lesser prairie-chicken is not expected to create or increase the degree of threat to the species due to taking.

Conservation of lesser prairie-chickens and their essential habitats will focus on, among other things, habitat management, protection, and restoration, which will be aided by knowledge of habitat locations and the physical or biological features of the habitat. In the absence of finding that the designation of critical habitat would increase threats to a species, if there are any benefits to a critical habitat designation, then a prudent finding is warranted. We conclude that the designation of critical habitat for the lesser prairie-chicken will benefit the species by serving to focus conservation efforts on the restoration and maintenance of ecosystem functions within those areas considered essential for achieving its recovery and long-term viability. Other potential benefits include: (1) Triggering consultation under section 7(a)(2) of the Act in new areas for actions in which there may be a Federal nexus where consultation would not otherwise occur because, for example, the area is or has become unoccupied or the occupancy is in question; (2) focusing conservation activities on the most essential features and areas; (3) providing educational benefits to State or county governments or private entities; and (4) preventing inadvertent harm to the species.

Therefore, because we have determined that the designation of critical habitat will not likely increase the degree of threat to the species and may provide some benefit, we find that designation of critical habitat is prudent for the lesser prairie-chicken.

Critical Habitat Determinability

Having determined that designation is prudent, under section 4(a)(3) of the Act we must find whether critical habitat for the species is determinable. Our regulations at 50 CFR 424.12(a)(2) state that critical habitat is not determinable when one or both of the following situations exist:

(i) Information sufficient to perform required analyses of the impacts of the designation is lacking, or

(ii) The biological needs of the species are not sufficiently well known to permit identification of an area as critical habitat. When critical habitat is not determinable, the Act allows the Service an additional year following publication of a final listing rule to publish a final critical habitat designation (16 U.S.C. 1533(b)(6)(C)(ii)).

In accordance with section 3(5)(A)(i) and 4(b)(1)(A) of the Act and the regulations at 50 CFR 424.12, in determining which areas occupied by the species at the time of listing to designate as critical habitat, we consider the physical and biological features essential to the conservation of the species which may require special management considerations or protection. These include, but are not limited to:

(1) Space for individual and population growth and for normal behavior;

(2) Food, water, air, light, minerals, or other nutritional or physiological requirements;

(3) Cover or shelter;

(4) Sites for breeding, reproduction, and rearing (or development) of offspring; and

(5) Habitats that are protected from disturbance or are representative of the historical geographical and ecological distributions of a species.

We are currently unable to identify critical habitat for the lesser prairie-chicken because important information on the geographical area occupied by the species, the physical and biological habitat features that are essential to the conservation of the species, and the unoccupied areas that are essential to the conservation of the species is not known at this time. A specific shortcoming of the currently available information is the lack of data about: (1) The specific physical and biological features essential to the conservation of the species; (2) how much habitat may ultimately be needed to conserve the species; (3) where the habitat patches occur that have the best chance of rehabilitation; and (4) where linkages between current and future populations may occur. Additionally, while we have reasonable general information about habitat features in areas occupied by lesser prairie-chickens, we do not know what specific features, or combinations of features, are needed to ensure persistence of stable, secure populations.

Several conservation actions are currently underway that will help inform this process and reduce some of the current uncertainty. Incorporation of the information from these conservation actions will give us a better understanding of the species' biological requirements and what areas are needed to support the conservation of the species.

The five State conservation agencies within the occupied range of the lesser prairie-chicken, through coordination with the Western Association of Fish and Wildlife Agencies Grassland Initiative, were funded to develop a rangewide survey sampling framework and to implement aerial surveys in 2012 and 2013. The rangewide plan commits to continued rangewide population monitoring of the lesser prairie-chicken, including annual use of the aerial survey methodology used in 2012 and 2013 (Van Pelt *et al.* 2013, p. 122). Ongoing implementation of these aerial surveys is important, as they may enable biologists to determine location of leks that are too distant from public roads to be detected during standard survey efforts. Our critical habitat determination will benefit from this additional information and allow us to consider the most recent and best science in making our critical habitat determination.

Similarly, all five State conservation agencies within the occupied range of the lesser prairie-chicken have partnered with the Service and Playa Lakes Joint Venture, using funding from the DOE and the Western Governors' Association, to develop a decision support system that assists in evaluation of lesser prairie-chicken habitat, assists industry with nonregulatory siting decisions, and facilitates targeting of conservation activities for the species. The first iteration of that product went online in September 2011 (*http://kars.ku.edu/geodata/maps/sgpchat/*). This decision support system is still being refined, and a second iteration of the product, under oversight of the Western Association of Fish and Wildlife Agencies, went online during the fall of 2013. Further iterations will provide additional information that will help improve evaluation of lesser prairie-chicken habitat. The Steering Committee of the Great Plains Landscape Conservation Cooperative has made completion of Phase II one of their highest priorities for the next 18 months. The Lesser Prairie-chicken Interstate Working Group will be identifying the research and data needs for moving Phase II forward. Outputs derived from this decision support tool will help us more precisely identify the location and distribution of features essential to the conservation of the lesser prairie-chicken.

Therefore, we have concluded that critical habitat is not determinable for the lesser prairie-chicken at this time because we lack information on the precise area occupied by the species and on the physical and biological habitat features that are essential to the conservation of the species. Also, since the unoccupied areas that are essential to the conservation of the species are not known at this time, we lack information to assess the impacts of the potential critical habitat designation.

Required Determinations

National Environmental Policy Act (42 U.S.C. 4321 et seq.)

We have determined that environmental assessments and environmental impact statements, as defined under the authority of the National Environmental Policy Act (NEPA; 42 U.S.C. 4321 *et seq.*), need not be prepared in connection with listing a species as an endangered or threatened species under the Endangered Species Act. We published a notice outlining our reasons for this determination in the **Federal Register** on October 25, 1983 (48 FR 49244).

Government-to-Government Relationship with Tribes

In accordance with the President's memorandum of April 29, 1994 (Government-to-Government Relations with Native American Tribal Governments; 59 FR 22951), Executive Order 13175 (Consultation and Coordination With Indian Tribal Governments), and the Department of the Interior's manual at 512 DM 2, we readily acknowledge our responsibility to communicate meaningfully with recognized Federal Tribes on a government-to-government basis. In accordance with Secretarial Order 3206 of June 5, 1997 (American Indian Tribal Rights, Federal-Tribal Trust Responsibilities, and the Endangered Species Act), we readily acknowledge our responsibilities to work directly with tribes in developing programs for healthy ecosystems, to acknowledge that tribal lands are not subject to the same controls as Federal public lands, to remain sensitive to Indian culture, and to make information available to tribes.

By letter dated April 19, 2011, we contacted known tribal governments throughout the historical range of the lesser prairie-chicken. We sought their input on our development of a proposed rule to list the lesser prairie-chicken and encouraged them to contact the Oklahoma Ecological Services Field Office if any portion of our request was unclear or to request additional information. We did not receive any comments regarding this request. We continued to keep tribal governments informed by providing notifications of each new or reopened public comment period and specifically requesting their input. We did not receive any requests or comments as a result of our request.

References Cited

A complete list of all references cited in this rule is available on the Internet at *http://www.regulations.gov,* or upon request from the Field Supervisor, Oklahoma Ecological Services Field Office (see **FOR FURTHER INFORMATION CONTACT**).

Authors

The primary authors of this rule are the staff members of the Oklahoma Ecological Services Field Office (see **FOR FURTHER INFORMATION CONTACT**).

List of Subjects in 50 CFR Part 17

Endangered and threatened species, Exports, Imports, Reporting and recordkeeping requirements, Transportation.

Regulation Promulgation

Accordingly, we amend part 17, subchapter B of chapter I, title 50 of the Code of Federal Regulations, as set forth below:

PART 17—[AMENDED]

1. The authority citation for part 17 continues to read as follows:

Authority: 16 U.S.C. 1361–1407; 1531–1544; 4201–4245, unless otherwise noted.

2. Amend §17.11(h) by adding an entry for "Prairie-chicken, lesser" in alphabetical order under BIRDS to the List of Endangered and Threatened Wildlife to read as follows:

§17.11 Endangered and threatened wildlife.

* * * * *

(h) * * *

Species		Historic range	Vertebrate population where endangered or threatened	Status	When listed	Critical habitat	Special rules
Common name	Scientific name						
* * * * * * *							
BIRDS							
* * * * * * *							
Prairie-chicken, lesser	*Tympanuchus pallidicinctus*	U.S.A. (CO, KS, NM, OK, TX)	Entire	T	831	NA	17.41 (d)
* * * * * * *							

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Dated: March 21, 2014

Signed: /s/ Daniel M. Ashe

Director, U.S. Fish and Wildlife Service

Billing Code 4310–55–P