

Edits made by Julie MacDonald on a USFWS report synthesizing the sage grouse situation. MacDonald is the deputy assistant secretary for fish wildlife and parks in the Dept. of the Interior. This represents to DOI view of the sage grouse situation.

SYNTHESIS OF BIOLOGICAL AND HABITAT INFORMATION FOR USE IN THE GREATER SAGE-GROUSE EXTINCTION RISK ANALYSIS

U.S. Fish and Wildlife Service
18 October 2004

Introduction

This synthesis is a comprehensive examination of greater sage-grouse natural history and habitat relationships, distribution, population trends, and the analysis of the environmental and human-related factors that may influence the species' likelihood of extinction. It incorporates all substantial information on these topics known to the U.S. Fish and Wildlife Service (Service) as of October, 2004. Our purpose is to provide the expert panelists with a compendium of the 'best available' scientific and commercial data that may be relevant to projecting the species' risk of extinction. While the summary is not exhaustive, it is intended to present the full breadth of data available to us which may be relevant to making a determination as to extinction risk. By reading this synthesis before their November 3-4, 2004, meeting, the panelists can participate in the risk analysis exercises and discussions with a common baseline understanding of this scientific data that is available at this time.

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In addition to scientific literature on greater sage-grouse and their habitats, we have considered all information provided to us by State and Federal agencies and Tribes, as well as information provided through commercial and public comments. Our review of relevant materials included the Western Association of Fish and Wildlife Agencies' (WAFWA) Conservation Assessment of the Greater Sage-grouse and Sagebrush Habitats (Conservation Assessment), which was completed in June, 2004. We have considered the data presented in the Conservation Assessment, in conjunction with all other available information sources. A list of references is attached.

Comment: It is inappropriate to place our full reliance on a document for which there is a. no data, b. no information on the theoretical basis for data reduction (the models) 3. Assumptions included in the models 4. No peer review comments (since it was not published) Singling the document out in our preface gives it undue weight particularly in light of the Data Quality Act Petitions we have received with respect to its shortcomings. That is not to say that we won't use it along with the other information we have, just that we ought not highlight it as though it is the centerpiece of the rulemaking. We should treat it as we would treat an industry publication. Check the cites, check the data, check the analysis and if it is consistent with the requirements of the DQA, use the information.

Deleted: This assessment was written by species and habitat experts based on the analysis of information from scientific journals, peer reviewed agency reports and graduate theses, plus State and Federal agency reports and data sets regarding populations and habitat attributes. The Conservation Assessment was peer-reviewed through a contract with the Ecological Society of America.

The following document identifies all factors we were able to determine may affect the greater sage-grouse. By their inclusion, we are not making the determination that all of these factors are of equal importance to either the extinction risk analysis or the bird and its habitat. Rather, we intend this document to be comprehensive and not intended to pre-determine the comparative relevance of the issues.

This document was written by a team of Fish and Wildlife Service biologists, most of whom will be present when the expert panel convenes. In addition to this synthesis, the expert panelists will receive copies of the literature cited, and comments received by the Service for consideration in the on-going review of the status of the species (in electronic formats).

Background

On April 12, 2004, the Service determined that there was substantial information presented in three petitions and other pertinent information provided to us during our evaluation of the petitions, to indicate that listing the greater sage-grouse may be warranted (69 FR 21484). The finding was based primarily on information provided in the petition regarding the historic and current destruction, modification, or curtailment of greater sage-grouse habitat or range, and the inadequacy of existing regulatory mechanisms in protecting greater sage-grouse habitats throughout the species' range. Our finding acknowledged that there were some factual errors within the petitions and that we had not critically reviewed the status of the sage grouse. We also specifically noted that we did not know at that time whether the species should be listed, We can only come to a conclusion on that issue after a more thorough review of the species' status. With the publication of the 90-day finding, we initiated a status review. The status review must be completed within 12 months of receipt of a petition; in this case by December 29, 2004.

As part of the review and analysis of scientific data to determine whether or not the greater sage-grouse warrants listing under the Endangered Species Act, the

Comment: Footnote deleted. We discuss this in the synthesis document. There is no need to call it out. This document focuses on those issues we have identified as being appropriate based on the best available scientific data.

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Comment: After our discussion of the DQA Petitions and the fact that the Service did not critically review what was raised in the petition for accuracy or veracity, that our 90 day finding merely restates what petitioners assert, we ought not be including the finding. What the experts should be reviewing is that data we have reviewed and determined is the best available scientific data. That is what should be used in making their determination.

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Comment: The legal standard for listing is best available scientific and commercial data.

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Service is conducting an evaluation of extinction risk with assistance from experts in sage-grouse biology and habitats. The experts will be considering and responding individually in structured formats to questions pertaining to the species' extinction risk and the certainty of such projections. In contrast, the experts will not be considering or discussing the separate regulatory question of whether a proposal to list the species is warranted, not warranted, or warranted but precluded due to other higher priority listing actions.

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Greater Sage-Grouse Background Information

The sage-grouse was first described by Meriwether Lewis during the Lewis and Clark expedition in 1805 (Zwickel and Schroeder 2003; Connelly *et al.* 2004; Schroeder *et al.* 2004). Bonaparte wrote the first technical description of the species in 1827 and gave the bird its original scientific name, *Tetrao urophasianus* (Patterson 1952; Connelly *et al.* 2004). The species was subsequently re-named as *Centrocercus urophasianus* in 1831 (Patterson 1952). In 2000, the species was separated into 2 distinct species, the Greater (*C. urophasianus*) and the Gunnison sage-grouse (*C. minimus*) based on genetic, morphological and behavioral differences (Young *et al.* 2000). Because it is a separate species, the Gunnison sage-grouse is not included in this synthesis.² The American Ornithological Union (AOU) recognizes two subspecies of the greater sage-grouse, the eastern (*C. u. urophasianus*) and western (*C. u. phaios*), based on research by Aldrich (1946). Recent genetic analyses, however, do not support this delineation (Benedict *et al.* 2003), and no delimiting differences in habitat use, natural history, or behavior are known between the two subspecies. Therefore, the Service no longer acknowledges the subspecies designation (68 FR 6500; February 7, 2003; 69 FR 933; January 7, 2004).

Natural History

The sage-grouse is the largest North American grouse species. Adult males range in length from 66 to 76 centimeters (cm) (26 to 30 inches (in)) and weigh between 2 and 3 kilograms (kg) (4 and 7 pounds (lb)). Adult females range in length from 48 to 58 cm (19 to 23 in) and weigh between 1 and 2 kg (2 and 4 lb). Males and females have dark grayish-brown body plumage with many small gray and white speckles, fleshy yellow combs over the eyes, long pointed tails, and dark green toes. Males also have blackish chin and throat feathers, conspicuous phylloplumes (specialized erectile feathers) at the back of the head and neck, and white feathers forming a ruff around the neck and upper belly. During breeding displays, males exhibit olive-green apteria (fleshy bare patches of skin) on their breasts (Schroeder *et al.* 1999).

² The Gunnison sage-grouse is currently on the Service's candidate list for threatened and endangered species (67 FR 40657).

Sage-grouse depend on a variety of shrub-steppe habitats throughout their life cycle, and are considered obligate users of several species of sagebrush (i.e., Wyoming big sagebrush (*Artemisia tridentata wyomingensis*), mountain big sagebrush (*A. t. vaseyana*), and basin big sagebrush (*A. t. tridentata*) (Patterson 1952; Braun *et al.* 1976; Connelly *et al.* 2000a). Sage-grouse also use other sagebrush species such as low sagebrush (*A. arbuscula*), black sagebrush (*A. nova*), fringed sagebrush (*A. frigida*) and silver sagebrush (*A. cana*) (Schroeder *et al.* 1999; Connelly *et al.* 2004). Thus, sage-grouse distribution is strongly correlated with the distribution of sagebrush habitats (Schroeder *et al.* 2004); they are found outside of this habitat only during migration.

Comment: I am uncomfortable with this statement. I realize that a number of the publications cited make this statement, but we also have other cites that note the SG ability to adapt (most notably Schroeder 1999)

Deleted: Connelly *et al.* 2004

Data are not available regarding minimum sagebrush patch sizes required to support populations of sage-grouse.

Comment: Umm... this ignores a very pointed comment in Shroeder that they adapt easily to other habitats and then proceeds to include wheat, alfalfa and several other row crop type habitats.

Comment: I am deleting Connolly unless we are talking about the data they cite because for any other statement or data, they are not a primary source.

Deleted: While sage-grouse are dependent on large, interconnected expanses of sagebrush (Patterson 1952; Connelly *et al.* 2004),

Sage-grouse generally exhibit site fidelity (loyalty to a particular area) for breeding and nesting areas. Variation in breeding and nesting areas between years is less in older than younger birds, suggesting that site fidelity results from experience and a period of territory establishment (Schroeder and Robb 2003).

Comment: Removed the earlier sentence because the cite I have consists of a title page and table of contents. The point in asking for cited documents is to be able to assess the validity of the statements in our work. If you cite an entire book, that's not very helpful, so, give me the title page, and the cited pages which include the reference. If you can do that, we can put the sentence back in.

Comment: We have comment letters that question the statement .

During the spring breeding season male sage-grouse gather together and perform courtship displays on display areas called leks, primarily during the morning hours just after dawn. Areas of bare soil, short-grass steppe, windswept ridges, exposed knolls, or other relatively open sites may serve as leks (Patterson 1952). Leks are often surrounded by denser shrub-steppe cover, which is used for escape, thermal and feeding-cover. Leks can be formed opportunistically at any appropriate site within or adjacent to nesting habitat (Connelly *et al.* 2000a), and therefore lek habitat availability is not considered to be a limiting factor for sage-grouse (Schroeder 1997). Leks range in size from less than 0.04 hectare (ha) (0.1 acre (ac)) to over 36 ha (90 ac) and can host from several to hundreds of males (Johnsgard 2002). Males defend individual territories within leks and perform elaborate displays with their specialized plumage and vocalizations to attract females for mating. A relatively small number of dominant males accounts for the majority of breeding on each lek (Schroeder *et al.* 1999).

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Comment: Non Sequitur

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Comment: Cite Shroeder 1999

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Comment: Cite the actual studies, not Connolly and references therein... this is our document, we have a duty to review the documents the report relies on, to ensure that we are basing the rule on real information. I left this in, although I am concerned, this cite applies solely to Wyoming.

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Comment: Cite primary source[s]

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Comment: What about the "sneaking" issue?

Some leks are used for many years (Patterson 1952). These "historic" leks are typically larger than and often surrounded by smaller "satellite" leks, which may be less stable in size and location (Connelly *et al.* 2004). Population size may determine the extent of male attendance on satellite leks and these smaller leks may not be active (used during one or more years) when population numbers are low (Dalke *et al.* 1963). A group or associated collection of leks where males and females may interact within a breeding season or between years is called a lek complex.

Females have been documented to travel more than 20 km (12.5 mi) after mating, but distances between a nest site and the lek on which breeding occurred is variable. While earlier studies indicated that most hens nest within 3.2 km (2 mi) of a lek, more recent research indicates that many hens actually move much further from leks to nest based on nesting habitat quality. Research by Bradbury *et al.* (1989) and Wakkinen *et al.* (1992) demonstrated that nest sites are selected independent of lek locations.

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Sage-grouse typically select nest sites under sagebrush cover, although other shrub or bunchgrass species are sometimes used (Klebenow 1969; Connelly *et al.* 2000a; Connelly *et al.* 2004). However, nest success is typically higher for hens nesting under sagebrush than other plant species (Connelly *et al.* 1991). The sagebrush understory of productive nesting areas contains native grasses and forbs, with horizontal and vertical structural diversity that provides an insect prey base, herbaceous forage for pre-laying and nesting hens, and cover for the hen while she is incubating (Gregg 1991; Schroeder *et al.* 1999). Hens require an abundance of forbs for pre-laying and nesting periods, and their diet during the pre-laying period has been linked to subsequent reproductive success (Barnett and Crawford 1994). Shrub canopy and grass cover provide concealment for sage-grouse nests and young, and are critical for reproductive success (Barnett and Crawford 1994; Gregg *et al.* 1994; DeLong *et al.* 1995; Connelly *et al.* 2004). However, variation in other vegetative features associated with nest success across the species' range is likely due to habitat availability and the variation of sagebrush habitats. Vegetation characteristics of successful nests that are consistent rangewide include live and residual grass height, residual vegetative cover,

Comment: The U of Nevada study should be included in this list, and its findings characterized here.

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forb cover, and visual obstruction. One study, (Shultz 2004) indicated that it is possible that forb cover is the more important herbaceous attribute.

Sage-grouse nests are relatively simple, consisting of scrapes on the ground that are sometimes lined with feathers and vegetation. Clutch size ranges from 6 to 13 eggs (Schroeder *et al.* 2000). Nest success (one or more eggs hatching from a nest) ranges from 15 to 86 percent of initiated nests (Schroeder *et al.* 1999), which is lower than for other gallinaceous species (Connelly *et al.* 2000a) and indicative of a lower intrinsic (potential) population growth rate than in most game bird species (also see mortality rates, below). Nest success is greater for adult females when compared with inexperienced, yearling females (Patterson 1952; Schroeder 1997). Renesting rates following nest loss range from 5 to 41 percent (Schroeder 1997). One exception is the renesting rate of 87 percent recorded in north-central Washington, although it was unclear whether this high rate resulted from study methodology or reflected higher reproductive effort in this area as a result of habitat or other unobserved conditions (Schroeder 1997).

Hens rear their broods in the vicinity of the nest site for the first 2 to 3 weeks following hatching. Forbs and insects are essential nutritional components for chicks (Klebenow and Gray 1968; Johnson and Boyce 1991). Therefore, early brood-rearing habitat must provide adequate cover adjacent to areas rich in forbs and insects to assure chick survival during this period.

Most juvenile mortality occurs while the chicks are still in the nest or during their flightless stage, and is due primarily to predation or severe weather conditions (Schroeder *et al.* 1999; Schroeder and Baydack 2001; Gregg *et al.* unpublished data 2004). Chicks begin to fly at 2 to 3 weeks of age, and broods remain together for up to 12 weeks. Documented rates of mortality and survival are elaborated upon further below.

Sage-grouse move from sagebrush uplands to more mesic areas during the late brood-rearing (summer) period (from 3 weeks post-hatch) in response to annual dessication of herbaceous vegetation. Summer use areas can include sagebrush habitats as well as riparian areas, wet meadows

Comment: You have received a paper that has been peer reviewed and accepted for publication from Brad Schultz that discusses the Connelly guidelines and notes that there is no explanation of how Connelly arrived at his numbers. Schultz conducts a meta-analysis of the studies used by Connelly for the guidelines as well as two more recently published works.

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Deleted: Vegetation characteristics as reported in the scientific literature have been summarized by Connelly *et al.* (2000a).

Comment: NO primary cite here, they cite two other studies that are not included in our information.

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Comment: Where is the cite for this statement? Connelly *et. al* note that they are longer lived than most similar species ... how do you get to higher mortality from this?

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Comment: Good description of the data and knowledge.

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Comment: There are comments in the cites that there is little data on this...

Comment: It seems like Schroeder *et. al* would be a better cite here, it's much better annotated and more comprehensive. Connelly *et. al* is not a source of basic biology, it's a document for managers to use as guidance for habitat conditions.

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and alfalfa fields. These areas provide an abundance of forbs and insects for both hens and chicks (Schroeder *et al.* 1999). The use of a variety of habitats associated with or adjacent to sagebrush in late summer is likely attributable to variation in succulent forb availability. Sage-grouse do not require free water, obtaining this habitat component from vegetation. However, natural water bodies and reservoirs can provide mesic areas for succulent forb production, thereby attracting sage-grouse hens with broods. Broodless hens and cocks will also use more mesic areas in close proximity to sagebrush cover during the late summer.

Comment: The following sentence is speculative, should be deleted unless you have a particular argument for why it should stay in, and if so, state factually what you know or the literature indicates. Connolly is not a primary source.

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As vegetation continues to dessicate through the late summer and fall, sage-grouse shift their diet entirely to sagebrush (Schroeder *et al.* 1999). Sage-grouse depend entirely on sagebrush throughout the winter for both food and cover. Differences in the species of sagebrush consumed in the winter may be tied to availability, as well as preferences based on protein and volatile oil levels (Connolly *et al.* 2000a).

Comment: I believe that is an overstatement, as they will eat other stuff if it's available. Please provide a cite if you disagree.

Habitat selection in winter is influenced by sagebrush shrub density and structure (Connolly *et al.* 2000a). In a review of published scientific literature, Connolly *et al.* (2000a) report that sagebrush canopy cover ranges from 12 to 43 percent and sagebrush height ranges from 25 to 56 cm (10 to 22 in). Sage-grouse typically select areas of greater sagebrush canopy cover and sagebrush height when compared to random sites within sagebrush habitat (Connolly *et al.* 2000a). Sagebrush stand selection is influenced by snow depth (Patterson 1952; Connolly 1982 as cited in Connolly *et al.* 2000a), and, in some areas, topography (Beck 1977; Crawford *et al.* 2004). Sage-grouse may move between areas in response to changing weather conditions and snow depth (sagebrush availability above the snow), thus showing limited fidelity to wintering areas between years (Schroeder *et al.* 1999). Despite this adaptability, a sufficiently large area of suitable winter habitat is necessary to sustain populations of sage-grouse over winter (Eng and Schladweiler 1972), particularly where several populations converge in a common wintering area (Lyon 2000).

Comment: We need to talk about Connolly *et al.* 2002 and the paper provided by the U of Nevada extension. Our characterization of cover selection and height is wrong. U of Nevada study indicated that the picture is much more complicated, and explicitly stated that grass height should not be the only variable used. That particular study used all the data Connolly did as well as 2 additional studies, and noted that nowhere does Connolly indicate how they arrived at their conclusion.

Comment: The research cited does not support this statement. The research examined densities of cover used by wintering sage grouse. The paper noted that the particular areas studied were between 2 and 7 thousand acres, and that they supported up to 300 sage grouse. However, the study did not examine the area required by sage grouse for overwintering.

Many populations of sage-grouse migrate between seasonal ranges in response to habitat distribution

(Connelly *et al.* 2004). Migration can occur between winter and breeding/summer areas, between breeding, summer and winter areas, or not at all. Migration distances of up to 161 kilometers (km) (100 mi) have been recorded (Patterson 1952); however, average individual movements are generally less than 34 km (21 mi) (Schroeder *et al.* 1999). Migration distances for female sage-grouse generally are less than for males (Connelly *et al.* 2004). Almost no information is available regarding the distribution and characteristics of migration corridors for sage-grouse (Connelly *et al.* 2004). Sage-grouse dispersal (permanent moves to other areas) is poorly understood (Connelly *et al.* 2004) and appears to be sporadic (Dunn and Braun 1986).

Sage-grouse typically live between 1 and 4 years, but individuals up to 10 years of age have been recorded in the wild. Juvenile survival (from hatch to first breeding season) is affected by food availability, habitat quality, harvest and weather and ranged between 7 and 60 percent in a review of many field studies (Crawford *et al.* 2004). The average annual mortality rate for male sage-grouse (all ages combined) documented in various studies ranged from 38 to 60 percent (Schroeder *et al.* 1999), and for females 55 to 75 percent (Schroeder 1997; Schroeder *et al.* 1999). These mortality rates are low compared with other prairie grouse species (Schroeder *et al.* 1999). Although seasonal patterns of mortality have not been thoroughly examined, over-winter mortality is low (Connelly *et al.* 2004). See the discussion under the Predation section for a complete discussion on seasonal patterns of mortality.

Life History Traits Affecting Population Viability

Sage-grouse have comparatively low reproductive rates and high annual survival (Schroeder *et al.* 1999; Connelly *et al.* 2000a), resulting in slower potential or intrinsic population growth rates than is typically observed in other game birds. Therefore, recovery of populations after a loss from any reason may require years. While these natural history characteristics would not limit sage-grouse populations at large scales under historical conditions of extensive habitat, they may contribute to population declines when humans alter habitats or mortality rates.

Sage-grouse have one of the most polygamous mating systems observed among birds (Deibert 1995).

Comment: This unfortunately neglects to mention predation. And yet, we received multiple comments on the importance of predation, and have a number of cites that indicate predation is the primary cause of chick loss.

In addition, Shroeder and Baydack 2001, one of the FWS cited documents, note that relatively little mortality is caused by fire, weather, and collisions with wires, fences and vehicles (Patterson 1952, Dalke et al. 1967, Schroeder et. al 1999).

Finally, Gregg et al 1994 note that the Oregon decrease in abundance was related to nest productivity and that may result from excessive nest predation. The work goes on to cite 3 works Autenreith 1981, Gatterson and Morse 1948 and Nelson 1955 which identified predation as the primary factor directly influencing sage grouse nesting success in Oregon.

Of the 3 cites, Autenreith 1981 is included in the works cited by the FWS. This document notes Nelson 1955 documented 51% nest predation from a variety of species in Oregon. The study finishes with the statement that... "Sage Grouse predation the rest of the year is less important when compared with the lak of recruitment caused by next predation." It goes on to cite Wallestad 1975 indicated 40% of the hatch succumbed to some form of mortality between hatching and hunting season.

I do not understand why this literature was ignored and the importance of predation ignored given the clear importance our cited documents place on it.

Comment: No cites were provided to me that substantiate this. Ie... you have these cites listed, but Schroeder 1997 is not in my list of cited documents, and Johnsgard is only a title page and table of contents, not particularly helpful. I suspect this is taken out of context and that the statement does not come from a study related specifically to predation.

Deleted: Higher female survival rates account for a female-biased sex ratio in adult birds (Schroeder 1997; Johnsgard 2002).

Comment: Yes, but where are the primary cites for this information? I know, they are published documents, but the published information on historic incidence is misleading when you read the primary source information. There is no basis other than the author's assertions without the primary cites.

Comment: Cites for the basis of this comment. These are mathematical relationships, so the relative rates will result in different outcomes, what and where is the basis for the statement that the SG has a slower potential or intrinsic grown rate than other game birds?

Comment: Cite please

Comment: There might be lags and there might not be.... The cited work examines 5 bird species, none of which are sage grouse, and each species responded differently, so there is no conclusion that can be drawn from it as far as I can tell.

Deleted: . Also, due to site fidelity to breeding and brood-rearing habitats, there may be lags from when a negative habitat impact occurs to when this event is reflected in parameters used to measure changes in sage-grouse populations in response to changing conditions (Wiens and Rotenberry 1985).

Only one or two males are chosen by all females attending the lek (Patterson 1952; Gibson and Bradbury 1986). This asymmetrical mate selection should result in reduced effective population sizes (Deibert 1995), meaning the actual amount of genetic material contributed to the next generation is smaller than predicted by the number of individuals present in the population. With only 10 to 15 percent of sage-grouse males breeding each year (Aldridge and Brigham 2003), the genetic diversity of sage-grouse would be predicted to be low. However, in a recent survey of 16 greater sage-grouse populations, only the Columbia Basin population in Washington showed low genetic diversity, likely as a result of long-term population declines and population isolation (Benedict *et al.* 2003). The level of genetic diversity in the remaining range of sage-grouse has generated a great deal of interest in the field of behavioral ecology, specifically sexual selection (Boyce 1990; Deibert 1995). There is some evidence of "sneaky" copulations in sage-grouse (copulations that occur off the lek by subordinate males), as well as multiple paternity within one clutch (Connelly *et al.* 2004). Dispersal may also contribute to genetic diversity, but little is known about dispersal in sage-grouse (Connelly *et al.* 2004). However, the lek breeding system suggests that population sizes in sage-grouse must be greater than non-lekking birds to maintain long-term genetic diversity.

Comment: There are no cites provided that substantiate this number. Aldridge and Brigham do not provide a cite other than anonymous and personal conversation, hardly data.

Comment: Where is the cite for this statement?? The source, not the summary document.

Comment: Why? Why isn't it enough that first year males move from lek to lek, and that 30% of the males go to a different lek?

Comment: This particular cite is appalling... they 5,000 number is based on a breeding rate of 10-15% of males actually breeding... basis is anonymous and personal conversation, neither of which meets the standards of the Data Quality Act.

Deleted: Aldridge and Brigham (2003) estimated that up to 5,000 individual sage-grouse may be necessary to maintain an effective population size of 500 birds. Their estimate was based on individual male breeding success, variation in reproductive success of males that do breed, and the death rate of juvenile birds. We were unable to find any other published estimates of minimal population sizes necessary to maintain genetic diversity and long-term population sustainability in sage-grouse.

Comment: The research cited in the section is completely mischaracterized. The authors examined models to make a determination about what affected them. They found that assumptions about habitat influenced the outcome of models, and that the models themselves were only as good as the assumptions they included. In addition, they noted that the ability of pva to even rank the probability of extinction was poor. They noted that loss of habitat just reduced the steady state population number. Please delete as the findings really shed no light whatsoever on the question before the experts.

Deleted: Sage-grouse population growth is influenced more by habitat quality than other extrinsic environmental factors (LaMontagne *et al.* 2002). Modeling of population viability and trends in sage-grouse suggest that density-dependent mechanisms may regulate their population cycles under natural conditions (LaMontagne *et al.* 2002; Connelly *et al.* 2004). The role of habitat carrying capacity in controlling population trends may be exacerbated by the fidelity of sage-grouse to established breeding and brood-rearing areas.

Historical and Current Sage-grouse Status and Trends

No complete census of greater sage-grouse distribution or abundance has ever been done. It is not logistically feasible to accomplish such a census due to the fact that the range of the birds is so great and because sage grouse are not reliably faithful to leks, nests, migrations or any other habitat specific behaviors, making it difficult to design an accurate sampling program. The estimates of past and present population status and trends used in this document rely on various indicators as their basis. The available population data include incidental historical records of sage grouse observations, and the use and availability of habitat. Later records include formal sampling of habitat use and mapping of vegetation communities in recent decades, as well as reported numbers and characteristics of hunter-killed birds from regulated seasons, and counts of males displaying at leks since formal surveys began in the 1960s. All of these data are badly flawed in some manner. The earliest records are not sampled data, but rather notes of sightings from diaries of explorers, settlers, and naturalists. Even the more formal sampling data suffer from a lack of reliability in that sampling methods varied from location to location, there are data gaps, and it is not always clear when a population was extirpated from a sight or there was just no sampling effort at that location for the period of time there is a data gap. The various studies cited have drawn inferences from these data inferences about trends in total range or area occupied, potential habitat available, total abundance, male use of known leks, and numbers of males per lek. However, because each of these estimates involves its own set of sampling and inferential limitations and resulting uncertainty, no single indicator is assured of representing the true condition of the species. Considering multiple and at least somewhat independent indices, as we do in this section, provides a stronger picture of the most likely historical trends and present status of the species.

We begin by considering trends in the geographic area occupied by greater sage-grouse. Researchers have speculated that prior to the settlement of the western United States by European immigrants in the 19th century, sage-grouse lived in 13 States and 3 Canadian provinces—Washington, Oregon, California, Nevada, Idaho, Montana, Wyoming, Colorado, Utah, South Dakota, North Dakota, Nebraska, Arizona, British Columbia, Alberta, and

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Comment: I am concerned that the FWS did not bother to consider the paper on the bias toward undercounting when using lek-lekcount data for population estimates. This particular bias, since it is systematic and pervasive throughout all our population estimates is critical to an accurate assessment of the species' status.

Comment: We are not writing a dissertation here, and conjectures about why or why not seem inappropriate. Since the readers are themselves sage grouse experts, they are capable of ascribing causality to these issues.

Deleted: Subsequent sections of this synthesis consider possible causes for the indicated historical trends and a basis for assessing whether similar or different trajectories are likely to continue into the future.¶

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Saskatchewan (Schroeder *et al.* 1999; Young *et al.* 2000; Schroeder *et al.* 2004).³ These same researchers have estimated that the occurrence of sagebrush habitats that potentially supported sage-grouse occupied approximately 1,200,483 km² (463,509 mi²) before 1800 (Schroeder *et al.* 2004). Schroeder *et al.* (2004) based this estimate on the locations where museum specimens were collected and published observations of the species along with the potential habitat areas occupied (Figure 1). However, this characterization of sage grouse abundance is not supported by contemporary accounts⁴. Commenters provided extensive information from primary sources indicating that between 1804 (Lewis and Clark) and 1831 (Work 1971) sage grouse were not abundant and were relatively scarce to absent over much of the range they occupy today. Contemporary accounts provided by commenters indicate that only with the advent of settlement in the 1860s and accompanying predator control and grazing which virtually eliminated fire in some areas did the sage grouse become common and abundant throughout the current range.

Much of the indicated historical decline in sage-grouse abundance occurred from the late 1800s to the early-1900s apparently from overharvesting if contemporary accounts are accurate (Hornaday 1916; Crawford 1982; Drut 1994; Washington Department of Fish and Wildlife 1995; Braun 1998; Schroeder *et al.* 1999). Other declines in sage-grouse populations apparently occurred in the 1920s and 1930s, and then again in the 1960s and 1970s (Connelly and Braun 1997; Braun 1998). State wildlife agencies were sufficiently concerned with the decline in the 1920s and 1930s that many closed their hunting seasons and others significantly reduced bag limits and season lengths (Braun 1998).

Currently, sage-grouse occur in 11 States and 2 Canadian provinces, ranging from extreme southeastern Alberta and southwestern Saskatchewan, south to western Colorado, and west to eastern California, Oregon, and Washington. Sage-grouse have been extirpated from Nebraska, British Columbia, and possibly Arizona

³ The historical occurrence/distribution of greater sage-grouse in Arizona is under question (Patterson 1952; Connelly *et al.* 2004). Discrepancies with earlier descriptions of the species' range also result from including the distribution of the Gunnison sage-grouse with that of the greater sage-grouse.

⁴ Cite the Black Rock Research and comment letter.

Comment: This paragraph completely ignores the comments received from the Owyhee Cattlemen's Association and the Idaho Cattle Association. This submission included a report by the Black Rock Resource Company that identifies mischaracterizations in the petitions and literature of the abundance and distribution of sage grouse at the time of exploration roughly 1820-1850. The comment letter also provides extensive information relative to the expansion of sage grouse populations with the advent of settlement and draws conclusions regarding the effect of grazing and predator control on sage grouse. This raises two issues. First, why was this information disregarded in our characterization of early conditions and second, the correlation between heavy grazing and sage grouse increases. Empirically speaking, the comment letter illustrates what one would conclude... pre-settlement there were scattered sage grouse populations locally numerous but not ubiquitous... those conditions corresponded to low grazing numbers and arid conditions, a circumstance which is becoming more and more prevalent on public lands.

Our cited references for the historic populations provide few references and primary citations. They also compress 100 years of population characterization ignoring the changes in sage grouse abundance and distribution over that period.

Frankly, I think this entire discussion of the estimated habitat, estimated range, estimated population, should be eliminated as it is 1. not supported by contemporary accounts, 2. not supported by any data, and 3. simply a fairly tale, constructed out of whole cloth, based on a series of arbitrary assumptions (since the contemporary accounts have been disregarded). It certainly does not meet the IQA standard.

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Comment: Comment letter from Idaho Cattlemen and Owyhee County provided the information included in this section.

Comment: Moved from a later section.

(Schroeder *et al.* 1999; Young *et al.* 2000; Schroeder *et al.* 2004). It should be noted however, that the sage grouse have been absent from Nebraska and Arizona since at least 1916. Current distribution is estimated at 668,412 km² (258,075 mi²; based on digital mapping of habitat and State distribution data). The largest reductions in sage-grouse distribution [since when, add a specific date as to the point you are calculating from... it's not pre-settlement, so it has to be something else] occurred along the northwestern corner of the range (Oregon, Washington and British Columbia), as a result of habitat conversion (Schroeder *et al.* 2004). However, the species' distribution was also reduced in the southern portions of range and habitats that were most likely to be developed for agricultural purposes (Schroeder *et al.* 2004). The vast majority of the current distribution of the greater sage-grouse is within the United States.

Total abundance estimates are the next approach to evaluating trends. They can be derived in several ways, including: multiplying the occupied range area by density estimates; expanding counts of males at leks by an estimated, average ratio of observed males to total population per lek area; or by expanding the number of birds reported killed in sport harvests by the estimated, average portion of populations harvested. ||

Estimates of current or recent total sage-grouse abundance vary, but are all much lower than the historical estimates of a million or more birds which would have occurred in the middle to late 1800s. Braun (1998) estimated that the 1998 rangewide spring population numbered about 142,000 sage-grouse, derived from numbers of males counted on leks. The Service then estimated the rangewide abundance of sage-grouse in 2000 was at up to 500,000 birds (based on harvest data from Idaho, Montana, Oregon and Wyoming, as adjusted by the assumption that 10 percent of the population is typically harvested) (65 FR 51578; August 24, 2000). Survey intensity has increased markedly in recent years and in 2003 more than 50,000 males were counted on leks (Connelly *et al.* 2004). Therefore, Connelly *et al.* (2004) concluded that rangewide population numbers in 2003 were likely much greater than the 142,000 estimated in 1998, allowing for another 25,000 males at leks that were not surveyed, non-displaying males at all leks, and females

Comment: Per Hornaday, 1916 on the FWS cite list.

Comment: The historic numbers are pure speculation and we have no data to support them. At issue here, is where the sage grouse are, what the population is, and whether they are threatened with extinction in the foreseeable future.

Deleted: or 56 percent of the potential pre-settlement distribution (Schroeder *et al.* 2004; Connelly *et al.* 2004).

Comment: Ok, if there are statements being made about the distribution being reduced, we had better know why... it's either urban, ag, or they stopped showing up? If they just stopped showing up, there could be a number of reasons unrelated to the current habitat conditions in the NW.

Comment: Pure speculation, not supported by anything other than the author's guess.

Deleted: Other, undocumented distribution changes may have occurred in the early 1900s (Connelly *et al.* 2004).

Comment: You have comment data that provide more information to refute that speculation than you have to support it.

Comment: The WSSCSTGTC may have estimated, but if there is no supporting data, we can't use it, and I would hope we would not want to use something that has no visible scientific data basis.

Deleted: The U.S. Fish and Wildlife Service (2000) calculated that prior to European expansion across the continent, there may have been between 1.6 and 16 million sage-grouse in western North America based on the historical range and average population densities between 1 and 10 grouse per square kilometer (65 FR 51578).

Deleted: The Western Association of Fish and Wildlife Agencies (WAFWA) sage- and Columbian sharp-tailed grouse technical committee (WSSCSTGTC; 1999) estimated there may have been 1.1 million birds in 1800, without identifying the basis for their estimate.

Comment: No need to recite the Braun estimate, particularly since it is rounded off.

Deleted: least 100,000 (from the Braun (1998) figure rounded off) and

outnumbering males by roughly 2:1 on average. Since neither pre-settlement nor current numbers of sage-grouse are precisely known, the actual rate and extent of decline can not be determined exactly, which is reflected by the differences in published estimates. Another source of error and potential undercounting of populations arises from the use of lek-lekcount estimates. [Include a discussion of the undercounting issue with use of lek-lekcount data]

Comment: I have requested this paper from the library. It was noted in a comment letter, but for some reason, the FWS overlooked it.

Another approach to determining trends is through the use of systematic survey data. Population data have only been collected consistently since the 1950s (Connelly *et al.* 2004), making anything other than qualitative estimates of population change before that date impossible. Because of differences in subsequent data collection techniques, consistency, and effort across States and wildlife agencies, estimates of current population numbers and trends are difficult and the results questionable (Connelly *et al.* 2003; Connelly *et al.* 2004). However, counting the number of males per lek (lek counts) can indicate breeding population trend (Braun 1998). This lek count survey technique has been used in some form consistently by all agencies collecting sage-grouse population data for approximately 50 years (Connelly *et al.* 2003). Information on lek distribution, activity and attendance provides the only long-term, scientifically-collected data on sage-grouse breeding population trends and any trends based on those data are suspect for all the abovementioned reasons. (Connelly *et al.* 2004).

Comment: Moved, this is a discussion of historical trends, not estimates.

Deleted: Much of the indicated historical decline in sage-grouse abundance occurred from the late 1800s to the early-1900s (Hornaday 1916; Crawford 1982; Drut 1994; Washington Department of Fish and Wildlife 1995; Braun 1998; Schroeder *et al.* 1999). Other declines in sage-grouse populations apparently occurred in the 1920s and 1930s, and then again in the 1960s and 1970s (Connelly and Braun 1997; Braun 1998). State wildlife agencies were sufficiently concerned with the decline in the 1920s and 1930s that many closed their hunting seasons and others significantly reduced bag limits and season lengths (Braun 1998).¶

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Connelly *et al.* (2004) examined lek-based population trends using several indices – number of active leks (expressed as a percentage), the average and median number of males per all leks, the average and median number of males per active leks, and the change in the size of leks over time (small leks ≤ 19 males, medium leks 20 to ≤ 49 males, and large leks 50 males or greater). They also calculated annual rates of change where sufficient data were available (i.e., continuous monitoring for individual leks over several years). As evaluated by Connelly *et al.* (2004), the most robust and widely used of these statistics are the average and median number of males per active lek reported. The results of trend estimation based on all leks is problematic and so should be used with caution in drawing conclusions as to population health. This stems

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from several circumstances, first, rarely are all leks surveyed in a year. Rather, due to personnel and time limitations, most State agencies focus on counting only active leks. Alternatively, using the number of males per active lek does not consider the leks that have been lost, either through natural or human-caused disturbances. Connelly *et al.* (2004) assert that both indices exhibit the same trends, however, we did not have access to the data or the models that formed the basis for these analyses so we are unable to determine whether the results are valid.

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Comment: They don't demonstrate, we have no idea how they got the numbers they did... they state it, and let us know there was some data manipulation but the entire process is a black box.

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Because of the foregoing limitations, we also report the number of males per active lek as well as wing count data. Number of males per active lek is the parameter reported most consistently in the scientific literature. However, we note that this data has been shown to consistently underreport populations (Walsh *et al.* (2004). When those data were unclear, we refer to other indices (e.g., average annual rate of change in the number of males observed at individual leks monitored annually for numerous years) to evaluate population trend. In addition, these types of data have been collected inconsistently across different States so that comparisons between all States are not possible. We encourage the reader to review the Conservation Assessment for more comprehensive details about survey data and trends. The following sections describe analyses of the lek data rangewide and by State and province.

Comment: The data inadequacies we point out with respect to all the various methods of estimating exist here as well, to exclude this data and not the other data which have the same inadequacies is not consistent.

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Comment: This is unclear... is we the FWS? Are we talking about how we evaluate rate of change for the listing determination? The whole discussion is somewhat confusing.

Comment: No Cite provided. We should be including this wing data as well, since the data suffers from the same defects as the lek-lekcount data.

Deleted: We do not report harvest (wing) data or brood counts as these data may not reflect population trends accurately (Connelly *et al.* 2003).

Deleted: and Walsh *et al.* (2004)

Rangewide population trends

Following review of published literature and anecdotal reports Connelly *et al.* (2004) concluded that the abundance and distribution of sage-grouse have declined dramatically to present abundance from pre-settlement numbers. Most of the historic population changes were the result of local extirpation, which has been inferred by the changes in sage-grouse distribution described by Schroeder *et al.* 2004 (Connelly *et al.* 2004). In an analysis of lek counts, Connelly *et al.* (2004) also found substantial declines from 1965 through 2003. Average declines were 2 percent of the population per year from 1965 to 2003. The decline was more pronounced from 1965 through 1985, with an average annual change of 3.5 percent. Of 41 populations delineated rangewide on biological, not political boundaries, five have been extirpated and 14 are at high risk of extirpation due to small numbers (only one

Comment: This should be in tabular format, too difficult to assess and compare. Not only that, this needs to be accurately characterized... it appears this is the data from the WAFWA Report. This data has been manipulated, through a number of models, we have not seen the raw data, and the work has not been peer reviewed in the real sense that it was published and there was a true peer review process that one would see with a published paper. This information should not be included as it is not consistent with the provisions of the Information Quality Act.

So put it in tabular form, where data is not comparable so note, and characterize it accurately.

The peer review on the WAFWA Report by the Ecological Society notes that no information is provided regarding the assumptions, the data manipulation, or the sensitivity of the models to assumptions that would allow the reader to accurately assess the validity of these numbers.

These numbers do not meet the requirements of the IQA. Because of that, we cannot base our decisions on them, nor should we be distributing them without appropriate caveats. Reading this section, you would never know that the numbers were subjected to significant manipulation.

Comment: I am going to take issue with this since we have historic accounts in our comments that dispute this characterization.

Comment: Again, that presupposes that the pre-settlement numbers were very high, as opposed to the information we received in the comments.

active lek). Twelve additional populations also have small numbers (7 to 18 known active leks), and nine of those are declining at a statistically significant rate (Connelly *et al.* 2004). However, the rate of decline rangewide slowed from 1986 to 2003 to 0.37 percent annually (Connelly *et al.* 2004). See Connelly *et al.* (2004), Table 6.22, for more detail. Sage-grouse population numbers in the late 1960s and early 1970s were likely two to three times greater than current numbers (Connelly *et al.* 2004). The WSSCSTGTC (1999) estimated the decline between historical and present day to have been about 86 percent. Although individual State and provincial data are presented by several authors (see the following section), Connelly *et al.* (2004) and Connelly and Braun (1997) are the only peer-reviewed scientific analyses of rangewide trends.

Provincial and State population trends

Alberta. Since pre-settlement, the range occupied by sage-grouse in Alberta has been reduced by approximately 92 percent based on estimated habitat availability and occurrence records (49,000 km² to 4,000 km²) (Aldridge 1998). Lek surveys were initiated in 1968 and initial counts were 600 males on 21 active leks; the average number of males per lek exceeded 25 (Aldridge 1998). In 1997 only eight leks were active and the total number of males was 122, with an average male attendance of 15 (Aldridge 1998). While the exact rate of population decline from 1968 to 1997 is difficult to quantify because of inconsistent survey effort, the survey data that are available indicate that the breeding male population declined by 80 percent, number of active leks by 62 percent, and average number of males per active lek by 40 percent over 30 years (Aldridge 1998; Aldridge and Brigham 2003; Connelly *et al.* 2004). Looking at the 28 years from 1975 until 2003, Connelly *et al.* (2004) estimated a rate of decline in the average and median numbers of males per active lek between 28 and 31 percent, respectively (Table 1). There was a statistically significant decline in lek size from 1975 until 2003 ($r^2 = 0.48$, $P = 0.00$). The number of active leks has declined by 71 percent during that same period (Table 1; Connelly *et al.* 2004).⁵ Based on lek counts, the total

Comment: This entire section should be presented in tabular form so that the reader can easily see the differences in information as well as what we know and don't know.

⁵ The data from both these time periods translate into average annual rates of decline of about 1-2 percent per year for average number of males per lek and 3-4 percent per year for number of active leks.

population estimate in 1999 was 420 to 622 individuals⁶ (Aldridge and Brigham 2003).

Saskatchewan. In Saskatchewan, the first lek surveys were performed in 1987 with 600 males on 30 leks counted; the average number of males per lek was 20 (Aldridge and Brigham 2003). Lek counts declined in the 1990s and varied (in part due to survey intensity) from 61 on 10 leks in 1997, 144 males on 12 leks in 1998, to 131 males on 10 leks in 1999, or an average of 6.1 to 13.1 males per lek (Aldridge and Brigham 2003). Connelly *et al.* (2004) report populations estimated from average and median number of males per active lek declined in Saskatchewan by approximately 50 percent from 1987 to 2003. The percent of active leks (percent of leks known to have been used any time within the last 10 years that were actively used by displaying males) declined 36 percent during the same time period (Table 1).

Canada. Using lek count data, the total Canadian population of sage-grouse in 1987 was estimated to be 2,745 to 4,067 individuals (Aldridge and Brigham 2003).⁷ Sage-grouse populations have experienced an 80 percent decline since that time (Aldridge 1998; Aldridge and Brigham 2003). This is likely an underestimate since search efforts from the mid-1990s have intensified resulting in higher count totals for surveyed leks (Aldridge 1998; Aldridge and Brigham 2003). Male lek counts have remained stable since the late 1990s, but survey efforts continue to increase, potentially masking a continuing population decline (Aldridge and Brigham 2003).

California. Little published information is available on California sage-grouse population trends (Connelly *et al.* 2004). A total of 71 leks have been identified and few have become inactive since 1965 (Connelly *et al.* 2004). Counts at leks with long-term monitoring data indicate a stable to increasing population trend (Connelly *et al.* 2004). The average and median numbers of males per active lek have increased somewhat over this time period (Table 1; Connelly *et al.* 2004). Lek size has increased from 1965 to 2003 ($r^2 = 0.12$, $P = 0.02$).

Colorado. Analyses of lek counts in Colorado have resulted in conflicting population trend patterns. Connelly and Braun (1997) reported that breeding populations (based on average males per lek) in Colorado declined by approximately 31 percent between 1984 and 1997. Population trends calculated using average and median numbers of males per active lek indicate a decline of 20 and 29 percent, respectively, from 1965 through 2003, and the average lek size has similarly declined ($r^2 = 0.40$, $P = 0.00$; Table 1; Connelly *et al.* 2004). Average annual rates of change in number of males observed at a subset of individual leks monitored consistently for numerous years, however, indicate a stable to increasing population trend since 1965 (Connelly *et al.* 2004). This discrepancy may be in part due to data collection methods where total numbers of birds, and not numbers of males were recorded for many leks (Connelly *et al.* 2004). Braun (1998) estimated that the distribution of sage-grouse in Colorado has declined by greater than 50 percent since the early 1900s, and sage-grouse are no longer present in 5 of 13 counties where they originally occurred (Colorado Division of Wildlife, *in litt* 2004). Recent data suggest an increase in the number of active leks and males observed over 17 years (Colorado Division of

⁶ Lower figure from assuming a 2:1 sex ratio adds 280 females in addition to the 140 males observed; larger estimate from assuming 90 percent of leks were counted and 75 percent of males on the counted leks were observed, then expanding the estimate for 2:1 sex ratio.

⁷ The populations of sage-grouse in Alberta and Saskatchewan are considered contiguous (Aldridge 1998).

Wildlife, *in litt.* 2004).

Idaho. Based on average and median number of males per active lek for 1965 to 2003, Connelly *et al.* (2004) report that populations in Idaho have declined by at least 40 percent (Table 1; see also Connelly and Braun 1997; Idaho Department of Fish and Game 1997, 1998). This trend indicator is consistent with the unpublished data Rich (1985) compiled on counts at 33 leks in Idaho and Utah from 1978 to 1985. Using State-provided data, Connelly *et al.* (2004) calculated the percent of active leks declined over 40 years from 94 to 77 percent, and lek size also declined ($r^2 = 0.50$, $P = 0.00$). Lek populations in the 1960s and 1970s were approximately 2 to 3 times higher than current populations. Connelly *et al.* (2004) reported that populations in Idaho have increased since the mid-1990s.

Montana. Population trends in Montana from 1965 to 2003, as estimated by average and median number of males per active lek, indicated an approximate 43 percent decline in that State (Table 1; Connelly and Braun 1997; Connelly *et al.* 2004). The percent of active leks declined by 24 percent (Table 1). There was a decline in the size of active leks ($r^2 = 0.52$, $P = 0.00$), with more than 60 percent of leks having fewer than 20 males. Average annual rates of change in males counted at leks monitored long-term also suggest a long-term population decline for Montana (Connelly *et al.* 2004). Lek populations in the 1960s and 1970s were approximately 2 to 3 times higher than current populations. Connelly *et al.* (2004) report that populations in Montana have increased since the mid-1990s.

Nevada. Nevada has reported declining sage-grouse populations since 1970 (Nevada Department of Wildlife, *in litt.* 2004). From 1965 through 2003, population trends in Nevada, as indicated by average and median number of males per active lek, declined by 37 and 42 percent, respectively (Table 1; Connelly *et al.* 2004). The number of active leks declined 15 percent during the same time period (Table 1). Lek size has declined during the same time period ($r^2 = 0.23$, $P = 0.00$), with 65 percent of all leks now having fewer than 20 males in attendance (Connelly *et al.* 2004). Connelly *et al.* (2004) noted that these analyses should be viewed with caution since efforts to monitor leks have been erratic. Population numbers reached a low point in the mid-1990s and have not changed substantially since then.

North Dakota. For North Dakota, a declining total population trend of 7 to 17 percent has been observed from 1965 to 2003, based on the average and median males per active lek, respectively (Table 1; Connelly *et al.* 2004). The number of active leks has declined 32 percent in the same time period (Table 1). Average annual rates of change at leks monitored long-term suggest a greater long-term decline in North Dakota's population, however, declining at nearly 3 percent per year from 1965 to 2003 (i.e., a 69 percent total decline) (Connelly *et al.* 2004). Lek size has significantly declined since 1965 ($r^2 = 0.35$, $P = 0.00$). Some populations have disappeared, and current population estimates based on lek counts are 3 to 6 times lower than estimates from the late 1960s and early 1970s (Connelly *et al.* 2004).

Oregon. Population trends in Oregon, as measured by average and median number of males per active lek, have remained relatively stable from 1965 through 2003 (Table 1; Connelly *et al.* 2004). Yet the number of active leks declined by 5 percent during that time (Table 1; Connelly *et al.* 2004). Average annual rates of change in males observed at leks monitored for

long periods, calculated over the same time period, indicated a more rapid rate of decline (3.5 percent per year), however (Connelly *et al.* 2004). Similarly, by comparing average lek size from 1985 to 1994 to long-term trends pre-1985, Connelly and Braun (1997) determined that breeding populations in Oregon have declined by 30 percent and Crawford and Lutz (1985) report a 50 percent decline in Oregon populations since 1940 based on distribution maps and personal observations by Oregon biologists. Sage-grouse productivity (chicks/hen and chicks/adult) has also declined by 51 percent since the 1950s (Connelly and Braun 1997). However, productivity has shown an increase from 1985 to 2000 (Connelly *et al.* 2004). In summary, although the average size of active leks has shown no significant change since 1965 ($r^2 = 0.05$, $P = 0.19$), the total number of sage-grouse in Oregon have been reduced; therefore populations associated with individual leks or groups have likely disappeared (Connelly *et al.* 2004).

South Dakota. Drut (1994) estimated that sage-grouse numbers in South Dakota declined from approximately 25,000 birds in the 1950s to 5,000 in 1992, based on extrapolation from lek counts. Connelly and Braun (1997) reported a 45 percent decline in the breeding populations based on male lek counts prior to 1984. While the average and median numbers of males per active lek have remained relatively unchanged from 1990 to 2003, the number of active leks decreased from 87 percent in 1990 to 45 percent in 2003 (Table 1; Connelly *et al.* 2004). Lek size has remained relatively unchanged ($P = 0.40$). Therefore, as in Oregon, based on this information, Connelly *et al.* (2004) suggested that the decline of sage-grouse in South Dakota is likely a result of the loss of entire populations.

Utah. Drut (1994) reports a 50 percent decline in the distribution of sage-grouse in Utah since settlement of the area, without details for how he came to that estimate. Connelly and Braun (1997) reported a 37 percent decline based on comparisons of average lek size during 1987 to 1997 with long-term averages prior to 1987. Beck *et al.* (2003) also report a decline in the number of males per lek from 1971 through 2000. While the average and median number of males per active lek have changed little from 1965 through 2003 (Table 1), annual rates of change at individual leks suggest a long-term decline for sage-grouse in Utah (Connelly *et al.* 2004). The percent of active leks in Utah declined by 12 percent during the same time period (Table 1; Connelly *et al.* 2004). Lek size has also declined ($r^2 = 0.16$, $P = 0.01$). Populations at leks in the early 1970s were about two times greater than current populations. Although populations have been increasing since the mid-1990s, population numbers have not returned to the early 1970s level (Connelly *et al.* 2004). Connelly *et al.* (2004) report that populations in Utah have increased since the mid-1990s. However, Beck *et al.* (2003) reported that males per lek declined for all populations in Utah from 1971 to 2000.

Washington. In Washington, sage-grouse lek populations have declined by at least 77 percent since pre-settlement, and sage-grouse currently occupy only 8 percent of their historical range in this State (Schroeder *et al.* 2000). Connelly *et al.* (2004) estimated a 45 percent decline in populations based on changes in the average and median males per active lek from 1965 to 2003 (Table 1). The number of active leks in Washington has declined by nearly 60 percent within the same time period (Table 1), and lek size also declined ($r^2 = 0.69$, $P = 0.00$). A long-term population decline was also indicated through the analyses of annual rates of change at leks monitored long term (Connelly *et al.* 2004). As of 2003, two populations remained in

Washington, and the Statewide breeding population was estimated to be approximately 1,000 birds (about 62 percent in one population, 38 percent in the other; Stinson *et al.* 2004).

Wyoming. Based on changes in the average and median numbers of males per active lek, sage-grouse populations in Wyoming have declined approximately 45 percent between 1965 and 2003 (Connelly *et al.* 2004). Additionally, while the number of active leks has remained relatively stable within the same time period, the average lek size has decreased (a greater proportion of leks have fewer than 20 males; $r^2 = 0.49$, $P = 0.00$). Average annual rates of change at leks monitored consistently suggest a long-term population decline (Connelly *et al.* 2004). Lek surveys and counts repeated in a historical study area of southwestern Wyoming indicate a 90 percent decline of populations in that area since 1952 (Wyoming Greater Sage-grouse Conservation Plan 2003; Connelly *et al.* 2004).

Table 1. Comparisons of average (avg. # of males/active lek) and median (median # of males/ active lek) numbers of male Greater Sage-grouse per active lek, and percent (per. active leks) of active leks (percent of leks that are active in a year) between 1965 and 2003. Data were pooled across a maximum of 5 years (i.e., 1965 to 1969 and 2000 to 2003). Data were presented previously by Connelly *et al.* (2004). For graphical depictions of population trends, see Connelly *et al.* (2004), Chapter 6.

State/ Province	Avg. # males/ active lek 1965-1969	Avg. # males/ active lek 2000-2003	Med. # males/ active lek 1965-1969	Med. # males/ active lek 2000-2003	Per. active leks 1965-1969	Per. active leks 2000-2003
Albta*	18	13	16	11	100	29
Sask [‡]	24	12	18	11	87	51
CA	24	28	16	18	87	88
CO	41	33	31	22	78	67
ID	46	27	34	20	94	77
MT	29	23	20	18	98	74
NV	30	19	24	14	94	79
ND	15	14	12	10	90	58
OR	24	25	15	18	92	87
SD [†]	13	13	12	12	87	45
UT	30	28	21	19	89	77
WA	33	18	31	17	100	41
WY	50	26	35	20	73	71

*Data for Alberta were not collected until 1975, so data collected from 1975 to 1979 in Alberta are presented under the 1965-1969 columns of this table.

[‡]Data for Saskatchewan were not collected until 1987, so data collected from 1987 to 1989 in Saskatchewan are presented under the 1965-1969 columns of this table.

[†]Data for South Dakota were sporadically collected prior to 1989, and were not useful for this analysis. Therefore, data collected from 1989 to 1994 in South Dakota are presented under the 1965-1969 columns of this table.

Comment: The data is so flawed as to tell us nothing.

[Why are we including this since we don't evaluate habitat changes – which is what FWS says in the last section—this should be deleted as it is extraneous information]

Comment: This entire section is useless since we didn't evaluate habitat changes (see our last paragraph).

Sagebrush Ecology

Sagebrush is the most widespread vegetation in the intermountain lowlands in the western United States (West and Young 2000). Sagebrush species and subspecies occurrence in an area is dictated by local soil, soil moisture, and climatic conditions (West 1983a; West and Young 2000), and the actual size and degree of dominance by sagebrush varies with local site conditions and disturbance history. For example, sagebrush density is typically higher, but stature shorter on xeric sites. Sagebrush also increases in abundance with intensive livestock grazing and lower fire frequency (West and Young 2000).

Comment: Not Germaine to the question we are addressing.

Deleted: Scientists recognize many species and subspecies of sagebrush (Table 2; Connelly et al. 2004), each with unique habitat requirements and responses to perturbations (West and Young 2000). The taxonomy of sagebrush is a work in progress, with sagebrush experts trying to determine the degree of hybridization amongst species and the ecological and genetic differences between hybrids.

All species of sagebrush produce large ephemeral leaves in the spring, which persist until soil moisture stress develops in the summer. Most species also produce smaller, over-wintering leaves in the late spring that last through summer and winter. Sagebrush have fibrous, tap root systems, which allow the plants to draw surface soil moisture, but also access water deep within the soil profile when surface water is limiting (West and Young 2000). Most sagebrush flower in the fall. However, during years of drought or other moisture stress, flowering may not occur. Although seed viability and germination are high, seed dispersal is limited. Additionally, for unknown reasons, sagebrush seeds do not persist in seed banks beyond the year of their production (West and Young 2000).

Comment: Not Germaine.

Deleted: Plant associations, typically defined by perennial grasses, further define distinctive sagebrush communities (Miller and Eddleman 2000; Connelly et al. 2004) and are influenced by topography, elevation, precipitation and soil type.

Sagebrush are long-lived, with plants of some species surviving up to 150 years (West 1983a). They produce allelopathic chemicals that reduce seed germination, seedling growth and root respiration of competing plant species and inhibit the activity of soil microbes and nitrogen fixation. Sagebrush have resistance to environmental extremes, with the exception of fire and occasionally defoliating insects (e.g., the webworm (Aroga spp.; West 1983a)). Most species of sagebrush are killed by fire (Miller and Eddleman 2000; West 1983a; West and Young 2000). Natural sagebrush re-colonization in burned areas depends on the presence of adjacent live plants for a

seed source or on the seed bank, if present (Miller and Eddleman 2000).

Sagebrush is typically divided into two groups, big and low sagebrush (Table 2), based on their affinities for different soil types (West and Young 2000). Big sagebrush species and subspecies are limited to coarse-textured and/or well-drained sediments, whereas low sagebrush subspecies typically occur where erosion has exposed clay or calcified soil horizons (West 1983a; West and Young 2000). Reflecting these soil differences, big sagebrush will die if surfaces are saturated long enough to create anaerobic conditions for 2 to 3 days (West and Young 2000). Some of the low sagebrush are more tolerant of occasionally supersaturated soils, and many low sage sites are partially flooded during spring snowmelt. None of the sagebrush tolerate soils with high salinity (West and Young 2000). Both groups of sagebrush are used by sage-grouse.

Sagebrush plant communities typically consist of four structural layers; the shrubs overstory, an understory of tall forbs and grasses, an understory of low growing grasses and forbs, and the cryptogamic soil crust (comprised of moss, alga, lichen and fungi) (West 1983a; Miller and Eddleman 2000; Connelly et al. 2004). The soil crust provides protection against wind and water erosion (West 1983a). Plant cover is not continuous and there may be areas of bare ground, depending on local precipitation conditions and the type of perturbations that have occurred in an area (West 1983a; West and Young 2000; Connelly et al. 2004).

The response of sagebrush and sagebrush ecosystems to natural and human-influenced disturbances varies based on the species of sagebrush and its understory component, as well as abiotic factors such as soil types and precipitation. For example, mountain big sagebrush can generally recover more quickly and robustly following disturbance than do Wyoming big sagebrush (Miller and Eddleman 2000), likely due to its occurrence on moist, well drained soils, versus the very dry soils typical of Wyoming big sagebrush communities. Soil associations have also resulted in disproportionate levels of habitat conversion across different sagebrush communities. For example, basin big sage is found at lower elevations, in soils that retain moisture two to four weeks longer than in well

Comment: Not germane.

Deleted: Table 2: Common sagebrush species and subspecies. Research is on-going to determine if additional hybrids or species should be recognized. Therefore, this list should not be considered complete, but representative of the variety and diversity of sagebrush ecosystems. ¶

<sp>¶

Species . Common Name¶

<sp>¶

Big sagebrush group . ¶

. Artemisia tridentata vaseyana . Mountain big sagebrush¶

. Artemisia tridentata tridentata . Basin big sagebrush¶

. Artemisia tridentata wyomingensis . Wyoming big sagebrush¶

. Artemisia spiciformis . Spiked or Snowfield sagebrush¶

. Artemisia tripartita rupicola . Wyoming three-tip sagebrush¶

. Artemisia tripartita tripartita . Three-tip sagebrush¶

. Artemisia cana . Silver sagebrush¶

. ¶

Low sagebrush group¶

. Artemisia arbuscula . Low or dwarf sagebrush¶

. Artemisia longiloba . Alkali sagebrush¶

. Artemisia nova . Black sagebrush¶

. Artemisia rigida . Rigid or stiff sagebrush¶

. Picrothamnus desertorum . Bud sagebrush¶

. Artemisia frigida . Prairie sagewort or fringed sagebrush¶

. Artemisia papposa . Owyhee sagebrush¶

. Artemisia pedatifida . Birdsfoot sagebrush¶

. Artemisia bigelovii . Bigelow sagebrush¶

. Artemisia pygmaea . Pygmy sagebrush¶

<sp>¶

¶

drained, but dry and higher elevation soils typical of Wyoming big sagebrush locations. Therefore, sagebrush communities dominated by basin big sagebrush have been converted to agriculture more extensively than have communities on poorer soil sites (Winward 2004).

The effects of disturbance to sagebrush are not constant across the range of the sage-grouse. Thus, Connelly et al. (2004) presented sage-grouse population data by the described delineations of sagebrush ecosystems and communities (Miller and Eddleman 2000, from Kuchler's 1985 map; and West 1983a). Unfortunately, information on impacts to the habitats has not been collected in a compatible manner, making analyses of these impacts specifically within each distinct ecosystem and community impossible. Therefore, while we acknowledge habitat differences across the greater sage-grouse range, we were unable to conduct our review at that level. Where habitat impacts are restricted within the range of the species or associated with particular plant communities, we present that information accordingly.

Factors Potentially Affecting Greater Sage-Grouse Extinction Risk

Habitat and Range Destruction, Modification, and Curtailment

Habitat Conversion

Comment: This section should begin with a chart outlining your estimated habitat and then habitat loss, with a final available habitat number.

Comment: This chart is designed to give a historic perspective on how much habitat might have been available, compared to how much is currently available.

<u>State</u>	<u>Estimated presettlem ent habitat</u>	<u>Curre nt Ag Lands</u>	<u>Curre nt Urban</u>	<u>Loss es to Misc (powe r lines, fences roads etc.)</u>	<u>Availa ble Habita t</u>
<u>Californi a</u>					
<u>Colorado</u>					
<u>Idaho</u>					
<u>Montana</u>					
<u>Nevada</u>					
<u>N. Dakota</u>					
<u>Oregon</u>					
<u>S. Dakota</u>					
<u>Utah</u>					
<u>Washingt on</u>					
<u>Wyomin g</u>					

Agriculture

Conversion of sagebrush and sagebrush shrub-
steppe to agricultural purposes has reduced available sage-
grouse habitat beginning in the middle 1800s and
continuing to the early 1960s. With passage of the
FLPMA, wholesale conversion of federal lands to
agriculture and other uses came to a halt. Since then, range
wide agricultural conversion has played a minor role in
reducing sage grouse habitat. (Patterson 1952, Hamerstrom
and Hamerstrom 1961). Western rangelands were
converted to agricultural lands on a large scale beginning
with the series of Homestead Acts in the 1800s (Braun
1998, Hays *et al.* 1998), especially where suitable deep soil
terrain and water were available (Rogers 1964). The
widespread conversions were finally ended with the

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Comment: This was an unfortunate choice of cites and time frame since it neglects the significant changes in land management with the passage of FLPMA. In addition, this section once again neglects the substantial information provided by commenters on habitat conversion.

Deleted: populations for over a century

Deleted: Sagebrush once covered roughly 63 million ha (156 million acres (ac)) in western North America, but millions of those hectares have been cultivated for the production of potatoes, wheat, and other crops (Schroeder *et al.* 1999, 2000) and most of the remaining habitat has been altered from pre-European condition (West 1996; Miller and Eddleman 2000, Knick *et al.* 2003).

passage of FLPMA and the past 30 years has seen a

reversal with the federal government acquiring, rather than

disposing land. Within the 206.3 million ha (510 million

ac) range of greater sage-grouse, Connelly *et al.* (2004)

estimated that 24.9 million ha (61.5 million ac; 12 percent)

is now comprised of agricultural lands (note, not all of the

species' total range is sagebrush habitat).

Comment: Cite comment letter and the peer review # comments.

Comment: What is the basis for the buffer, and why are we including cowbirds and foxes and ... umm... cats??? Since when are cats associated with wheat fields and potato fields? Cowbirds and foxes would not exist in the absence of ag land?

Not only that, where is the primary reference for this statement?

Deleted: Influences extend into sagebrush habitats from adjoining agricultural lands, including increased predation and nest parasitism, and reduced nest success, due to predators associated with agriculture. Adding a 6.9 km (4.3 mi) buffer around agricultural areas (for the potential foraging distance of domestic cats, red foxes (*Vulpes vulpes*), and cowbirds (*Molothrus ater*)), an estimated 115.2 million ha (284.7 million ac) (56 percent) within the range of sage-grouse is influenced by agriculture (Connelly *et al.* 2004; Figure 7.12 in the Conservation Assessment).

Comment: Replace the generalized horror statistic with the actual percentage state by state in the table. If you don't have the numbers to substantiate the statement, you can't make it.

Comment: Again, while I am sure the vanished expanses of semi-arid sage grouse habitat represent an irreplaceable loss, it's not particularly helpful for analysis to have factual data presented in a piecemeal fashion. This paper's presentation makes it difficult to draw the rangewide inferences that are necessary for the proper consideration of the species status. Accordingly, please remove all the individual descriptions and replace with cold hard numbers in the table. It will reduce the size of the document and will facilitate analysis, which is after all, the point.

Comment: There is no reference cited in Braun 1998, it's just a number thrown out.

Deleted: In some States, more than 70 percent of sagebrush shrub-steppe habitats have been converted to agricultural crops (Braun 1998).

Deleted: This impact has been especially apparent in the Columbia Basin of the Northwest and the Snake River Plain of Idaho (Schroeder *et al.* 2004). Between 1975 and 1992, approximately 29,800 ha (73,606 ac) of sagebrush was converted to agricultural fields on the Upper Snake River Plain; a change from a total of 40,300 ha (99,840 ac) of croplands in 1975 to 70,100 ha (173,440 ac) of croplands by 1992 in that area (Leonard *et al.* 2000). Hironaka *et al.* (1983) estimated that 99 percent of basin big sagebrush (*A. t. tridentata*) habitat in the Snake River Plain has been converted to cropland.

Prior to European immigrant settlement in the 19th

century, Washington had an estimated 42 million ha (103.8

million ac) of shrub-steppe (Connelly *et al.* 2004).

Although conversion of shrub-steppe habitat to

agricultural crops impacts sage-grouse through the loss of

sagebrush on a broad scale, the use of agricultural crops

(e.g., alfalfa) by sage-grouse has also been documented

(Schroeder, 1999). When alfalfa fields and other croplands

are adjacent to extant sagebrush habitat, sage-grouse have

been observed feeding in these fields, especially during

brood-rearing (Patterson 1952, Rogers 1964, Wallestad

1971, Connelly *et al.* 1988, Fischer *et al.* 1997). Connelly

et al. (1988) reported seasonal movements of sage-grouse

to agricultural crops as sagebrush habitats desiccated

during the summer.

Comment: This factoid belongs in the table.

Deleted: In eastern Washington, land conversion to dryland farming occurred mostly between 1900 and the 1940s (Hays *et al.* 1998) and then in the 1950s and 1960s large-scale irrigation projects (made possible through the construction of dams) reduced sage-grouse habitat even further (Hofmann 1991 in Hays *et al.* 1998). The land conversions in Washington decreased sagebrush from 44 percent to 16 percent across the landscape in the eastern portion of the State (McDonald and Reese 1998). Most (75 percent) of the deep soil areas within the shrub-steppe zone in Washington have been converted to agriculture, while only 15 percent of the shallow soil shrub-steppe zone has been converted (Connelly *et al.* 2004). Deep soils supporting shrub-steppe communities in Washington continue to be converted to agricultural uses (Vander Haegen *et al.* 2000). Dobler (1994) estimated that approximately 60 percent of the original shrub-steppe habitat in Washington has been converted to primarily agricultural uses. In north central Oregon, approximately 2.6 million ha (6.4 million acres) of habitat were converted for agricultural purposes, essentially eliminating sage-grouse from this area (Willis *et al.* 1993). More broadly, across the Interior Columbia Basin of southern Idaho, northern Utah, northern Nevada, eastern Oregon and Washington, approximate 6 million ha (14.8 million acres) of shrub-steppe has been converted to orchards, row crops, and wheat fields (Altman and Holmes 2000). In this region, dry and cool shrub habitats have declined by 30 and 11 percent, respectively, from historical conditions due to agricultural and urban conversion (Quigley and Arbelbide 1997).¶

¶ Development of irrigation projects to support agricultural production, in some cases conjointly with hydroelectric dam construction, has resulted in additional sage-grouse habitat loss (Braun 1998). The reservoirs formed by these projects impacted native shrub-steppe habitat adjacent to the rivers (see Nonrenewable Energy section, below) in addition to supporting the irrigation and direct conversion of shrub-steppe lands to agriculture as previously described. In the early to mid-1900s, the Riverton Project in Wyoming had virtually eliminated sage-grouse within a 40,468 ha (100,000 acres) area over 20-year period (Patterson 1952). However, other small and isolated reclamation projects (4,000-8,000 ha [10,000-20,000 acres]) were responsible for localized increases in sage-grouse populations (Patterson 1952) by providing water in a semi-arid environment which provided additional insect and forb food resources (e.g., Eden Reclamation Project in Wyoming). Shrub-steppe habitat continues to be converted for both dryland and irrigated crop production, albeit at much-reduced levels (65 FR 51578; Braun 1998).

Deleted: some studies report

Comment: Ok, if you want to talk about SG not using plowed ground, take a paragraph and lay it out... but don't stick it at the end of a paragraph about agricultural crops and SG use of them. Plowing destroys habitat and food, so... if you want to include a paragraph about plowing of winter feeding grounds resulting in destruction of habitat (not replacement of sage steppe habitat with ag crops, but destruction of habitat... then write the chole paragraph so that the information is in context. This sentence is not in context.

Deleted: However, in south central Montana, Swenson *et al.* (1987) reported a 73 percent decline in lekking males from 1973 to 1984 after plowing wintering habitat was plowed for agricultural purposes.

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Vegetation Treatment

Sagebrush habitat has been converted through removal of sage in order to increase herbaceous forage and grasses for domestic and wild ungulates is a common practice in sagebrush ecosystems (Connelly *et al.* 2004).

By the 1970s, over 2 million ha (494,000 ac) of sagebrush had been mechanically treated, sprayed with herbicide, or burned (Crawford *et al.* 2004). Thinning to reduce sagebrush density has long been practiced and continues today (Wamboldt *et al.* 2002). Braun (1998) concluded that since European settlement of western North America, all sagebrush habitats used by greater sage-grouse have been treated in some way to reduce shrub cover. ↓

Comment: So? Why are we telling the reader this? Is there some consequence to SG? These individual bits need to be strung together in some manner that relates them to sage grouse.

Comment: So? Why are we telling the reader this? Is there some consequence to SG? These individual bits need to be strung together in some manner that relates them to sage grouse.

Comment: And? So what... why do we care? These individual bits need to be strung together in some manner that relates them to sage grouse.

Comment: I removed this because I don't think you mean that removal by fire is intentional... if you do, please put it back, and add some context.

Deleted: Sagebrush removal can also occur through the use of fire. This type conversion and its effects on sage-grouse will be discussed in a separate section

Comment: A guess. Not germane. The only reason we would care about it, is if it is still continuing.

Comment: Ok guys, this is a nearly 15 year-old document. I happen to know that BLM is currently negotiating a new vegetation management plan with the FWS. Not only that, the last time I checked the FWS would not approve the use of any chemical management. Did you forget about that? Shouldn't we be including that information in this document? We don't have a problem speculating about future potential problems, how about future management?

Comment: So, actually, we have no information as to how much habitat was actually treated and lost and/or converted? So why are we even talking about it? Just so we can say it surely happened somewhere?

Deleted: The use of chemicals to control sagebrush was initiated in the 1940s and intensified in the 1960s and early 1970s (Braun 1987). While the total area treated with herbicide is unknown, Braun (1998) estimates it probably exceeds 20-25 percent of the remaining sagebrush-dominated rangelands. In a 1991 environmental impact statement regarding vegetation management on Bureau of Land Management (BLM) lands in 13 western States, the preferred alternative was to treat more than 9,000 km² (3,500 mi²; 2.2 million ac) annually (BLM 1991). We do not know how much of the proposed treatments included sagebrush habitats, or how much has actually been treated to date.¶

Beginning in the 1940s and continuing into the 90s, BLM used chemical and mechanical means to control sagebrush. BLM indicate that with rare exceptions, they no longer are involved in actions that convert sagebrush to other habitat types, and that mechanical or chemical treatments in sagebrush habitat on BLM lands currently focus on improving the diversity of the native plant community, reducing conifer encroachment, or reducing the risk of a large wildfire (BLM 2004a). However, we are unable to estimate how much mechanical or chemical conversion takes place on private lands.

Deleted: The extent to which mechanical and chemical removal or control of sagebrush currently occurs is not known, particularly with regard to private lands.

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Greater sage-grouse response to herbicide and mechanical treatments depends on the method and extent to which forbs and sagebrush are killed. Small chemical treatments interspersed with nontreated sagebrush habitats did not affect sage-grouse use, presumably due to minimal effects on food or cover (Braun 1998). Also application of herbicides in early spring to reduce sagebrush cover may enhance some brood-rearing habitats by increasing the coverage of herbaceous plant foods (Autenrieth 1981). However, when block treatments exceed 200 ha (494 ac) sage-grouse are unlikely to use the sprayed habitat since they generally do not forage more than about 60 m (197 ft) from shrub cover (Braun and Beck 1996, Connelly *et al.* 2004). Mechanical treatments, if carefully designed and executed, can be beneficial to sage-grouse by improving herbaceous cover, forb production, and resprouting of sagebrush (Braun 1998). We do not have data on the total amount of such land where restoration activities have been or are being implemented.

Comment: It is unclear to me why we are spending a lot of time discussing this since BLM has already indicated this no longer occurs other than on a site specific basis/

Comment: Do we have anything other than Connolly's word for it that SG have declined due to these treatments? And.. isn't the decline due to habitat conversion? So whether it's mechanical or chemical treatment, conversions of habitat forced declines... and... we all know... there is no data to substantiate this, just someone's opinion.

Comment: Here is a question, is the avoidance due to the chemical itself or to the fact that there are less insects and forbs to support chicks and hens?

Comment: Which is sort of obvious.

Deleted: Chemical control of sagebrush has resulted in declines of sage-grouse breeding populations through the loss of live sagebrush cover (Connelly *et al.* 2000a). Herbicide treatment also can result in sage-grouse emigration from affected areas (Connelly *et al.* 2000a), and has been documented to have a negative effect on nesting (avoidance of sprayed areas) and to reduce the brood carrying capacity of an area in Idaho (Klebenow 1970). Martin (1970) evaluated a sagebrush chemical control project in Montana and found that most sage-grouse observations were in areas not sprayed and that both total forb cover and preferred foods were more abundant in the unsprayed areas. In sage-grouse winter range, herbicide treatments reduced shrub cover essential for food and thermal cover in both Montana (Pyrah 1972 as cited in Connelly *et al.* 2000) and Wyoming (Higby 1969 as cited Connelly *et al.* 2000a). Conversely, small treatments interspersed with nontreated sagebrush habitats did not affect sage-grouse use, presumably due to minimal effects on food or cover (Braun 1998). Also application of herbicides in early spring to reduce sagebrush cover may enhance some brood-rearing habitats by increasing the coverage of herbaceous plant foods (Autenrieth 1981). However, when block treatments exceed 200 ha (494 ac) sage-grouse are unlikely to use the sprayed habitat since they generally do not forage more than about 60 m (197 ft) from shrub cover (Braun and Beck 1996, Connelly *et al.* 2004). ¶

Mechanical treatments are designed to either remove the aboveground portion of the sagebrush plant (mowing, roller chopping, and rotobearing), or to uproot the plant from the soil (grubbing, bulldozing, anchor chaining, cabling, rilling, raking, and plowing; Connelly *et al.* 2004). These treatments were begun in the 1930s and have continued at relatively low levels to the late 1990s (Braun 1998).

Deleted: However, adverse effects also have been documented (Connelly *et al.* 2000a). In Montana, the number of breeding males declined by 73 percent after 16 percent of the 202 km² (78 mi²) study area was plowed (Swenson *et al.* 1987). Mechanical treatments in blocks greater than 100 ha (247 ac), or of any size seeded with exotic grasses, degrade sage-grouse habitat by altering the structure and composition of the vegetative community (Braun 1998). Based on a review of empirical studies providing data on habitat use, Connelly *et al.* (2000a) recommend managing for 15-25 percent canopy cover to maintain breeding habitat. Treatments that remove this requisite vegetation cover from greater than 40 percent of breeding habitat can result in the loss of the breeding population (Connelly *et al.* 2000a).

Habitat Fragmentation

Habitat fragmentation is the separation or splitting apart of previously contiguous, functional habitat components across the landscape of a species. Fragmentation can result from direct habitat losses that leave the remainder in non-contiguous patches, as well as from alteration of habitat areas that render the altered patches unusable to a species (i.e., functional habitat loss). Functional habitat losses include disturbances that change a habitat's successional state or remove one or more habitat functions, physical barriers that preclude use of otherwise

suitable areas, and activities that prevent animals from using suitable habitats patches due to behavioral avoidance. The persistence of animal populations in fragmented habitat areas and the success of dispersing individuals in locating suitable habitat patches depend on the spatial arrangement of the landscape and the species' life history and resilience to disturbance (Connelly *et al.* 2004). Fragmentation often precedes absolute habitat destruction and when extant habitat becomes extensively fragmented it can have a greater effect on local wildlife populations than does direct habitat loss.

We have no information or data on the effect of various activities on sage steppe habitat and whether those activities result in fragmentation of sage grouse habitat with the resultant negative effects.

Fragmentation of previously extensive landscapes can influence distribution and abundance of birds through redistribution of habitat types, decreased patch area, and increased habitat edge (Vander Haegen *et al.* 2000). Avian productivity can also be negatively influenced from increased rates of nest predation and nest parasitism, which may be facilitated by the juxtaposition of disturbed habitats with breeding habitats, which encourages the influx of foxes, cowbirds, etc. (Vander Haegen *et al.* 2000; Knutson *et al.* 2004). Unfortunately, the effects of habitat fragmentation on both vegetation and fauna in arid shrub-steppe ecosystems are poorly understood, as most research on fragmentation impacts has focused on forested areas in eastern North America (Vander Haegen *et al.* 2000).

Sagebrush communities exhibit a high degree of variation in their resistance and resilience to change, beyond natural variation. Resistance (the ability to withstand disturbing forces without changing) and resilience (the ability to recover once altered) generally increase with increasing moisture and decreasing temperatures, and can also be linked to soil characteristics (Connelly *et al.* 2004). Federal agencies such as the BLM have budgeted programs for habitat restoration and treatment (e.g., 755,000 ha (1,864,850 ac) in 2000-2001; Knick *et al.* 2003), we could not locate information on how effective various treatments have been. It is possible that not all areas previously dominated by sagebrush can be restored because alteration of vegetation, nutrient cycles,

- Comment:** All these horrors can happen. But the only information we have is on birds other than sage grouse. So we have no data to support an assertion that fragmentation is occurring at a level that influences sage grouse populations.
- Comment:** It seems to me that the definition of fragmentation is based on the species we are talking about, and in this case, we don't know if the habitat is fragmented for sage grouse or not. There is no information on it, certainly no data that demonstrates some kind of minimum size area.
- Comment:** How many times do we want to say this? I am guessing there isn't an inch of habitat anywhere that hasn't been altered since settlement, and even pre-settlement I would imagine there were anthropogenic forces at work. People were after all, living here before the Europeans arrived.
- Deleted:** However, most extant sagebrush habitat has been altered since European immigrant settlement of the West (Baker *et al.* 1976; Braun 1998; Knick *et al.* 2003; Connelly *et al.* 2004), and
- Deleted:** sagebrush habitat continues to be fragmented and lost (Knick *et al.* 2003) through the factors we describe below (see Figures 5.16 and 5.17 in the Conservation Assessment). The cumulative effects of habitat fragmentation have not been quantified over the range of sagebrush and most fragmentation cannot be attributed solely to specific land uses (Knick *et al.* 2003). Although
- Deleted:** much effort is directed at sagebrush restoration specifically or on how
- Deleted:** N

topsoil, cryptobiotic crusts, and disturbance processes can push these systems past critical thresholds from which recovery is unlikely (Knick *et al.* 2003).

Sage-grouse are well adapted to the historical mosaic of sagebrush habitats throughout their range (Patterson 1952; Braun 1998; Schroeder *et al.* 1999; Beck and Mitchell 2000; Connelly *et al.* 2000a; Johnsgard 2002; Pedersen *et al.* 2003). A number of authors have cited fragmentation of sagebrush habitats as a primary cause of the decline of sage-grouse populations indicating that the species requires large expanses of contiguous sagebrush (Patterson 1952; Connelly and Braun 1997; Braun 1998; Johnson and Braun 1999; Connelly *et al.* 2000a; Miller and Eddleman 2000; Schroeder and Baydack 2001; Johnsgard 2002; Aldridge and Brigham 2003; Beck *et al.* 2003; Pedersen *et al.* 2003; Connelly *et al.* 2004; Schroeder *et al.* 2004). However, the statements are opinion and speculation as there is no literature that provides data to substantiate the assertion. For example, in the Strawberry Valley of Utah, a population of 3,000 to 4,000 sage-grouse in the 1930s decreased to 160 to 185 birds by 1989 as a result of habitat loss and fragmentation (Beck *et al.* 2003).

However, there is a lack of data to assess how different degrees of fragmentation influences specific greater sage-grouse life history parameters such as productivity, density, and home range. There is a belief that sage-grouse are dependent on large, interconnected expanses of sagebrush (Patterson 1952; Connelly *et al.* 2004), data are not available regarding minimum sagebrush patch sizes to support populations of sage-grouse. Estimating the impact of habitat fragmentation on sage-grouse is complicated by time lags in response to habitat changes, particularly since these long-lived birds generally continue to return to altered breeding areas due to site fidelity as well as the fact that they are somewhat adaptable to changes in the habitat. Because of these complicating factors it is likely that fragmentation effects are a matter of degree, dependent on the type of habitat affected, the effect on biological activities and possibly other factors, (Wiens and Rotenberry 1985).

The following sections of this document discuss specific activities that may contribute to habitat fragmentation or direct habitat losses. This document, does

Comment: Note the Knick is not really the source document, he merely makes the statement. The source document is a range management paper that discusses the effects of removal of grazing and whether it results in significant recovery of sage steppe habitat. Unfortunately, the FWS neglects to include the full sense of the study which is that you can push the systems past critical thresholds from which recovery is unlikely without a significant expenditure of energy ... read active restoration.

The point of the paper is that often removal of grazing has no effect whatsoever, and that significant effort (ie restoration) must be invested in order to change one steady-state habitat condition for another. This is consistent with observations regarding the effect of grazing removal and the fact that it does not result in restoration of sage-brush steppe habitat.

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Comment: This Strawberry Valley example is troubling... when you read the cite, you learn, a dam was built, roads, homes and various other structures built, I am guessing that if we actually got the information we will find that it was not fragmentation in the sense we are concerned with... ie power poles, roads, and fences... but really and truly urbanization. Citing examples like this, which are extreme, does not elucidate the issues we are faced with. The FWS is asserting (later in the document) that fragmentation is caused by roads, power lines, communication towers and fences; the example this gives is one of urbanization. This example should be deleted because it appears to be more conversion than fragmentation.

Comment: These documents assert that, but there is no data or analysis or anything other than the authors opinions. The fact that these opinions are picked up and recited repeatedly doesnt make them anything more than opinion.

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Comment: Ok, first of all, this cite refers to research conducted with respect to tweetie birds in sage-steppe habitat not sage grouse. Second, the birds had varying responses, and none of them had anything like sage grouse habits. Finally, we have Shroeder who states that they are very adaptable. Hence my edits, and I think you ought to remove that cite because it certainly does not apply to sage grouse.

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not address whether the the effect of these activities result in fragmentation to a degree that impacts the bird's ability to use the habitat. We attempt to accurately characterize the state of our knowledge regarding these activities and their effects on sage grouse habitat.

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Infrastructure

Powerlines

Power grids were first constructed in the United States in the late 1800s and have expanded resulting in more than 804,500 km (500,000 mi) of transmission lines (lines carrying $\geq 115,000$ volts/115kV) by 2002 within the United States (Manville 2002). A similar estimate is not available for distribution lines (lines carrying $\leq 69,000$ volts/69kV).

Deleted: . The public demand for electricity has grown as human population and industrial activities

Deleted: (Manville 2002),

Powerlines can indirectly affect greater sage-grouse by increasing predation (Connelly *et al.* 2004). In areas where the vegetation is low and the terrain relatively flat, power poles provide an attractive hunting and roosting perch, as well as nesting stratum for many species of raptors (Steenhof *et al.* 1993; Connelly *et al.* 2000a; Manville 2002; Vander Haegen *et al.* 2002). Power poles increase a raptor's range of vision, allow for greater speed during attacks on prey, and serve as territorial markers (Steenhof *et al.* 1993; Manville 2002). Raptors may actively seek out power poles where natural perches are limited. For example, within one year of construction of a 596-km (372.5-mi) transmission line in southern Idaho and Oregon, raptors and common ravens (*Corvus corax*) began nesting on the supporting poles (Steenhof *et al.* 1993). Within 10 years of construction, 133 pairs of raptors and ravens were nesting along this stretch (Steenhof *et al.* 1993). The increased abundance of raptors and corvids within occupied sage-grouse habitats can result in increased predation. Ellis (1985) reported that golden eagle predation on sage-grouse on leks increased from 26 to 73 percent of the total predation after completion of a transmission line within 200 m (220 yd) of an active sage-grouse lek in northeastern Utah. The sage-grouse in this area eventually abandoned their daytime feeding and loafing area; this was attributed to their being vulnerable to golden eagles nesting on this transmission line during daily movements to this area from the lek (Ellis 1985). The lek was also eventually abandoned. Ellis (1985) concluded that the presence of the powerline resulted in changes in sage-grouse dispersal

Comment: Umm... what is the basis of this 31.1 mile buffer??? That significantly increases the affected land base, and I am not at all clear what the basis for it is.

Deleted: , and we are not aware of data for Canada. Within the analysis area of the Conservation Assessment (i.e., the pre-European settlement distribution of greater sage-grouse, including Canada, plus a 50-km (31.3-mi) buffer (buffer is to allow for external factors that may have contributed to current trends in populations or habitats; Connelly *et al.* 2004) there is a minimum of 15,296 km² (5,904 mi²) of land in transmission powerline corridors. Connelly *et al.* (2004) also did not estimate the total area of distribution lines.

Comment: Sorry, but somehow one sighting in 1939 with no other documented occurrences and no studies documenting this as a hazard, consists of anecdote, not data. There is no explanation of how power lines fragment habitat and no explanation of how they facilitate invasion of annual exotics. Finally, There is no data presented regarding the electrocution danger from power lines. The cited work below (Manville 2000) notes that electrocution is a problem for raptors and that collision is a problem for songbirds.

Deleted: posing a collision and electrocution hazard (Braun 1998; Connelly *et al.* 2000a), and can have indirect effects by

Deleted: fragmenting habitat (Braun 1998), and facilitating the invasion of exotic annual plants (Knick *et al.* 2003; Connelly *et al.* 2004). In 1939, Borell reported the deaths of 3 adult sage-grouse as a result of colliding with a telegraph line in Utah (Borell 1939). This line had been constructed within a movement corridor of the local population. Both Braun (1998) and Connelly *et al.* (2000a) report that sage-grouse collisions with powerlines occur, although no specific instances were presented. Other than an unpublished observation reported by Aldridge and Brigham (2003), we were unable to find documentations of other collisions and/or electrocutions of sage-grouse resulting from powerlines. However, not all powerlines are monitored for avian mortalities. ¶

Comment: Steenhof documents nesting on power lines, no data or information on predation.

patterns and fragmentation of the habitat. Leks within 0.4 km (0.25 mi) of new powerlines constructed for coalbed methane development in the Powder River Basin of Wyoming have significantly lower growth rates, as measured by recruitment of new males onto the lek, than leks further from these lines, presumably as the result of increased raptor predation (Braun *et al.* 2002). Within the Conservation Assessment area, Connelly *et al.* (2004) estimated that the area influenced by additional perches for corvids and raptors provided by powerlines, assuming a 5 to 6.9-km (3.1 to 4.3-mi) buffer based on the average foraging distance of these predators, was 672,644 to 837,390 km² (259,641 to 323,23 mi²), or 32 to 40 percent of sagebrush habitats.

Comment: Braun 1998 documents effects of 600m and suggests 1km... how do we get 5-7km?

The presence of a powerline may fragment sage-grouse habitats even if raptors are not present. Braun (1998; unpublished data) found that sage grouse use of habitat near powerlines increased as distance from the powerline increased for up to 600 m (660 yd) and based on that data reported that the presence of powerlines may limit sage-grouse use within 1 km (0.6 mi) in otherwise suitable habitat. Connelly *et al.* (2000a) recommended burying powerlines or constructing poles to inhibit raptor perching if lines are to be constructed within 3 km (1.9 mi) of any seasonal sage-grouse habitats to minimize potential predation by raptors. Braun noted that it is possible to markedly reduce the impact of power lines by elimination of raptor perch sites, however, the effectiveness of using raptor perch inhibitors in reducing predation rates on sage-grouse is unknown, as is the effectiveness of such inhibitors in minimizing habitat fragmentation.

Deleted: otherwise suitable

Deleted: by sage-grouse

Comment: Braun found...implies that Braun did research on this, he has a paragraph where he makes two broad statements about sage grouse mortality associated with powerlines, the Service has provided no data to support this statement.

Deleted: . Based on sage-grouse pellet counts Braun (1998)

Deleted: The

Deleted: (John Connelly, Idaho Dept. Game and Fish, pers. comm. 2004). ¶

Comment: The cited work looked exclusively at roads, and thus is inappropriate.

Deleted: Linear corridors through sagebrush habitats can facilitate the spread of invasive species, such as cheatgrass (*Bromus tectorum*) (Gelbard and Belnap 2003; Knick *et al.* 2003; Connelly *et al.* 2004) (see Invasive Species section). Although powerlines are commonly identified as creating such corridors, we were unable to find any information regarding the amount of invasive species incursion as a result of powerline construction

Deleted: Powerlines are common to nearly every type of anthropogenic habitat use, except perhaps some forms of agricultural development (e.g., livestock grazing) and fire (see Fig. 7.19 of the Conservation Assessment). Although w

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Comment: I am not certain that is accurate. The only place they will increase is where they don't already exist, although that may be restating the obvious... what I am trying to say, at some point, there will only be marginal increases as they can be connected to other existing lines... so there would be no net increase. That said, not sure if this is the appropriate place to point out that some power lines are being buried, even in the middle of nowhere.

Comment: Manville also notes the MOUs between FWS and energy producers for development of comprehensive avian protection plans... did the FWS happen to do any research on the agreements extent in sage grouse habitat?

We were unable to find an estimate of all future proposed powerlines within currently occupied sage-grouse habitats, but we anticipate that the incidence of powerlines will increase, particularly given the increasing development of energy resources and urban areas. For example, up to 8,579 km (5,311 mi) of new powerlines are predicted for the development of the Powder River Basin coal-bed methane field in northeastern Wyoming (BLM 2003a) in addition to the approximately 9,656 km (6,000mi) already constructed in that area. In addition to not having information on the number of new lines that may be

constructed, we have no information to what extent those lines will be buried instead of overhead. To the extent the lines are buried, that removes the ongoing problem of increased predation.

Communication towers

There are over 138,000 communication towers in the US and more are being constructed annually.

Documented mortalities due to collisions with communication towers and their associated structures (guy wires, lights, etc.; Manville 2002), consist primarily of migratory songbirds. We were unable to find any sage-grouse mortalities due to collision with communication towers or their supporting structures. Communication towers do provide perches for corvids and raptors (Steenhof *et al.* 1993; Connelly *et al.* 2004) (see preceding Powerlines discussion for predation effects from artificial perch sites).

Fences

Fences are used to delineate property boundaries and for livestock management (Braun 1998; Connelly *et al.* 2000a). They are relatively new features within the sagebrush landscape, which historically was open range (Braun 1998). The effects of fencing on sage-grouse are primarily related to direct mortality through collisions and creation of predator (raptor) perch sites. (Call and Maser 1985; Braun 1998; Connelly *et al.* 2000a; Beck *et al.* 2003; Knick *et al.* 2003; Connelly *et al.* 2004).

Sage-grouse frequently fly low and fast across sagebrush flats and new fences particularly if they are located in swales and on ridge lines where birds come across them unexpectedly, can create a collision hazard (Call and Maser 1985). The type of fence makes a difference in the effect on sage grouse with 1 to 3 wire fences being less detrimental than woven fences. While fence collisions are identified as a source of mortality the effects on populations are not understood.

Fence posts also create perching places for raptors and corvids, which may increase their ability to prey on sage-grouse (Braun 1998; Connelly *et al.* 2000b; Oyler-McCance *et al.* 2001; Connelly *et al.* 2004). While we have no data to confirm this, the effect on sage-grouse populations is likely similar to that of power lines in that

Deleted: Construction of

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Deleted: increasing nationally at a rate of approximately 5,000 new towers per year as cellular telephone systems and digital television systems expand (Shire *et al.* 2000). Within sage-grouse habitats, 9,510 new communication towers have been constructed within recent years (Connelly *et al.* 2004; see Fig. 7.21 in the Conservation Assessment). While millions of birds are killed annually in the United States through

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Deleted: , as most towers are not monitored and those that are lie outside the range of the species (Shire *et al.* 2000; Kerlinger 2000). C

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Comment: Ok, there is NO DATA anywhere, not even anecdotal on the issue of exotic introduction and predator corridors. This is purely opinion on the part of Braun... and apparently some kind of "piling on". The Predator/perch thin is not documented nor is the the collision issue other than anecdotal. However, I left in the collision portion because it seems reasonable and there is at least anecdotal information.

Deleted: , the potential creation of a predator corridor along fences (particularly if a road is maintained next to the fence), incursion of exotic species along the fencing corridor, and habitat fragmentation

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Deleted: Thirty-six carcasses of sage-grouse were found near Randolph, Utah, along a 3.2 km (2 mi) fence within three months of its construction (Call and Maser 1985). Twenty-one incidents of mortality through fence collisions near Pinedale, Wyoming, were reported in 2003 to the BLM (Connelly *et al.* 2004). F

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Deleted: (Braun 1998; Connelly *et al.* 2000a; Oyler-McCance *et al.* 2001; Connelly *et al.* 2004), although

Comment: I agree that this is important data, but it does not really belong in this section, we are describing BMPs that perhaps should go into our discussion of conservation actions underway or available. Because while it's easily fixed, it does not seem likely we would have any information on how often it is implemented.

Deleted: Flagging of fences to increase their visibility to sage-grouse has been recommended (Call and Maser 1985; Connelly *et al.* 2000a).

Deleted: We anticipate that

raptor perches are created stimulating an attendant increase in predation.

Deleted: through the creation of new

Comment: Braun 1998 is primarily opinion and not primary research nor does it cite any research to support his pronouncements regarding fences and predator increased access and invasive increases, or avoidance of fences generally. Also, this document notably neglects to make the distinction that Braun makes regarding woven fences and 3 strand barbed wire, woven is bad, barbed wire ok... so I have made those additions.

More than 1,000 km (625 mi) of fences were constructed annually in sagebrush habitats from 1996 through 2002; mostly in Montana, Nevada, Oregon and Wyoming (Connelly *et al.* 2004; see Fig. 7.22 in the Conservation Assessment). Over 51,000 km (31,690 mi) of fences were constructed on BLM lands supporting sage-grouse populations between 1962 and 1997 (Connelly *et al.* 2000a). The linear density of fences exceeds 2 km/km² (3.24 mi/mi²) the Conservation Assessment study area (Connelly *et al.* 2004). We could not identify how much of the existing fence is either 1 to 3 wire or woven, nor was there any actual data on mortality, decrease in habitat use, or predation increase on sage grouse populations related to fencing. We also have no information on potential expansion of new fences in sagebrush habitats.

Deleted: and predator corridors into sagebrush habitats are similar to that of powerlines discussed previously (Braun 1998; Connelly *et al.* 2004). Fences and their associated roads also facilitate the spread of invasive plant species that replace sagebrush plants up which sage-grouse depend (Braun 1998; Connelly *et al.* 2000a; Gelbard and Belnap 2003; Connelly *et al.* 2004). Greater sage-grouse avoidance of habitat adjacent to fences, presumably to minimize the risk of predation, effectively results in habitat fragmentation even if the actual habitat is not removed (Braun 1998).

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Roads and Railroads

Roads can have substantial ecological impacts, ranging from direct habitat loss, direct mortality, creating barriers to migration corridors or seasonal habitats, facilitating predator and invasive vegetative species spread, and other indirect influences such as noise (Forman and Alexander 1998). Interstates and major paved roads cover approximately 14,272 km² (22,835 mi²) within the Conservation Assessment study area (Connelly *et al.* 2004; see Figs. 7.16 and 7.17 in the Conservation Assessment). Secondary paved road densities within this area ranged to greater than 2 km/km² (3.24 mi/mi²). No estimate of unpaved roads or the total area of sagebrush habitat lost to road construction is available.

Comment: Exactly how did we arrive at this figure? Did we use the 5-7km buffer... a much wider buffer I would note than that suggested by your cited work.

We have no data regarding sage-grouse mortalities from vehicular collisions, but assume their vulnerability is similar to that of other large-bodied, low-flying birds. General avian fatalities have been estimated to range from 3 to 144 deaths per mile of road based on the summaries of several studies and sage-grouse mortality resulting from collisions from vehicles does occur (Patterson 1952). Sage grouse mortalities are typically not monitored or recorded and as a result we have no data upon which to base any determination of the importance of this factor on sage-grouse populations.

Comment: For which we also have no data?

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The extent to which roads are barriers to wildlife movement depends on the species affected, road width, and traffic density (Forman and Alexander 1998). In general, data regarding how roads affect seasonal habitat availability for individual sage-grouse populations and the ability of sage-grouse to reach these areas are not available. While some of the literature contains assertions that highways are a source of predators and that highway rest areas provide a source of food and perches for corvids and raptors, and facilitate their movements into surrounding areas (Connelly *et al.* 2004; see Fig. 7.18 in the Conservation Assessment) there is no data to substantiate this assertion.

The presence of roads does increase human access and any resulting disturbance effects in remote areas (Forman and Alexander 1998; Forman 2000; Connelly *et al.* 2004). In 1916, Hornaday (1916) cautioned that the expansion of roads into sage-grouse habitats was resulting in significant population impacts from hunting and poaching activities. Increases in legal and illegal hunting activities resulting from road incursions into sagebrush habitats have been asserted (Patterson 1952; Connelly *et al.* 2004). However, there is no data to substantiate the actual current extent of increased hunting, poaching and other more general disturbance activities and the existence of any effects on sage-grouse populations has not been identified.

Comment: Sorry, that study did not find that. The study defined fragmentation as roads, and the measured how much there was, and then asserted that populations surrounded by roads were cut off from other populations, but there was absolutely no data (observations) that supported the assertion.

Comment: The studies contain nothing even close to the text.

Comment: None of these cites substantiate this statement with primary research., they simply assert.

Comment: What does that have to do with highways? The statement belongs in the section on predators.

Deleted: Road development within Gunnison sage-grouse habitats precluded movement of local populations between the resultant patches, presumably to minimize their exposure to predation (Oyler-McCance *et al.* 2001). ¶

¶ Roads can provide corridors for predators to move into previously unoccupied areas. For some mammalian species, dispersal along roads has greatly increased their distribution (Forman and Alexander 1998; Forman 2000). Corvids also use linear features such as primary and secondary roads as travel routes, expanding their movements into previously unused regions (Connelly *et al.* 2000b; Aldridge and Brigham 2003; Connelly *et al.* 2004). In an analysis of anthropogenic impacts, Connelly *et al.* (2004) reported that greater than at least 58 percent of the Conservation Assessment area has a high or medium presence of corvids, a known sage-grouse nest and chick predator (Schroder and Baydack 2001). Additionally,

Comment: The cited work contains no such conclusion... this work says they are not a major conduit and do not contribute.

Deleted: While these risks have been identified for greater sage-grouse (Connelly *et al.* 2000a; Aldridge and Brigham 2003; Connelly *et al.* 2004), in general predation has not been found to be a limiting factor for sage-grouse populations (see Predation in the Other Factors section) and it has not been documented that sage-grouse populations are affected by predators using roads as corridors into sagebrush habitats.

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Comment: Neither of these is primary work.

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Comment: We are talking about roads and their ill effects. We will talk about oil and gas exploration and the increased incidence of roads in that section. This is repetitive.

Deleted: determined.

Deleted: Roads may also facilitate access for habitat treatments (Connelly *et al.* 2004), resulting in subsequent direct habitat losses. New roads are being constructed to support development activities within the greater sage-grouse extant range. For example, in the Powder River Basin of Wyoming, up to 28,572 km (17,754 mi) of roads to support coalbed methane development are proposed (BLM 2003a). ¶

The roads have been documented to contain higher levels of exotic plants. The authors speculate this may be due to invasions via introduced roadfill, vehicle transport, or soil conditions that result from road maintenance activities (Forman and Alexander 1998; Forman 2000; Gelbard and Belnap 2003). Invasive species are not limited to roadsides (or verges), but have also encroached into the surrounding habitats (Forman and Alexander 1998; Forman 2000; Gelbard and Belnap 2003). In their study of roads on the Colorado Plateau of southern Utah, Gelbard and Belnap (2003) found that improved roads had more exotics than unimproved four-wheel drive roads to paved roads. This effect was associated with road construction and maintenance activities and vehicle traffic, and not to differences in site characteristics. Gelbard and Belnap (2003) estimated that the 117,205 km (187,528 mi) of rural paved roads in Utah may have already converted as much as 164,087 ha (405,295 ac) of land from native plant communities to exotic roadside plant communities. They speculate that the presence of an unbroken biological soil crust cover precluded the spread of invasive species into adjacent, native areas.

- Deleted: expansion of
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- Deleted: and
- Comment: Forman and Alexander 1998 state (pg 210) and 211 that: "few documented cases are known of species that have successfully spread more than 1km because of roads" ... and close with ... "In conclusion roadside vegetation is rich in plant species, although apparently not an important conduit for plants." I find nothing in this paper that supports your assertion.
- Comment: Not primary research, although none of your cites here is primary.
- Deleted: ; Knick *et al.* 2003; Connelly *et al.* 2004)
- Deleted: ing unpaved
- Deleted: resulted in increased cover of exotic plant species within the interior of adjacent vegetative communities.

Additional indirect effects of roads may result from birds' behavioral avoidance of road areas because of noise, visual disturbance, pollutants, and predators moving along a road. This "road effect" (the distance from a road at which a population density decrease is detected) is greater for birds in grasslands than birds from timbered areas (Forman and Alexander 1998). This study speculated that noise was the basis for the avoidance and that possible reasons for the avoidance were hearing loss, an increase in stress hormones, altered behaviors, interference with communication during breeding activities, differential sensitivity to different frequencies, and deleterious effects on food supply of other habitat attributes (Forman and Alexander 1998). The higher effect distance for grasslands was attributed to an absence of screening vegetation. There is the potential for road noise to disturb lek use as sage-grouse depend on acoustical signals to attract females to leks (Gibson and Bradbury 1985; Gratson 1993). If noise interferes with mating displays, and thereby female attendance, younger males will not attend the lek and eventually leks will become inactive (Amstrup and Phillips 1977; Braun 1986). Although, there are documented occurrences of leks continued use to such an extent that

- Deleted: Only
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- Deleted: because of the open habitat
- Deleted: Noise may affect local bird populations through
- Comment: I could find no reference at all in Suter to this.
- Deleted: in arid and semiarid regions further exacerbates the problem (Suter 1978).
- Deleted: S

strutting occurs on the road itself, so the factors affecting sage grouse response are likely more complicated than just the presence of a road or noise (Lyon 2000). The noise effect is calculated to be roughly 305m in grasslands (Forman 2000).

Indirect effects of roads on sage-grouse are better documented. In a study on the Pinedale Anticline in Wyoming, sage-grouse hens that bred on leks within 3 km (1.9 mi) of roads associated with oil and gas development traveled twice as far to nest as did hens bred on leks greater than 3 km (1.9 mi) from roads. The difference in nest initiation rates for hens bred on leks "close" to roads were not statistically significant, (Lyon 2000; Lyon and Anderson 2003), Lyon and Anderson (2003) suggested that roads may be the primary impact of oil and gas development to sage-grouse. Braun et al. (2002) suggested that daily vehicular traffic along road networks for oil wells can impact sage-grouse breeding activities based on lek abandonment patterns.

In a study of 804 leks within 100 km (62.5 mi) of Interstate 80 in southern Wyoming and northeastern Utah, Connelly et al. (2004) found that there were no leks within 2 km (1.25 mi) of the interstate and only 9 leks were found between 2 and 4 km (1.25 and 2.5 mi) of the same stretch. The number of active leks increased with increasing distance from the interstate. Lek persistence and activity relative to distance from the interstate were also measured. The distance of a lek from the interstate was a significant predictor of lek activity, with leks further from the interstate more likely to be active. An analysis of long-term changes in populations between 1970 and 2003 showed that leks closest to the interstate declined at a greater rate than those further away (Connelly et al. 2004). What is not clear from these studies is what specific factor relative to roads (e.g., noise, changes in vegetation, etc.) sage-grouse are responding to, and Connelly et al. (2004) caution that they have not included other potential sources of indirect disturbance (e.g., powerlines) in their analyses.

We were unable to document any effects due to road-related pollutants on sage-grouse (see Contaminants in the Other Factors section).

Railroads presumably have the same impacts to sage-grouse as do roads. Railroads cover 137 km² of the

Comment: Has nothing to do with sage grouse. This belongs in a treatise on "Why roads are bad"?

Deleted: Dust from roads and exposed roadsides can damage vegetation through interference with photosynthetic activities. The actual amount of potential damage depends on winds, wind direction, the type of surrounding vegetation and topography (Forman and Alexander 1998). Chemicals used for road maintenance, particularly in areas with snowy or icy precipitation, can affect the composition of roadside vegetation (Forman and Alexander 1998).

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Comment: That is not in the paper, so I deleted.

Deleted: due to their persistence and continued use even after drilling and production have ceased.

Comment: We are not considering other sage grouse species, and we've already captured the avian effects based on the Forman paper.

Deleted: The density of other sagebrush-obligate birds within 100 km (62.5 mi) of roads in Wyoming was 50 percent lower than at greater distances (Knick et al. 2003). ¶

Comment: Ok, Connelly et. al is not a study. It's a compilation of information. I suspect that Connelly et. al found that of the known active leks, none were within 2km of the interstate and only 9 were within 4km. Did they actually go out and do new surveys? Please tell me the page, I can't find it.

Comment: *cough* ... ok, is this a Connolly et. al study? Or a review of other studies?

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Deleted: We anticipate these effects are minimal, however, given the general avoidance of roads exhibited by this species

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Comment: Add square mile number.

Deleted: Railways were primarily responsible for the initial spread of cheatgrass in the intermountain region (Connelly et al. 2004). Cheatgrass, an exotic species that is unsuitable as sage-grouse habitat, readily invaded the disturbed soils adjacent to railroads, being distributed by trains and the cattle they transported. Fires created by trains facilitated the spread of cheatgrass into adjacent areas.

sage-grouse Conservation Assessment area, but have an ecological influence of 183,915 km² (3 km (1.8 mi) buffer; see Fig. 7.20 in the Conservation Assessment). Avian collisions with trains occur, although no estimates of mortality rates are documented in the literature (Erickson *et al.* 2001). We could find no documentation of effects of railroads on sage grouse.

Comment: We are documenting current threats to the sage grouse, to enable experts to make assessments regarding the threat of extinction. What happened in the past is immaterial unless it's still happening today.

Deleted: specific information regarding the potential expansion of railroad facilities in sage-grouse habitats.

Grazing

The intermountain west prior to settlement was an arid region largely devoid of big game. Expeditions occurring between 1820-1850 were routed through the heart of the sagebrush steppe and there is a notable lack of any mention of sage grouse. However, by the late 1800s sage grouse were more abundant in the region.

Comment: Included in comments from the State of Idaho.

Livestock grazing within the range of the greater sage-grouse began with European immigrant settlement of the western United States in the 1860s and by the mid 1880s the western range was fully stocked. Comments submitted by the State of Idaho note that the resulting changes initially favored sage grouse as the range was essentially fire-proofed and became brushy and shrubby. The State also speculates that predator control by settlers was an indirect benefit.

Deleted: to late 1800s.

Comment: Title page and contents are all that is on the CD, no text.

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By the late 1800s settlers were a significant ecological factor in western rangelands (Miller and Eddleman 2000, Connelly *et al.* 2004). From 1870 to the early 1930s livestock fully stocked or over-stocked western lands. Since that peak, there has been a continual downward trend in livestock grazing. This downward trend closely parallels projected downward trends in sage grouse numbers. However, it is not possible to draw the conclusion that sage grouse populations and cattle grazing are positively correlated. There are too many confounding factors. All that can be said of the relationship is that there is no obvious direct negative correlation.

Comment: This entire insert based on the comments from the State of Idaho.

Comment: I have deleted all the statistics, feel free to put them back in, but I think if you want to put more than two (peak and current) the paper would be better served to have them in a table. Also, make sure that you are providing numbers that are comparable. Still... it's not the numbers that are important, but the fact that there used to be a lot, they affected the habitat and now there are few.

Comment: Cite not included in list of references.

Comment: This cite, which confirms comments submitted by the Idaho Cattlemen regarding advent of grazing, addresses only Nevada.

Deleted: the numbers of cattle, sheep, and horses rapidly increased, peaking at the turn of the century (Oliphant 1968, Young *et al.* 1976) with an estimated 26 million cattle and 20 million sheep in the West (Wilkenson 1992). All sage-grouse habitats were exposed to livestock grazing. Cattle and sheep animal unit months (AUMs; the amount of forage required to feed one cow with calf, one horse, five sheep, or five goats for one month) on all Federal land have declined since the early 1900s (Laycock *et al.* 1996). By the 1940s AUMs on all Federal lands was estimated to be 14.6 million, increasing to 16.5 million in the 1950s, and gradually declining to 10.2 million by the 1990s (Miller and Eddleman 2000). As of 2003 active AUMs for BLM lands in States where sage-grouse occur totaled about 10.1 million (BLM 2003b; see also Table 7.9 in the Conservation Assessment). Most of the 78.3 million acres of BLM-administered land within the current range of the greater sage-grouse are open to livestock grazing (BLM 2004a).

The effect of livestock grazing on sage grouse is unclear and there is little data to support. Several authors have examined the issue and concluded that livestock grazing can have negative impacts on western ecosystems (Fleischner 1994, Jones 2000, Freilich *et al.* 2003) and livestock grazing is the most widespread type of land use across the sagebrush biome (Connelly *et al.* 2004) what is important is that these studies also concluded that properly

Deleted: by livestock in the western United States

Deleted: remains a contentious issue (Wamboldt *et al.* 2002, Connelly *et al.* 2004).

manager livestock grazing can coexist with sage grouse. However, few studies have directly addressed the effect of livestock grazing on sage-grouse (Beck and Mitchell 2000, Wamboldt et al 2002, Crawford et al. 2004), and there is little direct experimental evidence linking grazing practices to sage-grouse population levels (Braun 1987, Connelly and Braun 1997).

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Native herbivores, such as pronghorn antelope (*Antilocarpo americana*), were present in the sagebrush steppe region prior to European settlement of western States (Miller et al. 1994), and sage-grouse co-evolved with these animals. However contemporary accounts by early explorers indicated that mule deer were rare, while elk and bison were absent, occasionally antelope and bighorn sheep were encountered. So it is unlikely that sage-grouse evolved with intensive grazing by wild herbivores (Connelly et al. 2000a).

Comment: Removed the second portion, since we have comments by experts to the contrary.

Deleted: , such as bison, since the ranges of the two species do not overlap

In a 2002 Wamboldt et. al reviewed the question of grazing and sage grouse. They noted that there are few scientific, peer-reviewed articles that address the grazing and sage grouse issue, that none are experimental and none with replicates. The paper states that any argument that livestock grazing presently is the primary cause of sage-grouse population declines cannot be supported by the available literature. They also note that the alternative hypothesis, that grazing has no effect on sage-grouse populations cannot be supported either. Finally, the authors note that with reasonable certainty that sage-grouse and livestock use of habitat are not mutually exclusive. What is clear from the literature reviewed for this synthesis, historic information and information and data provided by commenters is that badly managed grazing degrades habitat and well managed grazing supports multiple uses.

While there is a limited amount of available information on livestock grazing impacts to sage-grouse recent work has been done demonstrating that shrub and herbaceous cover and forb availability are the primary factors that influence nest success, and grass height did not influence success. This finding is contrary to accepted guidance found in guidelines currently used for sage grouse management. It does however, lend credence to concerns that livestock consumption of forbs may reduce food availability for sage-grouse. This is particularly important for hens, as forbs provide essential calcium, phosphorus, and protein. A hen's nutritional condition affects nest

Comment: This comment ignores a substantial study that was done using the same studies as Connolly and a meta-analysis. Why did we ignore this? There is a clear explanation of what was done, the data used and the results. We also have information that it has been accepted for publication and has been peer reviewed.

Comment: Uof Nevada Study which

Deleted: it has been demonstrated that the reduction of grass heights due to grazing of sage-grouse nesting and brood-rearing areas negatively affects nesting success by reducing cover necessary for predator avoidance (Gregg et al. 1994; Delong et al. 1995; Connelly et al. 2000a).

Deleted: In addition,

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initiation rate, clutch size, and subsequent reproductive success, as well as the nest success once hatching has taken place. (Connelly *et al.* 2000a).

This information suggests that poorly managed livestock grazing can reduce the suitability of breeding habitat, and negatively affect sage-grouse populations (Braun 1987, Dobkin 1995, Beck and Mitchell 2000). However, additional replication studies are necessary to determine the effect of grazing management on sage-grouse nesting success (Beck and Mitchell 2000). Enclosure studies have demonstrated that domestic livestock grazing can reduce water infiltration rates and cover of herbaceous plants and litter, as well as compacting soils and increasing soil erosion (Braun 1998). This results in a change in the proportion of shrub, grass, and forb components in the affected area, and an increased invasion of exotic plant species that do not provide suitable habitat for sage-grouse (Miller and Eddleman 2000). Hulet (1983, as cited in Connelly *et al.* 2000a) found that heavy grazing could lead to increases in ground squirrels that depredate sage-grouse nests. Thus, poorly managed livestock operations can have negative impacts on sage-grouse habitat. Some of the important parameters that effect the habitat include stocking levels, season of use, type of sage brush habitat, and utilization levels. Stocking levels refers to the number of livestock placed on any livestock range and this can have a large influence on range health and productivity (Van Poolen and Lacey 1979, Skovlin 1987, and Holechek *et al.* 1987).

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Comment: The cited literature is not included in my list.

Comment: No cited literature provided.

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Deleted: livestock operations related to impacts on

Comment: While all of these things may occur anecdotally, there is no literature identifying them as a problem for sage grouse.

Deleted: Other consequences of grazing include several related to livestock trampling. Outright nest destruction by livestock trampling does occur and the presence of livestock can cause sage-grouse to abandon their nests (Rasmussen and Griner 1938, Patterson 1952, Call and Maser 1985, Crawford *et al.* 2004). Call and Maser (1985) indicate that forced movements of cattle and sheep could have significant effects on nesting hens and young broods caught in the path of these drives. Livestock may also trample sagebrush seedlings thereby removing a source of future sage-grouse food and cover (Connelly *et al.* 2000a). Finally trampling of soil by livestock can reduce or eliminate biological soil crusts making these areas susceptible to cheatgrass invasion (Mack 1981 as cited in Miller and Eddleman 2000; Young and Allen 1997; Forman and Alexander 1998).

Another concern with regard to livestock grazing is the direct competition between sage-grouse and livestock for rangeland resources. Cattle are grazers, feeding mostly on grasses, but they will make seasonal use of forbs browse species like sagebrush (Vallentine 2001). Domestic sheep are intermediate feeders making high use of forbs, but also use a large volume of grass and browse species like sagebrush (Vallentine 2001). Pedersen *et al.* (2003) documented sheep consumption of rangeland forbs in areas where sage-grouse occur. The effects of direct competition between livestock and sage-grouse will depend on condition of the habitat and grazing practices, and thus vary across the range of the species. For example, Aldridge and

Brigham (2003) suggest that poor livestock management in mesic sites, which are considered limited habitats for sage-grouse in Alberta, results in a reduction of forbs and grasses available to sage-grouse chicks, thereby affecting chick survival. Livestock may modify sage-grouse habitat by altering vegetation structure and changing composition. Again, the potential effects of grazing are not systematically documented in the literature and are highly dependent on management of the stock, and local conditions.

Some of the documented effects of livestock grazing have positive consequences for sage-grouse. Evans (1986) studied the effects of cattle grazing on upland meadows in northern Nevada and found that sage-grouse used grazed meadows significantly more during late summer than ungrazed meadows because grazing had stimulated the regrowth of forbs. In contrast food forbs on the ungrazed meadows were already mature and unpalatable (Evans 1986). Klebenow (1982) noted that sage-grouse sought out and used openings in meadows created by cattle grazing in northern Nevada. Finally both sheep and goats have been used to control invasive weeds (Mosely 1996 as cited in Connelly *et al.* 2004; Olson and Wallander 2001; Merritt *et al.* 2001) and woody plant encroachment (Riggs and Urness 1989) in sage-grouse habitat. Again, the effects of grazing are site specific and dependent on the management of the stock and the local conditions.

Free-roaming horses and burros have been a component of sagebrush and other arid communities since they were brought to North America at the end of the 16th century (Wagner 1983; Beaver 2003). About 31,000 wild horses occur in 10 western States with herd sizes being largest in States with the most extensive sagebrush cover (Nevada, Wyoming, and Oregon; Connelly *et al.* 2004). Burros occur in five western States with about 5,000 of these present (Connelly *et al.* 2004). Due to physiological differences, a horse consumes 20-65 percent more forage than would a cow of equivalent body mass (Wagner 1983; Menard *et al.* 2002).

We are unaware of any studies that directly address the impact of wild horses or burros on sagebrush and sage-grouse. However there is some evidence of possible

indirect effects on sage-grouse from wild horses. Crane *et al.* (1997) found that wild horses preferentially selected streamside and bog/meadow habitat during the growing season in an area of Wyoming where these habitats comprised a small portion of the study area. Beever and Brussard (2000) compared water sources used by feral horses where some were excluded from horse use vs. others that were not. Low elevation springs excluded from horses had greater plant species richness, percent cover, and abundance of grasses and shrubs versus springs horses could access (Beever and Brussard 2000). High elevation meadows where horses were excluded had maximal vegetation heights 2.8 times greater than those where horses had access (Beever and Brussard 2000). Based on consideration of such studies, some authors have suggested that wild horses could negatively impact important meadow and spring brood-rearing habitats used by sage-grouse (Crawford *et al.* 2004; Connelly *et al.* 2004). Other impacts from wild horse grazing may be similar to the impacts resulting from domestic livestock in sagebrush habitats, but these have not been documented.

While BLM reports that they no longer implement actions that result in removing large expanses of sagebrush and reseeding with non-native grasses (BLM 2004a), historically, the elimination of sagebrush is usually followed with rangeland seedings to improve forage for livestock grazing operations (Knick *et al.* 2003; Connelly *et al.* 2004). As a result, large expanses of sagebrush were removed and reseeded with non-native grasses, such as crested wheatgrass (*Agropyron cristatum*), to increase forage production on public lands (Shane *et al.* 1983, cited in Knick *et al.* 2003; Connelly *et al.* 2004). These treatments had the effect of reducing or eliminating many native grasses and forbs present prior to the seedings. Sage-grouse were affected indirectly through the loss of native forbs that serve as food and the loss of native grasses that provide concealment or hiding cover within the understories of the former sagebrush stands (Connelly *et al.* 2004). One study contained in (Autenrieth 1981) documented sage grouse nest success was higher in crested wheat grass than sage brush despite lower cover amounts. Currently BLM undertakes significant habitat restoration

Deleted: Sagebrush removal to increase herbaceous forage and grasses for domestic and wild ungulates is a common practice in sagebrush ecosystems (Connelly *et al.* 2004). Removal from chemical and mechanical means has been discussed previously (see Habitat Conversion). Another technique used to reduce sagebrush cover is prescribed burning, which is discussed below under Fire. ¶

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efforts on an annual basis as part of its operations⁸, however, resulting benefits to sage grouse populations may be slow to manifest on a measureable basis for two reasons. First, our current census of sage grouse provides virtually no baseline against which to compare any increases. Second, because BLM manages habitat not species populations habitat restoration is not just implemented to benefit sage-grouse but is rather an attempt to restore historic ecosystems which may have supported only sparsely distributed sage grouse populations (see comments from the State of Idaho).

Deleted: BLM reports that they no longer implement actions that result in removing large expanses of sagebrush and reseeded with non-native grasses (BLM 2004a).

Water developments for the benefit of livestock on public lands are common (Connelly *et al.* 2004). These include altering springs, streams and other water sources and diverting them into catchments or watering ponds to serve as livestock watering areas. There are mixed opinions as to whether this provides a net benefit to sage grouse.

Comment: This is pure speculation by Braun, it is not a study, but an opinion piece and doesn't even contain cites. It certainly does not meet the IQA standard. The fact that we are relying on Braun, who is a contractor for one of the petitioners is troubling.

Mining

Comment: This is purely speculative on the part of the FWS.

Development of mines within the distribution of the sage-grouse began before 1900 (Robbins and Ward 1994, cited in Braun 1998). Surface mining for any mineral resource (coal, uranium, copper, bentonite, gypsum, oil shale, phosphate, limestone, gravel, etc.) will result in direct but time limited habitat loss for sage-grouse if the mining occurs in occupied sagebrush habitats. The actual effect of this loss depends on the quality, amount, and type

Deleted: Development of springs and other water sources to support livestock in upland shrub-steppe habitats can artificially concentrate domestic and wild ungulates in important sage-grouse habitats, thereby exacerbating grazing impacts in those areas through vegetation trampling, etc. (Braun 1998). Diverting the water sources has the secondary effect of changing the habitat present at the water source before diversion. This could result in the loss of either riparian or wet meadow habitat important to sage-grouse as sources of forbs or insects.

Deleted: BLM reports that sage-grouse benefited directly or indirectly by the installation of 1,100 water developments/structures on BLM-managed land during the 5-year period covering FY 2000 to 2004 (BLM 2004a), but did not provide any information explaining the direct or indirect benefits or the specific basis for determining that benefits occurred.¶

Comment: Ok, this is a stupid term, but I put it in to serve as a marker for the fact that surface mining law requires reclamation, it's not like a house or a parking lot which is not intended to be depleted and abandoned at some point.

⁸ BLM habitat restoration efforts:

FY-2004:

Treated 8700 acres of lake and wetlands and 800 miles of stream and riparian areas that were classified as "functioning at risk" or "non-functioning" to improve functioning condition.

Treated 119,000 acres for fire rehabilitation and 105,000 acres for emergency stabilization in focus burned areas to restore lands that were unlikely to recover naturally from severe fire damage.

Completed fuel treatment of 179,000 acres of wildland/urban interface (WUI) and 293,000 acres of non-WUI lands

Conducted 10.1 million acres of weed inventory and treatment of 318,000 acres of land infested with noxious or invasive weeds.

Conducted 1586 rangeland health evaluations.

FY-2003:

funded 486 CCS projects and 87 CCI projects. Partners contributed \$23 million dollars in cash, in-kind work and services (about 3 times the BLM contribution) to the CCS projects and \$10.8 million (more than twice the BLM contribution) to the CCI projects. FY 2004 data is still being tallied.

of habitat disturbed, the scale of the disturbance, and if non-breeding habitat is affected, the availability of adjacent habitats (Proctor *et al.* 1983; Remington and Braun 1991). Mining infrastructure, such as roads, railroads, powerlines, etc., may impact sage-grouse, but those effects have been previously described. Presumably, direct habitat loss will not be as large from subsurface mining. However, the amount of supporting infrastructure and indirect effects may be similar as for surface mines (Thomas and Leistriz 1981).

Comment: No cite.

Deleted: Indirect effects of mining, such as noise, may affect local sage-grouse populations, even if the direct habitat loss is not extensive.

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In surface mining operations, the overburden (sediments overlying the target strata) must be removed. This may involve a variety of techniques, including bulldozing and/or blasting (Thomas and Leistriz 1981), depending on the type and depth of overburden. The exposed target seam is similarly removed, and hauled to a processing facility (Thomas and Leistriz 1981). Those areas stripped constitute a direct loss of habitat. Direct habitat loss can also occur if the overburden and/or topsoil are stored in sagebrush habitats. Methods for removal of all mineral resources by surface mining are similar, although the scale of surface disturbance may vary (Moore and Mills 1977). Sage-grouse habitat losses from mining have occurred in Utah (Beck *et al.* 2003), Colorado (Braun 1986), and Wyoming (Hayden-Wing Associates 1983), but the actual amount of habitat loss has not been tabulated on either a gross or net (net of reclaimed habitat) basis.

Comment: Repetitive, earlier paragraph said the same thing.

Deleted: Underground mining minimizes surface disturbance, but not necessarily surface infrastructure (Thomas and Leistriz 1981).

Reclamation of surface mining disturbances is a legislated requirement in the United States (coal only) and Canada (all types; Smyth and Dearden 1998). However, legislation in each country is relatively recent (27 and 41 years, respectively; Smyth and Dearden 1998). Since completion of actual reclamation has taken place even more recently, there is a resulting lack of long-term monitoring data to gauge its success. Primary standards are usually the establishment of suitable vegetative requirements, such as shrub density, percent vegetative cover, or vegetative species diversity, although these may not reflect or attempt to attain natural successional trajectories (Smyth and Dearden 1998). Early efforts to restore sage-grouse habitats on mined lands focused on creating artificial leks, which was largely unsuccessful (Tate *et al.* 1979; Proctor *et al.* 1983). Most efforts now rely on seasonal restrictions to avoid lek destruction, and restoration of sagebrush habitats

Comment: If the federal gov't is the owner then we can specify what conditions and monitor as we choose. Based on BLM's current management guidance on sage grouse habitat, one could reasonably assert that BLM would request restoration of sage grouse habitat if that was the state of the ground prior to mining.

Comment: And why is this a problem? If the person owns the land, and wishes to convert its use in any other circumstance, we don't prevent it.

Deleted: Therefore, "successful" reclamation, as measured by current legislation, may not restore the affected area to pre-mining conditions. Surface mining legislation also allows for a change in post-mining land use from pre-mining conditions, and restoration of pre-mining sagebrush habitat may not occur if the surface owner determines an alternative habitat type is preferable.

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(Proctor *et al.* 1983; Parrish and Anderson 1994). Regulation of non-coal mining in the United States is at the discretion of the individual States, and may or may not include wildlife habitat restoration as a criterion (Pat Deibert, U.S. Fish and Wildlife Service, pers. comm. 2004) however, the extent to which coal mining disturbs surface conditions dwarfs the effects of other mining activities which are primarily deep mining.

In Wyoming and Montana an estimated 38,833 ha (96,000 ac) of disturbed Federal and non-Federal surface are associated with existing coal mining operations (Kermit Witherbee, Bureau of Land Management, pers. comm. 2004). Over the next ten years, approximately 20,243 ha (50,000 acres) are estimated to be disturbed for coal mining activities. Of that, 14,170 ha (35,000 acres) should be reclaimed within the same time-period, resulting in a net annual disturbance of 607 ha (1,500 acres). The actual impact to sage-grouse habitats may be longer, as it takes 15 to 30 years for sagebrush regeneration to usable conditions (Connelly and Braun 1997). We could find no estimates for surface mining disturbance in other States within the range of sage-grouse, beyond the number of coal mining permits issued as of October, 2002 (Table 3).

Table 3: Number of coal mining permits by State as of October, 2002 (data from the Office of Surface Mining, www.osm.gov/coal/2002coal.htm). Surface disturbance was not provided. Six of the 11 States within the extant range of sage-grouse have active coal mining operations.

subsurface State Permits	Number of Surface Permits Total	Number of Sub-surface
Colorado	9	10
Montana	9	0
North Dakota	1	0
Utah	4	14
	18	

Comment: Again, this depends on the owner, and if the owner is the federal govt, management plans will address sage grouse issues. If it's not the government, then it can happen anyway on private land.

Comment: No, they don't because we already tallied them under mining losses. If they are removed, then it will be a net number, and a caveat will have to be added to our discussion of mining losses that some of the infrastructure will be temporary.

Comment: This entire paragraph is speculative, and there is no data to substantiate this is happening and reducing sage grouse habitat today. If it happened, we have already identified those areas as habitat lost to grouse.

Deleted: New vegetation types including exotic species may become established on mined areas (Moore and Mills 1977), altering suitability for sage-grouse. Temporary habitat loss can stem from intentional planting to minimize erosion or for nurse crops (those crops planted to create suitable microhabitat conditions for the desired vegetative species). The length of this temporary conversion depends on the life-of-mine, the success of reclamation, and whether or not reclamation is concurrent with mining disturbance. If reclamation plans call for the permanent conversion of the mined area to a different habitat type (e.g., agriculture) the habitat loss becomes permanent. Invasive exotic plants may also establish on the disturbed surfaces. Removal of the overburden and target mineral may result in changes in topography, subsequently resulting in changes in microclimates and microhabitats (Moore and Mills 1977). Significant topographical changes can affect the ability to successfully restore the mined area to pre-existing vegetative conditions (Moore and Mills 1977). Additional habitat losses can occur if supporting infrastructure, such as roads, railroads, utility corridors, etc., become permanent landscape features after mining and reclamation are completed (Moore and Mills 1977). ¶

Washington	2	2	0
Wyoming	29	28	1
Total	78	53	25

Comment: None of this is very useful unless you can identify the number of surface acres associated in total with this activity.

NO COMMENTS PAST THIS POINT. REVIEW

TERMINATED
