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Part II

Department of the Interior

Fish and Wildlife Service

50 CFR Part 17

Endangered and Threatened Wildlife and Plants; Endangered Status for Gunnison Sage-Grouse; Proposed Rule

DEPARTMENT OF THE INTERIOR

Fish and Wildlife Service

50 CFR Part 17

[Docket No. FWS–R6–ES–2012–0108; 4500030113]

RIN 1018–AZ20

Endangered and Threatened Wildlife and Plants; Endangered Status for Gunnison Sage-Grouse

AGENCY: Fish and Wildlife Service, Interior.

ACTION: Proposed rule.

SUMMARY: We, the U.S. Fish and Wildlife Service, propose to list the Gunnison sage-grouse *(Centrocercus minimus)* as endangered under the Endangered Species Act of 1973, as amended (Act). The effect of this regulation would be to add the Gunnison sage-grouse to the Lists of Endangered and Threatened Wildlife under the Act.

DATES: We will accept comments received or postmarked on or before March 12, 2013. Comments submitted electronically using the Federal eRulemaking Portal (see **ADDRESSES** section, below) must be received by 11:59 p.m. Eastern Time on the closing date. We must receive requests for public hearings, in writing, at the address shown in the **FOR FURTHER INFORMATION CONTACT** section by February 25, 2013.

ADDRESSES: You may submit comments by one of the following methods:

(1) *Electronically:* Go to the Federal eRulemaking Portal: *http://www.regulations.gov.* In the Keyword box, enter Docket No. FWS–R6–ES–2012–0108, which is the docket number for this rulemaking. Then, in the Search panel on the left side of the screen, under the Document Type heading, check on the Proposed Rules link to locate this document. You may submit a comment by clicking on ''Comment Now!''

(2) *By hard copy:* Submit by U.S. mail or hand-delivery to: Public Comments Processing, Attn: FWS–R6–ES–2012–0108; Division of Policy and Directives Management; U.S. Fish and Wildlife Service; 4401 N. Fairfax Drive, MS 2042–PDM; Arlington, VA 22203.

We request that you send comments only by the methods described above. We will post all comments on *http://www.regulations.gov.* This generally means that we will post any personal information you provide us (see the Information Requested section below for more information).

FOR FURTHER INFORMATION CONTACT: Patty Gelatt, Western Colorado Supervisor, U.S. Fish and Wildlife Service, Western Colorado Field Office, 764 Horizon Drive, Building B, Grand Junction, CO 81506–3946; telephone 970–243–2778; facsimile 970–245–6933. If you use a telecommunications device for the deaf (TDD), call the Federal Information Relay Service (FIRS) at 800–877–8339.

SUPPLEMENTARY INFORMATION:

Executive Summary

Why we need to publish a rule. Under the Act, if a species is determined to be an endangered or threatened species throughout all or a significant portion of its range, we are required to promptly publish a proposal in the **Federal Register** and make a determination on our proposal within one year. Listing a species as an endangered or threatened species can only be completed by issuing a rule. In this case, we are required by a judicially approved settlement agreement to make a final determination on this proposal regarding the Gunnison sage-grouse by no later than September 30, 2013.

This rule proposes the listing of the Gunnison sage-grouse as endangered.

- We are proposing to list the Gunnison sage-grouse as endangered under the Endangered Species Act.

The basis for our action. Under the Act, we can determine that a species is an endangered or threatened species based on one or more any of five factors: (A) The present or threatened destruction, modification, or curtailment of its habitat or range; (B) overutilization for commercial, recreational, scientific, or educational purposes; (C) disease or predation; (D) the inadequacy of existing regulatory mechanisms; or (E) other natural or manmade factors affecting its continued existence.

Based on the best available scientific and commercial data, we have determined that the principal threat to Gunnison sage-grouse is habitat loss, degradation, and fragmentation due to residential, exurban, and commercial development and associated infrastructure such as roads and power lines. The human population is increasing throughout much of the range of Gunnison sage-grouse, and data indicate this trend will continue. With this growth, we expect an increase in human development, further contributing to loss and fragmentation of Gunnison sage-grouse habitats. Other threats to the species include improper grazing management; predation (often facilitated by human development or disturbance); genetic risks in the declining, smaller populations; and inadequate local, State, and Federal regulatory mechanisms (e.g., laws, regulations, zoning) to conserve the species. Other factors that may not individually threaten the continued existence of Gunnison sage-grouse but, collectively, have the potential to threaten the species, include invasive plants, fire, and climate change, and the interaction of these three factors; fences; renewable and non-renewable energy development; piñon-juniper encroachment; water development; disease;, drought; and recreation.

We will seek peer review. We are seeking comments from knowledgeable individuals with scientific expertise to review our analysis of the best available science and application of that science and to provide any additional scientific information to improve this proposed rule. Because we will consider all comments and information received during the comment period, our final determination may differ from this proposal.

Information Requested

We intend that any final action resulting from this proposed rule will be based on the best scientific and commercial data available and be as accurate and as effective as possible. Therefore, we request comments or information from the public, other concerned governmental agencies, Native American tribes, the scientific community, industry, or any other interested parties concerning this proposed rule. We particularly seek comments concerning:

(1) The species' biology, range, and population trends, including:

(a) Habitat requirements for feeding, breeding, and sheltering;

(b) Genetics and taxonomy;

(c) Historical and current range, including distribution patterns;

(d) Historical and current population levels, and current and projected trends; and

(e) Past and ongoing conservation measures for the species, its habitat, or both.

(2) The factors that are the basis for making a listing determination for a species under section 4(a) of the Act (16 U.S.C. 1531 *et seq.*), which are:

(a) The present or threatened destruction, modification, or curtailment of its habitat or range;

(b) Overutilization for commercial, recreational, scientific, or educational purposes;

(c) Disease or predation;

(d) The inadequacy of existing regulatory mechanisms; or

(e) Other natural or manmade factors affecting its continued existence.

(3) Biological, commercial trade, or other relevant data concerning any threats (or lack thereof) to this species and existing regulations that may be addressing those threats.

(4) Additional information concerning the historical and current status, range, distribution, and population size of this species, including the locations of any additional populations of this species.

(5) Any information on the biological or ecological requirements of the species and ongoing conservation measures for the species and its habitat.

Please include sufficient information with your submission (such as scientific journal articles or other publications) to allow us to verify any scientific or commercial information you include.

Please note that submissions merely stating support for or opposition to the action under consideration without providing supporting information, although noted, will not be considered in making a determination, as section 4(b)(1)(A) of the Act directs that determinations as to whether any species is a threatened or endangered species must be made ''solely on the basis of the best scientific and commercial data available,''.

You may submit your comments and materials concerning this proposed rule by one of the methods listed in the **ADDRESSES** section. We request that you send comments only by the methods described in the **ADDRESSES** section.

If you submit information via *http://www.regulations.gov,* your entire submission—including any personal identifying information—will be posted on the Web site. If your submission is made via a hardcopy that includes personal identifying information, you may request at the top of your document that we withhold this information from public review. However, we cannot guarantee that we will be able to do so. We will post all hardcopy submissions on *http://www.regulations.gov.* Please include sufficient information with your comments to allow us to verify any scientific or commercial information you include.

Comments and materials we receive, as well as supporting documentation we used in preparing this proposed rule, will be available for public inspection on *http://www.regulations.gov,* or by appointment, during normal business hours, at the U.S. Fish and Wildlife Service, Western Colorado Field Office (see **FOR FURTHER INFORMATION CONTACT**).

Previous Federal Actions

On January 18, 2000, we designated the Gunnison sage-grouse as a candidate species under the Act, with a listing priority number of 5. However, a **Federal Register** notice regarding this decision was not published until December 28, 2000 (65 FR 82310). Candidate species are plants and animals for which the Service has sufficient information on their biological status and threats to propose them as endangered or threatened under the Act, but for which the development of a proposed listing regulation is precluded by other higher priority listing activities. A listing priority of 5 is assigned to species with high-magnitude threats that are nonimminent.

On January 26, 2000, American Lands Alliance, Biodiversity Legal Foundation, and others petitioned the Service to list the Gunnison sage-grouse (Webb 2000, pp. 94–95). In 2003, the U.S. District Court for the District of Columbia ruled that the species was designated as a candidate by the Service prior to receipt of the petition, and that the determination that a species should be on the candidate list is equivalent to a 12-month finding *(American Lands Alliance* v. *Gale A. Norton,* C.A. No. 00–2339, D. DC). Therefore, we did not need to respond to the petition.

In annual documents that we call Candidate Notices of Review (CNOR), we summarize the status and threats that we evaluated in order to determine that species qualify as candidates and to assign a listing priority number (LPN) to each species or to determine that species should be removed from candidate status. In the 2003 Candidate Notice of Review (CNOR), we elevated the listing priority number for Gunnison sage-grouse from 5 to 2 (69 FR 24876; May 4, 2004), as the imminence of the threats had increased. In the subsequent CNOR (70 FR 24870; May 11, 2005), we maintained the LPN for Gunnison sage-grouse as a 2. A LPN of 2 is assigned to species with high-magnitude threats that are imminent.

Plaintiffs amended their complaint in the DC district court in May 2004, to allege that the Service's warranted-but-precluded finding and decision not to emergency list the Gunnison sage-grouse were in violation of the Act. The parties filed a stipulated settlement agreement with the court on November 14, 2005, which included a provision that the Service would make a proposed listing determination by March 31, 2006. On March 28, 2006, the plaintiffs agreed to a one-week extension (April 7, 2006) for this determination.

In April 2005, the Colorado Division of Wildlife (CDOW) (hereafter, Colorado Parks and Wildlife (CPW), pursuant to the agency's reorganization on July 1, 2011) applied to the Service for an Enhancement of Survival Permit for the Gunnison sage-grouse pursuant to section 10(a)(1)(A) of the Act. The permit application included a proposed Candidate Conservation Agreement with Assurances (CCAA) between CPW and the Service. The standard that a CCAA must meet is that the ''benefits of the conservation measures implemented by a property owner under a CCAA, when combined with those benefits that would be achieved if it is assumed that conservation measures were also to be implemented on other necessary properties, would preclude or remove any need to list the species'' (64 FR 32726, June 17, 1999). The CCAA, the permit application, and the environmental assessment were made available for public comment on July 6, 2005 (70 FR 38977). The CCAA and environmental assessment were finalized in October 2006, and the associated permit was issued on October 23, 2006. Landowners with eligible property in southwestern Colorado who wish to participate can voluntarily sign up under the CCAA and associated permit through a Certificate of Inclusion by providing habitat protection or enhancement measures on their lands. If the Gunnison sage-grouse is listed under the Act, the CCAA remains in place and the permit authorizes incidental take of Gunnison sage-grouse due to otherwise lawful activities specified in the CCAA, when performed in accordance with the terms of the CCAA (e.g., crop cultivation, crop harvesting, livestock grazing, farm equipment operation, commercial/residential development, etc.), as long as the participating landowner is performing conservation measures voluntarily agreed to in the Certificate of Inclusion. Fourteen Certificates of Inclusion have been issued by the CPW and Service to private landowners to date (CPW 2012b, p. 11).

On April 11, 2006, the Service determined that listing the Gunnison sage-grouse as an endangered or threatened species was not warranted and published the final listing determination in the **Federal Register** on April 18, 2006 (71 FR 19954). As a result of this determination, we also removed Gunnison sage-grouse from the candidate species list.

On November 14, 2006, the County of San Miguel, Colorado; Center for Biological Diversity; WildEarth Guardians; Public Employees for Environmental Responsibility; National Audubon Society; The Larch Company; Center for Native Ecosystems; Sinapu; Sagebrush Sea Campaign; Black Canyon Audubon Society; and Sheep Mountain

Alliance filed a complaint for declaratory and injunctive relief, pursuant to the Act, and on October 24, 2007, filed an amended complaint for declaratory and injunctive relief, alleging that our determination on the Gunnison sage-grouse violated the Act. On August 18, 2009, a stipulated settlement agreement and Order was filed with the court, with a June 30, 2010, date by which the Service was to submit to the **Federal Register** a 12-month finding, pursuant to 16 U.S.C. 1533(b)(3)(B), that listing the Gunnison sage-grouse under the Act is (a) Warranted; (b) not warranted; or (c) warranted but precluded by higher priority listing actions. We then published a notice of intent to conduct a status review of Gunnison sage-grouse on November 23, 2009 (74 FR 61100). Later, the Court approved an extension of the June 30, 2010, deadline for the 12-month finding to September 15, 2010.

On September 15, 2010, we determined that listing the Gunnison sage-grouse as an endangered or threatened species was warranted but precluded by higher priority actions to amend the Lists of Endangered and Threatened Wildlife and Plants. This finding was published in the **Federal Register** on September 28, 2010 (75 FR 59804). The finding also reported that the species was added to the candidate species list and assigned a listing priority of 2 based on the Service's determination that threats to the species were of high magnitude and immediacy, as well as the taxonomic classification of Gunnison sage-grouse as a full species.

On September 9, 2011, the U.S. District Court for the District of Columbia approved a settlement agreement laying out a multi-year listing work plan for addressing candidate species, including the Gunnison sage-grouse. As part of this agreement, the Service agreed to publish a proposed rule in the **Federal Register** on whether to list Gunnison sage-grouse and designate critical habitat by September 30, 2012. On August 13, 2012, in response to a motion from the Service, the U.S. District Court for the District of Columbia modified the settlement agreement to extend this original deadline by 3 months, to December 30, 2012. The deadline for the final rule did not change and remains September 30, 2013. The request for an extension was made to allow more time to complete the proposed rule and more opportunity to engage with State and local governments, landowner groups, and other entities to discuss the conservation needs of the species.

Background

Gunnison sage-grouse and greater sage-grouse (a similar, closely related species) have similar life histories and habitat requirements (Young 1994, p. 44). In this proposed rule, we use information specific to the Gunnison sage-grouse where available but still apply scientific management principles for greater sage-grouse (*C. urophasianus*) that are relevant to Gunnison sage-grouse management needs and strategies, a practice followed by the wildlife and land management agencies that have responsibility for management of both species and their habitat.

Species Information

A detailed discussion of Gunnison sage-grouse taxonomy, the species description, historical distribution, habitat, and life-history characteristics can be found in the 12-month finding published September 28, 2010 (75 FR 59804).

Current Distribution and Population Estimates

Gunnison sage-grouse currently occur in seven widely scattered and isolated populations in Colorado and Utah, occupying 3,795 square kilometers (km^2) (1,511 square miles [mi^2]) (Gunnison Sage-grouse Rangewide Steering Committee) [GSRSC] 2005, pp. 36–37; CDOW 2009a, p. 1). The seven populations are Gunnison Basin, San Miguel Basin, Monticello–Dove Creek, Piñon Mesa, Crawford, Cerro Summit–Cimarron–Sims Mesa, and Poncha Pass (Figure 1). A comparative summary of the land ownership and recent population estimates among these seven populations is presented in Table 1, and Figures 2 and 3, respectively. Population trends over the last 12 years indicate that six of the populations are in decline. The largest population, the Gunnison Basin population, while showing variation over the years, has been relatively stable through the period (CDOW 2010a, p. 2; CPW 2012a, pp.1–4). Six of the populations are very small and fragmented (all with less than 40,500 hectares (ha) (100,000 acres [ac]) of habitat likely used by grouse and, with the exception of the San Miguel population, less than 50 males counted on leks (communal breeding areas)) (CDOW 2009b, p. 5; CPW 2012a, p. 3). The San Miguel population, the second largest, comprises six fragmented subpopulations.

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Figure 1. Locations of Current Gunnison Sage-grouse Populations.

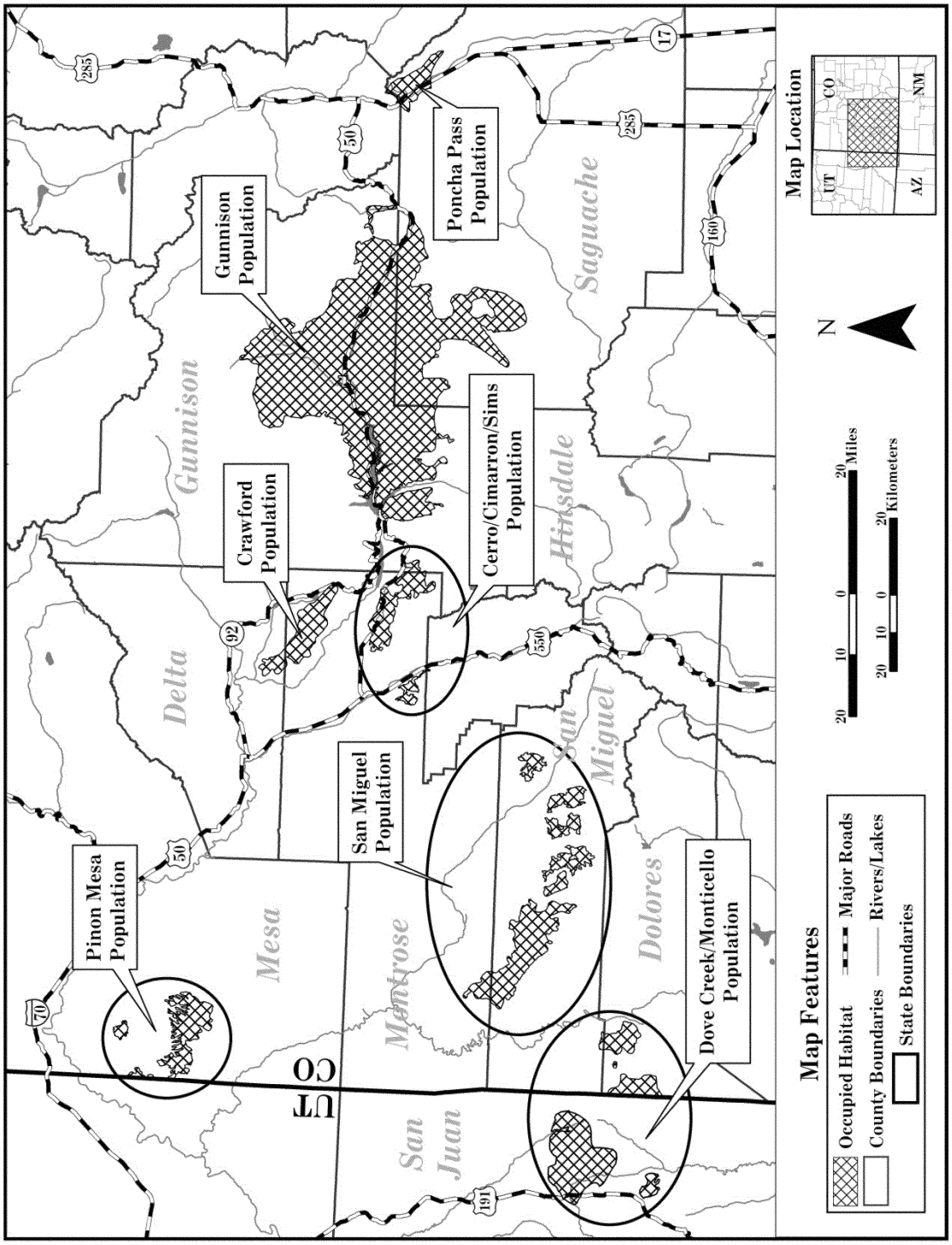


TABLE 1—PERCENT SURFACE OWNERSHIP OF GUNNISON SAGE-GROUSE OCCUPIED [a] HABITAT

[GSRSC [b] 2005, pp. D–3–D–6; CDOW [c] 2009a, p. 1]

Population	Hectares	Acres	Gunnison sage-grouse occupied habitat management and ownership						
			BLM [d]	NPS [e]	USFS [f]	CPW	CO state land board	State of UT	Private
			%	%	%	%	%	%	%
Gunnison Basin	239,953	592,936	51	2	14	3	<1	0	29
San Miguel Basin	41,022	101,368	[g] 36	0	1	11	[g] 3	0	[g] 49
Monticello-Dove Creek (Combined)	45,275	111,877	7	0	0	3	0	<1	90
Dove Creek	16,706	41,282	11	0	0	8	0	0	81
Monticello	28,569	70,595	4	0	0	0	0	1	95
Piñon Mesa	15,744	38,904	28	0	2	19	0	0	51
Cerro Summit-Cimarron-Sims Mesa	15,039	37,161	13	<1	0	11	0	0	76
Crawford	14,170	35,015	63	12	0	2	0	0	23
Poncha Pass	8,262	20,415	48	0	26	0	2	0	23
Rangewide	379,464	937,676	42	2	10	5	<1	<1	41

[a] Occupied Gunnison sage-grouse habitat is defined as areas of suitable habitat known to be used by Gunnison sage-grouse within the last 10 years from the date of mapping, and areas of suitable habitat contiguous with areas of known use, which have no barriers to grouse movement from known use areas (GSRSC 2005, p. 54).

[b] Gunnison Sage-grouse Rangewide Steering Committee.

[c] Colorado Parks and Wildlife.

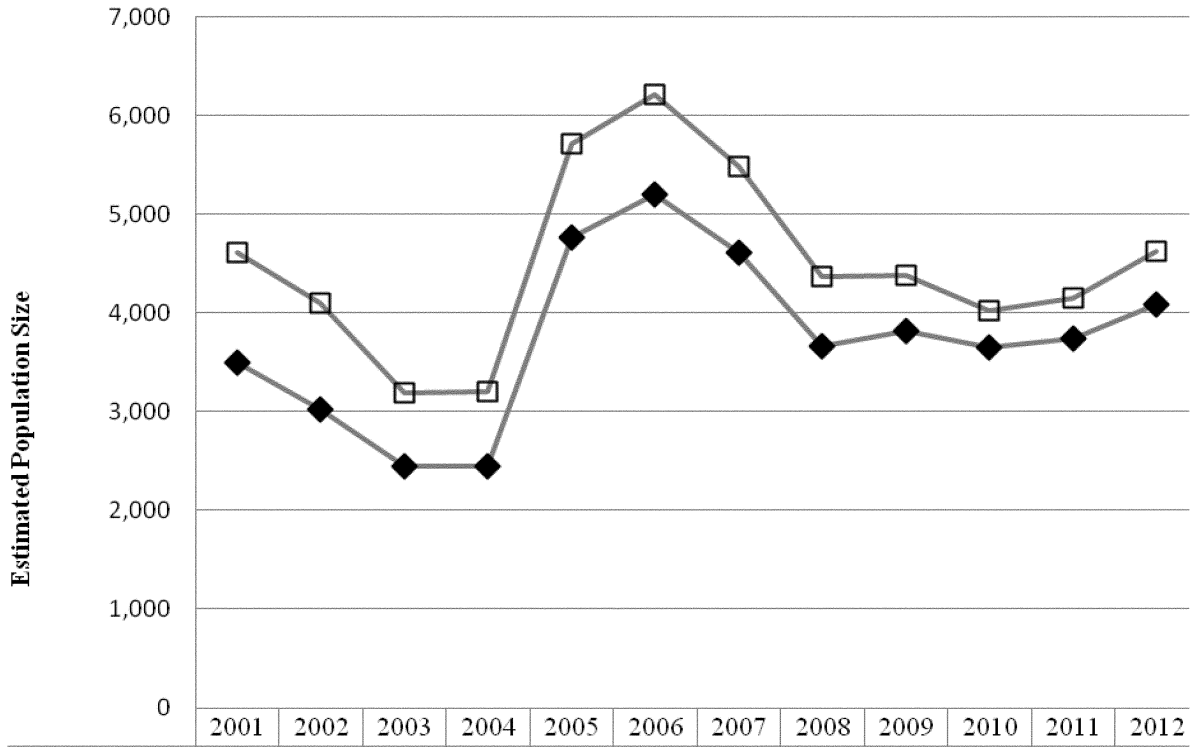
[d] Bureau of Land Management.

[e] National Park Service.

[f] United States Forest Service.

[g] Estimates reported in San Miguel Basin Gunnison Sage-grouse Conservation Plan (San Miguel Basin Gunnison Sage-grouse Working Group (SMBGSWG) 2009, p. 28) vary by 2 percent in these categories from those reported here. We consider these differences insignificant.

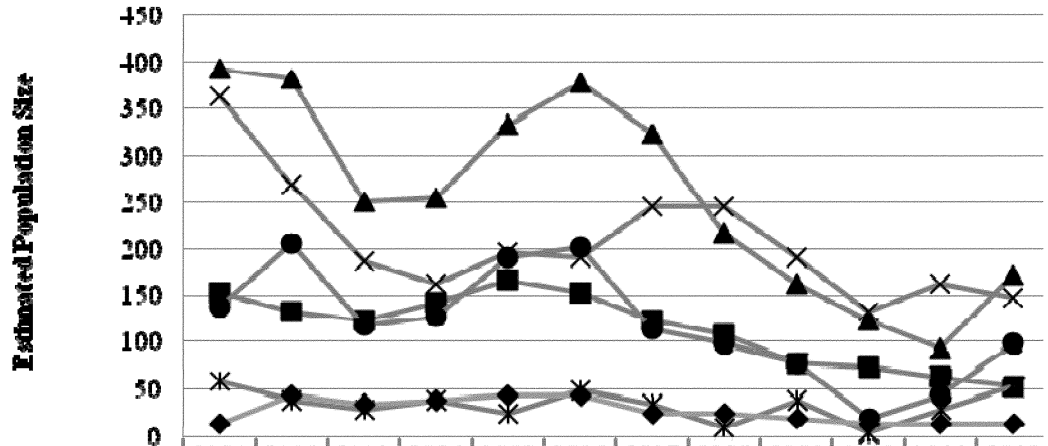
Figure 2. Population estimates by year for the Gunnison Basin population and the rangewide total Gunnison sage-grouse population derived from the formula presented in the Gunnison sage-grouse Rangewide Conservation Plan (GSRSC[a] 2005, pp. 44–45) applied to high male counts on leks (CDOW[b] 2012a, pp. 1-3).



	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
Gunnison Basin	3,493	3,027	2,453	2,443	4,763	5,205	4,616	3,669	3,817	3,655	3,743	4,082
Totals	4,611	4,101	3,194	3,208	5,720	6,220	5,480	4,371	4,386	4,023	4,150	4,621

[a]Gunnison Sage-grouse Rangewide Steering Committee
[b]Colorado Parks and Wildlife

Figure 3. Population estimates by year for the six smaller Gunnison sage-grouse populations derived from the formula presented in the Gunnison sage-grouse Rangewide Conservation Plan (GSRSC[a] 2005, pp. 44–45) applied to high male counts on leks (CPW[b] 2012a, pp. 1-3).



	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
San Miguel Basin	392	383	250	255	334	378	324	216	162	123	93	172
Monticello–Dove Creek (Combined)	363	270	186	162	196	191	245	245	191	132	162	147
Pinon Mesa	152	132	123	142	167	152	123	108	78	74	64	54
Cerro Summit–Cimarron–Sims Mesa	59	39	29	39	25	49	34	10	39	5	29	54
Crawford	137	206	118	128	191	201	113	98	78	20	44	98
Poncha Pass	15	44	34	39	44	44	25	25	20	15	15	15

[a]Gunnison Sage-grouse Rangewide Steering Committee
[b]Colorado Parks and Wildlife

Gunnison Basin Population—The Gunnison Basin is an intermontane (located between mountain ranges) basin that includes parts of Gunnison and Saguache Counties, Colorado. The current Gunnison Basin population is distributed across approximately 240,000 ha (593,000 ac), roughly centered on the town of Gunnison. Elevations in the area occupied by Gunnison sage-grouse range from 2,300 to 2,900 meters (m) (7,500 to 9,500 feet [ft]). Approximately 70 percent of the land area occupied by Gunnison sage-grouse in this population is managed by Federal agencies (67 percent) and CPW (3 percent), and the remaining 30 percent is primarily private lands. Wyoming big sagebrush (*Artemisia tridentata* ssp. *wyomingensis*) and mountain big sagebrush (*A. t.* ssp. *vaseyana*) dominate the upland vegetation and have highly variable growth form depending on local site conditions.

In 1961, Gunnison County was one of five counties containing the majority of all sage-grouse in Colorado (Rogers 1964, p. 20). The vast majority (87 percent) of Gunnison sage-grouse are now found only in the Gunnison Basin population. The 2012 population estimate for the Gunnison Basin was 4,082 (CPW 2012a, pp. 1–2). In 2011, 42 of 83 leks surveyed in the area were active (at least two males in attendance during at least two of four 10-day count periods), 6 were inactive (inactive for at least 5 consecutive years), 11 were deemed historic (inactive for at least 10 consecutive years), and 24 were of unknown status (variability in counts resulted in lek not meeting requirements for active, inactive, or historic) (CPW 2011b, pp. 27–29). Approximately 45 percent of leks in the Gunnison Basin occur on private land and 55 percent on public land, primarily land administered by the BLM (GSRSC 2005, p. 75).

San Miguel Basin Population—The San Miguel Basin population is in Montrose and San Miguel Counties in Colorado, and is composed of six small subpopulations (Dry Creek Basin, Hamilton Mesa, Miramonte Reservoir, Gurley Reservoir, Beaver Mesa, and Iron Springs) occupying approximately 41,000 ha (101,000 ac). Gunnison sage-grouse use some of these areas year-round, while others are used seasonally. Gunnison sage-grouse in the San Miguel Basin move widely between the six subpopulation areas (Apa 2004, p. 29; Stiver and Gibson 2005, p. 12). The area encompassed by this population is believed to have once served as critical migration corridors between populations to the north (Cerro Summit-Cimarron-Sims Mesa) and to the south (Monticello-Dove Creek) (Oyler-McCance *et al.* 2005, p. 636; SMBGSWG 2009, p. 9), but gene flow among these populations is currently very low (Oyler-McCance *et al.* 2005, p. 635). Historically, Gunnison sage-grouse used all available big sagebrush plant communities in San Miguel and Montrose Counties (Rogers 1964, p. 9).

Habitat conditions vary among the six subpopulation areas of the San Miguel Basin population areas. The following discussion addresses conditions among the subpopulations beginning in the west and moving east. The majority of occupied acres in the San Miguel Basin population (approximately 25,130 ha (62,100 ac) or 62 percent of the total population area) occur in the Dry Creek Basin subpopulation (SMBGSWG) 2009, p. 28). However, the Dry Creek Basin contains some of the poorest habitat and the smallest individual grouse numbers in the San Miguel population (SMBGSWG) 2009, pp. 28, 36). Sagebrush habitat in the Dry Creek Basin area is patchily distributed. Where irrigation is possible, private lands in the southeastern portion of Dry Creek Basin are cultivated. Sagebrush habitat on private land has been heavily thinned or removed entirely (GSRSC 2005, p. 96). Elevations in the Hamilton Mesa subpopulation are approximately 610 m (2,000 ft.) higher than in the Dry Creek Basin, resulting in more mesic conditions. Agriculture is very limited on Hamilton Mesa and the majority of the vegetation consists of oakbrush and sagebrush. Gunnison sage-grouse use the Hamilton Mesa area (1,940 ha (4,800 ac)) in the summer, but use of Hamilton Mesa during other seasons is unknown.

Gunnison sage-grouse occupy approximately 4,700 ha (11,600 ac) around Miramonte Reservoir (GSRSC 2005, p. 96). Sagebrush stands there are generally contiguous with a mixed-grass and forb understory. Occupied habitat at the Gurley Reservoir area (3,305 ha (7,500 ac)) is heavily fragmented by human development, and the understory is a mixed-grass and forb community. Farming attempts in the Gurley Reservoir area in the early 20th century led to the removal of much of the sagebrush, although agricultural activities are now restricted primarily to the seasonally irrigated crops (hay meadows), and sagebrush has reestablished in most of the failed pastures. However, grazing pressure and competition from introduced grasses have kept the overall sagebrush representation low (GSRSC 2005, pp. 96–97). Sagebrush stands in the Iron Springs and Beaver Mesa areas (2,590 ha and 3,560 ha (6,400 ac and 8,800 ac respectively)) are contiguous with a mixed-grass understory. The Beaver Mesa area has numerous scattered patches of oakbrush *(Quercus gambelii).*

In 2012, the entire San Miguel Basin population contained an estimated 172 individuals on nine leks (CPW 2012a, p. 3). CPW translocated Gunnison sage-grouse from the Gunnison Basin to Dry Creek Basin in 2006, 2007, and 2009. In the spring of 2006, six individuals were released and an additional two individuals were released in the fall of that year. Nine individuals were translocated in the spring of 2007. Another 30 individuals were translocated in the fall of 2009. A 40 to 50 percent mortality rate was observed within the first year after release, compared to an average annual mortality rate of approximately 20 percent for radiomarked adult sage-grouse (CDOW 2009b, p. 9; CPW 2012b, p. 4). For a more detailed discussion of translocation efforts, please refer to the *Scientific Research* section below.

Monticello-Dove Creek Population—This population is divided into two disjunct subpopulations of Gunnison sage-grouse, the Monticello and Dove Creek subpopulations. Currently, the larger subpopulation is near the town of Monticello, in San Juan County, Utah. Gunnison sage-grouse in this subpopulation inhabit a broad plateau on the northeastern side of the Abajo Mountains, with fragmented patches of sagebrush interspersed with large grass pastures and agricultural fields. In 1972, the population was estimated at between 583 and 1,050 individuals; by 2002, the estimate decreased to between 178 and 308 individuals (UDWR 2011, p. 1). The 2012 population estimate for this subpopulation was 103 individuals with two active leks (CPW 2012a, p. 3). Gunnison sage-grouse currently occupy an estimated 28,570 ha (70,600 ac) in the Monticello area (GSRSC 2005, p. 81).

The Dove Creek subpopulation is located primarily in western Dolores County, Colorado, north and west of Dove Creek, although a small portion of occupied habitat extends north into San Miguel County. All sagebrush plant communities in Dolores and Montezuma Counties within Gunnison sage-grouse range in Colorado were historically used by Gunnison sage-grouse (Rogers 1964, p. 9). Habitat north of Dove Creek is characterized as mountain shrub habitat, dominated by oakbrush interspersed with sagebrush. The area west of Dove Creek is dominated by sagebrush, but the habitat is highly fragmented by agricultural fields. Lek counts in the Dove Creek area were more than 50 males in 1999,

suggesting a population of about 245 birds, but declined to 2 males in 2009 (CDOW 2009b, p. 71), suggesting a population of 10 birds. A new lek was found in 2010, and the 2011 population estimate was 59 individuals on 2 leks (CPW 2011a, p. 1). The 2012 population estimate was 44 individuals on the same two leks (CPW 2012a, p. 1). Low sagebrush canopy cover, as well as low grass height, exacerbated by drought, may have led to nest failure and subsequent population declines (Connelly *et al.* 2000a, p. 974; Apa 2004, p. 30).

In the fall of 2010, 13 Gunnison sage-grouse were transplanted from the Gunnison Basin to the Dove Creek population area. Another 29 individuals were transplanted in 2011 (CPW 2012b, p. 4). For a more detailed discussion of translocation efforts, please refer to the *Scientific Research* section below.

Piñon Mesa Population—The Piñon Mesa population occurs on the northwestern end of the Uncompahgre Plateau in Mesa County, about 35 km (22 mi) southwest of Grand Junction, Colorado. Gunnison sage-grouse likely occurred historically in all suitable sagebrush habitat in the Piñon Mesa area, including the Dominguez Canyon area of the Uncompaghre Plateau, southeast of Piñon Mesa proper (Rogers 1964, p. 114). Their current distribution is approximately 15,744 ha (38,904 ac) (GSRSC 2005, p. 87) which, based on a comparison of potential presettlement distribution, is approximately 6 percent of presettlement habitat on the northern portion of the Uncompahgre Plateau in Mesa County, Colorado, and Grand County, Utah. The 2012 population estimate for Piñon Mesa was 54 birds. Of the 10 known leks, only 3 were active in 2011. Two new possible leks were found in 2012 (CPW 2012a, pp. 2–3). The Piñon Mesa area may have additional leks, but the high percentage of private land, a lack of roads, and heavy snow cover during spring make locating additional leks difficult (CDOW 2009b, p. 109).

Between 2010 and 2012, 44 Gunnison sage-grouse were transplanted from the Gunnison Basin to the Piñon Mesa population. Over 50 percent of birds transplanted to date have not survived (CPW 2012b, p.5). For a more detailed discussion of translocation efforts, please refer to the *Scientific Research* section below.

Crawford Population—The Crawford population of Gunnison sage-grouse is in Montrose County, Colorado, about 13 km (8 mi) southwest of the town of Crawford and north of the Gunnison River. Basin big sagebrush *(A. t.* ssp. *tridentata)* and black sagebrush *(A. nova)* dominate the mid-elevation uplands (GSRSC 2005, p. 62). The 2012 population estimate for Crawford was 98 individuals in 14,170 ha (35,015 ac) of occupied habitat. Three leks are currently active in the Crawford population (CPW 2012a, p. 1). All active leks are on BLM lands in sagebrush habitat near an 11 km (7 mi) stretch of road. This area represents the largest contiguous sagebrush plant community within the occupied area of the Crawford population (GSRSC 2005, p. 64).

In the spring of 2011, seven Gunnison sage-grouse were transplanted from the Gunnison Basin to the Crawford area population. Another 20 individuals were transplanted in 2011 (CPW 2012b, p. 4). For a more detailed discussion of translocation efforts, please refer to the *Scientific Research* section below.

Cerro Summit-Cimarron-Sims Mesa Population—This population is divided into two geographically separated subpopulations, both in Montrose County, Colorado: the Cerro Summit-Cimarron and Sims Mesa subpopulations. We do not know if sage-grouse currently move between the Cerro Summit-Cimarron and Sims Mesa subpopulations.

The Cerro Summit-Cimarron subpopulation is centered about 24 km (15 mi) east of Montrose. Rogers (1964, p. 115) noted a small population of sage-grouse in the Cimarron River drainage, but did not report population numbers. He noted that lek counts at Cerro Summit in 1959 listed four individuals. The habitat consists of 15,039 ha (37,161 ac) of patches of sagebrush habitat fragmented by oakbrush and irrigated pastures. Five leks are currently known in the Cerro Summit-Cimarron group. Eleven individuals were observed on one lek in 2012, resulting in a population estimate of 54 individuals (CPW 2012a, p. 1).

The Sims Mesa area, about 11 km (7 mi) south of Montrose, consists of small patches of sagebrush that are heavily fragmented by piñon-juniper, residential and recreational development, and agriculture (CDOW 2009b, p. 43). Rogers (1964, p. 95) recorded eight males in a lek count at Sims Mesa in 1960. In 2000, the CPW translocated six Gunnison sage-grouse from the Gunnison Basin to Sims Mesa (Nehring and Apa 2000, p. 12). There is only one currently known lek in Sims Mesa and, since 2003, it has lacked Gunnison sage-grouse attendance. However, lek counts did not occur in 2011. A lek is designated historic when it is inactive for at least 10 consecutive years, according to CPW standards. Therefore, the current status of the Sims Mesa lek is unknown (CDOW 2009b, p. 7; CPW 2012a, p. 1).

Poncha Pass Population—The Poncha Pass Gunnison sage-grouse population is located in Saguache County, approximately 16 km (10 mi) northwest of Villa Grove, Colorado. The known population distribution is in 8,262 ha (20,415 ac) of sagebrush habitat from the summit of Poncha Pass extending south for about 13 km (8 mi) on either side of U.S. Highway 285. Sagebrush in this area is continuous with little fragmentation; sagebrush habitat quality throughout the area is adequate to support a population of the species (Nehring and Apa 2000, p. 25). San Luis Creek runs through the area, providing a year-round water source and wet meadow riparian habitat for brood-rearing.

This population lies within potential presettlement habitat, but was extirpated prior to 1964 (Rogers 1964, p. 116). The reestablishment of this population is a result of 30 birds transplanted from the Gunnison Basin in 1971 and 1972, during efforts to reintroduce the species to the San Luis Valley (GSRSC 2005, p. 94). In 1992, a CPW effort to simplify hunting restrictions inadvertently opened the Poncha Pass area to sage-grouse hunting, and at least 30 grouse were harvested from this population. Due to declining population numbers since the 1992 hunt, in the spring of 2000, CPW translocated 24 additional birds from the Gunnison Basin (Nehring and Apa 2000, p. 11). In 2001 and 2002, an additional 20 and 7 birds, respectively, were moved to Poncha Pass by the CPW (GSRSC 2005, p. 94). Translocated females have bred successfully (Apa 2004, pers. comm.), and male display activity resumed on the historic lek in the spring of 2001. A high male count of 3 males occurred in 2012, resulting in an estimated population size of 15 for the Poncha Pass population. The only known lek is located on BLM-administered land (CPW 2011a, p. 1; CPW 2012a, p. 3).

Additional Special Status Considerations

The Gunnison sage-grouse has an International Union for Conservation of Nature (IUCN) Red List Category of ''endangered'' (Birdlife International 2009). NatureServe currently ranks the Gunnison sage-grouse as G1-Critically Imperiled (Nature Serve 2010, entire). The Gunnison sage-grouse is on the National Audubon Society's WatchList 2007 Red Category which is ''for species that are declining rapidly or have very small populations or limited ranges, and face major conservation threats.''

Summary of Factors Affecting the Species

Section 4 of the Act (16 U.S.C. 1533), and its implementing regulations at 50 CFR part 424, set forth the procedures for adding species to the Federal Lists of Endangered and Threatened Wildlife and Plants. Under section 4(a)(1) of the Act, we may list a species based on any of the following five factors: (A) The present or threatened destruction, modification, or curtailment of its habitat or range; (B) overutilization for commercial, recreational, scientific, or educational purposes; (C) disease or predation; (D) the inadequacy of existing regulatory mechanisms; and (E) other natural or manmade factors affecting its continued existence. Listing actions may be warranted based on any of the above threat factors, singly or in combination. Each of these factors as applied to the Gunnison sage-grouse is discussed below. We rely on the status review and analysis reported in the September 28, 2010, 12-month finding (75 FR 59804), but have updated it as appropriate to incorporate new information.

A. The Present or Threatened Destruction, Modification, or Curtailment of Its Habitat or Range

The historic and current distribution of the Gunnison sage-grouse closely matches the distribution of sagebrush. Potential Gunnison sage-grouse range is estimated to have been 5,536,358 ha (13,680,640 ac) historically (GSRSC 2005, p. 32). Gunnison sage-grouse currently occupy approximately 379,464 ha (937,676 ac) in southwestern Colorado and southeastern Utah (CDOW 2009a, p. 1; GSRSC 2005, p. 81); an area that represents approximately 7 percent of the species' potential historic range. The following describes the factors affecting Gunnison sage-grouse and Gunnison sage-grouse habitat within the current range of the species.

The onset of EuroAmerican settlement in the late 1800s resulted in significant alterations to sagebrush ecosystems throughout North America (West and Young 2000, pp. 263–265; Miller *et al.* 2011, p. 147) primarily as a result of urbanization, agricultural conversion, and irrigation projects. Areas that supported basin big sagebrush were among the first sagebrush community types converted to agriculture because their typical soils and topography are well suited for agriculture (Rogers 1964, p. 13).

In southwestern Colorado, between 1958 and 1993, 20 percent (155,673 ha (384,676 ac)) of sagebrush was lost, and 37 percent of sagebrush plots examined were fragmented (Oyler-McCance *et al.* 2001, p. 326). In another analysis, it was estimated that approximately 342,000 ha (845,000 ac) of sagebrush, or 13 percent of the pre-EuroAmerican settlement sagebrush extent, were lost in Colorado, which includes both greater sage-grouse and Gunnison sage-grouse habitat (Boyle and Reeder 2005, p. 3–3). However, the authors noted that the estimate of historic sagebrush area used in their analyses was conservative, possibly resulting in a substantial underestimate of historic sagebrush losses (Boyle and Reeder 2005, p. 3–4). Within the range of Gunnison sage-grouse, the principal areas of sagebrush loss were in the Gunnison Basin, San Miguel Basin, and areas near Dove Creek, Colorado. The authors point out that the rate of loss in the Gunnison Basin was lower than other areas of sagebrush distribution in Colorado. The Gunnison Basin currently contains approximately 250,000 ha (617,000 ac) of sagebrush; this area partially comprises other habitat types such as riparian areas and patches of non-sagebrush vegetation types such as aspen forest, mixed-conifer forest, and oakbrush (Boyle and Reeder 2005, p. 3–3). Within the portion of the Gunnison Basin currently occupied by Gunnison sage-grouse, 170,000 ha (420,000 ac) is composed exclusively of sagebrush vegetation types, as derived from Southwest Regional Gap Analysis Project (SWReGAP) landcover data (multiseason satellite imagery acquired 1999–2001) (USGS 2004, entire).

Sagebrush habitats within the range of Gunnison sage-grouse are becoming increasingly fragmented as a result of various changes in land uses and the expansion in the density and distribution of invasive plant species (Oyler-McCance *et al.* 2001, pp. 329–330; Schroeder *et al.* 2004, p. 372). Habitat fragmentation is the separation or splitting apart of previously contiguous, functional habitat components of a species. Fragmentation can result from direct habitat losses that leave the remaining habitat in noncontiguous patches, or 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; or activities that prevent animals from using suitable habitat patches due to behavioral avoidance.

A variety of human developments including roads, energy development, residential development, and other factors that cause habitat fragmentation have contributed to or been associated with Gunnison and greater sage-grouse extirpation (Wisdom *et al.* 2011, pp. 465–468). Because of the loss and fragmentation of habitat within its range, no expansive, contiguous areas that could be considered strongholds (areas of occupied range where the risk of extirpation appears low) are evident for Gunnison sage-grouse (Wisdom *et al.,* 2011, p. 469). However, landscapes containing large and contiguous sagebrush patches and sagebrush patches in close proximity have an increased likelihood of sage-grouse persistence (Wisdom *et al.* 2011, p. 462).

Habitat loss and fragmentation has adverse effects on Gunnison sage-grouse populations. Many of the factors that result in fragmentation may be exacerbated by the effects of climate change, which may influence long-term habitat and population trends. The following sections examine factors that can contribute to habitat loss and fragmentation to determine whether they threaten Gunnison sage-grouse and their habitat.

Residential Development

Human population growth in the rural Rocky Mountains is driven by the availability of natural amenities, recreational opportunities, aesthetically desirable settings, grandiose viewscapes, and perceived remoteness (Riebsame *et al.* 1996, p. 396, 402; Theobald *et al.* 1996, p. 408; Gosnell and Travis 2005, pp. 192–197; Mitchell *et al.* 2002, p. 6; Hansen *et al.* 2005, pp. 1899–1901). Human population growth is occurring throughout much of the range of Gunnison sage-grouse. The human population in all counties within the range of Gunnison sage-grouse averaged a 70 percent increase since 1980 (Colorado Department of Local Affairs (CDOLA) 2009a, pp. 2–3). The year 2050 projected human population for the Gunnison River basin (an area that encompasses the majority of the current range of Gunnison sage-grouse) is expected to be 2.3 times greater than the 2005 population (CWCB 2009, p. 15). The population of Gunnison County, an area that supports more than 80 percent of all Gunnison sage-grouse, is predicted to more than double to approximately 31,100 residents by 2050 (CWCB 2009, p. 53).

The increase in residential and commercial development associated with the expanding human population is different from historic land use patterns in these areas (Theobald 2001, p. 548). The allocation of land for resource-based activities such as agriculture and livestock production is

decreasing as the relative economic importance of these activities diminishes (Theobald *et al.* 1996, p. 413; Sammons 1998, p. 32; Gosnell and Travis 2005, pp. 191–192). Currently, agribusiness occupations constitute approximately 3 percent of the total job base in Gunnison County (CDOLAb 2009, p. 4). Recent conversion of farm and ranch lands to housing development has been significant in Colorado (Odell and Knight 2001, p. 1144). Many large private ranches in the Rocky Mountains, including the Gunnison Basin, are being subdivided into both high-density subdivisions and larger, scattered ranchettes with lots typically greater than 14 ha (35 ac), which encompass a large, isolated house (Riebsame *et al.* 1996, p. 399; Theobald *et al.* 1996, p. 408).

The resulting pattern of residential development is less associated with existing town sites or existing subdivisions, and is increasingly exurban in nature (Theobald *et al.* 1996, pp. 408, 415; Theobald 2001, p. 546). Exurban development is described as low-density growth outside of urban and suburban areas (Clark *et al.* 2009, p. 178; Theobald 2004, p. 140) with less than one housing unit per 1 ha (2.5 ac) (Theobald 2003, p. 1627; Theobald 2004, p. 139). The resulting pattern is one of increased residential lot size and the diffuse scattering of residential lots in previously rural areas with a premium placed on adjacency to federal lands and isolated open spaces (Riebsame *et al.* 1996, p. 396, 398; Theobald *et al.* 1996, pp. 413, 417; Theobald 2001, p. 546; Brown *et al.* 2005, p. 1858). The residential subdivision that results from exurban development causes landscape fragmentation (Gosnell and Travis 2005, p. 196) primarily through the accumulation of roads, buildings, (Theobald *et al.* 1996, p. 410; Mitchell *et al.* 2002, p. 3) and other associated infrastructure such as power lines, and pipelines. In the East River Valley of Gunnison County, for example, residential development in the early 1990s increased road density by 17 percent (Theobald *et al.* 1996, p. 410). The habitat fragmentation resulting from this development pattern is especially detrimental to Gunnison sage-grouse because of their dependence on large areas of contiguous sagebrush (Patterson 1952, p. 48; Connelly *et al.* 2004, p. 4–1; Connelly *et al.* 2011, p. 72; Wisdom *et al.* 2004, pp. 452–453).

Residential Development in the Gunnison Basin Population Area—Nearly three quarters (approximately 71 percent) of the Gunnison Basin population of Gunnison sage-grouse occurs within Gunnison County, with the remainder occurring in Saguache County. Within Gunnison County, approximately 30 percent of the occupied range of this species occurs on private lands. We performed a GIS analysis of parcel ownership data that was focused on the spatial and temporal pattern of human development within occupied Gunnison sage-grouse habitat. Some of our analyses were limited to the portion of occupied habitat in Gunnison County because parcel data was only available for Gunnison County and not for Saguache County. This analysis determined that the cumulative number of human developments has increased dramatically in Gunnison County, especially since the early 1970s (USFWS 2010a, p. 1). The number of new developments averaged approximately 70 per year from the late 1800s to 1969, increasing to approximately 450 per year from 1970 to 2008 (USFWS 2010a, pp. 2–5). Furthermore, there has been an increasing trend toward development away from major roadways (primary and secondary paved roads) into areas of occupied Gunnison sage-grouse habitat that had previously undergone very limited development (USFWS 2010b, p. 7). Between 1889 and 1968, approximately 51 human developments were located more than 1.6 km (1 mi) from a major road in currently occupied Gunnison sage-grouse habitat. Between 1969 and 2008, this number increased to approximately 476 developments (USFWS 2010b, p. 7).

A landscape-scale spatial model predicting Gunnison sage-grouse nesting probability was developed based on nesting data from the western portion of the Gunnison Basin (Aldridge *et al.* 2011, entire). The model was extrapolated to the entire Gunnison Basin to predict the likelihood of Gunnison sage-grouse nesting in the area (Aldridge *et al.* 2011, pp. 7–9). Results of the model indicate that Gunnison sage-grouse tend to select nest sites in larger landscapes (1.5 km [0.9 mi] radii) with a low density of residential development (<1 percent) (Aldridge *et al.* 2011, p. 10). The study indicates nest site selection by Gunnison sage-grouse decreases near residential developments, until approximately 2.5 km (1.6 mi) from any given residential development (Aldridge *et al.* 2011, p. 10).

Within occupied Gunnison sage-grouse habitat in Gunnison County, 49 percent of the land area within the range of Gunnison sage-grouse has at least one housing unit within a radius of 1.5 km (0.9 mi) (USFWS 2010b, p. 7). This level of residential development is strongly decreasing the likelihood of Gunnison sage-grouse using these areas as nesting habitat. Furthermore, since early brood-rearing habitat is often in close proximity to nest sites (Connelly *et al.* 2000a, p. 971), the loss of nesting habitat is closely linked with the loss of early brood-rearing habitat. Limitations in the quality and quantity of nesting and early brood-rearing habitat are particularly problematic because Gunnison sage-grouse population dynamics are most sensitive during these life history stages (GSRSC 2005, p. G–15).

We recognize that the potential percentages of habitat loss mentioned above, whether direct or functional, will not necessarily correspond to the same percentage loss in sage-grouse numbers. The recent efforts to conserve Gunnison sage-grouse and their habitat within the Basin provide protection into the future for several areas of high-quality habitat (see discussion below in Factors A and D). Nonetheless, given the large landscape-level needs of this species, we expect future habitat loss, degradation, and fragmentation from residential development, as described above, to substantially limit the probability of persistence of Gunnison sage-grouse in the Gunnison Basin.

The GSRSC (2005, pp. 160–161) hypothesize that residential density in excess of one housing unit per 1.3 km^2 (0.5 mi^2) could cause declines in Gunnison sage-grouse populations. However, because the analyses that formed the basis of this hypothesis were preliminary and did not take into account potential lags in Gunnison sage-grouse population response to development, the threshold at which impacts are expected could be higher or lower (GSRSC 2005, p. F–3). The resulting impacts are expected to occur in nearly all seasonal habitats, including moderate to severe winter use areas, nesting and brood-rearing areas, and leks (GSRSC 2005, p. 161). Within Gunnison County, approximately 18 percent of the land area within the range of Gunnison sage-grouse has a residential density greater than one housing unit per 1.3 km^2 (0.5 mi^2) (USFWS 2010b, p. 8). Therefore, according to the GSRSC estimate of potential residential impacts, human residential densities in the Gunnison Basin population area are such that we expect they are limiting the Gunnison sage-grouse population in at least 18 percent of the population area. However, based on results from the quantitative model for nesting probability described above (Aldridge *et al.* 2011), residential development currently may be impacting 49 percent

of the Gunnison Basin population area (USFWS 2010b, p. 7).

Based on population projections (CWCB 2009, p. 15) and the corresponding increased need for housing, we expect the density and distribution of human residences to expand in the future. Of the private land in Gunnison County not protected by conservation easements, approximately 20,236 ha (50,004 ac) on approximately 1,190 parcels currently lack human development in occupied Gunnison sage-grouse habitat (USFWS 2010b, p. 11). These lands are scattered throughout occupied Gunnison sage-grouse habitat in the Gunnison Basin. We used the 20,236 ha (50,004 ac) as an initial basis to assess the potential impacts of future development. A lack of parcel data availability from surrounding counties precluded expanding this analysis beyond Gunnison County; however, the analysis area constitutes 71 percent of the Gunnison Basin population area.

Approximately 93 percent of occupied Gunnison sage-grouse habitat in Gunnison County consists of parcels greater than 14.2 ha (35 ac), which are exempt from some county land development regulations. Applying a 1.7 percent average annual population increase under a ''middle'' growth scenario (CWCB 2009, p. 56) and an average 2.29 persons per household (CDOLA 2009b, p. 6) to the 2008 Gunnison County human population estimate results in the potential addition of nearly 7,000 housing units to the county by 2050. Currently, approximately two-thirds of the human population in Gunnison County occurs within the currently mapped occupied range of Gunnison sage-grouse. Assuming this pattern will continue, two-thirds of the population increase will occur within occupied Gunnison sage-grouse habitat. The above projection could potentially result in the addition of approximately 4,630 housing units and the potential for 25,829 ha (63,824 ac) of new habitat loss, whether direct or functional, on parcels that currently have no development. This potential for additional habitat loss constitutes 15 percent of the currently occupied Gunnison sage-grouse habitat in the Gunnison Basin population area (USFWS 2010b, p. 14). Combined with the 49 percent of occupied habitat potentially impacted by current residential development (USFWS 2010b, p.7), approximately 64 percent of Gunnison sage-grouse occupied habitat may be impacted by residential development in the foreseeable future. We also anticipate increased housing density in many areas of occupied Gunnison sage-grouse habitat because the anticipated number of new housing units will exceed the number of undeveloped parcels by nearly four times (USFWS 2010b, p. 16).

Some of this anticipated development and subsequent habitat loss will undoubtedly occur on parcels that currently have existing human development, which could lessen the effects to Gunnison sage-grouse. However, the above calculation of an increase in future housing units is likely an underestimate because it does not take into account the expected increase in second home development (CDOLA 2009b, p. 7), which would increase negative effects to Gunnison sage-grouse. The U.S. Census Bureau only tallies the inhabitants of primary residences in population totals. This methodology results in an underestimate of the population, particularly in amenity communities like Gunnison, because of the increased number of part-time residents inhabiting second homes and vacation homes in these areas (Riebsame *et al.* 1996, p. 397; Theobald 2001, p. 550, Theobald 2004, p. 143). In Gunnison County, approximately 90 percent of vacant housing units were composed of seasonal use units (CDOLA 2009c, p. 1), and the housing vacancy rate was 42.5 percent in Gunnison County over the last two decades (CDOLA 2009d, p. 2).

We expect some development to be moderated by the establishment of additional voluntary landowner conservation easements such as those currently facilitated by the CPW and land trust organizations. The CPW has spent more than $30 million to protect approximately 13,413 ha (33,145 ac) since 2003 (CPW 2012b, p. 6). Conservation easements, if properly managed, can minimize the overall impacts to Gunnison sage-grouse. Including CPW and nongovernmental organization held properties, approximately 17,466 ha (43,160 ac), or 25 percent, of private lands in occupied Gunnison sage-grouse habitat have been placed in conservation easements or are protected because the fee title was acquired to protect the land (CPW 2011c, pp. 9–10; CPW 2012b, p. 6). Due to the cost of acquisition we do not expect the amount of land potentially placed in future easements will adequately offset the overall effects of human development and subsequent habitat fragmentation.

Current and anticipated fragmentation is also ameliorated somewhat by the approximate 5,012 ha (12,385 ac), or 7 percent, of private lands in the Gunnison Basin currently enrolled under the Gunnison sage-grouse CCAA (CPW 2012b, p. 11). However, approximately one-third of this area is already covered under conservation easements as described above. Accounting for this overlap, conservation easements and fee title properties held by CPW and conservation organizations, and the CCAA as described above currently protect approximately 20,824 ha (51,458 ac), or 30 percent, of private lands in the Gunnison Basin population area.

Residential Development in All Other Population Areas—In 2004, within the Crawford population area, approximately 951 ha (2,350 ac), or 7 percent of the occupied Gunnison sage-grouse habitat was subdivided into 48 parcels (CDOW 2009b, p. 59). Local landowners and the National Park Service (NPS) have ongoing efforts to protect portions of the subdivided area through conservation easements. Residential subdivision continues to occur in the northern part of the Poncha Pass population area, and the CPW considers this to be the highest priority threat to this population (CDOW 2009b, p. 124). The rate of residential development in the San Miguel Basin population area increased between 2005 and 2008 but slowed in 2009 (CDOW 2009b, p. 135). However, a 429-ha (1,057-ac) parcel north of Miramonte Reservoir is currently being developed. The CPW reports that potential impacts to Gunnison sage-grouse resulting from this development may be reduced by possibly placing a portion of the property into a conservation easement and the relocation of a proposed major road to avoid occupied habitat (CDOW 2009b, p. 136). Scattered residential development has recently occurred along the periphery of occupied habitat in the Cerro Summit-Cimarron-Sims Mesa population (CDOW 2009b, p. 45). With the exception of the Monticello subpopulation and the Crawford population, the remaining limited amounts of habitat, the fragmented nature of this remaining habitat, and the anticipated increases in exurban development pose a threat to the remaining four smaller Gunnison sage-grouse populations.

Summary of Residential Development

Because Gunnison sage-grouse are dependent on expansive, contiguous areas of sagebrush habitat to meet their life history needs, the development patterns described above have resulted in the direct and functional loss of sagebrush habitat and have negatively affected the species by limiting already scarce habitat, especially within the six smaller populations. The collective

influences of fragmentation and disturbance from human activities around residences and associated roads reduce the effective habitat around these areas, making them inhospitable to Gunnison sage-grouse (Aldridge *et al.* 2011, p. 14; Knick *et al.* 2011, pp. 212–219 and references therein; Aldridge and Boyce 2007, p. 520). Human population growth that results in a dispersed exurban development pattern throughout sagebrush habitats will reduce the likelihood of sage-grouse persistence in these areas. Human populations are increasing throughout the range of Gunnison sage-grouse, and we expect this trend to continue. Given the demographic and economic trends of the past few decades described above, we believe residential development in Gunnison sage-grouse habitat will continue at least through 2050, and likely longer. The resulting habitat loss and fragmentation from residential development is a principal threat to Gunnison sage-grouse persistence.

Roads

Impacts to Gunnison sage-grouse from roads may include direct habitat loss, direct mortality, barriers to migration corridors or seasonal habitats, facilitation of predation and spread of invasive vegetative species, and other indirect influences such as noise (Forman and Alexander 1998, pp. 207–231). Greater sage-grouse mortality resulting from collisions with vehicles does occur, but mortalities are typically not monitored or recorded (Patterson 1952, p. 81). Therefore, we are unable to determine the importance of direct mortality from roads on sage-grouse populations.

Although we have no information on the number of direct mortalities of Gunnison sage-grouse resulting from vehicles or roads, because of similarities in their habitat and habitat use, we expect other effects to be similar to those observed in greater sage-grouse. Roads within Gunnison sage-grouse habitats have been shown to impede movement of local populations between the resultant patches, with road avoidance presumably being a behavioral means to limit exposure to predation (Oyler-McCance *et al.* 2001, p. 330).

The presence of roads increases human access and resulting disturbance effects in remote areas (Forman and Alexander 1998, p. 221; Forman 2000, p. 35; Connelly *et al.* 2004, pp. 7–6 to 7–25). In addition, roads can provide corridors for predators to move into previously unoccupied areas. Some mammalian species known to prey on sage-grouse, such as red fox *(Vulpes vulpes),* raccoons *(Procyon lotor),* and striped skunks *(Mephitis mephitis),* have greatly increased their distribution by dispersing along roads (Forman and Alexander 1998, p. 212; Forman 2000, p. 33; Frey and Conover 2006, pp. 1114–1115). Corvids (Family Corvidae: crows, ravens, magpies, etc.) also use linear features such as primary and secondary roads as travel routes (Bui 2009, p. 31), expanding their movements into previously unused regions (Knight and Kawashima 1993, p. 268; Connelly *et al.* 2004, p. 12–3). Corvids are significant sage-grouse nest predators and were responsible for more than 50 percent of nest predations in Nevada (Coates 2007, pp. 26–30). See Factor C below for further discussion of predation.

The expansion of road networks also contributes to exotic plant invasions via introduced road fill, vehicle transport, and road maintenance activities (Forman and Alexander 1998, p. 210; Forman 2000, p. 32; Gelbard and Belnap 2003, p. 426; Knick *et al.* 2003, p. 619; Connelly *et al.* 2004, p. 7–25). Invasive species are not limited to roadsides, but also encroach into surrounding habitats (Forman and Alexander 1998, p. 210; Forman 2000, p. 33; Gelbard and Belnap 2003, p. 427). Upgrading unpaved four-wheel-drive roads to paved roads resulted in increased cover of exotic plant species within the interior of adjacent plant communities (Gelbard and Belnap 2003, p. 426). This effect was associated with road construction and maintenance activities and vehicle traffic, and not with differences in site characteristics. The incursion of exotic plants into native sagebrush systems can negatively affect Gunnison sage-grouse through habitat losses and conversions (see further discussion below in the Invasive Plants section).

Gunnison sage-grouse may avoid road areas because of noise, visual disturbance, pollutants, and predators moving along a road, which further reduces the amount of habitat available to support them. The landscape-scale spatial model predicting Gunnison sage-grouse nest site selection showed strong avoidance of areas with high road densities of roads classed 1 through 4 (primary paved highways through primitive roads with 2-wheel drive sedan clearance) within 6.4 km (4 mi) of nest sites (Aldridge *et al.* 2011, p. 14). Nest sites also decreased with increased proximity to primary and secondary paved highways (roads classes 1 and 2) (Aldridge *et al.* 2011, p. 14). Male greater sage-grouse lek attendance was shown to decline within 3 km (1.9 mi) of a methane well or haul road with traffic volume exceeding one vehicle per day (Holloran 2005, p. 40). Male sage-grouse depend on acoustical signals to attract females to leks (Gibson and Bradbury 1985, p. 82; Gratson 1993, p. 692). If noise from roads interferes with mating displays, and thereby female attendance, younger males will not be drawn to the lek and eventually leks will become inactive (Amstrup and Phillips 1977, p. 26; Braun 1986, pp. 229–230).

In a study on the Pinedale Anticline in Wyoming, greater 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 that bred on leks greater than 3 km (1.9 mi) from roads. Nest initiation rates for hens bred on leks close to roads also were lower (65 versus 89 percent), affecting population recruitment (33 versus 44 percent) (Lyon 2000, p. 33; Lyon and Anderson 2003, pp. 489–490). Roads may be the primary impact of oil and gas development to sage-grouse, due to their persistence and continued use even after drilling and production have ceased (Lyon and Anderson 2003, p. 490). Lek abandonment patterns suggested that daily vehicular traffic along road networks for oil wells can impact greater sage-grouse breeding activities (Braun *et al.* 2002, p. 5). Because Gunnison sage-grouse and greater sage-grouse are similar, closely related species, we believe the effects of vehicular traffic on Gunnison sage-grouse, regardless of its purpose (e.g., in support of energy production or local commuting and recreation), are similar to those observed in greater sage-grouse.

Road density was not an important factor affecting greater sage-grouse persistence or rangewide patterns in sage-grouse extirpation (Aldridge *et al.* 2008, p. 992). However, the authors did not consider the intensity of human use of roads in their modeling efforts. They also indicated that their analyses may have been influenced by inaccuracies in spatial road data sets, particularly for secondary roads (Aldridge *et al.* 2008, p. 992). Historic range where greater and Gunnison sage-grouse have been extirpated has a 25 percent higher density of roads than occupied range (Wisdom *et al.* 2011, p. 467). Wisdom *et al.'s* (2011) greater and Gunnison sage-grouse rangewide analysis supports the findings of numerous local studies showing that roads can have both direct and indirect impacts on sage-grouse distribution and individual fitness (reproduction and survival) (e.g., Lyon and Anderson 2003 p. 490, Aldridge and Boyce 2007, p. 520).

Recreational activities including off-highway vehicles (OHV), all-terrain vehicles, motorcycles, mountain bikes,

and other mechanized methods of travel have also been recognized as a potential direct and indirect threat to Gunnison sage-grouse and their habitat (BLM 2009, p. 36). In Colorado, the number of annual off-highway vehicle (OHV) registrations has increased dramatically from 12,000 in 1991 to 131,000 in 2007 (BLM 2009, p. 37). Four wheel drive, OHV, motorcycle, specialty vehicle, and mountain bike use is expected to increase in the future based on increased human population in Colorado and within the range of Gunnison sage-grouse. Numerous off-road routes and access points to habitat used by Gunnison sage-grouse combined with increasing capabilities for mechanized travel and increased human population further contribute to habitat fragmentation.

Roads in the Gunnison Basin Population Area—On BLM lands in the Gunnison Basin currently 2,050 km (1,274 mi) of roads are within 6.4 km (4 mi) of Gunnison sage-grouse leks. Eighty-seven percent of all Gunnison sage-grouse nests were located less than 6.4 km (4 mi) from the lek of capture (Apa 2004, p. 21). However, the BLM proposes to reduce the roads on its Gunnison Basin lands to 1,157 km (719 mi) (BLM 2010, p. 147).

Currently, 1,349 km (838 mi) of roads accessible to 2-wheel-drive passenger cars exist in occupied Gunnison sage-grouse habitat in the Gunnison Basin. Four-wheel-drive vehicle roads, as well as motorcycle, mountain bike, horse, and hiking trails are heavily distributed throughout the range of Gunnison sage-grouse (BLM 2009, pp. 27, 55, 86), which further increases the overall density of roads and their direct and indirect effects on Gunnison sage-grouse. User-created roads and trails have increased since 2004 (BLM 2009, p. 33), although we do not know the scope of this increase.

Using a spatial dataset of roads in the Gunnison Basin, we performed GIS analyses on the potential effects of roads to Gunnison sage-grouse and their habitat. To account for secondary effects from invasive weed spread from roads (see discussion below in Invasive Plants), we applied a 0.7-km (0.4-mi) buffer (Bradley and Mustard 2006, p. 1146) to all roads in the Gunnison Basin. These analyses indicate that approximately 85 percent of occupied habitat in the Gunnison Basin has an increased likelihood of current or future road-related invasive weed invasion. When all roads in the Gunnison basin are buffered by 6.4 km (4 mi) or 9.6 km (6 mi) to account for decreased nesting probability (Aldridge *et al.* 2011, p. 14) and secondary effects from mammal and corvid foraging areas (Knick *et al* 2011, p. 216), respectively, all occupied habitat in the Gunnison Basin is indirectly affected by roads.

Roads in All Other Population Areas—Approximately 140 km (87 mi), 243 km (151 mi), and 217 km (135 mi) of roads (all road classes) occur on BLM lands within the Cerro Summit-Cimarron-Sims Mesa, Crawford, and San Miguel Basin population areas, respectively, all of which are managed by the BLM (BLM 2009, p. 71). We do not have information on the total length of roads within the Monticello-Dove Creek, Piñon Mesa, or Poncha Pass Gunnison sage-grouse populations. However, several maps provided by the BLM show that roads are widespread and common throughout these population areas (BLM 2009, pp. 27, 55, 86).

Summary of Roads

As described above in the 'Residential Development' section, the human population is increasing throughout the range of Gunnison sage-grouse (CDOLA 2009a, pp. 2–3; CWCB 2009, p. 15), and data indicates this trend will continue. Gunnison sage-grouse are dependent on large contiguous and unfragmented landscapes to meet their life history needs (GSRSC 2005, pp. 26–30), and the existing road density throughout much of the range of Gunnison sage-grouse has negatively affected the species. The collective influences of fragmentation and disturbance from roads reduce the effective habitat as they are avoided by sage-grouse (Aldridge *et al.* 2011, p. 14; Aldridge and Boyce 2007, p. 520; Knick *et al.* 2011, pp. 212–219 and references therein). Given the current human demographic and economic trends described above in the Residential Development section, we believe that increased road use and increased road construction associated with residential development will continue at least through 2050, and likely longer. The resulting habitat loss, degradation, and fragmentation from roads are a major threat to Gunnison sage-grouse persistence.

Powerlines

Powerlines can directly affect greater sage-grouse by posing a collision and electrocution hazard (Braun 1998, pp. 145–146; Connelly *et al.* 2000a, p. 974) and can have indirect effects by decreasing lek recruitment (Braun *et al.* 2002, p. 10), increasing predation (Connelly *et al.* 2004, p. 13–12), fragmenting habitat (Braun 1998, p. 146), and facilitating the invasion of exotic annual plants (Knick *et al.* 2003, p. 612; Connelly *et al.* 2004, p. 7–25). Proximity to powerlines is associated with Gunnison and greater sage-grouse extirpation (Wisdom *et al.* 2011, pp. 467–468). Due to the potential spread of invasive species and predators as a result of powerline construction and maintenance, the impact from a powerline is greater than its actual footprint. The effects of powerlines to Gunnison sage-grouse should be similar to those observed in greater sage-grouse.

In areas where the vegetation is low and the terrain relatively flat, power poles provide an attractive hunting, roosting, and nesting perch for many species of raptors and corvids (Steenhof *et al.* 1993, p. 27; Connelly *et al.* 2000a, p. 974; Manville 2002, p. 7; Vander Haegen *et al.* 2002, p. 503). 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, p. 275; Manville 2002, p. 7). Raptors may actively seek out power poles where natural perches are limited. For example, within 1 year of construction of a 596-km (370-mi) transmission line in southern Idaho and Oregon, raptors and common ravens began nesting on the supporting poles (Steenhof *et al.* 1993, p. 275). Within 10 years of construction, 133 pairs of raptors and ravens were nesting along this stretch (Steenhof *et al.* 1993, p. 275). Raven counts increased by approximately 200 percent along the Falcon-Gondor transmission line corridor in Nevada within 5 years of construction (Atamian *et al.* 2007, p. 2). The increased abundance of corvids within occupied Gunnison sage-grouse habitats can result in increased predation.

As with corvids, eagles can also increase following power line installation. Golden eagle *(Aquila chryrsaetos)* predation on sage-grouse on leks increased from 26 to 73 percent of the total predation after completion of a transmission line within 200 meters (m) (220 yards (yd)) of an active sage-grouse lek in northeastern Utah (Ellis 1985, p. 10). The lek was eventually abandoned, and Ellis (1985, p. 10) concluded that the presence of the powerline resulted in changes in sage-grouse dispersal patterns and caused fragmentation of the habitat. Golden eagles are found throughout the range of Gunnison sage-grouse (USGS 2010, p. 1), and golden eagles were found to be the dominant species recorded perching on power poles in Utah in Gunnison sage-grouse habitat (Prather and Messmer 2009, p. 12). The increased abundance of eagles within occupied Gunnison sage-grouse habitats can result in increased predation.

Leks within 0.4 km (0.25 mi) of new powerlines constructed for coalbed methane development in the Powder River Basin of Wyoming had significantly lower growth rates, as measured by recruitment of new males onto the lek, compared to leks further from these lines, presumably resulting from increased raptor predation (Braun *et al.* 2002, p. 10). Connelly *et al.* (2004, p. 7–26) assumed a 5- to 6.9-km (3.1- to 4.3-mi) radius buffer around the perches, based on the average foraging distance of these corvids and raptors, and estimated that the area potentially influenced by additional perches provided by powerlines was 672,644 to 837,390 km^2 (259,641 to 323,317 mi^2), or 32 to 40 percent of their assessment area. The impact on an area would depend on corvid and raptor densities within the area (see discussion in Factor C, below).

Powerlines may fragment sage-grouse habitats even if raptors are not present. The use of otherwise suitable habitat by sage-grouse near powerlines increased as distance from the powerline increased for up to 600 m (660 yd) (Braun 1998, p. 8). Based on those unpublished data, Braun (1998, p. 8) reported that the presence of powerlines may limit Gunnison and greater sage-grouse use within 1 km (0.6 mi) in otherwise suitable habitat. Similar results were recorded for other grouse species. For example, lesser and greater prairie-chickens *(Tympanuchus pallidicinctus* and *T. cupido,* respectively) avoided otherwise suitable habitat near powerlines (Pruett *et al.* 2009, p. 6). Additionally, both species also crossed powerlines less often than nearby roads, which suggests that powerlines are a particularly strong barrier to movement (Pruett *et al.* 2009, p. 6).

Sage-grouse also may avoid powerlines as a result of the electromagnetic fields present (Wisdom *et al.* 2011, p. 467). Electromagnetic fields alter the behavior, physiology, endocrine systems and immune function in birds, with negative consequences on reproduction and development (Fernie and Reynolds 2005, p. 135). Birds are diverse in their sensitivities to electromagnetic field exposures, with domestic chickens being very sensitive. Many raptor species are less affected (Fernie and Reynolds 2005, p. 135). No studies have been conducted specifically on sage-grouse. Therefore, we do not know the impact to the Gunnison sage-grouse from electromagnetic fields.

Linear corridors through sagebrush habitats can facilitate the spread of invasive species, such as cheatgrass *(Bromus tectorum)* (Gelbard and Belnap 2003, pp. 424–426; Knick *et al.* 2003, p. 620; Connelly *et al.* 2004, p. 1–2). However, we were unable to find any information regarding the amount of invasive species incursion as a result of powerline construction.

Powerlines in the Gunnison Basin Population Area—On approximately 121,000 ha (300,000 ac) of BLM land in the Gunnison Basin, 36 rights-of-way for power facilities, power lines, and transmission lines have resulted in the direct loss of 350 ha (858 ac) of occupied habitat (Borthwick 2005a, pers. comm.). As discussed above, the impacts of these lines likely extend beyond their actual footprint. We performed a GIS analysis of transmission line location in relation to overall habitat area and Gunnison sage-grouse lek locations in the Gunnison Basin population area to obtain an estimate of the potential effects in the Basin. These analyses indicate that 68 percent of the Gunnison Basin population area is within 6.9 km (4.3 mi) of an electrical transmission line and is potentially influenced by avian predators using the additional perches provided by transmission lines. This area contains 65 of 109 active leks (60 percent) in the Gunnison Basin population. These results suggest that potential increased predation resulting from transmission lines has the potential to affect a substantial portion of the Gunnison Basin population.

Powerlines in All Other Population Areas—A transmission line runs through the Dry Creek Basin group in the San Miguel Basin population, and the Beaver Mesa group has two transmission lines. None of the transmission lines in the San Miguel Basin have raptor proofing, nor do most distribution lines (Ferguson 2005, pers. comm.), so their use by raptors and corvids as perch sites for hunting and use for nest sites is not discouraged. One major electric transmission line runs east-west in the northern portion of the current range of the Monticello group (San Juan County Gunnison Sage-grouse Working Group 2005, p. 17). Powerlines do not appear to be present in sufficient density to pose a threat to Gunnison sage-grouse in the Piñon Mesa population at this time. One transmission line parallels Highway 92 in the Crawford population and distribution lines run from there to homes on the periphery of the current range (Ferguson 2005, pers. comm.).

Summary of Powerlines

Human populations are projected to increase in and near most Gunnison sage-grouse populations (see discussion under Residential Development). As a result, we expect an associated increase in distribution powerlines to meet this increased demand. Powerlines are likely negatively affecting Gunnison sage-grouse as they contribute to habitat loss and fragmentation and facilitation of predators of Gunnison sage-grouse. Given the current demographic and economic trends described above, we believe that existing powerlines and anticipated distribution of powerlines associated with residential development will continue at least through 2050, and likely longer. The resulting habitat loss and fragmentation from powerlines is a major threat to Gunnison sage-grouse persistence.

Domestic Grazing and Wild Ungulate Herbivory

At least 87 percent of occupied Gunnison sage-grouse habitat on Federal lands is currently grazed by domestic livestock (USFWS 2010c, entire). We lack information on the proportion of Gunnison sage-grouse habitat on private lands that is currently grazed, but we expect the proportion of the area subject to grazing is similar to that on Federal lands. Excessive grazing by domestic livestock during the late 1800s and early 1900s, along with severe drought, significantly impacted sagebrush ecosystems (Knick *et al.* 2003, p. 616). Although current livestock stocking rates in the range of Gunnison sage-grouse are substantially lower than historical levels (Laycock *et al.* 1996, p. 3), long-term effects from historic overgrazing, including changes in plant communities and soils, persist today (Knick *et al.* 2003, p. 116).

Although livestock grazing and associated land treatments have likely altered plant composition, increased topsoil loss, and increased spread of exotic plants, the impacts on Gunnison sage-grouse populations are not clear. Few studies have directly addressed the effect of livestock grazing on sage-grouse (Beck and Mitchell 2000, pp. 998–1000; Wamboldt *et al.* 2002, p. 7; Crawford *et al.* 2004, p. 11), and little direct experimental evidence links grazing practices to Gunnison sage-grouse population levels (Braun 1987, pp. 136–137, Connelly and Braun 1997, p. 7–9). Rowland (2004, pp. 17–18) conducted a literature review and found no experimental research that demonstrates grazing alone is responsible for reduction in sage-grouse numbers.

Despite the obvious impacts of grazing on plant communities within the range of the species, the GSRSC (2005, p. 114) could not find a direct correlation between historic grazing and reduced Gunnison sage-grouse numbers.

While implications on population-level impacts from grazing can be made based on impacts of grazing on individuals and habitat conditions, no studies have documented the impacts (positively or negatively) of grazing at the population level.

Sage-grouse need significant grass and shrub cover for protection from predators, particularly during nesting season, and females will preferentially choose nesting sites based on these qualities (Hagen *et al.* 2007, p. 46). In particular, nest success in Gunnison sage-grouse habitat is related to greater grass and forb heights and shrub density (Young 1994, p. 38). The reduction of grass heights due to livestock grazing in sage-grouse nesting and brood-rearing areas has been shown to negatively affect nesting success when cover is reduced below the 18 cm (7 in.) needed for predator avoidance (Gregg *et al.* 1994, p. 165). Based on measurements of cattle foraging rates on bunchgrasses both between and under sagebrush canopies, the probability of foraging on under-canopy bunchgrasses depends on sagebrush size and shape. Consequently, the effects of grazing on nesting habitats might be site specific (France *et al.* 2008, pp. 392–393).

Grazing by livestock could reduce the suitability of breeding and brood-rearing habitat, negatively affecting sage-grouse populations (Braun 1987, p. 137; Dobkin 1995, p. 18; Connelly and Braun 1997, p. 231; Beck and Mitchell 2000, pp. 998–1000). Domestic livestock grazing reduces water infiltration rates and the cover of herbaceous plants and litter, compacts the soil, and increases soil erosion (Braun 1998, p. 147; Dobkin *et al.* 1998, p. 213). These impacts change the proportion of shrub, grass, and forb components in the affected area, and facilitate invasion of exotic plant species that do not provide suitable habitat for sage-grouse (Mack and Thompson 1982, p. 761; Miller and Eddleman 2000, p. 19; Knick *et al.* 2011, pp. 228–232).

Livestock may compete directly with sage-grouse for rangeland resources. Cattle are grazers, feeding mostly on grasses, but they will make seasonal use of forbs and shrub species like sagebrush (Vallentine 1990, p. 226), a primary source of nutrition for sage-grouse. A sage-grouse hen's nutritional condition affects nest initiation rate, clutch size, and subsequent reproductive success (Barnett and Crawford 1994, p. 117; Coggins 1998, p. 30). Other effects of direct competition between livestock and sage-grouse depend on condition of the habitat and the grazing practices. Thus, the effects vary across the range of Gunnison sage-grouse. For example, poor livestock management in mesic sites results in a reduction of forbs and grasses available to sage-grouse chicks, thereby affecting chick survival (Aldridge and Brigham 2003, p. 30). Chick survival is one of the most important factors in maintaining Gunnison sage-grouse population viability (GSRSC 2005, p. 173).

Livestock can trample sage-grouse nests and nesting habitat. Although the effect of trampling at a population level is unknown, outright nest destruction has been documented, and the presence of livestock can cause sage-grouse to abandon their nests (Rasmussen and Griner 1938, p. 863; Patterson 1952, p. 111; Call and Maser 1985, p. 17; Holloran and Anderson 2003, p. 309; Coates 2007, p. 28). Sage-grouse have been documented to abandon nests following partial nest depredation by cows (Coates 2007, p. 28). In general, all recorded encounters between livestock and grouse nests resulted in hens flushing from nests, which could expose the eggs to predation. Visual predators like ravens likely use hen movements to locate sage-grouse nests (Coates 2007, p. 33). Livestock also may trample sagebrush seedlings, thereby removing a source of future sage-grouse food and cover (Connelly *et al.* 2004, pp. 7–31). Trampling of soil by livestock can reduce or eliminate biological soil crusts making these areas susceptible to cheatgrass invasion (Mack 1981, pp. 148–149; Young and Allen 1997, p. 531).

Livestock grazing may have positive effects on sage-grouse under some habitat conditions. Sage-grouse use grazed meadows significantly more during late summer than ungrazed meadows because grazing had stimulated the regrowth of forbs (Evans 1986, p. 67). Greater sage-grouse sought out and used openings in meadows created by cattle grazing in northern Nevada (Klebenow 1981, p. 121). Also, both sheep and goats have been used to control invasive weeds (Mosley 1996 *in* Connelly *et al.* 2004, pp. 7–49; Merritt *et al.* 2001, p. 4; Olsen and Wallander 2001, p. 30) and woody plant encroachment (Riggs and Urness 1989, p. 358) in sage-grouse habitat.

Sagebrush plant communities are not adapted to domestic grazing disturbance. Grazing changed the functioning of systems into less resilient, and in some cases, altered communities (Knick *et al.* 2011, pp. 229–232). The ability to restore or rehabilitate areas depends on the condition of the area relative to the ability of a site to support a specific plant community (Knick *et al.* 2011, pp. 229–232). For example, if an area has a balanced mix of shrubs and native understory vegetation, a change in grazing management can restore the habitat to its potential historic species composition (Pyke 2011, pp. 536–538). Wambolt and Payne (1986, p. 318) found that rest from grazing had a better perennial grass response than other treatments. Active restoration is likely required where native understory vegetation is much reduced (Pyke 2011, pp. 536–540). But, if an area has soil loss or invasive species, returning the site to the native historical plant community may be impossible (Daubenmire 1970, p. 82; Knick *et al.* 2011, pp. 230–231; Pyke 2011, p. 539).

Aldridge *et al.* (2008, p. 990) did not find any relationship between sage-grouse persistence and livestock densities. However, the authors noted that livestock numbers do not necessarily correlate with range condition. They concluded that the intensity, duration, and distribution of livestock grazing are more influential on rangeland condition than the livestock density values (Aldridge *et al.* 2008, p. 990). Currently, little direct evidence links grazing practices to population levels of Gunnison or greater sage-grouse. Although grazing has not been examined at large spatial scales, as discussed above, we do know that grazing can have negative impacts to individuals, nests, breeding productivity, and sagebrush and, consequently, to sage-grouse at local scales. However, how these impacts operate at large spatial scales and thus on population levels is currently unknown. The potential for population-level impacts should be further studied. Although baseline vegetation monitoring has been conducted in the past, detailed baseline vegetation monitoring efforts were conducted in the Gunnison Basin in 2010. In comparison to the best available information on habitat guidelines for the maintenance of Gunnison sage-grouse habitat (GSRSC 2005, Appendix H–1), cover and height estimates were within the breeding and summer-to-fall habitat guidelines, especially in cover and sagebrush height for dry mountain loam and mountain loam ecological sites across the Basin. Comparisons of existing conditions to winter habitat guidelines were not made in this assessment.

Livestock Grazing and Habitat Monitoring Methods—Our analysis of grazing is focused on BLM lands because nearly all of the information available to us regarding current grazing management within the range of Gunnison sage-grouse was provided by this agency. Similar information was

provided by the USFS, but was more limited since the USFS has less occupied habitat in grazing allotments and has a different habitat monitoring approach than BLM (see discussion below). A summary of domestic livestock grazing management on BLM and USFS lands in occupied Gunnison sage-grouse habitat is provided in Table 2.

Much of the available information on domestic livestock grazing and its relationship to habitat conditions on Federal lands is in the form of BLM's Land Health Assessment (LHA) data. The purpose of LHAs are to determine the status of resource conditions within a specified geographic area at a specific time, and livestock grazing practices are coupled to these LHA determinations. The LHA process incorporates land health standards that define minimum resource conditions that must be achieved and maintained. Further discussion on the LHA process is provided in the following section.

The USFS does not apply the LHA process, but monitors allotment trends through a combination of procedures including seasonal inspections, permanent photo points, and inventory and mapping of plant community conditions and changes over time (USFS 2010). The majority of Gunnison sage-grouse occupied habitat in USFS grazing allotments is located in the Gunnison Basin population area (Tables 1 and 2), and grazing information as it relates to Gunnison sage-grouse is therefore limited to this area (USFWS 2010c, p2).

Although grazing also occurs on lands owned or managed by other entities, we have no information on the extent of grazing in these areas. Livestock grazing on private lands, where present, has a greater potential to impact Gunnison sage-grouse because these areas are not required to meet agency-mandated land health standards, but we lack sufficient data to make an informed assessment of these areas.

TABLE 2—SUMMARY OF DOMESTIC LIVESTOCK GRAZING MANAGEMENT ON BLM [a] AND USFS [b] LANDS IN OCCUPIED HABITAT FOR EACH OF THE GUNNISON SAGE-GROUSE POPULATIONS (FROM BLM (2012) AND USFWS (2010C), COMPILATION OF DATA PROVIDED BY BLM AND USFS)

Population	Number of active USFS allotments	Number of active BLM allotments	Percent: Active allotments with GUSG [c] objectives	Percent: BLM allotments with completed LHA [d]	Percent: Assessed BLM allotments meeting LHA objectives
Gunnison	34	62	100	100	32
San Miguel Basin	*no data*	13	0	77	40
Monticello—Dove Creek:					
Dove Creek	*n/a*	3	0	0	*0*
Monticello	[e] *n/a*	6	100	83	80
Piñon Mesa	*no data*	15	53	27	100
Cerro Summit-Cimarron-Sims Mesa	[e] *n/a*	10	10	50	40
Crawford [f]	[e] *n/a*	7	71	100	86
Poncha Pass	*no data*	8	13	100	100
Rangewide Averages			34	67	60

[a] Bureau of Land Management.
[b] United States Forest Service.
[c] Gunnison sage-grouse.
[d] Land Health Assessments.
[e] No United States Forest land in occupied habitat in this population area.
[f] Includes allotments on National Park Service lands but managed by the Bureau of Land Management.

BLM Land Health Assessment Standards—LHA standards are based on the recognized characteristics of healthy ecosystems and include considerations of upland soils, riparian systems, plant and animal communities, habitat conditions and populations of special status species, and water quality (BLM 1997, pp. 6–7). Each LHA standard, such as the condition and health of soils, riparian areas, or plant communities, has varying degrees of applicability to basic Gunnison sage-grouse habitat needs. The most applicable LHA standard to Gunnison sage-grouse is LHA standard number four, which is specific to special status species (BLM 1997, p. 7). *Special status species* include Federally threatened, endangered, proposed, and candidate species; recently delisted (5 years or less) species; and BLM sensitive species. *BLM sensitive species* are those that require special management consideration to promote their conservation and reduce the likelihood and need for future listing under the ESA; they are designated by the BLM State Director(s) (BLM 2008). Gunnison sage-grouse was designated a BLM sensitive species in 2000 when it and greater sage-grouse were recognized as separate species (BLM 2009, p. 7).

In addition to requiring stable and increasing populations and suitable habitat for special status species, the specific indicators for LHA standard four include the presence of: minimal noxious weeds, sustainably reproducing native plant and animal communities, mixed age classes sufficient to sustain recruitment and mortality fluctuations, habitat connectivity, photosynthetic activity throughout the growing season, diverse and resilient plant and animal communities in balance with habitat potential, plant litter accumulation, and several plant communities in a variety of successional stages and patterns (BLM 1997, p. 7).

We recognize that LHAs are largely qualitative and other factors in addition to recent domestic livestock grazing, including the lingering effects of historic overgrazing, may influence the outcome of LHA determinations. Furthermore, BLM's application of LHA standards, methodologies used, and data interpretation varies depending on the Field Office. Therefore, the relationship between LHA determinations and the effects of domestic livestock grazing on Gunnison sage-grouse is imprecise. We also recognize that if an allotment does not meet LHA standard four, it does not mean the habitat is completely unsuitable for Gunnison sage-grouse. However, the fact that some grazing allotments or areas are not meeting LHA

objectives indicates that habitat conditions are likely degraded for Gunnison sage-grouse in portions of its range, and that domestic livestock grazing is contributing to these conditions.

Federal Lands Grazing in the Gunnison Basin Population Area—The BLM manages approximately 122,376 ha (301,267 ac), or 51 percent of the area currently occupied by Gunnison sage-grouse in the Gunnison Basin. Approximately 98 percent (119,941 ha [296,381 ac]) of this area is actively grazed (USFWS 2010c, p. 1). The USFS manages approximately 34,544 ha (85,361 ac), or 14 percent of the occupied portion of the Gunnison Basin population area. Therefore, this information is pertinent to approximately 65 percent of occupied habitat in the Gunnison Basin.

Within the 296,381 acres of occupied Gunnison sage-grouse habitat that are actively grazed on BLM Gunnison Field Office lands, and with respect to LHA standard four, approximately 24,208 acres (8 percent) are ''meeting'' the standard; 51,314 acres (17 percent) are ''moving towards'' meeting the standard; 187,387 acres (63 percent) are ''not meeting'' the standard; and 33,472 acres (11 percent) are of ''unknown'' status (BLM 2012, pp. 2–3).

This analysis indicates that, without taking into account habitat conditions on private lands and other Federal and State lands, at least 32 percent (187,387 acres ''not meeting'' standard four) of occupied Gunnison sage-grouse habitat in the Gunnison Basin (592,936 total ac) has diminished habitat conditions and likely a reduction in habitat quality for Gunnison sage-grouse.

Including those areas ''moving towards'' meeting LHA standard four (assuming conditions are less than optimal in these areas), overall habitat conditions for Gunnison sage-grouse may be worse than estimated above. Combining areas ''not meeting'' and ''moving toward'' standard four, as much as 81 percent (238,701 ac) of occupied habitat on BLM lands in the Gunnison Basin may have reduced habitat quality for Gunnison sage-grouse. Under these assumptions, as much as 40 percent (238,701 ac) of total occupied habitat in the Gunnison Basin (592,936 ac) may have reduced habitat quality for Gunnison sage-grouse. This estimate may be conservative since it assumes habitat conditions are being met for Gunnison sage-grouse in occupied habitat on the remaining, un-assessed (''unknown'') BLM lands as well as private, State, and other Federal lands in the Gunnison Basin.

In 2007 and 2008, the BLM Gunnison Field Office conducted Gunnison sage-grouse habitat assessments in two major occupied habitat locations in the Gunnison Basin population quantifying vegetation structural characteristics and plant species diversity. Data were collected and compared to Gunnison sage-grouse Structural Habitat Guidelines in the 2005 Rangewide Conservation Plan (RCP) (GSRSC, 2005, Appendix H) during optimal growing conditions in these two major occupied areas. Guidelines for sage cover, grass cover, forb cover, sagebrush height, grass height, and forb height were met in 45, 30, 25, 75, 81, and 39 percent, respectively, of 97 transects (BLM 2009, pp. 31–32). In addition, grazing has negatively impacted several Gunnison sage-grouse treatments (projects aimed at improving habitat condition) in the Gunnison Basin (BLM 2009, p. 34). Although these areas are generally rested from domestic livestock grazing for 2 years after treatment, several have been heavily used by cattle shortly after the treatment and the effectiveness of the treatments decreased (BLM 2009, p. 34), which reduced the potential benefits of the treatments.

As noted earlier, the USFS does not use the LHA process, but monitors allotment trends through a combination of procedures including seasonal inspections, permanent photo points, and inventory and mapping of plant community conditions and changes over time (USFS 2010). Three (9 percent) of the 35 USFS allotments in Gunnison sage-grouse occupied habitat in the Gunnison Basin population area have incorporated habitat objectives in their grazing plans. However, we have no specific data that evaluate allotment conditions as they relate to these objectives. Overall, USFS grazing allotments in the Gunnison Basin population area appear to be improving in forb and grass cover but are declining in sagebrush cover (USFS 2010).

All of this information indicates that grazing management has likely resulted in degraded habitat conditions for Gunnison sage-grouse in portions of the Gunnison Basin. Based on available LHA data for occupied habitat on BLM lands, 32 to 40 percent of total occupied habitat in the Gunnison Basin may have reduced habitat quality for Gunnison sage-grouse. This estimate may be conservative since it assumes habitat conditions are being met for Gunnison sage-grouse in occupied habitat on the remaining, un-assessed (''unknown'') BLM lands as well as private, State, and other Federal lands in the Gunnison Basin. Assuming conditions in occupied habitat on other lands are similar to those on BLM-administered lands, more than 40 percent of Gunnison sage-grouse occupied habitat in the Gunnison Basin may have reduced habitat conditions for Gunnison sage-grouse. Therefore, current and past livestock grazing may be negatively impacting the Gunnison Basin population.

However, the BLM has recently been modifying grazing permit terms and conditions in areas determined to be ''not meeting'' LHA standards through the permit renewal process. Examples of new permit terms or conditions required by the BLM include implementation of rotational grazing systems, deferment or elimination of grazing in certain pastures, reduced grazing duration (season of use), reduced stocking rates, fencing livestock out of riparian areas, or incorporating specific habitat objectives for Gunnison sage-grouse or other special status species (BLM 2012, pp. 1–2). It is anticipated that these changes will minimize further impacts to habitat and, in the future, improve degraded habitats for Gunnison sage-grouse in the Gunnison Basin, but there is no data at this time to substantiate this expectation.

Some data indicate habitat conditions within a portion of the Gunnison Basin may be favorable to Gunnison sage-grouse (Williams and Hild 2011, entire). Detailed vegetation monitoring was conducted on six study sites across the Gunnison Basin during the summer of 2010 in order to determine baseline habitat conditions for a potential future study of the effects of manipulating livestock grazing on Gunnison sage-grouse habitat (Williams and Hild 2011, entire). Transects were conducted on private, BLM, USFS, and CPW land. Results of this study indicated that, despite lower than average precipitation in the preceding year (2010), most vegetation measurements were within the structural habitat guidelines for Gunnison sage-grouse from the 2005 Rangewide Conservation Plan (GSRSC[b] 2005, pp. H–6–H–8). However, the study did not describe the extent of past or ongoing livestock grazing in these areas, nor did it compare un-grazed to grazed areas. Further, transect locations were prioritized and selected in areas used by radio-collared Gunnison sage-grouse. Therefore, the relationship between livestock grazing and habitat conditions is unclear, and the ability to infer conditions in other portions of the Gunnison Basin not prioritized for sampling is limited.

Federal Lands Grazing in All Other Population Areas—The BLM manages approximately 36 percent of the area currently occupied by Gunnison sage-grouse in the San Miguel Basin, and

approximately 79 percent of this area is actively grazed. Grazing certainly occurs on lands owned or managed by other entities, but we have no information on the extent of grazing in these areas. Within the occupied range in the San Miguel population, no active BLM grazing allotments have Gunnison sage-grouse habitat objectives incorporated into the allotment management plans or Records of Decision for permit renewals (USFWS 2010c, p. 9). In 2009, 10 of 15 (77 percent) active allotments had LHAs completed in the last 15 years, 4 of 10 allotments (40 percent) were deemed by the BLM to meet LHA objectives. Gunnison sage-grouse habitats within the 60 percent of allotments not meeting LHA objectives and the 5 allotments with no LHAs completed are likely impacted by grazing in the same manner and proportion. Therefore, it appears that grazing is reducing habitat quality for Gunnison sage-grouse in a large portion of this population area.

More than 81 percent of the area occupied by the Dove Creek group is privately owned. The BLM manages 11 percent of the occupied habitat, and 41 percent of this area is actively grazed. Within the occupied range in the Dove Creek group of the Monticello-Dove Creek population, no active BLM grazing allotments have Gunnison sage-grouse habitat objectives incorporated into the allotment management plans or Records of Decision for permit renewals (USFWS 2010c, p. 3). In 2009, no active allotments in occupied habitat had completed LHAs. Gunnison sage-grouse are not explicitly considered in grazing management planning and the lack of habitat data limits our ability to determine the impact to the habitat on public lands.

More than 95 percent of the area occupied by the Monticello group is privately owned. The BLM manages 4 percent of the occupied habitat, and 83 percent of this area is grazed. Within the occupied range in the Monticello group, all 6 active BLM grazing allotments have Gunnison sage-grouse habitat objectives incorporated into the allotment management plans or Records of Decision for permit renewals (USFWS 2010c, p. 6). In 2009, 88 percent of the area of occupied habitat in active allotments had a recently completed LHA. Approximately 60 percent of the area in occupied habitat in active allotments was deemed by the BLM to meet LHA objectives. Given the small amount of land managed by the BLM in this area, this information suggests that grazing the majority of lands managed by the BLM is likely not contributing to Gunnison sage-grouse habitat degradation in the Monticello population group.

Grazing certainly occurs on lands owned or managed by other entities but we have no information on the extent of grazing in these areas. Livestock grazing on private lands, where present, has a greater potential to impact Gunnison sage-grouse; however, we lack information to make an assessment. Conservation Reserve Program (CRP) land has provided a considerable amount of brood-rearing habitat in the Monticello group because of its forb component. Grazing of CRP land in Utah occurred in 2002 under emergency Farm Bill provisions due to drought and removed at least some of the grass and forb habitat component, thus likely negatively affecting Gunnison sage-grouse chick survival. Radio-collared males and non-brood-rearing females exhibited temporary avoidance of grazed fields during and after grazing (Lupis *et al.* 2006, pp. 959–960), although one hen with a brood continued to use a grazed CRP field.

The BLM manages 28 percent of occupied habitat in the Piñon Mesa population area, and approximately 97 percent of this area is grazed. Over 50 percent of occupied habitat in this population area is privately owned, and while grazing certainly occurs on these lands, we have no information on its extent. Within the occupied range in the Piñon Mesa population, 8 of 15 (53 percent) active BLM grazing allotments have Gunnison sage-grouse habitat objectives incorporated into the allotment management plans or Records of Decision for permit renewals (USFWS 2010c, p. 5). In 2009, 23 percent of the area of occupied Gunnison sage-grouse habitat in active allotments in the Piñon Mesa population area had LHAs completed in the last 15 years, and all of these were deemed by the BLM to meet LHA objectives. Therefore, for the portion of the Piñon Mesa population area for which we have information, it appears that grazing is managed in a manner consistent with Gunnison sage-grouse habitat requirements.

Over 76 percent of the area occupied by the Cerro Summit-Cimarron-Sims Mesa population area is privately owned. The BLM manages only 13 percent of the occupied habitat, and 83 percent of this area is grazed. Within the occupied range in the Cerro Summit-Cimarron-Sims Mesa population, 1 of 10 active BLM grazing allotments have Gunnison sage-grouse habitat objectives incorporated into the allotment management plans or Records of Decision for permit renewals (USFWS 2010c, p. 7). In 2009, of the 10 active allotments, 5 had LHAs completed in the last 15 years, and 3 of these were deemed by the BLM as not meeting LHA objectives. Therefore, for the small portion of the Cerro Summit-Cimarron-Sims Mesa population area for which we have information, it appears that grazing is reducing habitat quality for Gunnison sage-grouse in portions of this population area. Grazing certainly occurs on lands owned or managed by other entities but we have no information on the extent of grazing in these areas. Livestock grazing on private lands, where present, has a greater potential to impact Gunnison sage-grouse because these areas are not required to meet agency-mandated land health standards. Because we lack information on how these lands are managed; we assume that impacts to Gunnison sage-grouse from grazing are similar to the BLM lands.

Lands administered by the BLM and NPS comprise over 75 percent of occupied habitat in the Crawford population, and 96 percent of this area is actively grazed. Grazing allotments on NPS lands in this area are administered by the BLM. Within occupied range in the Crawford population, 1 of 7 active BLM grazing allotments have Gunnison sage-grouse habitat objectives incorporated into the allotment management plans or Records of Decision for permit renewals (USFWS 2010c, p. 8). In 2009, all of the active allotments had LHAs completed in the last 15 years, and 86 percent met LHA objectives. In addition, seasonal forage utilization levels were below 30 percent in most Crawford population allotments, although a small number of allotments had nearly 50 percent utilization (BLM 2009, p. 68). Based on this information, it appears that grazing is managed in a manner consistent with Gunnison sage-grouse conservation in the majority of the Crawford population area.

The BLM manages nearly half of occupied habitat in the Poncha Pass population area, and approximately 98 percent of this area is actively grazed. Within the occupied range in the Poncha Pass population, 1 of 8 active BLM grazing allotments have Gunnison sage-grouse habitat objectives incorporated into the allotment management plans or Records of Decision for permit renewals (USFWS 2010c, p. 4). In 2009, all active allotments in occupied habitat had completed LHAs and all were meeting LHA objectives. Based on this information it appears that grazing is managed in a manner consistent with Gunnison sage-grouse conservation in the majority of the Poncha Pass population area.

Wild Ungulate Herbivory in All Population Areas—Overgrazing by deer and elk may cause local degradation of habitats by removal of forage and residual hiding and nesting cover. Hobbs *et al.* (1996, pp. 210–213) documented a decline in available perennial grasses as elk densities increased. Such grazing could negatively impact nesting cover for sage-grouse. The winter range of deer and elk overlaps the year-round range of the Gunnison sage-grouse. Excessive but localized deer and elk grazing has been documented in the Gunnison Basin (BLM 2005a, pp. 17–18; Jones 2005, pers. comm.).

Grazing by deer and elk occurs in all Gunnison sage-grouse population areas. Although we have no information indicating that competition for resources is limiting Gunnison sage-grouse in the Gunnison Basin, BLM observed that certain mountain shrubs were being browsed heavily by wild ungulates (BLM 2009, p. 34). Subsequent results of monitoring in mountain shrub communities indicated that drought and big game were having large impacts on the survivability and size of mountain mahogany *(Cercocarpus utahensis),* bitterbrush *(Purshia tridentata),* and serviceberry *(Amelanchier alnifolia)* in the Gunnison Basin (Jupuntich *et al.* 2010, pp. 7–9). The authors raised concerns that observed reductions in shrub size and vigor will reduce drifting snow accumulation resulting in decreased moisture availability to grasses and forbs during the spring melt. Reduced grass and forb growth could negatively impact Gunnison sage-grouse nesting and early brood-rearing habitat.

Domestic Grazing and Wild Ungulate Herbivory Summary

Livestock management and domestic grazing have the potential to degrade Gunnison sage-grouse habitat. Grazing can adversely impact nesting and brood-rearing habitat by decreasing vegetation available for concealment from predators. Grazing also has been shown to compact soils, decrease herbaceous abundance, increase erosion, and increase the probability of invasion of exotic plant species (GSRSC 2005, p. 173).

The impacts of livestock operations on Gunnison sage-grouse depend upon stocking levels and season of use. We recognize that not all livestock grazing results in habitat degradation, and many livestock operations within the range of Gunnison sage-grouse are employing innovative grazing strategies and conservation actions (BLM 2012, pp. 1–2; Gunnison County Stockgrowers 2009, entire) in collaboration with the BLM and Forest Service. As discussed above, habitat conditions are likely favorable to Gunnison sage-grouse in a portion of the Gunnison Basin (Williams and Hild 2011, entire), although the extent of livestock grazing in those areas is unknown.

Available information suggests that LHA objectives important to Gunnison sage-grouse are not being met across portions of the species' range and that livestock grazing is contributing to those conditions. Reduced habitat quality in those areas, as reflected in unmet LHA objectives, is likely negatively impacting Gunnison sage-grouse in most of the populations, including the Gunnison Basin. However, the relationship between LHA determinations and the effects of domestic livestock grazing on Gunnison sage-grouse is imprecise.

We know that grazing can have negative impacts to sagebrush and consequently to Gunnison sage-grouse at local scales. Impacts to sagebrush plant communities as a result of grazing are occurring on a large portion of the range of the species. Given the widespread nature of grazing within the range of Gunnison sage-grouse, the potential for population-level impacts is likely. We expect grazing to persist throughout the range of Gunnison sage-grouse for at least several decades. Effects of domestic livestock grazing are likely being exacerbated by intense browsing of woody species by wild ungulates in portions of the Gunnison Basin. Habitat degradation that can result from improperly managed grazing, particularly with the interacting factors of invasive weed expansion and climate change, is a threat to Gunnison sage-grouse persistence.

Fences

The effects of fencing on sage-grouse include direct mortality through collisions, creation of raptor and corvid perch sites, the potential creation of predator corridors along fences (particularly if a road is maintained next to the fence), incursion of exotic species along the fencing corridor, and habitat fragmentation (Call and Maser 1985, p. 22; Braun 1998, p. 145; Connelly *et al.* 2000a, p. 974; Beck *et al.* 2003, p. 211; Knick *et al.* 2003, p. 612; Connelly *et al.* 2004, p. 1–2).

Sage-grouse frequently fly low and fast across sagebrush flats, and fences can create a collision hazard resulting in direct mortality (Call and Maser 1985, p. 22; Christiansen 2009, pp. 1–2). Not all fences present the same mortality risk to sage-grouse. Mortality risk appears to be dependent on a combination of factors including design of fencing, landscape topography, and spatial relationship with seasonal habitats (Christiansen 2009, pp. 1–2). This variability in fence mortality rate and the lack of systematic fence monitoring make it difficult to determine the magnitude of direct strike mortality impacts to sage-grouse populations; however, in some cases the level of mortality is likely significant to localized areas within populations. Greater sage-grouse fence collisions during the breeding season in Idaho were found to be relatively common and widespread, with collisions being influenced by the technical attributes of the fences, fence length and density, topography, and distance to nearest active sage-grouse lek (Stevens 2011, pp. 102–107). We assume that Gunnison sage-grouse are also killed by fences but do not have species-specific data.

Although the effects of direct strike mortality on populations are not fully analyzed, fences are generally ubiquitous across the landscape. At least 1,540 km (960 mi) of fence are on BLM lands within the Gunnison Basin (Borthwick 2005b, pers. comm.; BLM 2005a, 2005e) and an unquantified amount of fence is located on land owned or managed by other landowners. Fences are present within all other Gunnison sage-grouse population areas, but we have no quantitative information on the amount or types of fencing in these areas.

Fence posts create perching places for raptors and corvids, which may increase their ability to prey on sage-grouse (Braun 1998, p. 145; Oyler-McCance *et al.* 2001, p. 330; Connelly *et al.* 2004, p. 13–12). This is particularly significant for sage-grouse reproduction because corvids were responsible for more than 50 percent of nest predations in Nevada (Coates 2007, pp. 26–30). 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, p. 145). We anticipate that the effect on sage-grouse populations through the creation of new raptor perches and predator corridors into sagebrush habitats is similar to that of powerlines discussed above (Braun 1998, p. 145; Connelly *et al.* 2004, p. 7–3). Because of similarities in behavior and habitat use, the response of Gunnison sage-grouse should be similar to that observed in greater sage-grouse.

Summary of Fences

Fences contribute to habitat fragmentation and increase the potential for loss of individual grouse through collisions or enhanced predation. We expect that the majority of existing

fences will remain on the landscape indefinitely. In the smaller Gunnison sage-grouse populations, fencing is another source of mortality that cumulatively affects the ability of the species to persist. We also recognize that fences are located throughout all Gunnison sage-grouse populations and are, therefore, contributing to the fragmentation of remaining habitat and are a source of mortality within all populations. For these reasons, fences may be another factor contributing to the decline of Gunnison sage-grouse, both directly and indirectly. However, we have no specific data on the scope of this threat.

Invasive Plants

For the purposes of this proposed rule, we define invasive plants as those that are not native to an ecosystem and that have a negative impact on Gunnison sage-grouse habitat. Invasive plants alter native plant community structure and composition, productivity, nutrient cycling, and hydrology (Vitousek 1990, p. 7) and may cause declines in native plant populations through competitive exclusion and niche displacement, among other mechanisms (Mooney and Cleland 2001, p. 5446). Invasive plants reduce and can eliminate vegetation that sage-grouse use for food and cover. Invasive plants do not provide quality sage-grouse habitat. Sage-grouse depend on a variety of native forbs and the insects associated with them for chick survival, and on sagebrush, which is used exclusively throughout the winter for food and cover.

Along with replacing or removing vegetation essential to sage-grouse, invasive plants fragment existing sage-grouse habitat. They can create long-term changes in ecosystem processes, such as fire-cycles (see discussion under Fire below) and other disturbance regimes that persist even after an invasive plant is removed (Zouhar *et al.* 2008, p. 33). A variety of nonnative annuals and perennials are invasive to sagebrush ecosystems (Connelly *et al.* 2004, pp. 7–107 and 7–108; Zouhar *et al.* 2008, p 144). Cheatgrass is considered most invasive in Wyoming big sagebrush communities (Connelly *et al.* 2004, p. 5–9). Other invasive plants found within the range of Gunnison sage-grouse that are reported to take over large areas include: Spotted knapweed *(Centaurea maculosa),* Russian knapweed *(Acroptilon repens),* oxeye daisy *(Leucanthemum vulgare),* yellow toadflax *(Linaria vulgaris),* and field bindweed *(Convolvulus arvensis)* (BLM 2009, p. 28, 36; Gunnison Watershed Weed Commission (GWWC) 2009, pp. 4–6).

Although not yet reported to create large expanses in the range of Gunnison sage-grouse, the following weeds are also known from the species' range and have successfully invaded large expanses in other parts of western North America: Diffuse knapweed *(Centaurea diffusa),* whitetop *(Cardaria draba),* jointed goatgrass *(Aegilops cylindrica),* and yellow starthistle *(Centaurea solstitialis).* Other invasive plant species present within the range of Gunnison sage-grouse that are problematic yet less likely to overtake large areas include: Canada thistle *(Cirsium arvense),* musk thistle *(Carduus nutans),* bull thistle *(Cirsium vulgare),* houndstongue *(Cynoglossum officinale),* black henbane *(Hyoscyamus niger),* common tansy *(Tanacetum vulgare),* and absinth wormwood *(A. biennis)* (BLM 2009, p. 28, 36; GWWC 2009, pp. 4–6).

Cheatgrass impacts sagebrush ecosystems by potentially shortening fire intervals from several decades, depending on the type of sagebrush plant community and site productivity, to as low as 3 to 5 years, perpetuating its own persistence and intensifying the role of fire (Whisenant 1990, p. 4). Cheatgrass presence can shorten fire intervals to less than 10 years resulting in the elimination of shrub cover and reducing the availability and quality of forb cover (Connelly *et al.* 2004, p. 7–5). As discussed in the climate change section below, temperature increases may increase the competitive advantage of cheatgrass in higher elevation areas (such as the range of the Gunnison sage-grouse) where its current distribution is limited (Miller *et al.* 2011, pp. 181–183). Decreased summer precipitation reduces the competitive advantage of summer perennial grasses, reduces sagebrush cover, and subsequently increases the likelihood of cheatgrass invasion (Bradley 2009, pp. 202–204; Prevey *et al.* 2009, p. 11). This change could increase the susceptibility of sagebrush areas in Utah and Colorado to cheatgrass invasion (Bradley 2009, p. 204).

A variety of restoration and rehabilitation techniques are used to treat invasive plants, but they can be costly and are mostly unproven and experimental at a large scale. In the last 100 years, no broad-scale cheatgrass eradication method has been developed. Habitat treatments that either disturb the soil surface or deposit a layer of litter increase cheatgrass establishment in the Gunnison Basin when a cheatgrass seed source is present (Sokolow 2005, p. 51). Therefore, researchers recommend using habitat treatment tools, such as brush mowers, with caution and suggest that treated sites should be monitored for increases in cheatgrass emergence (Sokolow 2005, p. 49).

Invasive Plants in the Gunnison Basin Population Area—Quantifying the total amount of Gunnison sage-grouse habitat impacted by invasive plants is difficult due to differing sampling methodologies, incomplete sampling, inconsistencies in species sampled, and varying interpretations of what constitutes an infestation (Miller *et al.,* 2011, pp. 155–156). Cheatgrass has invaded areas in Gunnison sage-grouse range, supplanting sagebrush habitat in some areas (BLM 2009, p. 60). However, we do not have a reliable estimate of the amount of area occupied by cheatgrass in the range of Gunnison sage-grouse. While not ubiquitous, cheatgrass is found at numerous locations throughout the Gunnison Basin (BLM 2009, p. 60). Cheatgrass infestation within a particular area can range from a small number of individuals scattered sparsely throughout a site, to complete or near-complete understory domination of a site. Cheatgrass has increased throughout the Gunnison Basin in the last decade and is becoming increasingly detrimental to sagebrush community types (BLM 2009, p. 7). Currently in the Gunnison Basin, cheatgrass attains site dominance most often along roadways; however, other highly disturbed areas have similar cheatgrass densities. Cheatgrass is currently present in almost every grazing allotment in Gunnison sage-grouse occupied habitat and other invasive plant species, such as Canada thistle, black henbane, spotted knapweed, Russian knapweed, Kochia, bull thistle, musk thistle, oxeye daisy, yellow toadflax and field bindweed, are found in riparian areas and roadsides throughout the Gunnison Basin (BLM 2009, p. 7).

Although disturbed areas most often contain the highest cheatgrass densities, cheatgrass can readily spread into less disturbed and even undisturbed habitat. A strong indicator for future cheatgrass invasion is the proximity to current locations (Bradley and Mustard 2006, p. 1146) as well as summer, annual, and spring precipitation, and winter temperature (Bradley 2009, p. 196). Although we lack the information to make a detailed determination on the actual extent or rate of increase, given its invasive nature, it appears that cheatgrass and its negative influence on Gunnison sage-grouse will increase in the Gunnison Basin in the future because of potential exacerbation from climate change interactions and the

limited success of broad-scale control efforts. Based on experience from other areas in sagebrush ecosystems concerning the rapid spread of cheatgrass and the shortened fire return intervals that can result, the spread of cheatgrass within Gunnison sage-grouse habitat and the likely negative effects to Gunnison sage-grouse populations will increase.

Invasive Plants in All Other Population Areas—Cheatgrass is present throughout much of the current range in the San Miguel Basin (BLM 2005c, p. 6), but is most abundant in the Dry Creek Basin group (CDOW 2005, p. 101), which comprises 62 percent of the San Miguel Basin population. It is present in the five Gunnison sage-grouse subpopulations east of Dry Creek Basin, although at much lower densities that do not currently pose a serious threat to Gunnison sage-grouse (CDOW 2005, p. 101). Invasive species are present at low levels in the Monticello group (San Juan County GSGWG 2005, p. 20). However, there is no evidence that they are affecting the population.

Cheatgrass dominates 10–15 percent of the sagebrush understory in the current range of the Piñon Mesa population (Lambeth 2005, pers. comm.). It occurs in the lower elevation areas below Piñon Mesa that were formerly Gunnison sage-grouse range. Cheatgrass invaded two small prescribed burns in or near occupied habitat conducted in 1989 and 1998 (BLM 2005d, p. 6), and continues to be a concern with new ground-disturbing projects. Invasive plants, especially cheatgrass, occur primarily along roads, other disturbed areas, and isolated areas of untreated vegetation in the Crawford population. The threat of cheatgrass may be greater to sage-grouse than all other nonnative species combined and could be a major limiting factor when and if disturbance is used to improve habitat conditions, unless mitigated (BLM 2005c, p. 6).

Within the Piñon Mesa Gunnison sage-grouse population area, 520 ha (1,284 ac) of BLM lands are currently mapped with cheatgrass as the dominant species (BLM 2009, p. 3). This is not a comprehensive inventory of cheatgrass occurrence, as it only includes areas where cheatgrass dominates the plant community and does not include areas where the species is present at lower densities. Cheatgrass distribution has not been comprehensively mapped for the Monticello-Dove Creek population area; however, cheatgrass is beginning to be assessed on a site-specific and project-level basis. No significant invasive plant occurrences are currently known in the Poncha Pass population area.

Summary of Invasive Plants

Invasive plants negatively impact Gunnison sage-grouse primarily by reducing or eliminating native vegetation that sage-grouse require for food and cover, resulting in habitat loss and fragmentation. Although invasive plants, especially cheatgrass, have affected some Gunnison sage-grouse habitat, the impacts do not currently appear to be threatening individual populations or the species rangewide. However, invasive plants continue to expand their range, facilitated by ground disturbances such as fire, grazing, and human infrastructure. Climate change will likely alter the range of individual invasive species, increasing fragmentation and habitat loss of sagebrush communities. Even with treatments, given the history of invasive plants on the landscape, and our continued inability to control such species, invasive plants will persist and will likely continue to spread throughout the range of the species indefinitely. Therefore, invasive plants and associated increased fire risk will be on the landscape indefinitely. Although currently not a major threat to the persistence of Gunnison sage-grouse at the species level, we anticipate invasive species to become an increasing threat to the species in the future, particularly when considered in conjunction with future climate projections and potential changes in sagebrush plant community composition and dynamics.

Fire

The nature of historical fire patterns in sagebrush communities, particularly in Wyoming big sagebrush, is not well understood, and a high degree of variability likely occurred (Miller and Eddleman 2000, p. 16; Zouhar *et al.* 2008, p. 154; Baker 2011, p. 195). In general, mean fire return intervals in low-lying, xeric (dry) big sagebrush communities range from over 100 to 350 years, and return intervals decrease from 50 to over 200 years in more mesic (wet) areas, at higher elevations, during wetter climatic periods, and in locations associated with grasslands (Baker 2006, p. 181; Mensing *et al.* 2006, p. 75; Baker 2011, pp. 194–195; Miller *et al.* 2011, p. 166).

Mountain big sagebrush, the most important and widespread sagebrush species for Gunnison sage-grouse, is killed by fire and can require decades to recover. In nesting and wintering sites, fire causes direct loss of habitat due to reduced cover and forage (Call and Maser 1985, p. 17). While there may be limited instances where burned habitat is beneficial, these gains are lost if alternative sagebrush habitat is not readily available (Woodward 2006, p. 65). As we describe above in the Current Distribution and Population Estimates section, little alternative habitat is available for Gunnison sage-grouse, so beneficial effects of fire are highly unlikely.

Herbaceous understory vegetation plays a critical role throughout the breeding season as a source of forage and cover for Gunnison sage-grouse females and chicks. The response of herbaceous understory vegetation to fire varies with differences in species composition, pre-burn site condition, fire intensity, and pre- and post-fire patterns of precipitation. In general, when not considering the synergistic effects of invasive species, any beneficial short-term flush of understory grasses and forbs is lost after only a few years and little difference is apparent between burned and unburned sites (Cook *et al.* 1994, p. 298; Fischer *et al.* 1996a, p. 196; Crawford 1999, p. 7; Wrobleski 1999, p. 31; Nelle *et al.* 2000, p. 588; Paysen *et al.* 2000, p. 154; Wambolt *et al.* 2001, p. 250). In addition to altering plant community structure through shrub removal and potential weed invasion, fires can influence invertebrate food sources (Schroeder *et al.* 1999, p. 5). However, because few studies have been conducted and the results of those available vary, the specific magnitude and duration of the effects of fire on insect communities is still uncertain.

The invasion of the exotic annual grass cheatgrass increases fire frequency within the sagebrush ecosystem (Zouhar *et al.* 2008, p. 41; Miller *et al.* 2011, p. 170). Cheatgrass readily invades sagebrush communities, especially disturbed sites, and changes historical fire patterns by providing an abundant and easily ignitable fuel source that facilitates fire spread. While sagebrush is killed by fire and is slow to reestablish, cheatgrass recovers within 1 to 2 years of a fire event (Young and Evans 1978, p. 285). This annual recovery leads to a readily burnable fuel source and ultimately a reoccurring fire cycle that prevents sagebrush reestablishment (Eiswerth *et al.* 2009, p. 1324). The extensive distribution and highly invasive nature of cheatgrass poses substantial increased risk of fire and permanent loss of sagebrush habitat, as areas disturbed by fire are highly susceptible to further invasion and ultimately habitat conversion to an altered community state. For example, Link *et al.* (2006, p. 116) show that risk of fire increases from approximately 46

to 100 percent when ground cover of cheatgrass increases from 12 to 45 percent or more. We do not have a reliable estimate of the amount of area occupied by cheatgrass in the range of Gunnison sage-grouse. However, cheatgrass is found at numerous locations throughout the Gunnison Basin (BLM 2009, p. 60).

A clear positive response of Gunnison or greater sage-grouse to fire has not been demonstrated (Braun 1998, p. 9). The few studies that have suggested fire may be beneficial for greater sage-grouse were primarily conducted in mesic areas used for brood-rearing (Klebenow 1970, p. 399; Pyle and Crawford 1996, p. 323; Gates 1983, *in* Connelly *et al.* 2000c, p. 90; Sime 1991, *in* Connelly *et al.* 2000a, p. 972). In this type of habitat, small fires may maintain a suitable habitat mosaic by reducing shrub encroachment and encouraging understory growth. However, without available nearby sagebrush cover, the utility of these sites is questionable, especially within the six small Gunnison sage-grouse populations where fire could further degrade and fragment the remaining habitat.

Fire in the Gunnison Basin Population Area—Six prescribed burns have occurred on BLM lands in the Gunnison Basin since 1984, totaling approximately 409 ha (1,010 ac) (BLM 2009, p. 35). The fires created large sagebrush-free areas that were further degraded by poor post-burn livestock management (BLM 2005a, p. 13). As a result, these areas are no longer suitable as Gunnison sage-grouse habitat. Approximately 8,470 ha (20,930 ac) of prescribed burns occurred on Forest Service lands in the Gunnison Basin since 1983 (USFS 2009, p. 1). A small wildfire on BLM lands near Hartman Rocks burned 8 ha (20 ac) in 2007 (BLM 2009, p. 35). The total area of occupied Gunnison sage-grouse habitat burned in recent decades is approximately 8,887 ha (21,960 ac), which constitutes 1.5 percent of the occupied Gunnison sage-grouse habitat area. Cumulatively, this area equates to a relatively small amount of habitat burned over a period of nearly three decades. This information suggests that there has not been a demonstrated change in fire cycle in the Gunnison Basin population area to date.

Fire in All Other Population Areas—Two prescribed burns conducted in 1986 (105 ha (260 ac)) and 1992 (140 ha (350 ac)) on BLM land in the San Miguel Basin on the north side of Dry Creek Basin had negative impacts on sage-grouse. The burns were conducted for big game forage improvement, but the sagebrush died and was largely replaced with weeds (BLM 2005b, pp. 7–8). The Burn Canyon fire in the Dry Creek Basin and Hamilton Mesa areas burned 890 ha (2,200 ac) in 2000. Three fires have occurred in Gunnison sage-grouse habitat since 2004 on lands managed by the BLM in the Crawford, Cerro Summit-Cimarron-Sims Mesa, and San Miguel Basin population areas. There have been no fires since 2004 on lands managed by the BLM within the Monticello-Dove Creek population. Because these fires were mostly small in size, we do not believe they resulted in substantial impacts to Gunnison sage-grouse.

Several wildfires near or within the Piñon Mesa population area have occurred in the past 20 years. One fire burned a small amount of occupied Gunnison sage-grouse habitat in 1995, and several fires burned in potential Gunnison sage-grouse habitat. Individual burned areas ranged from 3.6 ha (9 ac) to 2,160 ha (5,338 ac). A wildfire in 2009 burned 1,053 ha (2,602 ac), predominantly within vacant or unknown Gunnison sage-grouse habitat (suitable habitat for sage-grouse that is separated from occupied habitats that has not been adequately inventoried, or without recent documentation of grouse presence) near the Piñon Mesa population. Since 2004, a single 2.8-ha (7-ac) wildfire occurred in the Cerro Summit-Cimarron-Sims Mesa population area, and two prescribed fires, both less than 12 ha (30 ac), were implemented in the San Miguel population area. There was no fire activity within occupied Gunnison sage-grouse habitat in the last two decades in the Poncha Pass population area (CDOW 2009b, pp. 125–126) or the Monticello-Dove Creek population area (CDOW 2009b, p. 75; UDWR 2009, p. 5). Because fires have burned primarily outside of occupied Gunnison sage-grouse habitat in the Piñon Mesa population area and fire has been recently absent or minimal in most other population areas, fire has not resulted in substantial impacts to Gunnison sage-grouse in these population areas.

Summary of Fire

Fires can cause the proliferation of weeds and can degrade suitable sage-grouse habitat, which may not recover to suitable conditions for decades, if at all (Pyke 2011, p. 539). Recent fires in Gunnison sage-grouse habitat were mostly small in size and did not result in substantial impacts to Gunnison sage-grouse, and there has been no obvious change in fire cycle in any Gunnison sage-grouse population area to date. Therefore, we do not consider fire to be a threat to the persistence of Gunnison sage-grouse at this time. We do not have the information to predict the extent or location of future fire events. However, the best available data indicates that fire frequency may increase in the future as cheatgrass continues to encroach on the sagebrush habitat and with the projected effects of climate change (see Invasive Plants and Climate Change discussions, above and below, respectively). Fire is, therefore, likely to become a threat to the persistence of Gunnison sage-grouse in the future.

Climate Change

Our analyses under the Endangered Species Act include consideration of ongoing and projected changes in climate. The terms ''climate'' and ''climate change'' are defined by the Intergovernmental Panel on Climate Change (IPCC). ''Climate'' refers to the mean and variability of different types of weather conditions over time, with 30 years being a typical period for such measurements, although shorter or longer periods also may be used (IPCC 2007, p. 78). The term ''climate change'' thus refers to a change in the mean or variability of one or more measures of climate (e.g., temperature or precipitation) that persists for an extended period, typically decades or longer, whether the change is due to natural variability, human activity, or both (IPCC 2007, p. 78). Various types of changes in climate can have direct or indirect effects on species. These effects may be positive, neutral, or negative and they may change over time, depending on the species and other relevant considerations, such as the effects of interactions of climate with other variables (e.g., habitat fragmentation) (IPCC 2007, pp. 8–14, 18–19). In our analyses, we use our expert judgment to weigh relevant information, including uncertainty, in our consideration of various aspects of climate change.

According to the Intergovernmental Panel on Climate Change (IPCC), ''Warming of the climate system in recent decades is unequivocal, as is now evident from observations of increases in global average air and ocean temperatures, widespread melting of snow and ice, and rising global sea level'' (IPCC 2007, p. 1). Average Northern Hemisphere temperatures during the second half of the 20th century were very likely higher than during any other 50-year period in the last 500 years and likely the highest in at least the past 1,300 years (IPCC 2007, p. 30). Over the past 50 years cold days, cold nights, and frosts have become less frequent over most land areas, and hot days and hot nights have become more

frequent. Heat waves have become more frequent over most land areas, and the frequency of heavy precipitation events has increased over most areas (IPCC 2007, p. 30).

For the southwestern region of the United States, including western Colorado, warming is occurring more rapidly than elsewhere in the country (Karl *et al.* 2009, p. 129). Annual average temperature in west-central Colorado increased 3.6 °C (2 °F) over the past 30 years, but high variability in annual precipitation precludes the detection of long-term precipitation trends (Ray *et al.* 2008, p. 5). Under high greenhouse gas emission scenarios, future projections for the southwestern United States show increased probability of drought (Karl *et al.* 2009, pp. 129–134) and the number of days over 32 °C (90 °F) could double by the end of the century (Karl *et al.* 2009, p. 34). Climate models predict annual temperature increase of approximately 2.2 °C (4 °F) in the Southwest by 2050, with summers warming more than winters (Ray *et al.* 2008, p. 29). Projections also show declines in snowpack across the West with the most dramatic declines at lower elevations (below 2,500 m (8,200 ft)) (Ray *et al.,* p. 29).

Colorado's complex, mountainous topography results in a high degree of spatial variability across the State. As a result, localized climate projections are problematic for mountainous areas because current global climate models are unable to capture this variability at local or regional scales (Ray *et al.* 2008, pp. 7, 20). To obtain climate projections specific to the range of Gunnison sage-grouse, we requested a statistically downscaled model from the National Center for Atmospheric Research for a region covering western Colorado. The resulting projections indicate the highest probability scenario is that average summer (June through September) temperature could increase by 2.8 °C (5.1 °F), and average winter (October through March) temperature could increase by 2.2 °C (4.0 °F) by 2050 (University Corporation for Atmospheric Research (UCAR) 2009, pp. 1–15). Annual mean precipitation projections for Colorado are unclear; however, multimodel averages show a shift towards increased winter precipitation and decreased spring and summer precipitation (Ray *et al.* 2008, p. 34; Karl *et al.* 2009, p. 30). Similarly, the multimodel averages show the highest probability of a 5 percent increase in average winter precipitation and a 5 percent decrease in average spring-summer precipitation in 2050 (UCAR 2009, p. 15). It is unclear at this time whether or not the year 2050 predicted changes in precipitation and temperature will be of enough magnitude to significantly alter sagebrush plant community composition and dynamics.

For sagebrush, spring and summer precipitation comprises the majority of the moisture available to the species; thus, the interaction between reduced precipitation in the spring-summer growing season and increased summer temperatures will likely decrease growth of mountain big sagebrush. This could result in a significant long-term reduction in the distribution of sagebrush communities (Miller *et al.* 2011, pp. 171–174). In the Gunnison Basin, increased summer temperature was strongly correlated with reduced growth of mountain big sagebrush (Poore *et al.* 2009, p. 558). Based on these results and the likelihood of increased winter precipitation falling as rain rather than snow and the corresponding increase in evaporation and decrease in deep soil water recharge, Poore *et al* (2009, p. 559) predict decreased growth of mountain big sagebrush, particularly at the lower elevation limit of the species. Because Gunnison sage-grouse are sagebrush obligates, loss of sagebrush would result in a reduction of suitable habitat and negatively impact the species. The interaction of climate change with other stressors likely has impacted and will impact the sagebrush steppe ecosystem within which Gunnison sage-grouse occur.

Climate change is likely to alter fire frequency, community assemblages, and the ability of nonnative species to proliferate. Increasing temperature as well as changes in the timing and amount of precipitation will alter the competitive advantage among plant species (Miller *et al.* 2011, pp. 175–179), and may shift individual species and ecosystem distributions (Bachelet *et al.* 2001, p. 174). Temperature increases may increase the competitive advantage of cheatgrass in higher elevation areas where its current distribution is limited (Miller *et al.* 2011, p. 182). Decreased summer precipitation reduces the competitive advantage of summer perennial grasses, reduces sagebrush cover, and subsequently increases the likelihood of cheatgrass invasion (Prevey *et al.* 2009, p. 11). This impact could increase the susceptibility of areas within Gunnison sage-grouse range to cheatgrass invasion (Bradley 2009, p. 204), which would reduce the overall cover of native vegetation, reduce habitat quality, and potentially decrease fire return intervals, all of which would negatively affect the species.

Under drought conditions, plants generally are less vigorous and less successful in reproduction and may require several years to recover following drought (Weltzin *et al.* 2003, p. 946). Increased drought and shifts in the magnitude and timing of temperature and precipitation could reduce herbaceous and insect production within Gunnison sage-grouse habitats. A recent climate change vulnerability index applied to Gunnison sage-grouse ranked the species as ''highly vulnerable'' to modeled climate change by the year 2050 (The Nature Conservancy 2011, p. 11). The mechanism of this vulnerability was considered to be the degradation of high-quality brood-rearing habitat due to the loss of adequate moisture to maintain mesic meadows, springs, seeps, and riparian areas, as well as potential changes in the fire regime and subsequent loss of sagebrush cover. A reduction in the quality and amount of these resources will likely affect key demographic processes such as the productivity of breeding hens and survival of chicks and result in reduced population viability. The drought conditions from 1999 through 2003 were closely associated with reductions in the sizes of all populations, although population estimates did recover to pre-drought levels in some populations (CDOW 2009, entire). The small sizes of six of seven Gunnison sage-grouse populations make them particularly sensitive to stochastic fluctuations, and these fluctuations are exacerbated by drought (GSRSC 2005, p. G–22).

Summary of Climate Change

Climate change predictions are based on models with assumptions, and there are uncertainties regarding the magnitude of associated climate change parameters such as the amount and timing of precipitation and seasonal temperature changes. There is also uncertainty as to the magnitude of effects of predicted climate parameters on sagebrush plant community dynamics. These factors make it difficult to predict whether or to what extent climate change will affect Gunnison sage-grouse. We recognize that climate change has the potential to alter Gunnison sage-grouse habitat by facilitating an increase in the distribution of cheatgrass and concurrently increasing the potential for wildfires, and reducing herbaceous vegetation and insect production in drought years, which would have negative effects on Gunnison sage-grouse. We do not consider climate change to be a threat to the persistence of Gunnison sage-grouse at this time

because of the uncertainties described above. However, based on the best available information on climate change projections into the next 40 years, climate change has the potential to alter the distribution and extent of cheatgrass and sagebrush and associated fire frequencies, and key seasonal Gunnison sage-grouse food resources, and, therefore, is likely to become an increasingly important threat to the persistence of Gunnison sage-grouse.

Renewable Energy Development—Geothermal, Wind, Solar

Geothermal Energy Development—Geothermal energy production is similar to oil and gas development in that it requires surface exploration, exploratory drilling, field development, and plant construction and operation and likely results in similar degrees of direct and functional habitat loss. Wells are drilled to access the thermal source. This can require 3 weeks to 2 months of continuous drilling (Suter 1978, p. 3), which may cause disturbance to sage-grouse. The ultimate number of wells, and, therefore, potential loss of habitat, depends on the thermal output of the source and expected production of the plant (Suter 1978, p. 3). Pipelines are needed to carry steam or superheated liquids to the generating plant, which is similar in size to a coal- or gas-fired plant, resulting in further habitat destruction and indirect disturbance. Direct habitat loss occurs from well pads, structures, roads, pipelines and transmission lines, and impacts would be similar to those described below for oil and gas development. The development of geothermal energy requires intensive human activity during field development and operation, which could lead to habitat loss. Furthermore, geothermal development could cause toxic gas release. The type and effect of these gases depends on the geological formation in which drilling occurs (Suter 1978, pp. 7–9). The amount of water necessary for drilling and condenser cooling may be high. Local water depletions may be a concern if such depletions result in the loss or degradation of brood-rearing habitat.

Geothermal Energy in the Gunnison Basin Population Area—Approximately 87 percent of the entire occupied range of Gunnison sage-grouse, including the entire Gunnison Basin, is within a region of known geothermal potential (BLM and USFS 2010, p. 1). We have no information on the presence of active geothermal energy generation facilities; however, we are aware of three current applications for geothermal leases within the range of Gunnison sage-grouse. All of the applications are located in the Gunnison Basin in the same general vicinity on private, BLM, USFS, and Colorado State Land Board lands near Tomichi Dome and Waunita Hot Springs in southeastern Gunnison County. The cumulative area of the geothermal lease application parcels is approximately 4,061 ha (10,035 ac), of which approximately 3,802 ha (9,395 ac) is occupied Gunnison sage-grouse habitat, or approximately 2 percent of the Gunnison Basin population area.

One active lek and two inactive leks are located within the lease application parcels. In addition, six active leks and four inactive leks are within 6.4 km (4 mi) of the lease application parcels indicating that a high degree of seasonal use may occur within the area surrounding these leks (GSRSC 2005, p. J–4). There are 74 active leks in the Gunnison Basin population, so approximately 10 percent of active leks may be affected. A significant amount of high-quality Gunnison sage-grouse nesting habitat also exists on and near the lease application parcels (Aldridge *et al.* 2011, p. 9). If geothermal development occurs on the lease application parcels, it would likely negatively impact Gunnison sage-grouse through the direct loss of habitat and the functional loss of habitat resulting from increased human activity in the area. However, we cannot determine the potential extent of the impacts of such development at this time because the size and location of potential geothermal energy generation infrastructure and final resource protection conditions currently are unknown, nor do we know where potential geothermal developments might occur.

Geothermal Energy in All Other Population Areas—We could find no information on the presence of existing, pending, or authorized geothermal energy sites, nor any other areas with high potential for geothermal energy development, within any other Gunnison sage-grouse population area.

Wind Energy Development—Most published reports of the effects of wind development on birds focus on the risks of collision with towers or turbine blades. No published research is specific to the effects of wind farms on Gunnison or greater sage-grouse. However, the avoidance of human-made structures such as powerlines and roads by sage-grouse and other prairie grouse is documented (Holloran 2005, p. 1; Pruett *et al.* 2009, pp. 1255–1256). Renewable energy facilities, including wind power, typically require many of the same features for construction and operation as do nonrenewable energy resources. Therefore, we anticipate that potential impacts from direct habitat losses, habitat fragmentation through roads and powerlines, noise, and increased human presence (Connelly *et al.* 2004, pp. 7–40 to 7–41) will generally be similar to those discussed below for nonrenewable energy development.

Wind farm development begins with site monitoring and collection of meteorological data to accurately characterize the wind regime. Turbines are installed after the meteorological data indicate the appropriate siting and spacing. Roads are necessary to access the turbine sites for installation and maintenance. Each turbine unit has an estimated footprint of 0.4 to 1.2 ha (1 to 3 ac) (BLM 2005e, pp. 3.1–3.4). One or more substations may be constructed depending on the size of the farm. Substation footprints are 2 ha (5 ac) or less in size (BLM 2005e, p. 3.7).

The average footprint of a turbine unit is relatively small from a landscape perspective. Turbines require careful placement within a field to avoid loss of output from interference with neighboring turbines. Spacing improves efficiency but expands the overall footprint of the field. Sage-grouse populations are impacted by the direct loss of habitat, primarily from construction of access roads as well as indirect loss of habitat due to avoidance of the wind turbines. Sage-grouse could be killed by flying into turbine rotors or towers (Erickson *et al.* 2001, entire), although reported collision mortalities have been few. One sage-grouse was found dead within 45 m (148 ft) of a turbine on the Foote Creek Rim wind facility in south-central Wyoming, presumably from flying into a turbine (Young *et al.* 2003, Appendix C, p. 61). This is the only known sage-grouse mortality at this facility during three years of monitoring. We have no recent reports of sage-grouse mortality due to collision with a wind turbine; however, many facilities may not be monitored. No deaths of gallinaceous birds were reported in a comprehensive review of avian collisions and wind farms in the United States; the authors hypothesized that the average tower height and flight height of grouse, and diurnal migration habitats of some birds minimized the risk of collision (Johnson *et al.* 2000, pp. ii–iii; Erickson *et al.* 2001, pp. 8, 11, 14, 15).

Noise is produced by wind turbine mechanical operation (gear boxes, cooling fans) and airfoil interaction with the atmosphere. No published studies have focused specifically on the effects of wind power noise and Gunnison or greater sage-grouse. In studies

conducted in oil and gas fields, noise may have played a factor in habitat selection and decrease in greater sage-grouse lek attendance (Holloran 2005, pp. 49, 56). However, comparison between wind turbine and oil and gas operations is difficult based on the character of sound. Adjusting for manufacturer type and atmospheric conditions, the audible operating sound of a single wind turbine has been calculated as the same level as conversational speech at 1 m (3 ft) at a distance of 600 m (2,000 ft) from the turbine. This level is typical of background levels of a rural environment (BLM 2005e, p. 5–24). However, commercial wind farms do not have a single turbine, and multiple turbines over a large area would likely have a much larger noise print. Low-frequency vibrations created by rotating blades also produce annoyance responses in humans (van den Berg 2003, p. 1), but the specific effect on birds is not documented.

Moving blades of turbines cast moving shadows that cause a flickering effect producing a phenomenon called ''shadow flicker'' (AWEA 2008, p. 5–33). Shadow flicker could mimic predator shadows and elicit an avoidance response in birds during daylight hours, but this potential effect has not been investigated. However, greater sage-grouse hens with broods have been observed under turbines at Foote Creek Rim (Young 2004, pers. comm.).

Wind Energy in the Monticello Subpopulation Area—There appears to be an increasing interest in wind energy development in the vicinity of the Monticello subpopulation as two energy development companies have recently leased private properties for wind turbine construction (UDWR 2011, p. 3). We have no further information on potential plans for development, or the size or scope of any planned development. A 388-ha (960-ac) wind energy generation facility is also authorized on BLM lands in San Juan County, UT. However, the authorized facility is approximately 12.9 km (8 mi) from the nearest lek in the Monticello subpopulation.

The State of Utah recently completed a statewide screening study to identify geographic areas with a high potential for renewable energy development (UDNR 2009, entire). An approximately 80,200-ha (198,300-ac) area northwest of the city of Monticello, UT, was identified, with a high level of confidence, as a wind power production zone with a high potential for utility-scale wind development (production of greater than 500 megawatts) (UDNR 2009, p. 19). The mapped wind power production zone overlaps with nearly all Gunnison sage-grouse occupied habitat in the Monticello subpopulation, as well as the large area surrounding the perimeter of occupied habitat. The Monticello subpopulation is currently small (approximately 100 individuals).

Wind Energy in All Other Population Areas—We could find no information on the presence of existing, pending, or authorized wind energy sites, or any other areas with high potential for wind energy development within any other Gunnison sage-grouse population area.

Solar Energy Development—Current information does not indicate that solar energy development is under consideration in the Gunnison sage-grouse range, and, therefore, there is no information indicating that the species may be exposed to any threats posed by such development.

Summary of Renewable Energy Development

Because of the lack of information on future development, we do not consider renewable energy development to be a threat to the persistence of Gunnison sage-grouse at this time. However, geothermal energy development could increase in the Gunnison Basin in the future and could (depending on the level of development and minimization and mitigation measures) influence the overall long-term viability of the Gunnison Basin population. Similarly, wind energy development could increase in the future in the Monticello subpopulation, which may lead to further population declines in this already small population and could lead to the extirpation of this subpopulation. Because we have no information indicating the presence of existing, pending, or authorized solar energy sites, nor any solar energy study areas within the range of Gunnison sage-grouse, we do not consider solar energy to be a threat to Gunnison sage-grouse.

Nonrenewable Energy Development

Energy development on Federal (BLM and USFS) lands is regulated by the BLM and can contain conservation measures for wildlife species (see Factor D for a more thorough discussion). The BLM (1999a, p. 1) has classified the area encompassing all Gunnison sage-grouse habitat for its gas and oil potential. Two populations have areas with high oil and gas development potential (San Miguel Basin, Monticello-Dove Creek) or medium (Crawford) oil and gas potential, while the remaining populations are classified as low or none. San Miguel County, where much oil and gas activity has occurred in the last few years, ranked 9 out of 39 in Colorado counties producing natural gas in 2009 (Colorado Oil and Gas Conservation Commission 2010, p. 1) and 29 of 39 in oil production in 2009 (Colorado Oil and Gas Conservation commission 2010, p. 2).

Energy development impacts sage-grouse and sagebrush habitats through direct habitat loss from well pad construction, seismic surveys, roads, powerlines and pipeline corridors, and indirectly from noise, gaseous emissions, changes in water availability and quality, and human presence. The interaction and intensity of effects could cumulatively or individually lead to habitat fragmentation (Suter 1978, pp. 6–13; Aldridge 1998, p. 12; Braun 1998, pp. 144–148; Aldridge and Brigham 2003, p. 31; Knick *et al.* 2003, pp. 612, 619; Lyon and Anderson 2003, pp. 489–490; Connelly *et al.* 2004, pp. 7–40 to 7–41; Holloran 2005, pp. 56–57; Holloran 2007 *et al.,,* pp. 18–19; Aldridge and Boyce 2007, pp. 521–522; Walker *et al.* 2007a, pp. 2652–2653; Zou *et al.* 2006, pp. 1039–1040; Doherty *et al.* 2008, p. 193; Leu and Hanser 2011, pp. 270–271). Increased human presence resulting from oil and gas development can also impact sage-grouse either through avoidance of suitable habitat, or disruption of breeding activities (Braun *et al.* 2002, pp. 4–5; Aldridge and Brigham 2003, pp. 30–31; Aldridge and Boyce 2007, p. 518; Doherty *et al.* 2008, p. 194).

The development of oil and gas resources requires surveys for economically recoverable reserves, construction of well pads and access roads, subsequent drilling and extraction, and transport of oil and gas, typically through pipelines. Ancillary facilities can include compressor stations, pumping stations, electrical generators and powerlines (Connelly *et al.* 2004, p. 7–39; BLM 2007, p. 2–110). Surveys for recoverable resources occur primarily through noisy seismic exploration activities. These surveys can result in the crushing of vegetation. Well pads vary in size from 0.10 ha (0.25 ac) for coal-bed natural gas wells in areas of level topography to greater than 7 ha (17.3 ac) for deep gas wells and multi-well pads (Connelly *et al.* 2004, p. 7–39; BLM 2007, p. 2–123). Pads for compressor stations require 5–7 ha (12.4–17.3 ac) (Connelly *et al.* 2004, p. 7–39).

The amount of direct habitat loss within an area of oil and gas development is ultimately determined by well densities and the associated loss from ancillary facilities. Roads associated with oil and gas development were suggested to be the primary impact

to greater sage-grouse due to their persistence and continued use even after drilling and production ceased (Lyon and Anderson 2003, p. 489). Declines in male greater sage-grouse lek attendance were reported within 3 km (1.9 mi) of a well or haul road with a traffic volume exceeding one vehicle per day (Holloran 2005, p. 40). Because of reasons discussed previously, we believe the effects to Gunnison sage-grouse are similar to those observed in greater sage-grouse. Sage-grouse also may be at increased risk for collision with vehicles simply due to the increased traffic associated with oil and gas activities (Aldridge 1998, p. 14; BLM 2003, p. 4–222).

Habitat fragmentation resulting from oil and gas development infrastructure, including access roads, may have greater effects on sage-grouse than the associated direct habitat losses. Energy development and associated infrastructure works cumulatively with other human activity or development to decrease available habitat and increase fragmentation. Greater sage-grouse leks had the lowest probability of persisting (40–50 percent) in a landscape with less than 30 percent sagebrush within 6.4 km (4 mi) of the lek (Walker *et al.* 2007a, p. 2652). These probabilities were even less in landscapes where energy development also was a factor.

Nonrenewable Energy Development in All Population Areas—Approximately 33 percent of the Gunnison Basin population area ranked as low oil and gas potential with the remainder having no potential for oil and gas development (GSRSC 2005, p. 130). Nonrenewable energy production is currently taking place on 43 gas wells that occur on private lands within the occupied range of the Gunnison sage-grouse. Of these, 27 wells occur in the San Miguel population, 8 in the Gunnison Basin population, 6 in the Dove Creek group of the Monticello-Dove Creek population, and 1 in each of the Crawford and Cerro Summit-Cimarron-Sims Mesa populations (derived from Colorado Oil and Gas Commission 2010, GIS dataset).

No Federal lands leased for oil and gas development exist within the Gunnison Basin population area (BLM and USFS 2010). The Monticello group is in an area of high energy potential (GSRSC 2005, p. 130); however, less than two percent of the population area contains Federal leases that are currently in production, and no producing leases occur in currently occupied Gunnison sage-grouse habitat (BLM and USFS 2010). No oil and gas wells or authorized Federal leases are within the Piñon Mesa population area (BLM 2009, p. 1; BLM and USFS 2010), and no potential for oil or gas exists in this area except for a small area on the eastern edge of the largest habitat block (BLM 1999, p. 1; GSRSC 2005, p. 130). The Crawford population is in an area with medium potential for oil and gas development (GSRSC 2005, p. 130). A single authorized Federal lease (BLM and USFS 2010) constitutes less than 1 percent of the Crawford population area.

Energy development is occurring primarily in the San Miguel Basin population area in Colorado. The entire San Miguel Basin population area has high potential for oil and gas development (GSRSC 2005, p. 130). Approximately 13 percent of occupied habitat area within the San Miguel Basin population has authorized Federal leases; of that, production is occurring on approximately 5 percent of the lease area (BLM and USFS 2010). Currently, 25 gas wells are active within occupied habitat of the San Miguel Basin, and an additional 18 active wells occur immediately adjacent to occupied habitat (San Miguel County 2009, p. 1). All of these wells are in or near the Dry Creek group. The exact locations of any future drill sites are not known, but because the area is small, they will likely lie within 3 km (2 mi) of one of only three leks in this group (CDOW 2005, p. 108).

Since 2005, the BLM has deferred (temporarily withheld from recent lease sales) oil and gas parcels nominated for leasing in occupied Gunnison sage-grouse habitat in Colorado. Nonetheless, we expect energy development in the San Miguel Basin on public and private lands to continue over the next 20 years based on the length of development and production projects described in existing project and management plans. Current impacts from gas development may be negatively impacting a portion of the Dry Creek subpopulation because this area contains some of the poorest habitat and smallest grouse populations within the San Miguel population (SMBGSWG) 2009, pp. 28 and 36).

Summary of Nonrenewable Energy Development

The San Miguel Basin population area is the only area within the Gunnison sage-grouse range that currently has a moderate amount of oil and gas production. However, immediate impacts to Gunnison sage-grouse in this area, and the species range more generally, are limited because only 13 percent of occupied habitat in the San Miguel population area is currently leased and the Uncompahgre Field Office of the BLM (San Miguel, Crawford, and Cerro Summit-Cimarron-Sims Mesa populations) is deferring additional leases in this area and in the species' range more generally, until they can be considered within Land Use Plans (BLM 2009, p. 78). We recognize that the Dry Creek subpopulation may currently be impacted by nonrenewable energy development. However, nonrenewable energy activities are limited to a small portion of the range. While the San Miguel, Monticello-Dove Creek, and Crawford populations have high or medium potential for future development, the potential for future development is low throughout the remaining population areas, which represent the majority of the range of the species. Because of these localized impacts we do not consider nonrenewable energy development to be a threat to the long-term persistence of the species at this time. However, given the already small and fragmented nature of the populations where oil and gas leases are most likely to occur, additional development within occupied habitat would negatively impact those populations by causing additional actual and functional habitat loss and fragmentation.

Piñon-Juniper Encroachment

Piñon-juniper woodlands are a native habitat type dominated by piñon pine *(Pinus edulis)* and various juniper species *(Juniperus spp.)* that can encroach upon, infill, and eventually replace sagebrush habitat. Piñon-juniper extent has increased ten-fold in the Intermountain West since Euro-American settlement, causing the loss of many bunchgrass and sagebrush-bunchgrass communities (Miller and Tausch 2001, pp. 15–16). Piñon-juniper woodlands have also been expanding throughout portions of the range of Gunnison sage-grouse (BLM 2009, pp. 14, 17, 25), although we do not have information that quantifies this expansion. Piñon-juniper expansion has been attributed to the reduced role of fire, the introduction of livestock grazing, increases in global carbon dioxide concentrations, climate change, and natural recovery from past disturbance (Miller and Rose 1999, pp. 555–556; Miller and Tausch 2001, p. 15; Baker 2011, p. 199). In addition, Gambel oak invasion as a result of fire suppression also has been identified as a potential threat to Gunnison sage-grouse (CDOW 2002, p.139).

Similar to powerlines, trees provide perches for raptors, and as a consequence, Gunnison sage-grouse avoid areas with piñon-juniper (Commons *et al.* 1999, p. 239). The number of male Gunnison sage-grouse on leks in southwestern Colorado

doubled after piñon-juniper removal and mechanical treatment of mountain sagebrush and deciduous brush (Commons *et al.* 1999, p. 238).

Piñon-Juniper Encroachment in All Population Areas—The Gunnison Basin population area is not currently undergoing significant piñon-juniper encroachment. All other populations have some degree of documented piñon-juniper encroachment. A considerable portion of the Piñon Mesa population is undergoing piñon-juniper encroachment. Approximately 9 percent (1,140 ha [3,484 ac]) of occupied habitat in the Piñon Mesa population area have piñon-juniper coverage, while 7 percent (4,414 ha [10,907 ac)] of vacant or unknown and 13 percent (7,239 ha [17,888 ac]) of potential habitat (unoccupied habitats that could be suitable for occupation of sage-grouse if practical restoration were applied) have encroachment (BLM 2009, p. 17).

Some areas on lands managed by the BLM within other population areas are known to be undergoing piñon-juniper invasion. However, the extent of the area affected has not been quantified (BLM 2009, p. 74; BLM 2009, p. 9). Approximately 9 percent of the 1,300 ha (3,200 ac) of the current range in the Crawford population is classified as dominated by piñon-juniper (GSRSC 2005, p. 264). However, BLM (2005d, p. 8) estimates that as much as 20 percent of the population area is occupied by piñon-juniper. Piñon and juniper trees have been encroaching in peripheral habitat on Sims Mesa, and to a lesser extent on Cerro Summit, but not to the point where it is a serious threat to the Cerro Summit-Cimarron-Sims Mesa population area (CDOW 2009b, p. 47). Piñon and juniper trees are reported to be encroaching throughout the current range in the Monticello group, based on a comparison of historical versus current aerial photos, but no quantification or mapping of the encroachment has occurred (San Juan County GSWG 2005, p. 20). A relatively recent invasion of piñon and juniper trees between the Dove Creek and Monticello groups appears to be contributing to their isolation from each other (GSRSC 2005, p. 276).

Within the range of Gunnison sage-grouse, approximately 5,341 ha (13,197 ac) of piñon-juniper have been treated with various methods designed to remove piñon and juniper trees since 2005, and nearly half of which occurred in the Piñon Mesa population area (CDOW 2009b, pp. 111–113). Mechanical treatment of areas experiencing piñon-juniper encroachment continues to be one of the most successful and economical treatments for the benefit of Gunnison sage-grouse habitat. However, the effect of such treatments on Gunnison sage-grouse population numbers is unclear as the Gunnison sage-grouse population has declined over the past 11 years in the Piñon Mesa population area.

Summary of Piñon-Juniper Encroachment

Most Gunnison sage-grouse population areas are experiencing low to moderate levels of piñon-juniper encroachment; however, considerable piñon-juniper encroachment in the Piñon Mesa has occurred. The encroachment of piñon-juniper into sagebrush habitats contributes to the fragmentation of Gunnison sage-grouse habitat. However, piñon-juniper treatments, particularly when completed in the early stages of encroachment when the sagebrush and forb understory is still intact, have the potential to provide an immediate benefit to sage-grouse. Approximately 5,341 ha (13,197 ac) of piñon-juniper encroachment within the range of Gunnison sage-grouse has been treated. Based on the rate of past treatment efforts (CDOW 2009c, entire), we expect piñon-juniper encroachment and corresponding treatment efforts to continue. Although piñon-juniper encroachment is contributing to habitat fragmentation in a limited area, the level of encroachment is not sufficient to pose a threat to Gunnison sage-grouse at a population or rangewide level at this time. However, in combination with other factors such as those contributing to habitat fragmentation (roads, powerlines, invasive plants, etc.), piñon-juniper encroachment potentially poses a threat to the species.

Conversion to Agriculture

While sage-grouse may forage on agricultural croplands, they avoid landscapes dominated by agriculture (Aldridge *et al.* 2008, p. 991) and do not nest or winter in agricultural lands where shrub cover is lacking. Influences resulting from agricultural activities extend into adjoining sagebrush, and include increased predation and reduced nest success due to predators associated with agriculture (Connelly *et al.* 2004, p. 7–23). Agricultural conversion can provide some limited benefits for sage-grouse as some crops such as alfalfa *(Medicago sativa)* and young bean sprouts (*Phaseolus* spp.) are eaten or used for cover by Gunnison sage-grouse (Braun 1998, pers. comm.). However, crop monocultures do not provide adequate year-round food or cover (GSRSC 2005, pp. 22–30).

Current Agriculture in All Gunnison Sage-grouse Population Areas—The following estimates of land area dedicated to agriculture (including grass/forb pasture) were derived from SWReGAP landcover data (USGS 2004, entire). Agricultural parcels are distributed patchily amongst what was recently a sagebrush landscape. These agricultural parcels are likely used briefly by grouse to move between higher quality habitat patches. Habitat conversion to agriculture is most prevalent in the Monticello-Dove Creek population area where approximately 23,220 ha (57,377 ac) or 51 percent of Gunnison sage-grouse occupied range is currently in agricultural production. In the Gunnison Basin, approximately 20,754 ha (51,285 ac) or 9 percent of the occupied range is currently in agricultural production. Approximately 6,287 ha (15,535 ac) or 15 percent of the occupied range in the San Miguel Basin is currently in agricultural production. In the Cerro Summit-Cimarron-Sims Mesa population, approximately 14 percent (5,133 ha (2,077 ac)) of the occupied range is currently in agricultural production. Habitat conversion due to agricultural activities is limited in the Crawford, Piñon Mesa, and Poncha Pass populations, with 3 percent or less of the occupied range currently in agricultural production in each of the population areas.

Other than in Gunnison County, total area of harvested cropland has declined over the past two decades in all counties within the occupied range of Gunnison sage-grouse (USDA NASS 2010, entire). The majority of agricultural land use in Gunnison County is in hay production, which has declined over the past two decades (USDA NASS 2010, p. 1). We do not have any information that predicts changes in the amount of land devoted to agricultural purposes. However, because of this long-term trend in reduced land area devoted to agriculture, we do not expect a significant amount of Gunnison sage-grouse habitat to be converted to agricultural purposes in the future.

Conservation Reserve Program—The loss of Gunnison sage-grouse habitat to conversion to agriculture has been mitigated somewhat by the Conservation Reserve Program (CRP). The CRP is administered by the United States Department of Agriculture (USDA) Farm Service Agency (FSA), which provides incentives to agricultural landowners to plant more natural vegetation in lands previously devoted to agricultural uses. Except in emergency situations such as drought, CRP-enrolled lands are not hayed or grazed.

Lands within the occupied range of Gunnison sage-grouse enrolled into the CRP are limited to Dolores and San Miguel counties in Colorado, and San Juan County in Utah (USDA FSA 2010, entire). From 2000 to 2008, CRP enrollment averaged 10,622 ha (26,247 ac) in Dolores County, 1,350 ha (3,337 ac) in San Miguel County, and 14,698 ha (36,320 ac) in San Juan County (USDA FSA 2010, entire). In 2011, approximately 9,793 ha (24,200 ac) are enrolled in the CRP program within occupied Gunnison sage-grouse habitat in the Monticello portion of the Monticello-Dove Creek population (UDWR 2011, p. 7). This area represents approximately 34 percent of the occupied habitat in the Monticello portion of the Monticello-Dove Creek population and approximately 22 percent of the entire occupied population area. Lands that recently dropped out of the CRP program were replaced by newly enrolled properties and the total acreage of lands enrolled in the CRP program remains at the maximum allowed by the FSA for San Juan County, UT (UDWR 2011, p. 7).

In San Juan County, Gunnison sage-grouse use CRP lands in proportion to their availability (Lupis *et al.* 2006, p. 959). The CRP areas are used by grouse primarily as foraging and brood-rearing habitat, but these areas vary greatly in plant diversity and forb abundance, and generally lack any shrub cover (Lupis *et al.* 2006, pp. 959–960; Prather 2010, p. 32) and thus are of limited value for nesting and wintering habitat. In response to a severe drought, four CRP parcels totaling 1,487 ha (3,674 ac) in San Juan County, UT, were emergency grazed for a duration of one to two months in the summer of 2002 (Lupis 2006, p. 959). Male and broodless females avoided the grazed areas while cattle were present but returned after cattle were removed (Lupis *et al.* 2006, pp. 960–961). Thus, the direct effects of habitat avoidance are negative but relatively short in duration, but the potential long-term implications to Gunnison sage-grouse survival are unknown.

Largely as a result of agricultural conversion, sagebrush patches in the Monticello-Dove Creek subpopulation area have progressively become smaller and more fragmented, which has limited the amount of available nesting and winter habitat (GSRSC 2005, pp. 82, 276). Overall, the CRP has provided important foraging habitat and has protected a portion of the Monticello-Dove Creek population from more intensive agricultural use and development. However, the overall value of CRP lands is limited at this time because they largely lack sagebrush cover required by Gunnison sage-grouse throughout most of the year. A new CRP signup for individual landowners is not anticipated until 2012, and the extent to which existing CRP lands will be reenrolled is unknown (UDWR 2009, p. 4).

Summary of Conversion to Agriculture

Throughout the range of Gunnison sage-grouse, the amount of land area devoted to agriculture is declining. Therefore, although we expect most land currently in agricultural production to remain so indefinitely, we do not expect significant additional, future habitat conversion to agriculture within the range of Gunnison sage-grouse. The loss of sagebrush habitat from 1958 to 1993 was estimated to be approximately 20 percent throughout the range of Gunnison sage-grouse (Oyler-McCance *et al.* 2001, p. 326). The exception is the Monticello-Dove Creek population where more than half of the occupied range is currently in agriculture or other land uses incompatible with Gunnison sage-grouse conservation. This habitat loss is being somewhat mitigated by the current enrollment of lands in the CRP. Because of its limited extent, we do not consider future conversion of sagebrush habitats to agriculture to be a current or future threat to the persistence of Gunnison sage-grouse. However, the large scale of historic conversion of sagebrush to agriculture has fragmented the remaining Gunnison sage-grouse habitat to a degree that currently occupied lands do not provide the species with adequate protection from extinction, especially in light of other threats discussed throughout this proposed rule.

Water Development

Water Development in All Population Areas—Irrigation projects have resulted in loss of sage-grouse habitat (Braun 1998, p. 6). Reservoir development in the Gunnison Basin flooded 3,700 ha (9,200 ac), or 1.5 percent of likely sage-grouse habitat (McCall 2005, pers. comm.). Three other reservoirs inundated approximately 2 percent of habitat in the San Miguel Basin population area (Garner 2005, pers. comm.). We are unaware of any plans for additional reservoir construction. Because of the small amount of Gunnison sage-grouse habitat lost to water development projects and the unlikelihood of future projects, we do not consider water development alone to be a current or future threat to the persistence of Gunnison sage-grouse. However, we expect these existing reservoirs to be maintained indefinitely, thus acting as another source of fragmentation of Gunnison sage-grouse habitat that, in combination with other factors, potentially poses a threat to the species.

Candidate Conservation Agreement With Assurances (CCAA)

The CPW has been implementing the CCAA referenced earlier in this document. As of the fall of 2012, 14 landowners have completed Certificates of Inclusion (CI) for their properties, enrolling a total of 13,200 ha (32,619 ac). Because the Service issues a permit to applicants with an approved CCAA, we have some regulatory oversight over the implementation of the CCAA. However, permit holders and landowners can voluntarily opt out of the CCAA at any time. Other properties currently going through the CCAA process (a total of 11,563 ha (28,573 ac) in Gunnison sage-grouse occupied habitat) include two properties under final review (406 ha (1,004 ac)); 12 properties in progress (10,322 ha (25,507 ac)); and five properties with completed baseline reports (834 ha (2,062 ac)) (CPW 2012b, pp. 11–12). Baseline reports describe property infrastructure and number of acres of Gunnison sage-grouse seasonal habitat. A CPW review of all these reports and the condition of the habitat is pending.

The CCAA/CI efforts described in this section provide conservation benefits to Gunnison sage-grouse throughout their range where they are completed and in place (9 in the Gunnison Basin, one in the San Miguel, two in the Crawford, and two in the Piñon Mesa population areas). Even assuming the acreage of all landowners who have not yet complete CIs but have expressed interest in pursuing CIs through the completion of baseline habitat reports will ultimately be covered under CIs, these properties constitute only 8.5 percent of the total private land throughout the species range. Completed and pending CI's (see preceding paragraph) combined would cover approximately 16 percent of the total private land throughout the species range. Several parcels covered under CIs are also under conservation easements. However, the Gunnison sage-grouse CCAA is voluntary, potentially temporary, and is limited in scale relative to the species' range Therefore, the CCAA/CI provides some protection for Gunnison sage-grouse, but does not cover a sufficient portion of the species' range to adequately protect Gunnison sage-grouse from the threat of habitat loss and fragmentation and ensure the species long-term conservation.

Gunnison Basin Candidate Conservation Agreement (CCA)

In January 2010, the Gunnison Basin Sage-Grouse Strategic Committee and the Service began developing a Candidate Conservation Agreement (CCA) for Gunnison sage-grouse in the Gunnison Basin (GBSSC 2012). Once finalized, the CCA will identify and provide for implementation of conservation measures to address specific threats to Gunnison sage-grouse on Federal lands in this area including existing and future development (roads, transmission lines, phone lines, etc.), recreation (roads and trails, special recreation permits, etc.), and livestock grazing authorizations (permit renewals). As planned, the CCA will cover the estimated 160,769 ha (397,267 ac) of occupied habitat on Federal lands in the Gunnison Basin, or about 67 percent of the total estimated 239,953 ha (592,936 ac) of occupied habitat in the Gunnison Basin. The CCA would thus cover approximately 78 percent of rangewide occupied habitat on Federal lands, and approximately 42 percent of rangewide occupied habitat. It is anticipated that signatories to the CCA will include CPW, Gunnison County, Saguache County, BLM, U.S. Forest Service, National Park Service, Natural Resources Conservation Service, and the Service.

Conservation measures in the CCA to address the above threats are expected to include, but would not be limited to, avoidance of high quality habitats or sensitive areas, seasonal restrictions and closures, siting and construction restrictions, weed control and reclamation standards, realigning or decommissioning of travel routes, monitoring of habitat conditions and standards, and modifying grazing practices. In addition, the CCA is expected to incorporate an adaptive management approach, an off-site mitigation plan for habitat loss, a comprehensive monitoring plan, and annual reporting requirements.

Candidate Conservation Agreements are formal, voluntary agreements between the Service and one or more parties to address the conservation needs of one or more candidate species or species likely to become candidates in the near future. Participants commit to implement specific actions designed to remove or reduce threats to the covered species, so that listing may not be necessary. Unlike CCAAs, CCAs do not provide assurances that additional conservation measures will not be required if a species is listed or critical habitat is designated.

Although CCAs are voluntary agreements, the anticipated Federal signatories have expressed a desire to conference with the Service, pursuant to section 7 of the ESA, on the Gunnison Basin CCA. This process would result in a conference opinion by the Service that it could confirm as a biological opinion if the species is listed or critical habitat is designated. If the Service adopts the conference opinion as a biological opinion, Federal projects and activities covered under the biological opinion would be required to apply the principles, conditions, and conservation measures identified in the CCA. Based on this information, the CCA may result in some level of protection for Gunnison sage-grouse in the Gunnison Basin. However, the effectiveness of the CCA will depend largely on the conservation measures proposed and their implementation.

Even with the planned CCA in place, negative impacts are still likely to occur to Gunnison sage-grouse on Federal lands in the Gunnison Basin due to Federal and other projects and activities. In addition, approximately 22 percent of rangewide occupied habitat on Federal lands—all within the six smaller, declining population areas—would not be covered under the CCA. Given this limited geographic scope, additional protections on Federal lands are essential for the conservation of these declining populations. Therefore, although the pending CCA may provide some protection to Gunnison sage-grouse, depending on the conservation measures implemented, it will not cover enough of the species' range to adequately protect Gunnison sage-grouse from the threat of habitat loss and fragmentation.

Summary of Factor A

Gunnison sage-grouse require large, contiguous areas of sagebrush for long-term persistence, and thus are affected by factors that occur at the landscape scale. Broad-scale characteristics within surrounding landscapes influence habitat selection, and adult Gunnison sage-grouse exhibit a high fidelity to all seasonal habitats, resulting in low adaptability to habitat changes. Fragmentation of sagebrush habitats are a primary cause of the decline of Gunnison and greater sage-grouse populations (Patterson 1952, pp. 192–193; Connelly and Braun 1997, p. 4; Braun 1998, p. 140; Johnson and Braun 1999, p. 78; Connelly *et al.* 2000a, p. 975; Miller and Eddleman 2000, p. 1; Schroeder and Baydack 2001, p. 29; Johnsgard 2002, p. 108; Aldridge and Brigham 2003, p. 25; Beck *et al.* 2003, p. 203; Pedersen *et al.* 2003, pp. 23–24; Connelly *et al.* 2004, p. 4–15; Schroeder *et al.* 2004, p. 368; Leu *et al.* 2011, p. 267). Documented negative effects of fragmentation include reduced lek persistence, lek attendance, population recruitment, yearling and adult annual survival, female nest site selection, and nest initiation rates, as well as the loss of leks and winter habitat (Holloran 2005, p. 49; Aldridge and Boyce 2007, pp. 517–523; Walker *et al.* 2007a, pp. 2651–2652; Doherty *et al.* 2008, p. 194).

We examined a number of factors that result in habitat loss and fragmentation. Historically, 93 percent of Gunnison sage-grouse habitat was lost to conversion for agricultural croplands; however, agricultural conversion has slowed or slightly reversed in recent decades. Currently, direct and functional loss of habitat due to residential and road development in all populations, including the largest population in the Gunnison Basin, is the principal threat to Gunnison sage-grouse. Functional habitat loss also contributes to habitat fragmentation as sage-grouse avoid areas due to human activities, including noise, even when sagebrush remains intact. The collective disturbance from human activities around residences and roads reduces the effective habitat around these areas, making them inhospitable to Gunnison sage-grouse. Human populations are increasing in Colorado and throughout the range of Gunnison sage-grouse. This trend will continue at least through 2050. The resulting habitat loss and fragmentation is diminishing the probability of Gunnison sage-grouse persistence.

Other threats from human infrastructure such as fences and powerlines may not individually threaten the probability of persistence of Gunnison sage-grouse. However, the cumulative presence of all these features, particularly when considered in conjunction with residential and road development, does constitute a major threat to Gunnison sage-grouse as they collectively contribute to habitat loss and fragmentation. This impact is particularly of consequence in light of the decreases in Gunnison sage-grouse population sizes observed in the six smallest populations. These infrastructure components are associated with overall increases in human populations, and thus we expect them to continue to increase.

Several issues discussed above, such as fire, invasive species, and climate change, may not individually threaten the probability of persistence of Gunnison sage-grouse. However, the documented synergy among these issues result in a high likelihood that they will

threaten the species in the future. Nonnative invasive plants, including cheatgrass and other noxious weeds, continue to expand their range, facilitated by ground disturbances such as fire, grazing, and human infrastructure. Invasive plants negatively impact Gunnison sage-grouse primarily by reducing or eliminating native vegetation that sage-grouse require for food and cover, resulting in habitat loss (both direct and functional) and fragmentation. Cheatgrass is present at varying levels in nearly all Gunnison sage-grouse population areas, but there has not yet been a demonstrated change in fire cycle in the range of Gunnison sage-grouse. However, climate change may alter the range of invasive plants, intensifying the proliferation of invasive plants to the point that they become a threat to the species. Even with aggressive treatments, invasive plants will persist and will likely continue to spread throughout the range of Gunnison sage-grouse.

Livestock management has the potential to degrade sage-grouse habitat at local scales by causing the loss of nesting cover and decreases in native vegetation, and by increasing the probability of incursion of invasive plants. Given the widespread nature of grazing within the range of Gunnison sage-grouse, the potential for population-level impacts is highly likely. Effects of domestic livestock grazing are likely being exacerbated by intense browsing of woody species by wild ungulates in portions of the Gunnison Basin. We conclude that habitat degradation that can result from improper grazing is a threat to Gunnison sage-grouse persistence.

We do not consider nonrenewable energy development to be impacting Gunnison sage-grouse habitat to the extent that it is a threat to the long-term persistence of the species at this time, because its current and anticipated extent is limited throughout the range of Gunnison sage-grouse. We do not consider renewable energy development to be a threat to the persistence of Gunnison sage-grouse at this time. However, geothermal and wind energy development could increase in the Gunnison Basin and Monticello areas, respectively, in the future. Piñon-juniper encroachment does not pose a threat to Gunnison sage-grouse at a population or rangewide level because of its limited distribution throughout the range of Gunnison sage-grouse. Current energy development alone may not threaten Gunnison sage-grouse. However, the cumulative presence of energy development and other threats within Gunnison sage-grouse habitat has the potential to threaten the species both now and in the future.

A review of a database compiled by the CPW that included local, State, and Federal ongoing and proposed Gunnison sage-grouse conservation actions (CDOW 2009c, entire) revealed a total of 224 individual conservation efforts. Of these 224 efforts, a total of 165 efforts have been completed and were focused on habitat improvement or protection. These efforts resulted in the treatment of 9,324 ha (23,041 ac), or approximately 2.5 percent of occupied Gunnison sage-grouse habitat. A monitoring component was included in 75 (45 percent) of these 165 efforts, although we do not have information on the overall effectiveness of these efforts. At least five habitat improvement or protection projects occurred between January 2011 and September 2012, treating an additional 300 acres (CPW 2012b, p. 7). We recognize ongoing and proposed conservation efforts by all entities across the range of the Gunnison sage-grouse, and all parties should be commended for their conservation efforts.

Our review of conservation efforts indicates that the measures identified are not adequate to address the primary threat of habitat fragmentation at this time in a manner that effectively reduces or eliminates the factors contributing to this threat. All of the conservation efforts are limited in size and the measures provided to us were simply not implemented at the scale (even when considered cumulatively) that would be required to effectively reduce the threats to the species and its habitat across its range. Depending on conservation measures implemented under the planned Gunnison Basin CCA and their effectiveness, some protection may be provided for Gunnison sage-grouse on federal lands in the Gunnison Basin, but would not cover enough of the species' range to ensure the species' long-term conservation. Similarly, the existing CCAA provides limited protection for Gunnison sage-grouse, but does not provide sufficient coverage of the species' range to ensure the species' long-term conservation. Thus, although the ongoing conservation efforts are a positive step toward the conservation of the Gunnison sage-grouse, and some have likely reduced the severity of some threats to the species (e.g., piñon-juniper invasion), on the whole we find that the conservation efforts in place at this time are not sufficient to offset the degree of threat posed to the species by the present and threatened destruction, modification, or curtailment of its habitat.

Threats identified above, particularly exurban and residential development and associated infrastructure such as roads and powerlines, are cumulatively causing significant habitat fragmentation, which is negatively affecting Gunnison sage-grouse. We have evaluated the best scientific information available on the present or threatened destruction, modification, or curtailment of the Gunnison sage-grouse's habitat or range. Based on the current and anticipated habitat threats identified above and their cumulative effects as they contribute to the overall fragmentation of Gunnison sage-grouse habitat, we have determined that the present or threatened destruction, modification, or curtailment of Gunnison sage-grouse habitat poses a threat to the species throughout its range. This threat is current (as evidenced by population declines) and is projected to continue and increase into the future with additional anthropogenic pressures.

B. Overutilization for Commercial, Recreational, Scientific, or Educational Purposes

Hunting

Hunting for Gunnison sage-grouse does not currently occur. Hunting was eliminated in the Gunnison Basin in 2000 due to concerns with meeting Gunnison sage-grouse population objectives (Colorado Sage Grouse Working Group (CSGWG) 1997, p. 66). Hunting has not occurred in the other Colorado populations of Gunnison sage-grouse since 1995 when the Piñon Mesa area was closed (GSRSC 2005, p. 122). Utah has not allowed hunting of Gunnison sage-grouse since 1989 (GSRSC 2005, p. 82).

Both Colorado and Utah will consider hunting of Gunnison sage-grouse only if populations can be sustained (GSRSC 2005, pp. 5, 8, 229). The local Gunnison Basin working group plan calls for a minimum population of 500 males counted on leks before hunting would occur again (CSGWG 1997, p. 66). The minimum population level in the Gunnison Basin population has been exceeded in all years since 1996, except 2003 and 2004 (CDOW 2009d, pp. 18–19). However, the sensitive State regulatory status and potential political ramifications of hunting the species has precluded the States from opening a hunting season. If hunting does ever occur again, harvest will likely be restricted to only 5 to 10 percent of the fall population, and will be structured to limit harvest of females to the extent possible (GSRSC 2005, p. 229). However, the ability of these measures

to be implemented is in question, as adequate means to estimate fall population size have not been developed (Reese and Connelly 2011, pp. 110–111) and limiting female harvest may not be possible (WGFD 2004, p. 4; WGFD 2006, pp. 5, 7).

One sage-grouse was known to be illegally harvested in 2001 in the Poncha Pass population (Nehring 2010, pers. comm.), but based on the best available information illegal harvest has not contributed to Gunnison sage-grouse population declines in either Colorado or Utah. We do not anticipate hunting to be opened in the Gunnison Basin or smaller populations for many years, if ever. Consequently, we do not consider hunting to be a threat to the species.

Lek Viewing

The Gunnison sage-grouse was designated as a new species in 2000 (American Ornithologists' Union 2000, pp. 847–858), which has prompted a much increased interest by bird watchers to view the species on their leks (Pfister 2010, pers. comm.). Daily human disturbances on sage-grouse leks could cause a reduction in mating, and some reduction in total production (Call and Maser 1985, p. 19). Human disturbance, particularly if additive to disturbance by predators, could reduce the time a lek is active, as well as reduce its size by lowering male attendance (Boyko *et al.* 2004, *in* GSRSC 2005, p. 125). Smaller lek sizes have been hypothesized to be less attractive to females, thereby conceivably reducing the numbers of females mating. Disturbance during the peak of mating also could result in some females not breeding (GSRSC 2005, p. 125). Furthermore, disturbance from lek viewing might affect nesting habitat selection by females (GSRSC 2005, p. 126), as leks are typically close to areas in which females nest. If females move to poorer quality habitat farther away from disturbed leks, nest success could decline. If chronic disturbance causes sage-grouse to move to a new lek site away from preferred and presumably higher quality areas, both survival and nest success could decline. Whether any or all of these have significant population effects would depend on timing and degree of disturbance (GSRSC 2005, p. 126).

Throughout the range of Gunnison sage-grouse, public viewing of leks is limited by a general lack of knowledge of lek locations, seasonal road closures in some areas, and difficulty in accessing many leks. Furthermore, 52 of 109 active Gunnison sage-grouse leks occur on private lands, which further limits access by the public. The BLM closed a lek in the Gunnison Basin to viewing in the late 1990s due to declining population counts perceived as resulting from recreational viewing, although no scientific studies were conducted (BLM 2005a, p. 13; GSRSC 2005, pp. 124, 126). The Waunita lek east of Gunnison is the only lek in Colorado designated by the CPW for public viewing (CDOW 2009b, p. 86). Since 1998, a comparison of male counts on the Waunita lek versus male counts on other leks in the Doyleville zone show that the Waunita lek's male counts generally follow the same trend as the others (CDOW 2009d, pp. 31–32). In fact, in 2008 and 2009, the Waunita lek increased in the number of males counted along with three other leks, while seven leks decreased in the Doyleville zone (CDOW 2009d, pp. 31–32). These data suggest that lek viewing on the Waunita lek has not impacted the Gunnison sage-grouse. Two lek viewing tours per year are organized and led by UDWR on a privately owned lek in the Monticello population. The lek declined in males counted in 2009, but 2007 and 2008 had the highest counts for several years, suggesting that lek viewing is also not impacting that lek. Data collected by CPW on greater sage-grouse viewing leks also indicates that controlled lek visitation has not impacted greater sage-grouse at the viewed leks (GSRSC 2005, p. 124).

A lek viewing protocol has been developed and has largely been followed on the Waunita lek, likely reducing impacts to sage-grouse (GSRSC 2005, p. 125). During 2004–2009, the percentage of individuals or groups of people in vehicles following the Waunita lek viewing protocol in the Gunnison Basin ranged from 71 to 92 percent (CDOW 2009b, pp. 86, 87; Magee *et al.* 2009, pp. 7, 10). Violations of the protocol, such as showing up after the sage-grouse started to display and creating noise, caused one or more sage-grouse to flush from the lek (CDOW 2009b, pp. 86, 87). Despite the protocol violations, the percentage of days from 2004 to 2009 that grouse were flushed by humans was relatively low, ranging from 2.5 percent to 5.4 percent (Magee *et al.* 2009, p. 10). Nonetheless, the lek viewing protocol is currently being revised to make it more stringent and to include considerations for photography, research, and education-related viewing (CDOW 2009b, p. 86). Implementation of this protocol should preclude lek viewing from becoming a threat to this lek.

The CPW and UDWR will continue to coordinate and implement lek counts to determine population levels. We expect annual lek viewing and lek counts to continue indefinitely. However, all leks counted will receive lower disturbance from counters than the Waunita lek receives from public viewing, so we do not consider lek counts a threat to the Gunnison sage-grouse.

Scientific Research

Gunnison sage-grouse have been the subject of scientific studies, some of which included the capture and handling of the species. Most of the research has been conducted in the Gunnison Basin population, San Miguel Basin population, and Monticello portion of the Monticello-Dove Creek population. Between zero and seven percent mortality of handled adults or juveniles and chicks has occurred during recent Gunnison sage-grouse studies where trapping and radio-tagging was done (Apa 2004, p. 19; Childers 2009, p. 14; Lupis 2005, p. 26; San Miguel Basin Gunnison Sage-grouse Working Group (SMBGSWG) 2009, p. A–10). Additionally, one radio-tagged hen was flushed off a nest during subsequent monitoring and did not return after the second day, resulting in loss of 10 eggs (Ward 2007, p. 52). The CPW does not believe that these losses or disturbance have any significant impacts on the sage-grouse (CDOW 2009b, p. 29).

Some radio-tagged sage-grouse have been translocated from the Gunnison Basin to other populations. Over a 5-year period (2000–2002 and 2006–2007), 68 sage-grouse were translocated from the Gunnison Basin to the Poncha Pass and San Miguel Basin populations (CDOW 2009b, p. 9). These experimental translocations were conducted to determine translocation techniques and survivorship in order to increase both size of the receiving populations and to increase genetic diversity in populations outside of the Gunnison Basin. However, the translocated grouse experienced 40–50 percent mortality within the first year after release, which is double the average annual mortality of nontranslocated sage-grouse (CDOW 2009b, p. 9). Greater sage-grouse translocations have not appeared to fare any better. Over 7,200 greater sage-grouse were translocated between 1933 and 1990, but only five percent of the translocation efforts were considered to be successful in producing sustained, resident populations at the translocation sites (Reese and Connelly 1997, pp. 235–238, 240). More recent translocations from 2003 to 2005 into Strawberry Valley, Utah, resulted in a 40 percent annual mortality rate (Baxter *et al.* 2008, p. 182). We believe the lack of success of translocations found in

greater sage-grouse is applicable to Gunnison sage-grouse because the two species exhibit similar behavior and life-history traits, and are managed accordingly.

Because the survival rate for translocated sage-grouse has not been as high as desired, the CPW started a captive-rearing program in 2009 to study whether techniques can be developed to captively rear and release Gunnison sage-grouse and enhance their survival (CDOW 2009b, pp. 9–12). The GSRSC conducted a review of captive-rearing attempts for both greater sage-grouse and other gallinaceous birds and concluded that survival will be very low, unless innovative strategies are developed and tested (GSRSC 2005, pp. 181–183). However, greater sage-grouse have been captively reared, and survival of released chicks was similar to that of wild chicks (CDOW 2009b, p. 10). Consequently, the CPW decided to try captive rearing of Gunnison sage-grouse. Of 40 Gunnison sage-grouse eggs taken from the wild, only 11 chicks (about 25 percent) survived through October 2009. In 2010, 27 captive-reared chicks were introduced to wild Gunnison sage-grouse broods. Apparent survival of all introduced chicks was 29%, which is comparable to wild chicks of the same age. In 2011, the same study introduced 51 captive-reared chicks to wild Gunnison sage-grouse broods. In that case, none of the released chicks survived. Although introduced chick survival has been low, chick survival during captivity increased with improved protocols, and valuable knowledge on Gunnison sage-grouse rearing techniques has been gained (CPW 2011d). As techniques improve, the CPW intends to develop a captive-breeding manual (CDOW 2009b, p. 11). Although adults or juveniles have been captured and moved out of the Gunnison Basin, as well as eggs, the removal of the grouse only accounts for a very small percentage of the total population of the Gunnison Basin sage-grouse population (about 1 percent).

The CPW has a policy regarding trapping, handling, and marking techniques approved by their Animal Use and Care Committee (SMBGSWG 2009, p. A–10, Childers 2009, p. 13). Evaluation of research projects by the Animal Use and Care Committee and improvement of trapping, handling, and marking techniques over the last several years has resulted in fewer mortalities and injuries. In fact, in the San Miguel Basin, researchers have handled more than 200 sage-grouse with no trapping mortalities (SMBGSWG 2009, p. A–10). The CPW has also drafted a sage-grouse trapping and handling protocol, which is required training for people handling Gunnison sage-grouse, to minimize mortality and injury of the birds (CDOW 2002, pp. 1–4 in SMBWG 2009, pp. A–22–A–25). Injury and mortality does occasionally occur from trapping, handling, marking, and flushing off nests. However, research-related mortality is typically below three percent of handled birds and equates to one half of one percent or less of annual population estimates (Apa 2004, p. 19; Childers 2009, p. 14; Lupis 2005, p. 26; SMBGSWG 2009, p. A–10).

Scientific research needs may gradually dwindle over the years but annual or occasional research is expected to continue. Short-term disturbance effects to individuals occur as does injury and mortality, but we do not believe these effects cause a threat to the Gunnison sage-grouse population as a whole. Based on the best available information, scientific research on Gunnison sage-grouse has a relatively minor impact that does not rise to the level of a threat to the species.

Summary of Factor B

We have no evidence suggesting that hunting, when it was legal, resulted in overutilization of Gunnison sage-grouse. However, a high degree of Gunnison sage-grouse harvest from an inadvertently opened hunting season resulted in a significant population decrease in the already small Poncha Pass population. If hunting is allowed again, future hunting may result in additive mortality due to habitat degradation and fragmentation, despite harvest level restrictions and management intended to limit impacts to hens. Nonetheless, we do not expect hunting to be reinstated in the future. Illegal hunting has only been documented once in Colorado and is not a threat. Lek viewing has not affected the Gunnison sage-grouse, and lek viewing protocols designed to reduce disturbance have generally been followed. CPW is currently revising their lek viewing protocol to make it more stringent and to include considerations for photography, research, and education-related viewing. Mortality from scientific research is low (2 percent) and is not a threat. We know of no overutilization for commercial or educational purposes. Thus, based on the best scientific and commercial data available, we have concluded that overutilization for commercial, recreational, scientific, or educational purposes is not a threat to Gunnison sage-grouse at this time.

C. Disease or Predation

Disease

No research has been published about the types or pathology of diseases in Gunnison sage-grouse. However, multiple bacterial and parasitic diseases have been documented in greater sage-grouse (Patterson 1952, pp. 71–72; Schroeder *et al.* 1999, pp. 14, 27). Some early studies have suggested that greater sage-grouse populations are adversely affected by parasitic infections (Batterson and Morse 1948, p. 22). However, the role of parasites or infectious diseases in population declines of greater sage-grouse is unknown based on the few systematic surveys conducted (Connelly *et al.* 2004, p. 10–3). No parasites have been documented to cause mortality in Gunnison sage-grouse, but the protozoan, *Eimeria* spp., which causes coccidiosis, has been reported to cause death in greater sage-grouse (Connelly *et al.* 2004, p. 10–4). Infections tend to be localized to specific geographic areas, and no cases of greater sage-grouse mortality resulting from coccidiosis have been documented since the early 1960s (Connelly *et al.* 2004, p. 10–4).

Parasites have been implicated in greater sage-grouse mate selection, with potentially subsequent effects on the genetic diversity of this species (Boyce 1990, p. 263; Deibert 1995, p. 38). These relationships may be important to the long-term ecology of greater sage-grouse, but they have not been shown to be significant to the immediate status of populations (Connelly *et al.* 2004, p. 10–6). Although diseases and parasites have been suggested to affect isolated sage-grouse populations (Connelly *et al.* 2004, p. 10–3), we have no evidence indicating that parasitic diseases are a threat to Gunnison sage-grouse populations.

Greater sage-grouse are subject to a variety of bacterial, fungal, and viral pathogens. The bacterium *Salmonella* sp. has caused a single documented mortality in the greater sage-grouse and studies have shown that infection rates in wild birds are low (Connelly *et al.* 2004, p. 10–7). The bacteria are apparently contracted through exposure to contaminated water supplies around livestock stock tanks (Connelly *et al.* 2004, p. 10–7). Other bacteria found in greater sage-grouse include *Escherichia coli,* botulism *(Clostridium* spp.), avian tuberculosis *(Mycobacterium avium),* and avian cholera *(Pasteurella multocida).* These bacteria have never been identified as a cause of mortality in greater sage-grouse and the risk of exposure and hence, population effects, is low (Connelly *et al.* 2004, p. 10–7 to

10–8). In Gunnison sage-grouse, captive reared chicks have died due to bacterial infections by *Klebsiella spp., E. coli,* and *Salmonella spp.* In one case (CDOW 2009b, p. 11), bacterial growth was encouraged by a wood-based brooder substrate used to raise chicks. However, in a subsequent study (CPW 2011d, pp. 14–15) where the wood-based substrate was not used, similar bacterial infections and chick mortality still occurred. The sources of infection could not be determined. This suggests that Gunnison sage-grouse may be less resistant to bacterial infections than greater sage-grouse. However, we have no information that shows the risk of exposure in the wild is different for Gunnison sage-grouse; therefore, these bacteria do not appear to be a threat to the species.

West Nile virus was introduced into the northeastern United States in 1999 and has subsequently spread across North America (Marra *et al.* 2004, p. 394). In sagebrush habitats, West Nile virus transmission is primarily regulated by environmental factors, including temperature, precipitation, and anthropogenic water sources, such as stock ponds and coal-bed methane ponds that support the mosquito vectors (Reisen *et al.* 2006, p. 309; Walker and Naugle 2011, pp. 131–132). The virus persists largely within a mosquito-bird-mosquito infection cycle (McLean 2006, p. 45). However, direct bird-to-bird transmission of the virus has been documented in several species (McLean 2006, pp. 54, 59), including the greater sage-grouse (Walker and Naugle 2011, p. 132; Cornish 2009, pers. comm.). The frequency of direct transmission has not been determined (McLean 2006, p. 54). Cold ambient temperatures preclude mosquito activity and virus amplification, so transmission to and in sage-grouse is limited to the summer (mid-May to mid-September) (Naugle *et al.* 2005, p. 620; Zou *et al.* 2007, p. 4), with a peak in July and August (Walker and Naugle 2011, p. 131). Reduced and delayed West Nile virus transmission in sage-grouse has occurred in years with lower summer temperatures (Naugle *et al.* 2005, p. 621; Walker *et al.* 2007b, p. 694). In non-sagebrush ecosystems, high temperatures associated with drought conditions increase West Nile virus transmission by allowing for more rapid larval mosquito development and shorter virus incubation periods (Shaman *et al.* 2005, p. 134; Walker and Naugle 2011, p. 131).

Greater sage-grouse congregate in mesic habitats in the mid-late summer (Connelly *et al.* 2000, p. 971), thereby increasing their risk of exposure to mosquitoes. If West Nile virus outbreaks coincide with drought conditions that aggregate birds in habitat near water sources, the risk of exposure to West Nile virus will be elevated (Walker and Naugle 2011, p. 131). Greater sage-grouse inhabiting higher elevation sites in summer (similar to the northern portion of the Gunnison Basin) are likely less vulnerable to contracting West Nile virus than birds at lower elevation (similar to Dry Creek Basin of the San Miguel population) as ambient temperatures are typically cooler (Walker and Naugle 2011, p. 131).

West Nile virus has caused population declines in wild bird populations on the local and regional scale (Walker and Naugle 2011, pp. 128–129) and has been shown to affect survival rates of greater sage-grouse (Naugle *et al.* 2004, p. 710; Naugle *et al.* 2005, p. 616). Experimental results, combined with field data, suggest that a widespread West Nile virus infection has negatively affected greater sage-grouse (Naugle *et al.* 2004, p. 711; Naugle *et al.* 2005, p. 616). The selective use of mesic habitats by sage-grouse in the summer potentially increases their exposure to West Nile virus. Greater sage-grouse are considered to have a high susceptibility to West Nile virus, with resultant high levels of mortality (Clark *et al.* 2006, p. 19; McLean 2006, p. 54). Greater sage-grouse do not develop a resistance to the disease, and death is certain once an individual is exposed (Clark *et al.* 2006, p. 18).

To date, West Nile virus has not been documented in Gunnison sage-grouse despite the presence of West Nile virus-positive mosquitoes in nearly all counties throughout their range (Colorado Department of Public Health 2009, pp. 1–4; U.S. Centers for Disease Control and Prevention 2004, entire). We do not know whether this is a result of the small number of birds that are marked, the relatively few birds that exist in the wild, or unsuitable conditions in Gunnison sage-grouse habitat for the virus to become virulent. West Nile virus activity within the range of Gunnison sage-grouse has been low compared to other parts of Colorado and the western United States. A total of 77 wild bird (other than Gunnison sage-grouse) deaths resulting from West Nile virus has been confirmed from counties within the occupied range of Gunnison sage-grouse since 2002 when reporting began in Colorado (USGS 2009, entire). Fifty-two (68 percent) of these West Nile virus-caused bird deaths were reported from Mesa County (where the Piñon Mesa population is found). Only San Miguel, Dolores, and Hinsdale Counties had no confirmed avian mortalities resulting from West Nile virus.

Walker and Naugle (2011, p. 140) predict that West Nile virus outbreaks in small, isolated, and genetically depauperate populations could reduce sage-grouse numbers below a threshold from which recovery is unlikely because of limited or nonexistent demographic and genetic exchange from adjacent populations. Thus, a West Nile virus outbreak in any Gunnison sage-grouse population, except perhaps the Gunnison Basin population, could limit the persistence of these populations.

Although West Nile virus is a potential threat in the future, the best available information suggests that it is not currently a threat to Gunnison sage-grouse, since West Nile virus has not been documented in Gunnison sage-grouse despite the presence of West Nile virus-positive mosquitoes in nearly all counties throughout their range. No other diseases or parasitic infections are considered to be threatening the Gunnison sage-grouse at this time.

Predation

Predation is the most commonly identified cause of direct mortality for sage-grouse during all life stages (Schroeder *et al.* 1999, p. 9; Connelly *et al.* 2000b, p. 228; Connelly *et al.* 2011, p. 66). However, sage-grouse have co-evolved with a variety of predators, and their cryptic plumage and behavioral adaptations have allowed them to persist despite this mortality factor (Schroeder *et al.* 1999, p. 10; Coates 2008, p. 69; Coates and Delehanty 2008, p. 635; Hagen 2011, p. 96). Until recently, little published information has been available that indicates predation is a limiting factor for the greater sage-grouse (Connelly *et al.* 2004, p. 10–1), particularly where habitat quality has not been compromised (Hagen 2011, p. 96). Although many predators will consume sage-grouse, none specialize on the species (Hagen 2011, p. 97). Generalist predators have the greatest effect on ground-nesting birds because predator numbers are independent of the density of a single prey source since they can switch to other prey sources when a given prey source (e.g., Gunnison sage-grouse) is not abundant (Coates 2007, p. 4). We believe that the effects of predation observed in greater sage-grouse are applicable to the effects anticipated in Gunnison sage-grouse since overall behavior and life-history traits are similar for the two species.

Major predators of adult sage-grouse include many species including golden eagles (*Aquila chrysaetos*), red foxes (*Vulpes fulva*), and bobcats (*Felis rufus*) (Hartzler 1974, pp. 532–536; Schroeder *et al.* 1999, pp. 10–11; Schroeder and

Baydack 2001, p. 25; Rowland and Wisdom 2002, p. 14; Hagen 2011, p. 97). Juvenile sage-grouse also are killed by many raptors as well as common ravens (*Corvus corax*), badgers (*Taxidea taxus*), red foxes, coyotes (*Canis latrans*), and weasels (*Mustela* spp.) (Braun 1995, entire; Schroeder *et al.* 1999, p. 10). Nest predators include badgers, weasels, coyotes, common ravens, American crows (*Corvus brachyrhyncos*), and magpies (*Pica* spp.), elk (*Cervus canadensis*) (Holloran and Anderson 2003, p. 309), and domestic cows (*Bovus* spp.) (Coates *et al.* 2008, pp. 425–426). Ground squirrels (*Spermophilus* spp.) also have been identified as nest predators (Patterson 1952, p. 107; Schroeder *et al.* 1999, p. 10; Schroder and Baydack 2001, p. 25), but recent data show that they are physically incapable of puncturing eggs (Holloran and Anderson 2003, p. 309; Coates *et al.* 2008, p. 426; Hagen 2011, p. 97). Several other small mammals visited sage-grouse nests in Nevada, but none resulted in predation events (Coates *et al.* 2008, p. 425).

The most common predators of Gunnison sage-grouse eggs are weasels, coyotes, and corvids (Young 1994, p. 37). Most raptor predation of sage-grouse is on juveniles and older age classes (GSRSC 2005, p. 135). Golden eagles were found to be the dominant raptor species recorded perching on power poles in Utah in Gunnison sage-grouse habitat (Prather and Messmer 2009, p. 12), indicating a possible source of predation. In a recent study, 22 and 40 percent of 111 adult mortalities were the result of avian and mammalian predation, respectively (Childers 2009, p. 7). Twenty-five and 35 percent of 40 chick mortalities were caused by avian and mammalian predation, respectively (Childers 2009, p. 7). A causative agent of mortality was not determined in the remaining depredations observed in the western portion of the Gunnison Basin from 2000 to 2009 (Childers 2009, p. 7).

Adult male Gunnison and greater sage-grouse are very susceptible to predation while on the lek (Schroeder *et al.* 1999, p. 10; Schroeder and Baydack 2001, p. 25; Hagen 2011, p. 5), presumably because they are conspicuous while performing their mating displays. Because leks are attended daily by numerous grouse, predators also may be attracted to these areas during the breeding season (Braun 1995, p. 2). In a study of greater sage-grouse mortality causes in Idaho, it was found that, among males, 83 percent of the mortality was due to predation and 42 percent of those mortalities occurred during the lekking season (March through June) (Connelly *et al.* 2000b, p. 228). In the same study, 52 percent of the mortality of adult females was due to predation and 52 percent of those mortalities occurred between March and August, which includes the nesting and brood-rearing periods (Connelly *et al.* 2000b, p. 228). The vast majority of adult female mortality outside of the breeding season was caused by hunting (Connelly *et al.* 2000b, p. 228). Adult female greater sage-grouse are susceptible to predators while on the nest but mortality rates are low (Hagen 2011, p. 97). Hens will abandon their nest when disturbed by predators (Patterson 1952, p. 110), likely reducing this mortality (Hagen 2011, p. 97). Sage-grouse populations are likely more sensitive to predation upon females given the highly negative response of Gunnison sage-grouse population dynamics to adult female reproductive success and chick mortality (GSRSC, 2005, p. 173). Predation of adult sage-grouse is low outside the lekking, nesting, and brood-rearing season (Connelly *et al.* 2000b, p. 230; Naugle *et al.* 2004, p. 711; Moynahan *et al.* 2006, p. 1536; Hagen 2011, p. 97).

Estimates of predation rates on juvenile sage-grouse are limited due to the difficulties in studying this age class (Aldridge and Boyce 2007, p. 509; Hagen 2011, p. 97). For greater sage-grouse, chick mortality from predation ranged from 10 to 51 percent in 2002 and 2003 on three study sites in Oregon (Gregg *et al.* 2003, p. 15; 2003b, p. 17). Mortality due to predation during the first few weeks after hatching was estimated to be 82 percent (Gregg *et al.* 2007, p. 648). Survival of juveniles to their first breeding season was estimated to be low (10 percent). It is reasonable, given the sources of adult mortality, to assume that predation is a contributor to the high juvenile mortality rates (Crawford *et al.* 2004, p. 4).

Sage-grouse nests are subject to varying levels of predation. Predation can be total (all eggs destroyed) or partial (one or more eggs destroyed). However, hens abandon nests in either case (Coates, 2007, p. 26). Over a 3-year period in Oregon, 106 of 124 nests (84 percent) were preyed upon (Gregg *et al.* 1994, p. 164). Patterson (1952, p. 104) reported nest predation rates of 41 percent in Wyoming. Holloran and Anderson (2003, p. 309) reported a predation rate of 12 percent (3 of 26) in Wyoming. Moynahan *et al.* (2007, p. 1777) attributed 131 of 258 (54 percent) of nest failures to predation in Montana. Re-nesting efforts may partially compensate for the loss of nests due to predation (Schroeder 1997, p. 938), but re-nesting rates for greater sage-grouse are highly variable (Connelly *et al.* 2011, p. 63). However, re-nesting rates are low in Gunnison sage-grouse (Young, 1994, p. 44; Childers, 2009, p. 7), indicating that re-nesting is unlikely to offset losses due to predation. Losses of breeding hens and young chicks to predation can influence overall greater and Gunnison sage-grouse population numbers, as these two groups contribute most significantly to population productivity (GSRSC, 2005, p. 29, Baxter *et al.* 2008, p. 185; Connelly *et al,* 2011, pp. 64–65).

Nesting success of greater sage-grouse is positively correlated with the presence of big sagebrush and grass and forb cover (Connelly *et al.* 2000, p. 971). Females actively select nest sites with these qualities (Schroeder and Baydack 2001, p. 25; Hagen *et al.* 2007, p. 46). Nest predation appears to be related to the amount of herbaceous cover surrounding the nest (Gregg *et al.* 1994, p. 164; Braun 1995, pp. 1–2; DeLong *et al.* 1995, p. 90; Braun 1998; Coggins 1998, p. 30; Connelly *et al.* 2000b, p. 975; Schroeder and Baydack 2001, p. 25; Coates and Delehanty 2008, p. 636). Loss of nesting cover from any source (e.g., grazing, fire) can reduce nest success and adult hen survival. However, Coates (2007, p. 149) found that badger predation was facilitated by nest cover as it attracts small mammals, a badger's primary prey. In contrast, habitat alteration that reduces cover for young chicks can increase their rate of predation (Schroeder and Baydack 2001, p. 27).

In a review of published nesting studies, Connelly *et al.* (2011, pp. 63–64) reported that nesting success was greater in unaltered habitats versus habitats affected by anthropogenic activities. Where greater sage-grouse habitat has been altered, the influx of predators can decrease annual recruitment (Gregg *et al.* 1994, p. 164; Braun 1995, pp. 1–2; Braun 1998; DeLong *et al.* 1995, p. 91; Schroeder and Baydack 2001, p. 28; Coates 2007, p. 2; Hagen 2011, pp. 97–98). Agricultural development, landscape fragmentation, and human populations can increase predation pressure on all life stages of greater sage-grouse by forcing birds to nest in less suitable or marginal habitats, increasing travel time through altered habitats where they are vulnerable to predation, and increasing the diversity and density of predators (Ritchie *et al.* 1994, p. 125; Schroeder and Baydack 2001, p. 25; Connelly *et al.* 2004, p. 7–23; and Summers *et al.* 2004, p. 523). We believe the aforementioned information is also applicable to Gunnison sage-grouse because overall behavior and life-history traits are

similar for the two species (Young 1994, p. 4).

Abundance of red fox and corvids, which historically were rare in the sagebrush landscape, has increased in association with human-altered landscapes (Sovada *et al.* 1995, p. 5). In the Strawberry Valley of Utah, low survival of greater sage-grouse may have been due to an unusually high density of red foxes, which apparently were attracted to that area by anthropogenic activities (Bambrough *et al.* 2000). The red fox population has increased within the Gunnison Basin (BLM, 2009, p. 37), while just recently being observed in habitat within the Monticello, Utah, population area (UDWR 2011, p. 4). Ranches, farms, and housing developments have resulted in the introduction of nonnative predators including domestic dogs (*Canis domesticus*) and cats (*Felis domesticus*) into greater sage-grouse habitats (Connelly *et al.* 2004, p. 12–2). Local attraction of ravens to nesting hens may be facilitated by loss and fragmentation of native shrublands, which increases exposure of nests to potential predators (Aldridge and Boyce 2007, p. 522; Bui 2009, p. 32). The presence of ravens was negatively associated with greater sage-grouse nest and brood fate in western Wyoming (Bui 2009, p. 27).

Raven abundance has increased as much as 1,500 percent in some areas of western North America since the 1960s (Coates 2007, p. 5). Breeding bird survey trends from 1966 to 2007 indicate increases throughout Colorado and Utah (USGS, 2009, pp. 1–2). Increases in raven numbers are suggested in the Piñon Mesa population, though data have not been collected (CDOW 2009b, p. 110). Raven numbers in the Monticello subpopulation remain high (UDWR 2011, p. 4). Human-made structures in the environment increase the effect of raven predation, particularly in low canopy cover areas, by providing ravens with perches (Braun 1998, pp. 145–146; Coates 2007, p. 155; Bui 2009, p. 2).

Reduction in patch size and diversity of sagebrush habitat, as well as the construction of fences, powerlines, and other infrastructure, also are likely to encourage the presence of the common raven (Coates *et al.* 2008, p. 426; Bui 2009, p. 4). For example, raven counts have increased by approximately 200 percent along the Falcon-Gondor transmission line corridor in Nevada (Atamian *et al.* 2007, p. 2). Ravens contributed to lek disturbance events in the areas surrounding the transmission line (Atamian *et al.* 2007, p. 2), but as a cause of decline in surrounding sage-grouse population numbers, it could not be separated from other potential impacts, such as West Nile virus. Holloran (2005, p. 58) attributed increased sage-grouse nest depredation to high corvid abundances, which resulted from anthropogenic food and perching subsidies in areas of natural gas development in western Wyoming. Bui (2009, p. 31) also found that ravens used road networks associated with oil fields in the same Wyoming location for foraging activities. Holmes (2009, pp. 2–4) also found that common raven abundance increased in association with oil and gas development in southwestern Wyoming.

Raven abundance was strongly associated with sage-grouse nest failure in northeastern Nevada, with resultant negative effects on sage-grouse reproduction (Coates 2007, p. 130). The presence of high numbers of predators within a sage-grouse nesting area may negatively affect sage-grouse productivity without causing direct mortality. Increased raven abundance was associated with a reduction in the time spent off the nest by female sage-grouse, thereby potentially compromising their ability to secure sufficient nutrition to complete the incubation period (Coates 2007, pp. 85–98).

As more suitable grouse habitat is converted to exurban development, agriculture, or other non-sagebrush habitat types, grouse nesting and brood-rearing become increasingly spatially restricted (Bui 2009, p. 32). As discussed in Factor A, we anticipate a substantial increase in the distribution of residential development throughout the range of Gunnison sage-grouse. This increase will likely cause additional restriction of nesting habitat within the species' range, given removal of sagebrush habitats and the strong selection for sagebrush by the species. Additionally, Gunnison sage-grouse avoid residential development, resulting in functional habitat loss (Aldridge *et al.* 2011, p. 14). Ninety-one percent of nest locations in the western portion of the Gunnison Basin population occur within 35 percent of the available habitat (Aldridge *et al.* 2011, p. 7). Unnaturally high nest densities, which result from habitat fragmentation or disturbance associated with the presence of edges, fencerows, or trails, may increase predation rates by making foraging easier for predators (Holloran 2005, p. C37). Increased nest density could negatively influence the probability of a successful hatch (Holloran and Anderson, 2005, p. 748).

The influence of the human footprint in sagebrush ecosystems may be underestimated (Leu and Hanser 2011, pp. 270–271) since it is uncertain how much more habitat sage-grouse (a large landscape-scale species) need for persistence in increasingly fragmented landscapes (Connelly *et al.* 2011, pp. 80–82). Therefore, the influence of ravens and other predators associated with human activities may be underestimated. In addition, nest predation may be higher, more variable, and have a greater impact on the small, fragmented Gunnison sage-grouse populations, particularly the six smallest populations (GSRSC 2005, p. 134). Unfortunately, except for the relatively few studies presented here, data are lacking that link Gunnison sage-grouse population numbers and predator abundance. However, in at least six of the seven populations where habitats have been significantly altered by human activities, we believe that predation could be limiting Gunnison sage-grouse populations.

Ongoing studies in the San Miguel population indicate that the lack of recruitment in Gunnison sage-grouse is likely due to predation (CDOW 2009b, p. 31). In this area, six of 12 observed nests were destroyed by predation, with none of the chicks from the remaining nests surviving beyond two weeks (CDOW 2009b, p. 30). In small and declining populations, small changes to habitat abundance or quality, or in predator abundance, could have large consequences. A predator control program initiated by CPW occurred between March 2011 and June 2012 in the Miramonte subpopulation area of the San Miguel population to evaluate the effects of predator removal on Gunnison sage-grouse juvenile recruitment in the subpopulation (CPW 2012b, pp. 8–10). Over the two-year period, the United States Department of Agriculture Animal and Plant Health Inspection Service removed 155 coyotes, 101 corvids, two bobcats, eight badgers, two raccoons, and three red foxes by means of aerial gunning, calling, ground shooting, and bait stations. Radio-marked hens, nest success, and chick survival were monitored during this time, and results were compared to baseline data collected for the same area from 2007 to 2010. Prior to predator control, of eight marked chicks, no individuals survived to 3 months. From 2011 through August of 2012, during which predator control occurred, of 10 marked chicks, four (40 percent) chicks survived to three months, and two (20 percent) survived at least one year. The study did not compare chick survival rates to non-predator removal areas, so it is unknown whether the apparent increase

in chick survival was due to predator control or other environmental factors (e.g., weather, habitat conditions, etc.).

Predator removal efforts have sometimes shown short-term gains that may benefit fall populations, but not breeding population sizes (Cote and Sutherland 1997, p. 402; Hagen 2011, pp. 98–99; Leu and Hanser 2011, p. 270). Predator removal may have greater benefits in areas with low habitat quality, but predator numbers quickly rebound without continual control (Hagen 2011, p. 99). Red fox removal in Utah appeared to increase adult greater sage-grouse survival and productivity, but the study did not compare these rates against other nonremoval areas, so inferences are limited (Hagen 2011, p. 98).

Slater (2003, p. 133) demonstrated that coyote control failed to have an effect on greater sage-grouse nesting success in southwestern Wyoming. However, coyotes may not be an important predator of sage-grouse. In a coyote prey base analysis, Johnson and Hansen (1979, p. 954) showed that sage-grouse and bird egg shells made up a very small percentage (0.4–2.4 percent) of analyzed scat samples. Additionally, coyote removal can have unintended consequences resulting in the release of smaller predators, many of which, like the red fox, may have greater negative impacts on sage-grouse (Mezquida *et al.* 2006, p. 752).

Removal of ravens from an area in northeastern Nevada caused only short-term reductions in raven populations (less than 1 year), as apparently transient birds from neighboring sites repopulated the removal area (Coates 2007, p. 151). Additionally, badger predation appeared to partially compensate for decreases due to raven removal (Coates 2007, p. 152). In their review of literature regarding predation, Connelly *et al.* (2004, p. 10–1) noted that only two of nine studies examining survival and nest success indicated that predation had limited a sage-grouse population by decreasing nest success, and both studies indicated low nest success due to predation was ultimately related to poor nesting habitat. Bui (2009, pp. 36–37) suggested removal of anthropogenic subsidies (e.g., landfills, tall structures) may be an important step to reducing the presence of sage-grouse predators. Leu and Hanser (2011, p. 270) also argue that reducing the effects of predation on sage-grouse can only be effectively addressed by precluding these features.

Summary of Predation

Gunnison sage-grouse may be increasingly subject to levels of predation that would not normally occur in the historically contiguous unaltered sagebrush habitats. Gunnison sage-grouse are adapted to minimize predation by cryptic plumage and behavior, however, predation has a strong relationship with anthropogenic factors on the landscape, and human presence on the landscape will continue to increase. The impacts of predation on greater sage-grouse can increase where habitat quality has been compromised by anthropogenic activities (exurban development, road development, etc.) (e.g., Coates 2007, pp. 154, 155; Bui 2009, p. 16; Hagen 2011, p. 100). Landscape fragmentation, habitat degradation, and human populations have the potential to increase predator populations through increasing ease of securing prey and subsidizing food sources and nest or den substrate. Thus, otherwise suitable habitat may change into a habitat sink (habitat in which reproduction is insufficient to balance mortality) for grouse populations (Aldridge and Boyce 2007, p. 517).

Anthropogenic influences on sagebrush habitats that increase suitability for ravens may also limit sage-grouse populations (Bui 2009, p. 32). Current land-use practices in the intermountain West favor high predator (in particular, raven) abundance relative to historical numbers (Coates *et al.* 2008, p. 426). The interaction between changes in habitat and predation may have substantial effects to sage-grouse at the landscape level (Coates 2007, pp. 3–5). Since the Gunnison and greater sage-grouse have such similar behavior and life-history traits, we believe the current impacts on Gunnison sage-grouse are at least as significant as those documented in greater sage-grouse and to date in Gunnison sage-grouse. Given the small population sizes and fragmented nature of the remaining Gunnison sage-grouse habitat, we believe that the impacts of predation will likely be even greater as habitat fragmentation continues.

The studies presented above for greater sage-grouse suggest that, in areas of intensive habitat alteration and fragmentation, sage-grouse productivity and, therefore, populations could be negatively affected by increasing predation. As more habitats face development, even dispersed development such as that occurring throughout the range of Gunnison sage-grouse, we expect this threat to spread and increase. Studies of the effectiveness of predator control have failed to demonstrate a long-term inverse relationship between the predator numbers and sage-grouse nesting success or population numbers. Therefore, the best available information shows that predation is currently a threat to the Gunnison sage-grouse and will continue to be a threat to the species.

Summary of Factor C

We have reviewed the available information on the effects of disease and predation on the long-term persistence of the Gunnison sage-grouse. The only disease that currently presents a potential impact on the survival of the Gunnison sage-grouse is West Nile virus. This virus is distributed throughout most of the species' range. However, despite its near 100 percent lethality, disease occurrence is sporadic in other taxa across the species' range and has not been detected to date in Gunnison sage-grouse. While we have no evidence of West Nile virus acting on the Gunnison sage-grouse, because of its presence within the species' range and the continued development of anthropogenic water sources in the area, the virus may pose a future threat to the species. We anticipate that West Nile virus will persist within the range of Gunnison sage-grouse indefinitely and will be exacerbated by any factor (e.g., climate change) that increases ambient temperatures and the presence of the vector on the landscape.

The best available information shows that existing and continued landscape fragmentation will increase the effects of predation on this species, particularly in the six smaller populations, resulting in a reduction in sage-grouse productivity and abundance in the future.

We have evaluated the best available scientific information regarding disease and predation and their effects on the Gunnison sage-grouse. Based on the information available, we have determined that predation is a threat to the persistence of the species throughout its range and that disease is not currently a threat but has the potential to become a threat in the future.

D. The Inadequacy of Existing Regulatory Mechanisms

Under this factor, we examine whether threats to the Gunnison sage-grouse are adequately addressed by existing regulatory mechanisms. Existing regulatory mechanisms that could provide some protection for Gunnison sage-grouse include: (1) Local land use laws, processes, and ordinances; (2) State laws and regulations; and (3) Federal laws and regulations. Regulatory mechanisms, if they exist, may preclude the need for listing if such mechanisms are judged to adequately address the threat to the species such that listing is not

warranted. Conversely, threats on the landscape continue to affect the species and may be exacerbated when not addressed by existing regulatory mechanisms, or when the existing mechanisms are not adequate (or not adequately implemented or enforced). We cannot predict when or how local, State, and/or Federal laws, regulations, and policies will change; however, most Federal land use plans are valid for at least 20 years.

An example of a regulatory mechanism is the terms and conditions attached to a grazing permit that describe how a permittee will manage livestock on a BLM allotment. They are nondiscretionary and enforceable, and would be considered a regulatory mechanism under this analysis. Other examples include city or county ordinances, State governmental actions enforced under a State statute or constitution, or Federal action under statute. Actions adopted by local groups, States, or Federal entities that are discretionary or are not enforceable, including conservation strategies and guidance, are typically not regulatory mechanisms. In this section we review actions undertaken by local, State, and Federal entities designed to reduce or remove threats to Gunnison sage-grouse and its habitat.

Local Laws and Regulations

Approximately 41 percent of occupied Gunnison sage-grouse habitat is privately owned (calculation from Table 1). Gunnison County and San Miguel County, Colorado, are the only local or county entities that have regulations and policy, respectively, that provide a level of conservation consideration for the Gunnison sage-grouse or its habitats on private land (Dolores County 2002; Mesa County 2003; Montrose County 2003). In 2007, the Gunnison County, Colorado Board of County Commissioners approved Land Use Resolution (LUR) Number 07–17 to ensure all applications for land use change permits, including building permits, individual sewage disposal system permits, Gunnison County access permits, and Gunnison County Reclamation permits be reviewed for impact to Gunnison sage-grouse habitat within occupied Gunnison sage-grouse habitat. If impacts are determined to result from a project, impacts are to be avoided, minimized, and/or mitigated. Approximately 79 percent of private land occupied by the Gunnison Basin population is in Gunnison County, and thereby under the purview of these regulations. The remaining 21 percent of the private lands in the Gunnison Basin population is in Saguache County where similar regulations are not in place or applicable.

Colorado State statute (C.R.S. 30–28–101) exempts parcels of land of 14 ha (35 ac) or more per home from regulation, so county zoning laws in Colorado such as LUR 07–17 only apply to properties with housing densities greater than one house per 14 ha (35 ac). C.R.S. 30–28–101 allows these parcels to be exempt from county regulation LUR 07–17 and may negatively affect Gunnison sage-grouse. A total of 1,190 parcels, covering 16,351 ha (40,405 ac), within occupied habitat in Gunnison County currently contain development. Of those 1,190 parcels, 851 are less than 14 ha (35 ac) in size and are thus subject to County review. However, those 851 parcels encompass only 13.1 percent of private land acreage with existing development in occupied habitat within Gunnison County. Parcels greater than 14 ha (35 ac) in size (339 of the 1,190) encompass 86.9 of the existing private land acreage within occupied habitat within Gunnison County. Cumulatively, 91 percent of the private land within the Gunnison County portion of the Gunnison Basin population that either has existing development or is potentially developable land is allocated in lots greater than 14 ha (35 ac) in size and, therefore, not subject to Gunnison County LUR 07–17. This situation limits the effectiveness of LUR 07–17 in providing protection to Gunnison sage-grouse in Gunnison County.

The only required review by Gunnison County under LUR 07–17 pertains to the construction of roads, driveways, and individual building permits. Gunnison County reviews all new development applications in the County. Gunnison County reviewed 380 projects from July 2006 through September 2012 under the LUR for impacts to Gunnison sage-grouse. All but six projects were within the overall boundary of the Gunnison Basin population's occupied habitat, with most of the activity focused in the northern portion of this population. All of these projects were approved and allowed to proceed with restrictions on pets and animals, timing of construction, adjustment of building envelopes, and other recommendations (Gunnison County 2012, pp. 1–13).

The majority of these projects were within established areas of development, and some were for activities such as outbuildings or additions to existing buildings; nonetheless, these projects provide an indication of further encroachment and fragmentation of the remaining occupied habitat. Sixty-six projects (17.4 percent of total projects) were within 1 km (0.6 mi) of a lek; most permits associated with these projects contained conditions or recommendations for the control of pets and animals, timing of construction, building envelopes, and similar restrictions. These minimally regulated negative impacts will continue to fragment the habitat and thus have substantial impacts on the conservation of the species. In summary, Gunnison County is to be highly commended for the regulatory steps it has implemented. However, the scope and implementation of that regulatory authority is limited in its ability to effectively and collectively conserve Gunnison sage-grouse due to the County's limited authority within the Gunnison Basin portion of the species' range. Furthermore, Saguache County, which contains approximately 21 percent of the Gunnison Basin population area, has no Gunnison sage-grouse specific LUR.

In 2005, San Miguel County amended its Land Use Codes to include consideration and implementation, to the extent possible, of conservation measures recommended in the 2005 RCP (GSRSC 2005, entire) for the Gunnison sage-grouse when considering land use activities and development located within its habitat (San Miguel County 2005). The County is only involved when there is a request for a special use permit, which limits their involvement in review of projects adversely affecting Gunnison sage-grouse and their habitat and providing recommendations. Conservation measures are solicited from the CPW and a local Gunnison sage-grouse working group. Implementation of the conservation measures is dependent on negotiations between the County and the applicant. Some positive measures (e.g., locating a special use activity outside grouse habitat, establishing a 324-ha (800-ac) conservation easement; implementing speed limits to reduce likelihood of bird/vehicle collisions) have been implemented as a result of the policy. Typically, the County has not been involved with residential development, and most measures that result from discussions with applicants result in measures that may minimize, but do not prevent, or mitigate for impacts (Henderson 2010, pers. comm.). The San Miguel County Land Use Codes provide some conservation benefit to the species through some minimization of impacts and encouraging landowners to voluntarily minimize/mitigate impacts of residential development in grouse habitat. However, they do not implement adequate regulatory authority to address the continued

degradation and fragmentation of the species habitat within the county.

In addition to the county regulations, Gunnison County hired a Gunnison Sage-grouse Coordinator (2005 to present) and organized a Strategic Committee (2005 to present) to facilitate implementation of conservation measures in the Gunnison Basin under both the local Conservation Plan and 2005 RCP (2005 RCP). San Miguel County hired a Gunnison Sage-grouse Coordinator for the San Miguel Basin population in March 2006. The Crawford working group hired a Gunnison sage-grouse coordinator in December 2009. Saguache County has applied for a grant to hire a part-time coordinator for the Poncha Pass population (grant status still pending). These efforts facilitate coordination relative to sage-grouse management and reflect positively on these counties' willingness to conserve Gunnison sage-grouse, but have no regulatory authority. None of the other counties with Gunnison sage-grouse populations have regulations or staff that implements regulation or policy review that consider the conservation needs of Gunnison sage-grouse.

Regulatory conservation measures implemented by Gunnison County in concert with State and Federal agencies include: Closing of shed antler collection in the Gunnison Basin by the Colorado Wildlife Commission due to its disturbance of Gunnison sage-grouse during the early breeding season; and a BLM/USFS/Gunnison County/CPW collective effort to implement and enforce road closures during the early breeding season (March 15 to May 15). These regulatory efforts have provided benefits to Gunnison sage-grouse during the breeding season. However, these mechanisms do not address the primary threat to the species of fragmentation of its habitat.

Habitat loss is not adequately regulated or monitored in Colorado counties where Gunnison sage-grouse occur. Therefore, conversion of agricultural land from one use to another, such as native pasture containing sagebrush converted to another use, such as cropland, would not normally come before a county zoning commission. Based on the information we have available for the range of the species, we do not believe that habitat loss from conversion of sagebrush habitat to agricultural lands is occurring at a level that makes it a threat. The permanent loss, and associated fragmentation and degradation, of sagebrush habitat is considered the largest threat to Gunnison sage-grouse (GSRSC 2005, p. 2). The minimally regulated residential/exurban development found throughout the vast majority of the species range is a primary cause of this loss, fragmentation, and/or degradation of Gunnison sage-grouse habitat. We are not aware of any local regulations that adequately address this threat.

We recognize that county or city ordinances in San Juan County, Utah, that address agricultural lands, transportation, and zoning for various types of land uses have the potential to influence sage-grouse. We have no information to suggest that other counties within the range of Gunnison sage-grouse have regulatory mechanisms that provide any protections for Gunnison sage-grouse.

Each of the seven population areas of Gunnison sage-grouse has a Conservation Plan written by the respective local working group with publication dates of 1999 to 2009. These plans provide recommendations for management of Gunnison sage-grouse and have been the basis for identifying and prioritizing local conservation efforts, but do not provide regulatory mechanisms for the conservation of the grouse.

State Laws and Regulations

State laws and regulations may impact sage-grouse conservation by providing specific authority for sage-grouse conservation over lands that are directly owned by the State, providing broad authority to regulate and protect wildlife on all lands within their borders, and providing a mechanism for indirect conservation through regulation of threats to the species (e.g., noxious weeds).

Colorado Revised Statutes section 33–1–104 gives CPW Board responsibility for the management and conservation of wildlife resources within State borders. Title 33 Article 1–101, Legislative Declaration requires a continuous operation of planning, acquisition, and development of wildlife habitats and facilities for wildlife-related opportunities. The CPW, which operates under the direction of the CPW Board, is required by statute (C.R.S. 24–65.1–302) to provide counties with information on ''significant wildlife habitat,'' and provide technical assistance in establishing guidelines for designating and administering such areas, if asked. The CPW Board also has authority to regulate possession of the Gunnison sage-grouse, set hunting seasons, and issue citations for poaching. CRS 33–1–106. These authorities provide individual Gunnison sage-grouse with protection from direct mortality from hunting.

The Wildlife Resources Code of Utah (Title 23) provides UDWR with the powers, duties, rights, and responsibilities to protect, propagate, manage, conserve, and distribute wildlife throughout the State. Section 23–13–3 declares that wildlife existing within the State, not held by private ownership and legally acquired, is property of the State. Sections 23–14–18 and 23–14–19 authorize the Utah Wildlife Board to prescribe rules and regulations for the taking and/or possession of protected wildlife, including Gunnison sage-grouse. These authorities provide adequate protection to individual Gunnison sage-grouse from direct mortality from hunting.

Gunnison sage-grouse are managed by CPW and UDWR on all lands within each State as resident native game birds. In both States this classification allows the direct human taking of the bird during hunting seasons authorized and conducted under State laws and regulations. In 2000, CPW closed the hunting season for Gunnison sage-grouse in the Gunnison Basin, the only area then open to hunting for the species. The hunting season for Gunnison sage-grouse in Utah has been closed since 1989. The Gunnison sage-grouse is listed as a species of special concern in Colorado, as a sensitive species in Utah, and as a Tier I species under the Utah Wildlife Action Plan, providing heightened priority for management (CDOW 2009b, p. 40; UDWR 2009, p. 9). Hunting and other State regulations that deal with issues such as harassment provide adequate protection for individual birds (see discussion under Factor B), but do not protect the habitat. Therefore, the protection afforded through the aforementioned State regulatory mechanisms is limited and is not sufficient to protect the Gunnison sage-grouse from extinction in the absence of listing under the Act.

In April 2009, the Colorado Oil and Gas Conservation Commission (COGCC), which is the entity responsible for permitting oil and gas well development in Colorado, adopted new rules addressing the impact of oil and gas development on wildlife resources (COGCC 2009 entire, promulgated pursuant to HB 07–1298, also available at 4 CCR 404–1). The rules went into effect on private lands on April 1, 2009, and on Federal lands July 1, 2009. The new rules require that permittees and operators determine whether their proposed development location overlaps with ''sensitive wildlife habitat,'' or is within a restricted surface occupancy (RSO) area. For Gunnison sage-grouse, areas within

1 km (0.6 mi) of an active lek can be designated as RSOs by CPW (CDOW 2009b, p. 27), and surface area occupancy will be avoided except in cases of economic or technical infeasibility (CDOW 2009b, p. 27).

Areas within approximately 6.4 km (4 mi) of an active lek are considered sensitive wildlife habitat (CDOW 2009b, p. 27), with the result that the development proponent is required to consult with the CPW to identify measures to (1) avoid impacts on wildlife resources, including sage-grouse; (2) minimize the extent and severity of those impacts that cannot be avoided; and (3) mitigate those effects that cannot be avoided or minimized (COGCC 2009, section 1202.a). The COGCC will consider CPW's recommendations in the permitting decision, although the final permitting and conditioning authority remains with COGCC. As stated in Section 1202.d of the new rules, consultation with CPW is not required under certain circumstances, such as the issuance of a variance by the Director of the COGCC, the existence of a previously CPW-approved wildlife mitigation plan, and others. Other categories for potential exemptions also can be found in the new rules (e.g., 1203.b).

Because the new rules have been in place for only 3 years and their implementation is still being discussed, it is not known what level of protection they will afford the Gunnison sage-grouse. However, since we did not consider that nonrenewable energy development, based on the information available to us, rose to the level of a threat to the species now or in the future, it is not necessary to consider the effectiveness of the relative regulatory mechanism.

We nonetheless note that the new rules could provide for greater consideration of the conservation needs of the species. Leases that have already been approved but not drilled (e.g., COGCC 2009, 1202.d(1)), or drilling operations that are already on the landscape, may continue to operate without further restriction into the future. We also are not aware of any situations where RSOs have been effectively applied or where conservation measures have been implemented for potential oil and gas development impacts to Gunnison sage-grouse on private lands underlain with privately owned minerals.

Colorado and Utah have laws that directly address the priorities for use of State school section lands, which require that management of these properties be based on maximizing financial returns. State school section lands account for only 1 percent of occupied habitat in Colorado and 1 percent in Utah, so impacts may be considered negligible. We have no information of any conservation measures that will be implemented under regulatory authority for Gunnison sage-grouse on State school section lands, other than a request to withdraw or apply ''no surface occupancy'' and conservation measures from the 2005 RCP (GSRSC 2005) to four sections available for oil and gas leasing in the San Miguel Basin population (see Factor A for further discussion).

In 2007, the Colorado State Land Board (SLB) purchased the Miramonte Meadows property (approximately 809 ha (2,300 ac) next to the Dan Noble State Wildlife Area (SWA)). Roughly 526 ha (1,300 ac) is considered prime Gunnison sage-grouse habitat (Garner 2010, pers. comm.). Discussions with the SLB have indicated a willingness to implement habitat improvements (juniper removal) on the property. They have also accepted an application to designate the tract as a ''Stewardship Trust'' parcel. The Stewardship Trust program is capped at 119,383 to 121,406 ha (295,000 to 300,000 ac), and no more property can be added until another tract is removed from the program. Because of this cap, it is unknown if or when the designation of the tract as a Stewardship Trust parcel may occur. The scattered nature of State school sections (generally single sections of land) across the landscape and the requirement to conduct activities to maximize financial returns minimize the likelihood of implementation of measures that will benefit Gunnison sage-grouse. Thus, no regulatory mechanisms are present on State trust lands to minimize degradation and fragmentation of habitat and thus ensure conservation of the species.

Some States require landowners to control noxious weeds, a potential habitat threat to sage-grouse (as discussed in Factor A). The types of plants considered to be noxious weeds vary by State. Cheatgrass is listed as a Class C species in Colorado (Colorado Department of Agriculture 2010, p. 3). The Class C designation delegates to local governments the choice of whether or not to implement activities for the control of cheatgrass. Gunnison, Saguache, and Hinsdale Counties target cheatgrass with herbicide applications (GWWC 2009, pp. 2–3). The CPW annually sprays for weeds on SWAs (CDOW 2009b, p. 106). The State of Utah does not consider cheatgrass as noxious within the State (Utah Department of Agriculture 2010, p. 1) nor in San Juan County (Utah Department of Agriculture 2010a, p. 1). The laws dealing with other noxious and invasive weeds may provide some protection for sage-grouse in local areas by requiring some control of the invasive plants, although large-scale control of the most problematic invasive plants is not occurring. Rehabilitation and restoration techniques for sagebrush habitats are mostly unproven and experimental (Pyke 2011, p. 543). These regulatory mechanisms have not been demonstrated to be effective in addressing the overall impacts of invasive plants on the degradation and fragmentation of sagebrush habitat within the species' range.

Federal Laws and Regulations

Gunnison sage-grouse are not covered or managed under the provisions of the Migratory Bird Treaty Act (16 U.S.C. 703–712) because they are considered resident game species. Federal agencies are responsible for managing 54 percent of the total Gunnison sage-grouse habitat. The Federal agencies with the most sagebrush habitat are BLM, an agency of the Department of the Interior, and USFS, an agency of the Department of Agriculture. The NPS in the Department of the Interior also has responsibility for lands that contain Gunnison sage-grouse habitat.

BLM

About 42 percent of Gunnison sage-grouse occupied habitat is on BLM-administered land (see Table 1). The Federal Land Policy and Management Act of 1976 (FLPMA) (43 U.S.C. 1701 et seq.) is the primary Federal law governing most land uses on BLM-administered lands. Section 102(a)(8) of FLPMA specifically recognizes wildlife and fish resources as being among the uses for which these lands are to be managed. Regulations pursuant to FLPMA and the Mineral Leasing Act (30 U.S.C. 181 et seq.) that address wildlife habitat protection on BLM-administered land include 43 CFR 3162.3–1 and 43 CFR 3162.5–1; 43 CFR 4120 et seq.; and 43 CFR 4180 et seq.

Gunnison sage-grouse have been designated as a BLM Sensitive Species since they were first identified and described in 2000 (BLM 2009, p. 7). The management guidance afforded sensitive species under BLM Manual 6840—Special Status Species Management (BLM 2008, entire) states that ''Bureau sensitive species will be managed consistent with species and habitat management objectives in land use and implementation plans to promote their conservation and to minimize the likelihood and need for listing under the ESA'' (BLM 2008, p.

05V). BLM Manual 6840 further requires that Resource Management Plans (RMPs) should address sensitive species, and that implementation ''should consider all site-specific methods and procedures needed to bring species and their habitats to the condition under which management under the Bureau sensitive species policies would no longer be necessary'' (BLM 2008, p. 2A1). As a designated sensitive species under BLM Manual 6840, sage-grouse conservation must be addressed in the development and implementation of RMPs on BLM lands.

RMPs are the basis for all actions and authorizations involving BLM-administered lands and resources. They establish allowable resource uses, resource condition goals and objectives to be attained, program constraints and general management practices needed to attain the goals and objectives, general implementation sequences, and intervals and standards for monitoring and evaluating the plan to determine its effectiveness and the need for amendment or revision (43 CFR 1601 et seq.).

The RMPs provide a framework and programmatic guidance for activity plans, which are site-specific plans written to implement decisions made in a RMP. Examples include Allotment Management Plans that address livestock grazing, oil and gas field development, travel management (motorized and mechanized road and trail use), and wildlife habitat management. Activity plan decisions normally require additional planning and National Environmental Policy Act (NEPA) analysis. If an RMP contains specific direction regarding sage-grouse habitat, conservation, or management, it represents an enforceable regulatory mechanism to ensure that the species and its habitats are considered during permitting and other decision making on BLM lands.

The BLM in Colorado manages Gunnison sage-grouse habitat under five existing RMPs. All five RMPs, and their subsequent revisions, contain some specific measures or direction pertinent to management of Gunnison sage-grouse or their habitats. Three of these RMPs (San Juan, Grand Junction, and Uncompahgre—covering all or portions of the San Miguel, Piñon Mesa, Crawford, and Cerro Summit-Cimarron-Sims Mesa populations, and the Dove Creek group) are in various stages of revision. All RMPs currently propose some conservation measures (measures that if implemented should provide a level of benefit to Gunnison sage-grouse) outlined in the 2005 RCP (GSRSC 2005, entire) or local Gunnison sage-grouse working group conservation plans through project or activity level NEPA reviews (BLM 2009, p. 6). In addition, several offices have undergone other program-level planning, such as travel management, which incorporates some conservation measures to benefit the species (BLM 2009, p. 6). However, the information provided to us by the BLM in Colorado did not specify what requirements, direction, measures, or guidance will ultimately be included in the revised RMPs to address threats to sage-grouse and sagebrush habitat. The 2008 final RMP for the BLM Monticello Field Office in Utah incorporates the recommendations of the 2005 RCP, which provides a level of benefit for Gunnison sage-grouse.

Current BLM RMPs do provide limited regulatory protection for Gunnison sage-grouse as they are being implemented through project-level planning (e.g., travel management (the management of the motorized and nonmotorized use of public lands) and grazing permit renewals). We do not know what final measures will be included in the revised RMPs and, therefore, what will ultimately be implemented. Based on modeling results demonstrating the effects of roads on Gunnison sage-grouse (Aldridge *et al.* 2011, entire—discussed in detail in Factor A), implementation of even the most restrictive travel management alternatives proposed by the BLM and USFS will still result in further degradation and fragmentation of Gunnison sage-grouse habitat in the Gunnison Basin.

In addition to land use planning, BLM uses Instruction Memoranda (IM) to provide instruction to district and field offices regarding specific resource issues. Instruction Memoranda are guidance that require a process to be followed but do not mandate results. Additionally, IMs are of short duration (1 to 2 years) and are intended to address resource concerns by providing direction to staff until a threat passes or the resource issue can be addressed in a long-term planning document. BLM issued IM Number CO–2005–038 on July 12, 2005, stating BLM's intent and commitment to assist with and participate in the implementation of the 2005 RCP. Although this IM has not been formally updated or reissued, it continues to be used for BLM-administered lands in the State of Colorado (BLM 2009, p. 6) and offers some conservation benefit for Gunnison sage-grouse through the establishment of Gunnison sage-grouse-specific management goals.

The BLM has regulatory authority for oil and gas leasing on Federal lands and on private lands with a severed Federal mineral estate, as provided at 43 CFR 3100 et seq., and they are authorized to require stipulations as a condition of issuing a lease. The BLM's planning handbook has program-specific guidance for fluid minerals (which include oil and gas) that specifies that RMP decisions will identify restrictions on areas subject to leasing, including closures, as well as lease stipulations (BLM 2000, Appendix C, p. 16). The handbook also specifies that all stipulations must have waiver, exception, or modification criteria documented in the plan, and notes that the least restrictive constraint to meet the resource protection objective should be used (BLM 2000, Appendix C, p. 16).

The BLM has regulatory authority to condition ''Application for Permit to Drill'' authorizations that are conducted under a lease that does not contain specific sage-grouse conservation stipulations, but utilization of conditions is discretionary and we are uncertain as to how this authority will be applied. However, since we did not consider that nonrenewable energy development, based on the information available to us, rose to the level of a threat to the species in the future, it is not necessary to consider the effectiveness of the relative regulatory mechanism. Also, oil and gas leases have a 200-m (650-ft) stipulation, which allows movement of the drilling area by that distance to avoid sensitive resources. However, in most cases this small amount of movement would have little to no conservation benefit to Gunnison sage-grouse because sage-grouse respond to nonrenewable energy development at much further distances (Holloran *et al.* 2007, p. 12; Walker *et al.* 2007, p. 10). Many of the BLM field offices work with the operators to move a proposed drilling site farther or justify such a move through the site-specific NEPA process.

For existing oil and gas leases on BLM land in occupied Gunnison sage-grouse habitat, oil and gas companies can conduct drilling operations if they wish, but are always subject to permit conditions. To our knowledge, BLM Field Offices are deferring the sale of new drilling leases in ''priority'' habitats for Gunnison sage-grouse until RMP revisions are complete and/or adequate protective stipulations are in place. However, there is currently no policy or regulatory mechanism in effect which assures that future lease sales in occupied habitat will not occur. In addition, leases already exist in 17 percent of the Piñon Mesa population, and 49 percent of the San Miguel Basin population. Given the already small and

fragmented nature of the populations where oil and gas leases are likely to occur, additional development within occupied habitat would negatively impact those populations by causing additional actual and functional habitat loss and fragmentation. Since we have no information on what minimization and mitigation measures might be applied, we cannot assess the overall conservation impacts of potential BLM regulations to those populations.

The oil and gas leasing regulations authorize BLM to modify or waive lease terms and stipulations if the authorized officer determines that the factors leading to inclusion of the term or stipulation have changed sufficiently to no longer justify protection, or if proposed operations would not cause unacceptable impacts (43 CFR 3101.1–4). We have no information that the BLM has granted any waivers of stipulations pertaining to the Gunnison sage-grouse and/or their habitat, which likely has benefitted the species.

The Energy Policy and Conservation Act Amendments of 2000 included provisions requiring the Secretary of the Department of the Interior to conduct a scientific inventory of all onshore Federal lands to identify oil and gas resources underlying these lands and the nature and extent of any restrictions or impediments to the development of such resources (42 U.S.C. 6217). On May 18, 2001, President Bush signed Executive Order 13212, Actions to Expedite Energy-Related Projects (66 FR 28357, May 22, 2001), which states that the executive departments and agencies shall take appropriate actions, to the extent consistent with applicable law, to expedite projects that will increase the production, transmission, or conservation of energy. The Executive Order specifies that this direction includes expediting review of permits or taking other actions as necessary to accelerate the completion of projects, while maintaining safety, public health, and environmental protections. Due to the relatively small amount of energy development activities occurring within Gunnison sage-grouse habitat (with the exception of the Dry Creek Basin subpopulation of the San Miguel population) and the low potential for oil and gas development over the majority of the species' range (BLM 2009, p. 1), we do not believe that energy development activities alone are a threat to Gunnison sage-grouse.

As stated previously, Gunnison sage-grouse are considered a BLM Sensitive Species and therefore receive Special Status Species management considerations. The BLM regulatory authority for grazing management is provided at 43 CFR 4100 (Regulations on Grazing Administration Exclusive of Alaska). Livestock grazing permits and leases contain terms and conditions determined by BLM to be appropriate to achieve management and resource condition objectives on the public lands and other lands administered by BLM, and to ensure that habitats are, or are making significant progress toward being, restored or maintained for BLM special status species (43 CFR 4180.1(d)). The State or regional standards for grazing administration must address habitat for endangered, threatened, proposed, candidate, or special status species, and habitat quality for native plant and animal populations and communities (43 CFR 4180.2(d)(4) and (5)). The guidelines must address restoring, maintaining, or enhancing habitats of BLM special status species to promote their conservation, as well as maintaining or promoting the physical and biological conditions to sustain native populations and communities (43 CFR 4180.2(e)(9) and (10)). The BLM is required to take appropriate action not later than the start of the next grazing year upon determining that existing grazing practices or levels of grazing use are significant factors in failing to achieve the standards and conform with the guidelines (43 CFR 4180.2(c)).

The BLM agreed to work with their resource advisory councils to expand the rangeland health standards required under 43 CFR 4180 so that there are public land health standards relevant to all ecosystems, not just rangelands, and that they apply to all BLM actions, not just livestock grazing (BLM Manual 180.06.A). Both Colorado and Utah have resource advisory councils. For instance, as of 2012, all active BLM grazing permits in occupied habitat managed by the BLM Gunnison Field Office have vegetation structure guidelines specific to Gunnison sage-grouse incorporated into allotment management plans or Records of Decision for permit renewals (BLM 2012, pp. 3–4). Habitat objectives for Gunnison sage-grouse within allotment management plans were designed such that they should provide good habitat for the species when allotments are managed in accordance with the objectives. Similar objectives are also incorporated into allotment plans in portions of some of the smaller population areas (see section, Public Lands Grazing in other Population Areas). However, as noted earlier (see Domestic Grazing and Wild Ungulate Herbivory under Factor A), available information suggests that LHA objectives important to Gunnison sage-grouse are not being met across portions of the species' range. Reduced habitat quality in those areas, as reflected in unmet LHA objectives, is likely negatively impacting Gunnison sage-grouse. However, the relationship between LHA determinations and the effects of domestic livestock grazing on Gunnison sage-grouse is imprecise.

Specific Gunnison sage-grouse habitat objectives from the Rangewide Conservation Plan are incorporated in some grazing permits and are likely the most effective means of ensuring that the needs of Gunnison sage-grouse are met on grazed lands. Certain grazing permits contain standard terms and conditions, such as forage utilization standards, that may indirectly help achieve habitat objectives for Gunnison sage-grouse. However, regulatory mechanisms applied within livestock grazing permits and leases are currently inadequate in portions of the range of Gunnison sage-grouse. It is anticipated that future changes will minimize further grazing impacts to habitat on BLM-administered lands and, in the future, improve degraded habitats for Gunnison sage-grouse, but there is no data at this time to substantiate this expectation.

USFS

The USFS manages 10 percent of the occupied Gunnison sage-grouse habitat (Table 1). Management of National Forest System lands is guided principally by the National Forest Management Act (NFMA) (16 U.S.C. 1600–1614, August 17, 1974, as amended). The NFMA specifies that all National Forests must have a Land and Resource Management Plan (LRMP) (16 U.S.C. 1600) to guide and set standards for all natural resource management activities on each National Forest or National Grassland. The NFMA requires USFS to incorporate standards and guidelines into LRMPs (16 U.S.C. 1600). USFS conducts NEPA analysis on its LRMPs, which include provisions to manage plant and animal communities for diversity, based on the suitability and capability of the specific land area in order to meet overall multiple-use objectives. The USFS planning process is similar to that of BLM.

The Gunnison sage-grouse is a USFS sensitive species in both Region 2 (Colorado) and Region 4 (Utah). USFS policy provides direction to analyze potential impacts of proposed management activities to sensitive species in a biological evaluation. The National Forests within the range of sage-grouse provide important seasonal habitats for the species, particularly the

Grand Mesa, Uncompahgre, and Gunnison (GMUG) National Forests. The 1991 Amended Land and Resource Management Plan for the GMUG National Forests has not directly incorporated Gunnison sage-grouse conservation measures or habitat objectives. The Regional Forester signed the 2005 RCP and as such has agreed to follow and implement those recommendations. Three of the 34 grazing allotments in occupied grouse habitat have incorporated Gunnison sage-grouse habitat objectives. To date, USFS has not deferred or withdrawn oil and gas leasing in occupied habitat, but sage-grouse conservation measures can be included at the ''Application for Permit to Drill'' stage. The BLM, which regulates oil and gas leases on USFS lands, has the authority to defer leases. However, the only population within USFS lands that is in an area of high or even medium potential for oil and gas reserves is the San Miguel Basin, and USFS lands only make up 1.4 percent of that population (GSRSC 2005, D–8). While consideration as a sensitive species and following the recommendations contained in the 2005 RCP (GSRSC 2005, entire) can provide some conservation benefits, they are voluntary in nature. Considering the aforementioned, the USFS has minimal regulatory authority that has been implemented to provide for the long-term conservation of Gunnison sage-grouse.

NPS

The NPS manages 2 percent of occupied Gunnison sage-grouse habitat (Table 1), which means that there is little opportunity for the agency to affect range-wide conservation of the species. The NPS Organic Act (39 Stat. 535; 16 U.S.C. 1, 2, 3, and 4) states that NPS will administer areas under their jurisdiction ''by such means and measures as conform to the fundamental purpose of said parks, monuments, and reservations, which purpose is to conserve the scenery and the natural and historical objects and the wild life therein and to provide for the enjoyment of the same in such manner and by such means as will leave them unimpaired for the enjoyment of future generations.'' Lands in the Black Canyon of the Gunnison National Park and the Curecanti National Recreation Area include portions of occupied habitat of the Crawford and Gunnison Basin populations. The 1993 Black Canyon of the Gunnison General Management Plan (NPS 1993, entire) and the 1995 Curecanti National Recreation Area General Management Plan (NPS 1995, entire) do not identify any specific conservation measures for Gunnison sage-grouse. However, these plans are outdated and will be replaced with Resource Stewardship Strategies, which will be developed in the next 5 to 7 years. In the meantime, NPS's ability to actively manage for species of special concern is not limited by the scope of their management plans.

NPS completed a Fire Management Plan in 2006 (NPS 2006, entire). Both prescribed fire and fire use (allowing wildfires to burn) are identified as a suitable use in Gunnison sage-grouse habitat. However, Gunnison sage-grouse habitat is identified as a Category C area, meaning that, while fire is a desirable component of the ecosystem, ecological constraints must be observed. For Gunnison sage-grouse, constraints include limitation of acreage burned per year and limitation of percent of project polygons burned. The NPS is currently following conservation measures in the local conservation plans and the 2005 RCP (Stahlnecker 2010, pers. comm.). In most cases, implementation of NPS fire management policies should result in minimal adverse effects since emphasis is placed on activities that will minimize, or ideally benefit, impacts to Gunnison sage-grouse habitat. Overall, implementation of NPS regulations should minimize impacts to Gunnison sage-grouse because they result in actions that intend to protect Gunnison sage-grouse habitat. Certain activities, such as human recreational activities occurring within occupied habitat, may have adverse effects although we believe the limited nature of such activities on NPS lands would limit their impacts on the species and thus not be considered a threat to Gunnison sage-grouse persistence. Grazing management activities on NPS lands are governed by BLM regulations, and their implementation and the results of these regulations are likely similar to those discussed for the BLM.

Conservation Easements and Fee Title Properties

Easements that prevent long-term or permanent habitat loss by prohibiting development are held by CPW, UDWR, Natural Resources Conservation Service (NRCS), NPS, and nongovernmental organizations. In addition, state and nongovernmental conservation organizations have secured properties through fee title acquisition. Some of the easements include conservation measures that are specific for Gunnison sage-grouse, while many are directed at other species, such as big game (GSRSC 2005, pp. 59–103). As of 2012, approximately 29,058 ha (71,084 ac), or 21 percent, of private lands in occupied Gunnison sage-grouse habitat in Colorado have been placed in conservation easements or acquired in fee title for conservation purposes (CPW 2011c, p. 11; CPW 2012b, p. 6; Cochran 2012, pers. comm.). This constitutes approximately 7.6 percent of rangewide occupied habitat (379,464 ha (937,676 ac)). Approximately 7,982 ha (19,725 ac), or 2 percent, of rangewide occupied habitat are under fee title ownership by conservation agencies or organizations noted above (Table 3).

Although the decision of whether to enter into a conservation easement is voluntary on the part of the landowner, conservation easements are legally binding documents once they are recorded. Therefore, we have determined that perpetual conservation easements that are recorded may offer some regulatory protection to the species, depending on the terms of the easement. Some of these easements protect existing Gunnison sage-grouse habitat. Similarly, fee title conservation properties (e.g. State Wildlife Areas) may offer regulatory protection to Gunnison sage-grouse, depending on the organization and conservation goals for the property.

TABLE 3—CONSERVATION EASEMENTS [a] BY POPULATION AND PERCENTAGES OF OCCUPIED HABITAT IN CONSERVATION EASEMENTS

[Lavender et al. 2011, CPW 2012b, p. 6]

Population	Hectares	Acres	Percent of occupied habitat in conservation easement
Gunnison Basin	11,334	28,008	4.7
Piñon Mesa	4,772	11,791	30.3

TABLE 3—CONSERVATION EASEMENTS [a] BY POPULATION AND PERCENTAGES OF OCCUPIED HABITAT IN CONSERVATION EASEMENTS—Continued

[Lavender et al. 2011, CPW 2012b, p. 6]

Population	Hectares	Acres	Percent of occupied habitat in conservation easement
Cerro Summit-Cimarron-Sims Mesa	1,395	3,447	9.3
Monticello	1,036	2,560	3.6
San Miguel Basin	1,029	2,543	2.5
Dove Creek Group	330	815	2.0
Crawford	249	616	1.8
Poncha Pass	0	0	0
Rangewide	20,145	49,780	5.3

[a] Includes conservation easements of all types and ownership as of September 2009, plus new CPW conservation easements since that time (CPW 2012b, p.6).

Based on our GIS analysis of data from Colorado Ownership Management and Protection (COMaP) data (Lavendar et al. 2011), approximately 69 percent of the area under conservation easements have land cover types other than agricultural (covering 31 percent) that provide habitat for Gunnison sage-grouse. However, considering that the total conservation easements recorded to date cover only 5.3 percent of rangewide occupied habitat, and not all easements have sage-grouse-specific habitat and/or conservation measures, and their scattered distribution throughout the range of the species, easements provide some level of protection from future development, but they do not provide adequate certainty against loss and fragmentation of Gunnison sage-grouse habitat. Similarly, since fee title properties held by conservation agencies or organizations cover only about 2 percent of rangewide occupied habitat, and protections vary widely depending on the owner or organization goals, they do not provide adequate certainty against loss and fragmentation of Gunnison sage-grouse habitat. The establishment of future conservation easements and fee title acquisition of properties will likely be limited considering their cost compared to the revenue generated by development of those lands, and money available through all sources to secure conservation properties. In addition, because entering into a conservation easement is voluntary on the part of the landowner, and fee title acquisitions will depend on the availability of lands for sale, market conditions, and other factors, we do not know if any future conservation easements or purchases will occur in such a configuration and magnitude that they will offer the species adequate protection.

Summary of Factor D

Gunnison sage-grouse conservation has been addressed in some local, State, and Federal plans, laws, regulations, and policies. Gunnison County has implemented regulatory authority over some development within their area of jurisdiction, for which they are to be highly commended. While the regulatory authority that has been implemented in Gunnison County has minimized some impacts, it has not curtailed the habitat loss, fragmentation, and/or degradation occurring within the County's jurisdictional boundary. Other counties with jurisdiction within occupied Gunnison sage-grouse habitat have not enacted regulations to address impacts resulting from residential development. Due to the limited scope and applicability of the regulations that exist throughout the range of the species and within all populations, the current local land use or development planning regulations do not provide adequate regulatory authority to protect sage-grouse from development or other harmful land uses that result in habitat loss, degradation, and/or fragmentation.

The CPW, UDWR, and other entities have implemented and continue to pursue conservation easements in Colorado and Utah, respectively, to conserve Gunnison sage-grouse habitat and meet the species' needs. These easements provide protection for the species where they occur, but do not cover enough of the landscape to provide for long-term conservation of the species. State wildlife regulations provide protection for individual Gunnison sage-grouse from direct mortality due to hunting but do not protect its habitat from the main threat of loss and fragmentation.

Energy development is currently only considered a threat in the Dry Creek Basin subpopulation of the San Miguel population. However, renewable and non-renewable energy development is likely to increase in the future in the Monticello-Dove Creek population which may impact this already small population. For the BLM and USFS, RMPs and LRMPs are mechanisms through which adequate and enforceable protections for Gunnison sage-grouse could be implemented. The extent to which appropriate measures to reduce or eliminate threats to sage-grouse have been incorporated into those planning documents, or are being implemented, varies across the range. As evidenced by the discussion above, and the ongoing threats described under Factor A, BLM and the USFS are not fully implementing the regulatory mechanisms available to conserve Gunnison sage-grouse and their habitats on their lands.

We have evaluated the best available scientific information on the adequacy of existing regulatory mechanisms to address threats to Gunnison sage-grouse and its habitats. While 54 percent of Gunnison sage-grouse habitat is managed by Federal agencies, these lands are interspersed with private lands which, as described above, do not have adequate regulatory mechanisms to ameliorate the further loss and fragmentation of habitat in all populations. This interspersion of private lands throughout Federal and other public lands extends the negative influence of those activities beyond the actual 41 percent of occupied habitat that private lands overlay. While we are unable to quantify the extent of the impacts on Federal lands resulting from activities on private lands, we have determined that the inadequacy of regulatory mechanisms on private lands as they pertain to human infrastructure development combined with inadequate regulatory mechanisms on some Federal

lands pose a threat to the species throughout its range.

E. Other Natural or Manmade Factors Affecting Its Continued Existence

Other factors potentially affecting the Gunnison sage-grouse's continued existence include genetic risks, drought, recreational activities, pesticides and herbicides, and contaminants.

Genetics and Small Population Size

Small populations face three primary genetic risks: Inbreeding depression; loss of genetic variation; and accumulation of new mutations. Inbreeding can have individual and population consequences by either increasing the phenotypic expression of recessive, deleterious alleles (the expression of harmful genes through the physical appearance) or by reducing the overall fitness of individuals in the population (GSRSC 2005, p. 109 and references therein). At the species level, Gunnison sage-grouse have low levels of genetic diversity particularly when compared to greater sage-grouse (Oyler-McCance *et al.* 2005, p. 635). There is no consensus regarding how large a population must be in order to prevent inbreeding depression. However, the San Miguel Basin Gunnison sage-grouse effective population size is below the level at which inbreeding depression has been observed to occur (Stiver *et al.* 2008, p. 479). Lowered hatching success is a well-documented indicator of inbreeding in wild bird populations (Stiver *et al.* 2008, p. 479 and references therein). Stiver *et al.* (2008, p. 479) postulated that the observed lowered hatching success rate of Gunnison sage-grouse in their study may be caused by inbreeding depression. Similarities of hatchability rates exist among other bird species that had undergone genetic bottlenecks. The application of the same procedures of effective population size estimation as used for the San Miguel Basin to the other Gunnison sage-grouse populations indicated that all populations other than the Gunnison Basin population may have population sizes low enough to induce inbreeding depression; and all populations could be losing adaptive potential (Stiver *et al.* 2008, p. 479).

Population structure of Gunnison sage-grouse was investigated using mitochondrial DNA sequence (mtDNA, maternally-inherited DNA located in cellular organelles called mitochondria) and nuclear microsatellite data from six geographic areas (Crawford, Gunnison Basin, Curecanti area of the Gunnison Basin, Monticello-Dove Creek, Piñon Mesa, and San Miguel Basin) (Oyler-McCance *et al.* 2005, entire). The Cerro Summit-Cimarron-Sims Mesa population was not included in the analysis due to inadequate sample sizes. The Poncha Pass population also was not included as it is composed of individuals transplanted from Gunnison Basin. Levels of genetic diversity were highest in the Gunnison Basin, which had more alleles and most of the alleles present in other populations (Oyler-McCance *et al.* 2005, entire). All other populations had much lower levels of diversity. The lower diversity levels are linked to small population sizes and a high degree of geographic isolation.

Collectively, the smaller populations contain 24 percent of the genetic diversity of the species. Individually, each of the small populations may not be important genetically to the survival of the species, but collectively it is likely that 24 percent of the genetic diversity is important to future rangewide survival of the species. Some of the genetic makeup contained within the smaller populations (with the potential exception of the Poncha Pass population since it consists of birds from the Gunnison Basin) may be critical to maintaining adaptability in the face of issues such as climate change or other environmental change. All populations sampled were found to be genetically discrete units (Oyler-McCance *et al.* 2005, p. 635), so the loss of any of them would result in a decrease in genetic diversity of the species. In addition, multiple populations across a broad geographic area provide insurance against a single catastrophic event (such as drought), and the aggregate number of individuals across all populations increases the probability of demographic persistence and preservation of overall genetic diversity by providing an important genetic reservoir (GSRSC 2005, p. 179). Thus, the loss of any one population would have a negative effect on the species as a whole.

Historically, the Monticello-Dove Creek, San Miguel, Crawford, and Piñon Mesa populations were larger and were connected through more contiguous areas of sagebrush habitat. The loss and fragmentation of sagebrush habitat between the late 1950s and the early 1990s led to the current isolation of these populations, which is reflected in low amounts of gene flow and isolation by distance (Oyler-McCance *et al.* 2005, p. 635). However, Oyler-McCance *et al.* (2005, p. 636) noted that a few individuals in their analysis appeared to have the genetic characteristics of a population other than their own, suggesting they were dispersers from a different population. Two probable dispersers were individuals moving from the San Miguel Basin population into Monticello-Dove Creek and Crawford. The San Miguel population itself appeared to have a mixture of individuals with differing probabilities of belonging to different clusters. This information suggests that the San Miguel population may act as a conduit of gene flow among the satellite populations surrounding the larger Gunnison Basin population. Additionally, another potential disperser into Crawford was found from the Gunnison Basin (Oyler-McCance *et al.* 2005, p. 636). This result is not surprising given their close geographic proximity.

Effective population size (Ne) is an important parameter in conservation biology. It is defined as the size of an idealized population of breeding adults that would experience the same rate of (1) loss of heterozygosity (the amount and number of different genes within individuals in a population), (2) change in the average inbreeding coefficient (a calculation of the amount of breeding by closely related individuals), or (3) change in variance in allele (one member of a pair or series of genes occupying a specific position in a specific chromosome) frequency through genetic drift (the fluctuation in gene frequency occurring in an isolated population) as the actual population.

The effective size of a population is often much less than its actual size or number of individuals. As effective population size decreases, the rate of loss of allelic diversity via genetic drift increases. Two consequences of this loss of genetic diversity, reduced fitness through inbreeding depression and reduced response to sustained directional selection (''adaptive potential''), are thought to elevate extinction risk (Stiver *et al.,* 2008, p. 472 and references therein). While no consensus exists on the population size needed to retain a level of genetic diversity that maximizes evolutionary potential (i.e., the ability to adapt to local changes), up to 5,000 greater sage-grouse may be necessary to maintain an effective population size of 500 birds (Aldridge and Brigham, 2003, p. 30). Other recent recommendations also suggest populations of at least 5,000 individuals to deal with evolutionary and demographic constraints (Traill *et al.* 2009, p. 3, and references therein). While the persistence of wild populations is usually influenced more by ecological rather than by genetic effects, once populations are reduced in size, genetic factors become increasingly important (Lande 1995, p. 318).

The CPW contracted a population viability analysis (PVA) for the

Gunnison sage-grouse (GSRSC 2005, Appendix G). The purpose of the Gunnison sage-grouse PVA was to assist the CPW in evaluating the relative risk of extinction for each population under the conditions at that time (i.e., the risk of extinction if nothing changed), to estimate relative extinction probabilities and loss of genetic diversity over time for various population sizes, and to determine the sensitivity of Gunnison sage-grouse population growth rates to various demographic parameters (GSRSC 2005, p. 169). The PVA was used as a tool to predict the relative, not absolute or precise, probability of extinction for the different populations under various management scenarios based on information available at that time and with the understanding that no data were available to determine how demographic rates would be affected by habitat loss or fragmentation. The analysis indicated that small populations (<50 birds) are at a serious risk of extinction within the next 50 years (assuming some degree of consistency of environmental influences in sage-grouse demography).

In contrast, populations in excess of 500 birds had an extinction risk of less than 5 percent within the next 50 years. These results suggested that the Gunnison Basin population is likely to persist long term in the absence of threats acting on it. In the absence of intervention, however, the Cerro Summit-Cimarron-Sims Mesa and Poncha Pass populations and the Dove Creek group of the Monticello-Dove Creek population were likely to become extirpated (GSRSC 2005, pp. 168–179). Based on a combination of information including the PVA (GSRSC 2005, p. 179), 2011 population estimates, and an overall declining population trend, the same three populations may soon be extirpated. Additionally, Gunnison sage-grouse estimates in the Crawford and Piñon Mesa populations have declined by more than 50 percent since the PVA was conducted (Table 2), so they too are likely trending towards extirpation. The San Miguel population has also declined, by 40 percent since 2004, so cumulative factors may be combining to cause its future extirpation.

The lack of large expanses of sagebrush habitat required by Gunnison sage-grouse in at least six of the seven Gunnison sage-grouse populations (as discussed in Factor A), combined with the results of the PVA and current population trends suggest that at least five, and most likely six, of the seven Gunnison sage-grouse populations are at high risk of extirpation due to small population size. The loss of genetic diversity from the extirpation of the aforementioned populations would result in a loss of genetic diversity of the species as a whole and thus contribute to decreased functionality of the remaining populations in maintaining viability and adaptability, as well as the potential loss of these populations' contribution to rangewide population connectivity and the continued existence of the entire species.

Six of the seven Gunnison sage-grouse populations may have effective sizes low enough to induce inbreeding depression, and all seven could be losing adaptive potential, with the assumption that the five populations smaller than the San Miguel population are exhibiting similar demography to the San Miguel population (Stiver *et al.* 2008, p. 479) and thus trending towards extirpation. Stiver *et al.* (2008, p. 479) suggested that long-term persistence of the six smaller populations would require translocations to supplement genetic diversity. The only population currently providing individuals to be translocated is the Gunnison Basin population, but because of substantial population declines such as those observed between the 2001 and 2004 lek counts (Stiver *et al.,* 2008, p. 479), questions arise as to whether this population would be able to sustain the loss of individuals required by a long-term, sustained translocation program. Lek counts, and consequently population estimates, especially in the San Miguel Basin and Gunnison Basin populations, have undergone substantial declines (Table 2) since peaks observed in the annual 2004 and 2005 counts, thus making inbreeding depression even more likely to be occurring within all populations except the Gunnison Basin. While we recognize that sage-grouse population sizes are cyclical, and that there are concerns about the statistical reliability of lek counts and the resulting population estimates (CDOW 2009b, pp. 1–3), we nonetheless believe that the overall declining trends of six of the seven Gunnison sage-grouse populations, and for the species as a whole, are such that they are impacting the species' ability to persist.

In summary, the declines in estimates of grouse numbers since 2005 are likely to contribute to even lower levels of genetic diversity and higher levels of inbreeding depression than previously considered, thus making the species as a whole less adaptable to environmental variables and more vulnerable to extirpation. Based on the information presented above, we have determined that genetics risks related to the small population size of Gunnison sage-grouse are a threat to the species.

Drought

Drought is a common occurrence throughout the range of the Gunnison and greater sage-grouse (Braun 1998, p. 148) and is considered a universal ecological driver across the Great Plains (Knopf 1996, p. 147). Infrequent, severe drought may cause local extinctions of annual forbs and grasses that have invaded stands of perennial species, and recolonization of these areas by native species may be slow (Tilman and El Haddi 1992, p. 263). Drought reduces vegetation cover (Milton *et al.* 1994, p. 75; Connelly *et al.* 2004, p. 7–18), potentially resulting in increased soil erosion and subsequent reduced soil depths, decreased water infiltration, and reduced water storage capacity. Drought also can exacerbate other natural events such as defoliation of sagebrush by insects. For example, approximately 2,544 km^2 (982 mi^2) of sagebrush shrublands died in Utah in 2003 as a result of drought and infestations with the *Aroga* (webworm) moth (Connelly *et al.* 2004, p. 5–11). Sage-grouse are affected by drought through the loss of vegetative habitat components, reduced insect production (Connelly and Braun 1997, p. 9), and increased risk of West Nile virus infections as described in Factor C above. These habitat component losses can result in declining sage-grouse populations due to increased nest predation and early brood mortality associated with decreased nest cover and food availability (Braun 1998, p. 149; Moynahan *et al.* 2007, p. 1781).

Greater sage-grouse populations declined during the 1930s period of drought (Patterson 1952, p. 68; Braun 1998, p. 148). Drought conditions in the late 1980s and early 1990s also coincided with a period when sage-grouse populations were at historically low levels (Connelly and Braun 1997, p. 8). Although drought has been a consistent and natural part of the sagebrush-steppe ecosystem, drought impacts on sage-grouse can be exacerbated when combined with other habitat impacts, such as human developments, that reduce cover and food (Braun 1998).

Aldridge *et al.* (2008, p. 992) found that the number of severe droughts from 1950 to 2003 had a weak negative effect on patterns of greater sage-grouse persistence. However, they cautioned that drought may have a greater influence on future sage-grouse populations as temperatures rise over the next 50 years, and synergistic effects of other threats affect habitat quality (Aldridge *et al.* 2008, p. 992). Populations on the periphery of the

range may suffer extirpation during a severe and prolonged drought (Wisdom *et al.* 2011, pp. 468–469).

Gunnison sage-grouse are capable of enduring moderate or severe, but relatively short-term, drought as observed from persistence of the populations during drought conditions from 1999 through 2003 throughout much of the range. The drought that began by at least 2001 and was most severe in 2002 had varying impacts on Gunnison sage-grouse habitat and is discussed in detail in our April 18, 2006, finding (71 FR 19954). Habitat appeared to be negatively affected by drought across a broad area of the Gunnison sage-grouse's range. However, the reduction of sagebrush density in some areas, allowing for greater herbaceous growth and stimulating the onset of sagebrush seed crops, may have been beneficial to sagebrush habitats over the long term. Nonetheless, six of the seven grouse populations (except for the Gunnison Basin population) have decreased in number since counts were conducted during the drought year of 2002 (Table 2).

Data are not available to scientifically determine if the declines are due to the drought alone. It is likely that drought exacerbates other impacts such as discussed above in Factors A through D. The current status of the various populations throughout the species' range make it highly susceptible to stochastic factors such as drought, particularly when it is acting in conjunction with others factors such as habitat fragmentation, small population size, predation, and low genetic diversity, as discussed in Factors A and C above and previously in Factor E. The available information is too speculative to conclude that drought alone is a threat to the species at this time; however, based on rapid species decline in drought years, it is likely that drought exacerbates other known threats and thus can negatively affect the species.

Recreation

Nonconsumptive recreational activities can degrade wildlife resources, water, and the land by distributing refuse, disturbing and displacing wildlife, increasing animal mortality, and simplifying plant communities (Boyle and Samson 1985, pp. 110–112). Sage-grouse response to disturbance may be influenced by the type of activity, recreationist behavior, predictability of activity, frequency and magnitude, timing, and activity location (Knight and Cole 1995, p. 71). We do not have any published literature concerning measured direct effects of recreational activities on Gunnison or greater sage-grouse, but can infer potential impacts on Gunnison sage-grouse from studies on related species and from research on nonrecreational activities. Baydack and Hein (1987, p. 537) reported displacement of male sharp-tailed grouse at leks from human presence resulting in loss of reproductive opportunity during the disturbance period. Female sharp-tailed grouse were observed at undisturbed leks while absent from disturbed leks during the same time period (Baydack and Hein 1987, p. 537). Disturbance of incubating female sage-grouse could cause displacement from nests, increased predator risk, or loss of nests. Disruption of sage-grouse during vulnerable periods at leks, or during nesting or early brood-rearing could affect reproduction or survival (Baydack and Hein 1987, pp. 537–538).

Recreational use of off-highway vehicles (OHVs) is one of the fastest-growing outdoor activities. In the western United States, greater than 27 percent of the human population used OHVs for recreational activities between 1999 and 2004 (Knick *et al.* 2011, p. 217). Knick *et al.* (2011, p. 219) reported that widespread motorized access for recreation facilitated the spread of predators adapted to humans and the spread of invasive plants. Any high-frequency human activity along established corridors can affect wildlife through habitat loss and fragmentation (Knick *et al.* 2011, p. 219). The effects of OHV use on sagebrush and sage-grouse have not been directly studied (Knick *et al.* 2011, p. 216). However, local working groups considered recreational uses, such as off-road vehicle use and biking, to be a risk factor in many areas.

Recreation from OHVs, hikers, mountain bikes, campers, snowmobiles, bird watchers, and other sources has affected many parts of the range, especially portions of the Gunnison Basin and Piñon Mesa population (BLM 2005a, p. 14; BLM 2005d, p. 4; BLM 2009, p. 36). These activities can result in abandonment of lekking activities and nest sites, energy expenditure reducing survival, and greater exposure to predators (GSRSC 2005).

Recreation is a significant use on lands managed by BLM (Connelly *et al.* 2004, p. 7–26). Recreational activities within the Gunnison Basin are widespread, occur during all seasons of the year, and have expanded as more people move to the area or come to recreate (BLM 2009, pp. 36–37). Four wheel drive, OHV, motorcycle, and other mechanized travel has been increasing rapidly. The number of annual OHV registrations in Colorado increased from 12,000 in 1991 to 131,000 in 2007 (BLM 2009, p. 37). Recreational activities have direct and indirect impacts to the Gunnison sage-grouse and their habitat (BLM 2009, p. 36). The Grand Mesa, Uncompaghre, and Gunnison (GMUG) National Forest is the fourth most visited National Forest in the Rocky Mountain Region of the USFS (Region 2) (Kocis et. al., 2004 in Draft Environmental Impact Statement for Gunnison Basin Federal Lands Travel Management (2009, p. 137)). The GMUG is the second most heavily visited National Forest on the western slope of Colorado (DEIS Gunnison Basin Federal Lands Travel Management 2009, p. 137). However, it is unknown what percentage of the visits occurs within Gunnison sage-grouse habitat on the Gunnison Ranger District (DEIS Gunnison Basin Federal Lands Travel Management 2009, p. 137). With human populations expected to increase in towns and cities within and adjacent to the Gunnison Basin and nearby populations (see Factor A), the impacts to Gunnison sage-grouse from recreational use will continue to increase.

The BLM and Gunnison County have 38 closure points to minimize impacts to Gunnison sage-grouse within the Basin from March 15 to May 15 each year (BLM 2009, p. 40). While road closures may be violated in a small number of situations, road closures are having a beneficial effect on Gunnison sage-grouse through avoidance or minimization of impacts during the breeding season.

Dispersed camping occurs at a low level on public lands in all of the populations, particularly during the hunting seasons for other species. However, we have no information indicating that these camping activities are adversely affecting Gunnison sage-grouse.

Domestic dogs accompanying recreationists or associated with residences can disturb, harass, displace, or kill Gunnison sage-grouse. Authors of many wildlife disturbance studies concluded that dogs with people, dogs on leash, or loose dogs provoked the most pronounced disturbance reactions from their study animals (Sime 1999 and references within). The primary consequences of dogs being off leash is harassment, which can lead to physiological stress as well as the separation of adult and young birds, or flushing incubating birds from their nest. However, we have no data indicating that this activity is adversely affecting Gunnison sage-grouse population numbers such that it can be

considered a rangewide or population level threat.

Recreational activities as discussed above do not singularly pose a threat to Gunnison sage-grouse. However, there may be certain situations where recreational activities are impacting local concentrations of Gunnison sage-grouse, especially in areas where habitat is already fragmented such as in the six small populations and in certain areas within the Gunnison Basin.

Pesticides and Herbicides

Insects are an important component of sage-grouse chick and juvenile diets (GSRSC 2005, p. 132 and references therein). Insects, especially ants (Hymenoptera) and beetles (Coleoptera), can comprise a major proportion of the diet of juvenile sage-grouse and are important components of early brood-rearing habitats (GSRSC 2005, p. 132 and references therein). Most pesticide applications are not directed at control of ants and beetles. Pesticides are used primarily to control insects causing damage to cultivated crops on private lands and to control grasshoppers (Orthoptera) and Mormon crickets (*Mormonius sp.*) on public lands.

Few studies have examined the effects of pesticides to sage-grouse, but at least two have documented direct mortality of greater sage-grouse from use of these chemicals. Greater sage-grouse died as a result of ingestion of alfalfa sprayed with organophosphorus insecticides (Blus *et al.* 1989, p. 1142; Blus and Connelly 1998, p. 23). In this case, a field of alfalfa was sprayed with methamidophos and dimethoate when approximately 200 greater sage-grouse were present; 63 of these sage-grouse were later found dead, presumably as a result of pesticide exposure (Blus *et al.* 1989; p. 1142, Blus and Connelly 1998, p. 23). Both methamidophos and dimethoate remain registered for use in the United States (Christiansen and Tate 2011, p. 125), but we found no further records of sage-grouse mortalities from their use. In 1950, rangelands treated with toxaphene and chlordane bait to control grasshoppers in Wyoming resulted in game bird mortality of 23.4 percent (Christiansen and Tate 2011, p. 125). Forty-five greater sage-grouse deaths were recorded, 11 of which were most likely related to the pesticide (Christiansen and Tate 2011, p. 125, and references therein). Greater sage-grouse who succumbed to vehicle collisions and mowing machines in the same area also were likely compromised from pesticide ingestion (Christiansen and Tate 2011, p. 125). Neither of these chemicals has been registered for grasshopper control since the early 1980s (Christiansen and Tate 2011, p. 125, and references therein) and thus are no longer a threat to Gunnison sage-grouse.

Infestations of Russian wheat aphids (*Diuraphis noxia*) have occurred in Gunnison sage-grouse occupied range in Colorado and Utah (GSRSC 2005, p. 132). Disulfoton, a systemic organophosphate extremely toxic to wildlife, was routinely applied to over a million acres of winter wheat crops to control the aphids during the late 1980s. We have no data indicating there were any adverse effects to Gunnison sage-grouse (GSRSC 2005, p. 132). More recently, an infestation of army cutworms *(Euxoa auxiliaries)* occurred in Gunnison sage-grouse habitat along the Utah-Colorado State line. Thousands of acres of winter wheat and alfalfa fields were sprayed with insecticides such as permethrin, a chemical that is toxic to wildlife, by private landowners to control them (GSRSC 2005, p. 132), but again, we have no data indicating any adverse effects to Gunnison sage-grouse.

Game birds that ingested sublethal levels of pesticides have been observed exhibiting abnormal behavior that may lead to a greater risk of predation (Dahlen and Haugen 1954, p. 477; McEwen and Brown 1966, p. 609; Blus *et al.* 1989, p. 1141). Wild sharp-tailed grouse poisoned by malathion and dieldrin exhibited depression, dullness, slowed reactions, irregular flight, and uncoordinated walking (McEwen and Brown 1966, p. 689). Although no research has explicitly studied the indirect levels of mortality from sublethal doses of pesticides (e.g., predation of impaired birds), it has been assumed to be the reason for mortality among some study birds (McEwen and Brown 1966 p. 609; Blus *et al.* 1989, p. 1142; Connelly and Blus 1991, p. 4). Both Post (1951, p. 383) and Blus *et al.* (1989, p. 1142) located depredated sage-grouse carcasses in areas that had been treated with insecticides. Exposure to these insecticides may have predisposed sage-grouse to predation. Sage-grouse mortalities also were documented in a study where they were exposed to strychnine bait used to control small mammals (Ward *et al.* 1942 as cited in Schroeder *et al.* 1999, p. 16). While we do not have specific information of these effects occurring in Gunnison sage-grouse, the effects observed in greater sage-grouse can be expected if similar situations arise within Gunnison sage-grouse habitat.

Cropland spraying may affect populations that are not adjacent to agricultural areas, given the distances traveled by females with broods from nesting areas to late brood-rearing areas (Knick *et al.* 2011, p. 211). The actual footprint of this effect cannot be estimated, because the distances sage-grouse travel to get to irrigated and sprayed fields is unknown (Knick *et al.* 2011, p. 211). Similarly, actual mortalities from pesticides may be underestimated if sage-grouse disperse from agricultural areas after exposure.

Much of the research related to pesticides that had either lethal or sublethal effects on greater sage-grouse was conducted on pesticides that have been banned or have had their use further restricted for more than 20 years due to their toxic effects on the environment (e.g., dieldrin). We currently do not have any information to show that the banned pesticides are having negative impacts to sage-grouse populations through either illegal use or residues in the environment. For example, sage-grouse mortalities were documented in a study where they were exposed to strychnine bait used to control small mammals (Ward *et al.* 1942 as cited in Schroeder *et al.* 1999, p. 16). According to the U.S. Environmental Protection Agency (EPA), above-ground uses of strychnine were prohibited in 1988 and those uses remain temporarily cancelled today. We do not know when, or if, above-ground uses will be permitted to resume. Currently, strychnine is registered for use only below-ground as a bait application to control pocket gophers (*Thomomys* sp.; EPA 1996, p. 4). Therefore, the current legal use of strychnine baits is unlikely to present a significant exposure risk to sage-grouse. No information on illegal use, if it occurs, is available. We have no other information regarding mortalities or sublethal effects of strychnine or other banned pesticides on sage-grouse.

Although a reduction in insect population levels resulting from insecticide application can potentially affect nesting sage-grouse females and chicks (Willis *et al.* 1993, p. 40; Schroeder *et al.* 1999, p. 16), there is no information as to whether insecticides are impacting survivorship or productivity of the Gunnison sage-grouse.

Herbicide applications can kill sagebrush and forbs important as food sources for sage-grouse (Carr 1968 *in* Call and Maser 1985, p. 14). The greatest impact resulting from a reduction of either forbs or insect populations is to nesting females and chicks due to the loss of potential protein sources that are critical for successful egg production and chick nutrition (Johnson and Boyce 1991, p. 90; Schroeder *et al.* 1999, p. 16). A comparison of applied levels of

herbicides with toxicity studies of grouse, chickens, and other gamebirds (Carr 1968, *in* Call and Maser 1985, p. 15) concluded that herbicides applied at recommended rates should not result in sage-grouse poisonings.

Use of insecticides to control mosquitoes is infrequent and probably does not have detrimental effects on sage-grouse. Available insecticides that kill adult mosquitoes include synthetic pyrethroids such as permethrin, which are applied at very low concentrations and have very low vertebrate toxicity (Rose 2004). Organophosphates such as malathion have been used at very low rates to kill adult mosquitoes for decades, and are judged relatively safe for vertebrates (Rose 2004).

In summary, historically insecticides have been shown to result in direct mortality of individuals, and also can reduce the availability of food sources, which in turn could contribute to mortality of sage-grouse. Despite the potential effects of pesticides, we could find no information to indicate that the use of these chemicals, at current levels, negatively affects Gunnison sage-grouse population numbers. Schroeder *et al.*'s (1999, p. 16) literature review found that the loss of insects can have significant impacts on nesting females and chicks, but those impacts were not detailed. Many of the pesticides that have been shown to have an effect on sage-grouse have been banned in the United States for more than 20 years. We currently do not have any information to show that either the illegal use of banned pesticides or residues in the environment are presently having negative impacts to sage-grouse populations. While the reduction in insect availability via insecticide application has not been documented to affect overall population numbers in sage-grouse, it appears that insect reduction, because of its importance to chick production and survival, could be having as yet undetected negative impacts in populations with low population numbers. At present, however, there is no information available to indicate that either herbicide or insecticide applications pose a threat to the species.

Contaminants

Gunnison sage-grouse exposure to various types of environmental contaminants may potentially occur as a result of agricultural and rangeland management practices, mining, energy development and pipeline operations, and transportation of materials along highways and railroads.

We expect that the number of sage-grouse occurring in the immediate vicinity of wastewater pits associated with energy development would be small due to the small amount of energy development within the species' range, the typically intense human activity in these areas, the lack of cover around the pits, and the fact that sage-grouse do not require free standing water. Most bird mortalities recorded in association with wastewater pits are water-dependent species (e.g., waterfowl), whereas dead ground-dwelling birds (such as the sage-grouse) are rarely found at such sites (Domenici 2008, pers. comm.). However, if the wastewater pits are not appropriately screened, sage-grouse may have access to them and could ingest water and/or become oiled while pursuing insects. If these birds then return to sagebrush cover and die, their carcasses are unlikely to be found as only the pits are surveyed.

A few gas and oil pipelines occur within the San Miguel population. Exposure to oil or gas from pipeline spills or leaks could cause mortalities or morbidity to Gunnison sage-grouse. Similarly, given the network of highways and railroad lines that occur throughout the range of the Gunnison sage-grouse, there is some potential for exposure to contaminants resulting from spills or leaks of hazardous materials being conveyed along these transportation corridors. We found no documented occurrences of impacts to Gunnison sage-grouse from such spills, and we do not expect they are a significant source of mortality or threat to the species because these types of spills occur infrequently and may involve only a small area within the occupied range of the species.

Summary of Factor E

Although genetic consequences of low Gunnison sage-grouse population numbers have not been definitively detected to date, the results from Stiver *et al.* (2008, p. 479) suggest that six of the seven populations may have effective sizes low enough to induce inbreeding depression and all seven could be losing adaptive potential. While some of these consequences may be ameliorated by translocations, information indicates the long-term viability of Gunnison sage-grouse is compromised by this situation, particularly when combined with threats discussed in Factors A and D. We have, therefore, determined that genetics risks related to the small population size of Gunnison sage-grouse are a threat to the species.

While sage-grouse have evolved with drought, population numbers suggest that drought is at least correlated with, and potentially an underlying cause of, the declines. Although we cannot determine whether drought alone is a threat to the species, we suspect it is an indirect threat exacerbating other factors such as predation or habitat fragmentation. Based on the available information, insecticides are being used infrequently enough and in accordance with manufacturer labeling such that they are not adversely affecting populations of the Gunnison sage-grouse. The most likely impact of pesticides on Gunnison sage-grouse is the reduction of insect prey items. However, we could find no information to indicate that use of pesticides, in accordance with their label instructions, is a threat to Gunnison sage-grouse. We similarly do not have information indicating that contaminants, as described above, are a threat to the species.

Thus, based on the best scientific and commercial data available, we have concluded that other natural or manmade factors (genetics risks related to small population size, and indirectly, drought that exacerbates other factors) are a threat to the Gunnison sage-grouse persistence.

Cumulative Effects From Factors A Through E

Many of the threats described in this finding may cumulatively or synergistically impact Gunnison sage-grouse beyond the scope of each individual threat. For example, improper grazing management alone may only affect portions of Gunnison sage-grouse habitat. However, improper grazing combined with invasive plants, drought, and recreational activities may collectively result in substantial habitat loss, degradation, or fragmentation across large portions of the species' range. In turn, climate change may exacerbate those effects, further diminishing habitat and increasing the isolation of already declining populations, making them more susceptible to genetic drift, disease, or catastrophic events such as fire. Further, predation on Gunnison sage-grouse may increase as a result of the increase in human disturbance and development. Numerous threats are likely acting cumulatively to further increase the likelihood that the species will become extinct within the foreseeable future.

Determination

We have carefully assessed the best scientific and commercial information available regarding the past, present, and future threats to Gunnison sage-grouse. Section 3(6) of the Act defines an endangered species as ''any species which is in danger of extinction

throughout all or a significant portion of its range,'' and defines a threatened species as ''any species which is likely to become an endangered species within the foreseeable future throughout all or a significant portion of its range.'' As described in detail above, this species is currently at risk throughout all of its range due to ongoing threats of habitat destruction and modification (Factor A), predation (Factor C), inadequacy of existing regulatory mechanisms (Factor D), and other natural or manmade factors affecting its continued existence (Factor E).

Based on the best available scientific and commercial data, we have determined that the principal threat to Gunnison sage-grouse is habitat loss, degradation, and fragmentation due to residential, exurban, and commercial development and associated infrastructure such as roads and power lines. The human population is increasing throughout much of the range of Gunnison sage-grouse, and data indicate this trend will continue. With this growth, we expect an increase in human development, further contributing to loss and fragmentation of Gunnison sage-grouse habitats. Other threats to the species include improper grazing management; predation (often facilitated by human development or disturbance); genetic risks in the declining, smaller populations; and inadequate local, State, and Federal regulatory mechanisms (e.g., laws, regulations, zoning) to conserve the species. Other factors that may not individually threaten the continued existence of Gunnison sage-grouse but, collectively, have the potential to threaten the species, include invasive plants, fire, and climate change, and the interaction of these three factors; fences; renewable and non-renewable energy development; piñon-juniper encroachment; water development; disease;, drought; and recreation.

We consider the threats that the Gunnison sage-grouse faces to be high in severity because many of the threats (exurban development, roads, predation, improper grazing management, inadequacy of regulatory mechanisms, genetic issues) occur throughout all of the species' range. Based on an evaluation of biotic, abiotic, and anthropogenic factors, no strongholds are believed to exist for Gunnison sage-grouse (Wisdom *et al.* 2011, entire). All seven populations are experiencing habitat degradation and fragmentation due to exurban development, roads, powerlines, and improper grazing management. Available habitat is limited and fragmented to extent that it is increasing the probability that the species will become extinct within the foreseeable future.

Six of the seven populations of Gunnison sage-grouse have population sizes low enough to induce inbreeding depression, and all seven may be losing their adaptive potential (Stiver 2008, p. 479). Predation is exerting a strong influence on all populations, but especially the six smaller populations. Invasive weeds are likely to exert a strong influence on all populations in the future. Regulations that are in place at the local, State, or Federal level are not adequate to minimize the threat of habitat degradation and fragmentation resulting from exurban development and other factors identified as threats to the species. The existing regulatory mechanisms are not being appropriately implemented such that land use practices result in habitat conditions that adequately support the life-history needs of the species. Existing regulations are not effective at ameliorating the threats resulting from predation, genetic issues, or invasive weeds. Due to the impacts resulting from the issues described above and the current small population sizes and habitat areas, impacts from other stressors such as fences, recreation, grazing, powerlines, and drought/weather are likely acting cumulatively to further increase the likelihood that the species will become extinct within the foreseeable future.

We have information that the threats are identifiable and that the species is currently facing them throughout its range. These actual, identifiable threats include habitat degradation and fragmentation from exurban development and roads, inadequate regulatory mechanisms, genetic issues, predation, and improper grazing management. In addition, the interaction among climate change, invasive plants, and drought/weather are impacting the species negatively. In addition to their current existence, we expect these threats to continue and likely intensify in the future.

Gunnison sage-grouse currently occupy a small fraction of their historic range. Large patches of sagebrush vegetation are extremely limited in southwestern Colorado and southeastern Utah. Extant Gunnison sage-grouse populations occur within the last remaining areas that support large areas of suitable sagebrush. As described in detail in the above *Summary of Factors Affecting the Species,* the threats of human infrastructure (residential and commercial development, roads and trails, powerlines, improper grazing management, and fences), predation, and small population sizes currently exist (at varying degrees) throughout the range of Gunnison sage-grouse and thus are imminent threats. These threats are anticipated to increase throughout the range of the species. The components of human infrastructure, once present on the landscape, become virtually permanent features resulting in the reduction or elimination of proactive and effective management alternatives. We anticipate other potential threats such as widespread invasive species invasion and increased fire frequency to increase in the future and likely will act synergistically to become threats to Gunnison sage-grouse. We anticipate renewable energy development, particularly geothermal and wind energy development, to increase in some population areas.

Therefore, based on the best available scientific and commercial information, we propose to list the Gunnison sage-grouse as an endangered species throughout all of its range. The ability of all remaining populations and habitat areas to retain the attributes required for long-term sustainability of this landscape-scale species is highly diminished, causing the species to meet the definition of endangered. Endangered status reflects the vulnerability of this species to threat factors negatively affecting it and its extremely limited and restricted habitat. We also examined the Gunnison sage-grouse to analyze if any significant portion of its range may warrant a different status. However, because of its limited and curtailed range, and uniformity of the threats throughout its entire range, we find there are no significant portions of any of the species' range that may warrant a different determination of status.

Available Conservation Measures

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

The primary purpose of the Act is the conservation of endangered and threatened species and the ecosystems upon which they depend. The ultimate goal of such conservation efforts is the recovery of these listed species, so that they no longer need the protective

measures of the Act. Subsection 4(f) of the Act requires the Service to develop and implement recovery plans for the conservation of endangered and threatened species. The recovery planning process involves the identification of actions that are necessary to halt or reverse the species' decline by addressing the threats to its survival and recovery. The goal of this process is to restore listed species to a point where they are secure, self-sustaining, and functioning components of their ecosystems.

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

Implementation of recovery actions generally requires the participation of a broad range of partners, including other Federal agencies, States, Tribes, nongovernmental organizations, businesses, and private landowners. Examples of recovery actions include habitat restoration (e.g., restoration of native vegetation), research, captive propagation and reintroduction, and outreach and education. The recovery of many listed species cannot be accomplished solely on Federal lands because their range may occur primarily or solely on non-Federal lands. To achieve recovery of these species requires cooperative conservation efforts on private, State, and Tribal lands.

If this species is listed, funding for recovery actions will be available from a variety of sources, including Federal budgets, State programs, and cost share grants for non-Federal landowners, the academic community, and nongovernmental organizations. In addition, pursuant to section 6 of the Act, the States of Colorado and Utah would be eligible for Federal funds to implement management actions that promote the protection and recovery of the Gunnison sage-grouse. Information on our grant programs that are available to aid species recovery can be found at: *http://www.fws.gov/grants.*

Although the Gunnison sage-grouse is only proposed for listing under the Act at this time, please let us know if you are interested in participating in recovery efforts for this species. Additionally, we invite you to submit any new information on this species whenever it becomes available and any information you may have for recovery planning purposes (see **FOR FURTHER INFORMATION CONTACT**).

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

Federal agency actions within the species' habitat that may require conference or consultation or both as described in the preceding paragraph include management and any other landscape-altering activities on Federal lands administered by the Bureau of Land Management, U.S. Forest Service, and National Park Service; issuance of section 404 Clean Water Act permits by the Army Corps of Engineers; construction and management of gas pipeline and power line rights-of-way by the Federal Energy Regulatory Commission; and construction and maintenance of roads or highways by the Federal Highway Administration.

The Act and its implementing regulations set forth a series of general prohibitions and exceptions that apply to all endangered wildlife. The prohibitions of section 9(a)(2) of the Act, codified at 50 CFR 17.21 for endangered wildlife, in part, make it illegal for any person subject to the jurisdiction of the United States to take (includes harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect; or to attempt any of these), import, export, ship in interstate commerce in the course of commercial activity, or sell or offer for sale in interstate or foreign commerce any listed species. Under the Lacey Act (18 U.S.C. 42–43; 16 U.S.C. 3371–3378), it is also illegal to possess, sell, deliver, carry, transport, or ship any such wildlife that has been taken illegally. Certain exceptions apply to agents of the Service and State conservation agencies.

We may issue permits to carry out otherwise prohibited activities involving endangered and threatened wildlife species under certain circumstances. Regulations governing permits are codified at 50 CFR 17.22 for endangered species, and at 17.32 for threatened species. With regard to endangered wildlife, a permit must be issued for the following purposes: For scientific purposes, to enhance the propagation or survival of the species, and for incidental take in connection with otherwise lawful activities.

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

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

(2) Actions that would result in the loss of sagebrush overstory plant cover or height. Such activities could include, but are not limited to, the removal of native shrub vegetation by any means for any infrastructure construction project; direct conversion of sagebrush habitat to agricultural land use; habitat improvement or restoration projects involving mowing, brush-beating, Dixie harrowing, disking, plowing, or

prescribed burning; and fire suppression activities.

(3) Actions that would result in the loss or reduction in native herbaceous understory plant cover or height, and a reduction or loss of associated arthropod communities. Such activities could include, but are not limited to, livestock grazing, the application of herbicides or insecticides, prescribed burning and fire suppression activities; and seeding of nonnative plant species that would compete with native species for water, nutrients, and space.

(4) Actions that would result in Gunnison sage-grouse avoidance of an area during one or more seasonal periods. Such activities could include, but are not limited to, the construction of vertical structures such as power lines, fences, communication towers, buildings; motorized and nonmotorized recreational use; and activities such as well drilling, operation, and maintenance, which would entail significant human presence, noise, and infrastructure.

Questions regarding whether specific activities would constitute a violation of section 9 of the Act should be directed to the Western Colorado Field Office (see **FOR FURTHER INFORMATION CONTACT**). Requests for copies of the regulations concerning listed animals and general inquiries regarding prohibitions and permits may be addressed to the U.S. Fish and Wildlife Service, Endangered Species Permits, Denver Federal Center, P.O. Box 25486, Denver, Colorado 80225–0489 (telephone (303) 236–4256; facsimile (303) 236–0027).

Peer Review

In accordance with our joint policy on peer review published in the **Federal Register** on July 1, 1994 (59 FR 34270), we will seek the expert opinions of at least three appropriate and independent specialists regarding this proposed rule. We have invited these peer reviewers to comment during this public comment period on our specific assumptions and conclusions in this proposed rule.

We will consider all comments and information received during this comment period on this proposed rule during our preparation of a final determination. Accordingly, the final decision may differ from this proposal.

Public Hearings

Section 4(b)(5) of the Act provides for one or more public hearings on this proposal, if requested. Requests must be received within 45 days after the date of publication of this proposed rule in the **Federal Register**. Such requests must be sent to the address shown in **FOR FURTHER INFORMATION CONTACT**. We will schedule public hearings on this proposal, if any are requested, and announce the dates, times, and places of those hearings, as well as how to obtain reasonable accommodations, in the **Federal Register** and local newspapers at least 15 days before the hearing.

Required Determinations

Paperwork Reduction Act of 1995 (44 U.S.C. 3501 et seq.)

This rule does not contain any new collections of information that require approval by OMB under the Paperwork Reduction Act of 1995 (44 U.S.C. 3501 *et seq.*). This rule will not impose recordkeeping or reporting requirements on State or local governments, individuals, businesses, or organizations. An agency may not conduct or sponsor, and a person is not required to respond to, a collection of information unless it displays a currently valid OMB control number.

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

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

Clarity of the Rule

We are required by Executive Orders 12866 and 12988 and by the Presidential Memorandum of June 1, 1998, to write all rules in plain language. This means that each rule we publish must:

(1) Be logically organized;

(2) Use the active voice to address readers directly;

(3) Use clear language rather than jargon;

(4) Be divided into short sections and sentences; and

(5) Use lists and tables wherever possible.

If you feel that we have not met these requirements, send us comments by one of the methods listed in the **ADDRESSES** section. To better help us revise the rule, your comments should be as specific as possible. For example, you should tell us the numbers of the sections or paragraphs that are unclearly written, which sections or sentences are too long, the sections where you feel lists or tables would be useful, etc.

References Cited

A complete list of references cited in this rulemaking is available on the Internet at *http://www.regulations.gov* and upon request from the Western Colorado Field Office (see **FOR FURTHER INFORMATION CONTACT**).

Authors

The primary authors of this package are the staff members of the Western Colorado Field Office.

List of Subjects in 50 CFR Part 17

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

Proposed Regulation Promulgation

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

PART 17—[AMENDED]

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

Authority: 16 U.S.C. 1361–1407; 16 U.S.C. 1531–1544; 16 U.S.C. 4201–4245; Pub. L. 99–625, 100 Stat. 3500; unless otherwise noted.

■ 2. Amend § 17.11(h) by adding an entry for ''Sage-grouse, Gunnison'' to the List of Endangered and Threatened Wildlife in alphabetical order under ''BIRDS'' to read as follows:

§ 17.11 Endangered and threatened wildlife.

* * * * *

(h) * * *

Species		Historic range	Vertebrate population where endangered or threatened	Status	When listed	Critical habitat	Special rules
Common name	Scientific name						
*	*	*	*	*	*		*
BIRDS							
*	*	*	*	*	*		*
Sage-grouse, Gunnison.	*Centrocercus minimus.*	U.S.A. (AZ, CO, NM, UT).	Entire	E		NA	NA
*	*	*	*	*	*		*

* * * * *

Dated: December 21, 2012.

Daniel M. Ashe,

Director, U.S. Fish and Wildlife Service.

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