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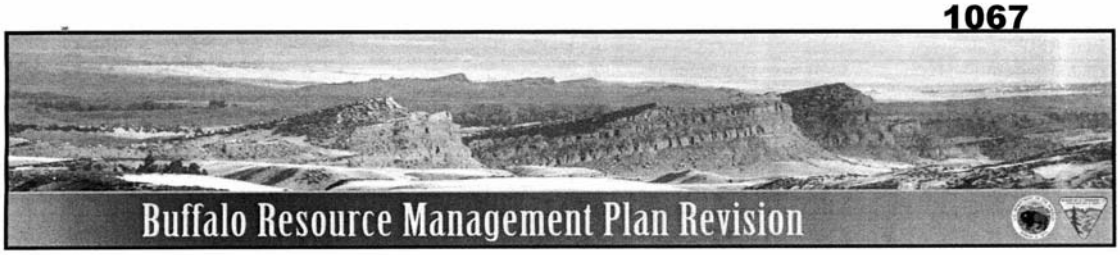

Written Comment Form

Thank you for your input!

All comments must be received or postmarked by **JANUARY 5, 2009** to:

Bureau of Land Management
ATTN: RMP Project Manager
2987 Prospector Drive
Casper, WY 82604
Phone: (307) 261-7520

2009 DEC 30 P 2: 10
BUREAU OF LAND MANAGEMENT
CASPER FIELD OFFICE

Electronic comments are encouraged and can be submitted to: BRMP_Rev_WYMail@blm.gov

NAME:	Brock Hanson
ORGANIZATION:	—
ADDRESS:	299 Brock Rd.
CITY/STATE/ZIP:	Kaycee Wy. 82639

Comments submitted to BLM for use in this planning effort, including names and home addresses of individuals submitting comments, are subject to disclosure under the Freedom of Information Act (FOIA) (5 U.S.C. 522). Written comments received during the public scoping process may be published as part of the environmental analysis process. After the close of the public scoping period, public comments submitted, including names, e-mail addresses, and street addresses of respondents, will be available for public review at the BLM Buffalo Field Office during regular business hours (7:45 a.m. to 4:30 p.m.), Monday through Friday (except federal holidays).

PLEASE PRINT **DATE:** 12-25-08

I urge, that in the BLM Federal planning process, that any proposed Areas of Critical Enviremental Concern should be evaluated for compliance with existing criteria, legal precendent, and local land use laws.

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Casper Field Office

Buffalo Resource Management Plan Revision - Comment

Nathan Williams

570 Mayoworth Rd

Kaycee, WY 82639

In the formation of the Buffalo RMP, I urge you to be cognizant of a few things. First, the essential role private property and private lands play through the entire scope of issues. From providing and enhancing ecological habitat through beneficial private land stewardship, to forming a solid economic base that communities rely upon, while also providing opportunities for recreation. In essence, private property and private lands provide and protect the open spaces that wildlife and the public alike find essential. That being said, it is my opinion that any RMP carefully consider any impacts it would have on the valuable resources contained within and managed by private resources.

Before tackling any more projects, I would recommend that the BLM address the preexisting concerns that are already present. These include noxious weeds, beetle killed pine resulting from no forest management, and the spread of monoculture range habitats as the result of rapidly propagating prairie dogs. These should be addressed through proactive management and not through additional regulations. Further, I believe that the productive harvesting of natural resources (grazing, timber, and energy assets) should be encouraged, as they are beneficial to the local communities as well as the country as a whole.

The one thing that is essential, regardless of issue or location, is keeping the local communities informed. I would strongly suggest with any special management consideration proposals, ACEC's, recreation management areas, etc., that you hold local meetings explaining your actions and any impacts you anticipate within the local community. Keeping the local communication lines open will be imperative and by holding meetings and directly soliciting local comments you can head off any potential problems later on. Further, I would suggest that you weight the comments from the local community significantly higher than comments that are from hundreds or thousands of miles away. After all, it is the local population that will be living with your actions.

As for specifics, I see you have listed several ACEC's as being proposed. Where specifically are they located, what specifically do they entail, and what management considerations and changes will be implemented if they are put in place? Further, what about the special Recreation Management Areas or zones you have listed. The same specific queries can and should be asked of these areas. These questions need to be answered prior to implementing and are a perfect example of the need for local meetings addressing local concerns. Further, solicit local comments at these meetings and weight them accordingly. There are many local resources that can be utilized, and garnering the support of the local residents should be a top priority with any action, and it is only through continuing communication that this support will be realized.

Thank you for your time and considerations

Nathan Williams

BLM
JAN 0 5 2009
BUFFALO FO

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307 W. Mountain View Drive
Sheridan, WY 82801
January 2, 2009

RECEIVED
JAN 0 6 2009
Bureau of Land Management
Casper Field Office

Ms. Linda Slone
Bureau of Land Management
Buffalo Resource Management Office
1424 Fort Street
Buffalo, WY 82834

Ms. Slone,

Last February 26th, Dave Paullin and I presented to about 15 of your staff a proposal to conserve a corridor along the lower 3 miles of Goose Creek and 13 miles of the Tongue River from Interstate 90 bridge to the Decker Highway (Wyoming Highway338) See enclosed map. We are members of the Sheridan Community Land Trust and one method of conserving and protecting property is by conservation easements. Property owners totally control the establishment of an easement.

We have met with nearly all of the landowners along these two sections off streams and will continue to pursue this proposal. We have also met with the Wyoming Game and Fish Department, Wyoming Highway Department and Sheridan County Commissioners. Responses have been favorable. At the meeting February meeting with your staff, Buddy Green suggested that we keep in touch and to participate in the updating of the Management Plan scheduled in a few months. My efforts to learn more about your planning effort from the Buffalo Office have been unsuccessful.

As I understand from the Sheridan County Conservation District, the deadline for scoping comments is January 5th, I would like consideration by the BLM to cooperate with our efforts to conserve particularly the section of the Tongue River described. It is nearly pristine, as out PowerPoint illustrated and the BLM owns and manages a large piece of property up-stream from the Decker Bridge.

Some of the discussion at the February 26, 2008 meeting included:

- The possibility of land exchanges between private property owners and the BLM.
- Exchange of water rights for riparian area(s)
- The riparian areas along the stream courses provide an abundance of quality wildlife habitat.

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- Livestock grazing intensity is not a significant issue
- Nature trails could be established for non-motorized recreation
- Canoeing is possible about 5 months of the year and increasing in popularity. Many canoers put in near the old town site of Acme and take out of the Tongue River at the Decker Bridge.

We will continue to pursue this project with the landowners. We would like the BLM to consider including cooperation with this effort in the new Unit Management Plan being developed.

If you have any questions or with a better explanation of what we plan and what we have accomplished to date, please do not hesitate to contact me at (307) 674-8027 or at rwilson@wyoming.com

Thank you for the opportunity to include my comments in your scoping process.

Sincerely,

Roger Wilson

Roger W. Wilson

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JAN 06 2009
Bureau of Land Management
Casper Field Office

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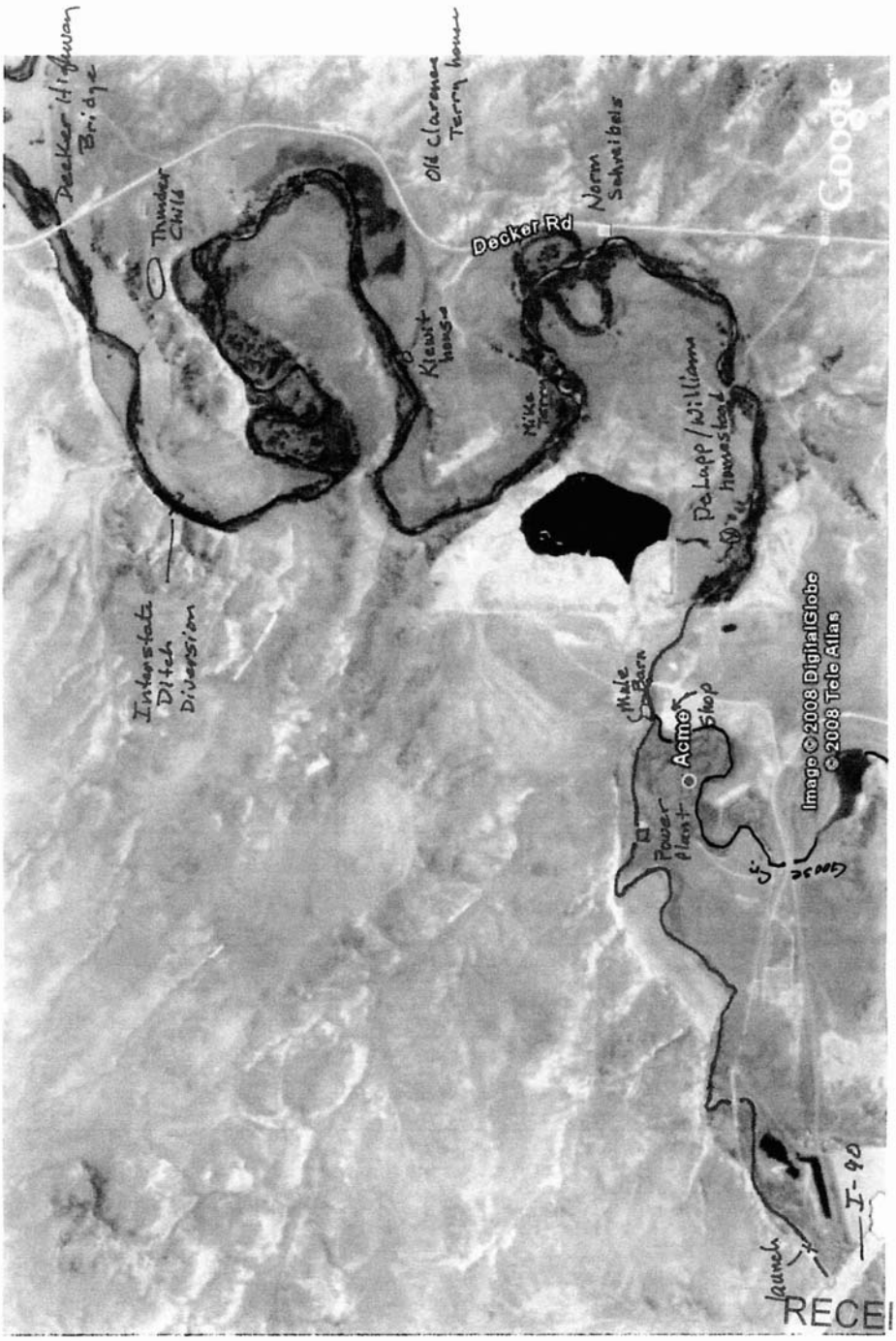

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JAN 06 2009
Bureau of Land Management
Casper Field Office

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Please Read

Names and addresses will be used to compile and update the mailing list for distributing future information regarding the RMP revision. Comments submitted to BLM for use in this planning effort, including names and home addresses of individuals submitting comments, are subject to disclosure under the Freedom of Information Act (FOIA) (5 U.S.C. 522). Written comments received during the public scoping process may be published as part of the environmental analysis process. After the close of the public scoping period, public comments submitted, including names, e-mail addresses, and street addresses of respondents, will be available for public review at the BLM Buffalo Field Office during regular business hours (7:45 a.m. to 4:30 p.m.), Monday through Friday (except federal holidays).

Enter your mailing information and comments below.

☐ Please add my name to the mailing list.

Click button to submit and to clear the screen once your have entered your comment(s) — Submit My Comments — Print Comment

Today's Date: 12/04/2008 (MM/DD/YYYY)

First Name: Phyllis | MI: M | Last Name: Simon

Title: Secretary | Org/Agency: Public Land Users Committee

Address Line 1: P.O.Box 50 12

Address Line 2:

City: Sheridan | State: Wyoming | Zip: 82801-

Home Phone: (307) 673-4460 | Work Phone: | Fax Phone:

Email Address: thedillerpm@wyoming.com

Enter your comment here:

It is occurs to me that more and more effort is being put forth for public recreation. You are doing an excellent job. However, what efforts are being done/planned to protect these areas from the "use" of public recreating? Who will monitor the conditions of the many rather remote locations? There needs to be a greater amount of education of personal responsibility to maintain the "leave no trace" teaching.

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Additional Comments from P. Simon written on scoping meeting comment pad: 12/04/2008 Public Scoping Meeting in Sheridan, WY.

a. publicizing your (our) assets = excellent
b. protecting " " " " " " " " = poor

1071

Biodiversity Conservation Alliance

Working to Protect Native Species and Their Habitats

P.O. Box 1512, Laramie, WY 82073 (307) 742-7978 fax: 742-7989

January 5, 2008

BUREAU OF LAND MANAGEMENT CASPER FIELD OFFICE
09 JAN -7 PM 12:46

Linda Slone
Buffalo Field Office, BLM
Attn: RMP Project Manager
2987 Prospector Drive
Casper, WY 82604

Dear Ms. Slone:

The following are the scoping comments of Biodiversity Conservation Alliance on the Buffalo RMP revision. BCA is a nonprofit conservation group working to protect wildlife and wild places in Wyoming and surrounding states. Our records indicate that we did not receive a scoping notice on this RMP revision. We only found out about it because we happened to catch a newspaper article on the planned revision in the Cody Enterprise (the story was not even carried in the major statewide newspaper). Please note that BCA has an interest in BLM-permitted activities potentially affecting wildlife and wild places in the Buffalo Field Office. **Please add BCA to your NEPA list to receive NEPA documents relating to oil and gas permitting, wind energy development, uranium mining, powerline and pipeline permitting, poisoning of native wildlife (especially prairie dogs), and coal leasing and development.** It is not necessary to send us NEPA documents for grazing allotment permitting, as we are not currently tracking these issues closely. We will let you know if the situation changes.

In the past, the BLM has erred on the side of permitting an excessive level and intensity of coalbed methane (CBM) development within the Buffalo Field Office, and these errors have had grave consequences for lands and wildlife. The population of sage grouse in the Powder River Basin is at risk of extirpation as a result, the loss of this species across a significant part of its range which has contributed to a trend toward listing the species under the Endangered Species Act, in violation of the BLM Sensitive Species Handbook. Likewise, the discharge of coalbed methane wastewater (both saline and purified) into surface waters has contributed to the decline of rare native fishes including the sturgeon chub and shovelnose sturgeon, and has also led to the destruction of cottonwood gallery woodlands which are key habitat features for songbirds and raptors.

The intensity of CBM development in the Powder River Basin, typically representing 8 wells per square mile plus access roads, pipelines, and overhead powerlines, has led to an unacceptable level of habitat fragmentation and subsequent disturbance of wildlife, rendering developed areas uninhabitable for many sensitive species of native wildlife. The new RMP should include substantial reforms of the way that the coalbed methane industry is permitted to do business on

1

public lands and public mineral estates, requiring that measures be put into place to ensure that the level of development is compatible with the habitat needs of native wildlife inhabiting the area and/or that phased leasing and development is mandated to ensure that there is a maximum percentage of land that is developed for industrial use at any one time. In addition, BLM should establish performance-based thresholds to maintain the viability of native wildlife in developed areas, and once populations fall below "set points" established in the new RMP, not less than 70% of the pre-development population, development activity must cease until populations rebound.

It is all well and good to include "adaptive management" approaches, but to date BLM's adaptive management efforts have largely been a failure because the requisite components for adaptive management success have not been in place. To succeed with adaptive management, BLM must (1) establish baseline conditions as a measurable benchmark for quantifying changes; (2) emplace rigorous, repeatable, and scientifically valid monitoring protocols so that changes can be recognized; (3) establish predetermined thresholds of change that will automatically trigger remedial measures; and (4) determine remedial measures in advance that will be triggered once thresholds have crossed. Failing this, BLM's current adaptive management efforts have amounted to a 'blank check' that allows decisionmakers to turn a blind eye to changes that are occurring as a result of permitted activity and essentially waiting for a disaster to strike before taking any action whatsoever. The practical result for the agency has been to engender distrust from the public, as this approach has caused many in the public (and we have been hearing about it from our members) to view the BLM as dishonest, incompetent, and/or in collusion with industry to destroy the wildlife and public land values the agency is entrusted to protect. We hope the new RMP will set a completely different tone and help to restore the credibility of BLM land stewardship. Major changes will be needed to accomplish this; cosmetic tweaks are not going to be adequate.

ECOSYSTEM MANAGEMENT

The new plans should be based on the concept of ecosystem management, under which all activities permitted within the bounds of the Buffalo Field Office would be managed under the framework of maintaining fully functioning ecosystems and viable populations of native plants and wildlife. Inherent to this alternative is the philosophy that human (and even industrial) uses of the public lands of the Powder River Basin are not necessarily incompatible with protecting wildlife, water and air quality, treasured landscapes, and recreational uses. According to the BLM's own Rangeland Reform publication, "The most effective way to address the challenge of restoring rangeland ecological condition is to manage the land in accordance with the principles of ecosystem management" (BLM 1993, p. 3). A keystone to maintaining ecosystem health is to maintain sufficient habitat to guarantee the viability of all native species broadly distributed throughout the Powder River Basin. The BLM should adopt this philosophy as an ironclad requirement in the new RMP. We further urge the BLM to adopt an Ecosystem Management approach to all permitted activities and projects in the planning area.

Sagebrush Habitats

Sagebrush steppe is an important plant community type found on much of the lands managed by the Buffalo Field Office. The sagebrush steppe ecosystem is home to many rare or declining wildlife species, including the ferruginous hawk, sage grouse, burrowing owl, black-tailed prairie dog, swift fox, black-footed ferret, and mountain plover. The fact that the Powder River Basin holds an important sage grouse population which is at very rewal risk of extirpation presents a compelling reason that the new RMP should allow development and human use in a way that promotes the persistence of large blocks of intact sagebrush steppe rather than allowing the continued fragmentation of sagebrush habitats until only a few tatters of sagebrush steppe remain.

The natural role of grazers in the sagebrush steppe found in the planning area in pre-settlement times is a subject of some controversy, with very little factual evidence to go on. Miller et al. (1994) postulated that pre-settlement sagebrush steppe conditions were likely typified by sagebrush cover of 5-10% in drier Wyoming big sagebrush sites and 10-20% in more mesic mountain big sagebrush sites, with a strong component of long-lived perennial grasses and forbs in the understory, western wheatgrass formed a heavy sod on the level areas. And yet other authorities assert that Intermountain shrubsteppes lack adaptations that evolved to accommodate heavy grazing levels, such as sod-forming grasses, dung beetles, and nitrogen-fixing species beyond biological soil crusts, which are sensitive to livestock trampling, unlike the Great Plains, which evolved with large herds of bison (Mack and Thompson 1982, Heiken 1995). And taking a different perspective on the evolution of the sagebrush steppe, West (1996) argued that sagebrush steppe evolved with the large browsers of the Pleistocene. The Pleistocene megafauna would have included steppe bison, saiga antelope, primitive horses, and other grazers similar in their ecological impacts to domestic livestock. Given the controversy over the degree of grazing pressure on sagebrush steppes in pre-settlement times, the potential sensitivity of these sagebrush landscapes to heavy grazing warrants a high degree of vigilance against overgrazing on individual allotments, and this vigilance should be formalized in RMP standards and guidelines.

Despite the controversy over the evolution of the sagebrush steppe, there is broad acceptance throughout the scientific community that current levels of livestock grazing are much higher than natural levels of wildlife grazing in pre-settlement times, and the patterns of grazing are substantially different. Miller et al. (1994) asserted that prior to the settlement of the West,

> "Grazing impacts by large herbivores in the sagebrush steppe were probably light, with heavy grazing limited to localized areas. Grazing was also probably seasonal, with animals moving up in elevation as the warm season ensued. Grazing by large and small mammals, birds and insects was also likely characterized by cyclic extremes of heavy and light grazing" (p.113).

Although sagebrush steppe ecosystems once dominated the western landscape, most of this landscape has been altered by human activity (Braun et al., in press). West (1996) reported that more than 99% of the sagebrush steppe has been impacted by livestock. Miller et al. (1994) described the situation as follows:

> "Since settlement, approximately 150 years ago, changes in plant and animal composition have occurred at unprecedented rates across the region. The introduction of cattle, sheep, horses and aggressive alien plant species, cultivation, elevated CO2 levels, altered fire frequencies, recreation, mining and demands for water, interacting with a gradual change in climate, have had a cumulative effect on the landscape. It is well documented that overgrazing by domestic livestock was a major factor in altering this large semi-desert region, causing dramatic changes in vegetation composition" (p. 101).

But Miller et al. also maintained that in some cases, light to moderate grazing can be compatible with sagebrush landscapes. Thus, the primary thrust of this alternative with regard to grazing is to prevent overgrazing that damages sagebrush ecosystems.

Several sagebrush-dependent species are sensitive to overgrazing. Baker et al. (1976) classified sage grouse, sage thrasher, sage sparrow, and Brewer's sparrow as sagebrush obligates, while green-tailed towhee and vesper sparrow were classified as near obligates. Bock et al. (1993b) reviewed the impacts of livestock grazing on birds, and reached the following conclusion: "All of these factors lead us to conclude that there is an urgent need for protection, restoration, and long-term study of shrubsteppe ecosystems (including their avifaunas) dominated by native perennial grasses, cryptogams, and moderate densities of shrubs, as we suspect these ecosystems existed prior to introductions of domestic livestock" (p. 304). Weins (1973) found that Brewer's sparrows were more abundant on lightly grazed and winter-grazed plots than on heavily-grazed plots. The maintenance of sagebrush steppes for the viability of sensitive species requires that overgrazing be prevented.

The spatial pattern and density of sagebrush stands in pre-settlement times, and the effects of grazing on these patterns, is also a subject of controversy. According to West (1996), "Sagebrush increases in abundance following excessive livestock grazing combined with lower fire frequency and drought" (p. 331). A primary effect of grazing is the reduction of fine fuels, which would be expected to lead a longer fire-free interval (Miller et al. 1994). Cattle grazing can cause an increase in both sagebrush (Brotherson and Brotherson 1981) and rabbitbrush (Brotherson and Brotherson 1981). But Baker et al. (1976) rejected the hypothesis that overgrazing has led to widespread sagebrush expansions, stating that "little evidence is available to support the widely held belief that present sagebrush ranges are the result of past overgrazing on most sagelands" (p. 165). And Johnson (1986) compared photographs taken in the 1870s with corresponding photographs from the 1970s and concluded, "While it is clear that changes in sagebrush density have occurred, it is equally clear that there has been no major shift in sagebrush distribution as a result of [livestock] use" (p. 231). And fall grazing by domestic sheep can actually reduce sagebrush density, as sheep browse heavily on sagebrush at this time of year (West 1996). Clearly, there is broad disagreement in the scientific community regarding the range of natural variability of sagebrush steppe ecosystems, and in light of this uncertainty, a conservative approach to sagebrush steppe is warranted, and radical alterations to sagebrush steppe distribution, plant composition, and architecture should be discouraged in the new RMP.

There are many areas of the Powder River Basin where sagebrush steppe is in good condition, and it behooves the BLM to manage for the persistence of large blocks of healthy sagebrush. In areas where sagebrush habitats have become degraded, restoring them to ecological health should be a primary activity under the new plans. Rosentreter (1997) recommended that relict shrubsteppe areas in good to excellent range condition be maintained in that state. According to West (1996),"It is much cheaper and satisfying to prevent such semi-natural areas from slipping over the brink of irreversible trends toward desertification than trying to rehabilitate or restore areas that have already been seriously degraded" (p. 341). We urge the BLM to adopt this conservative approach to land management in the sagebrush steppe habitats.

Juniper Woodlands

Juniper woodlands are an important minor component of the grassland ecosystems in the Powder River Basin, in particular the Fortification Creek area which is so important to elk and mule deer. Miller and Wigand (1994) reviewed the literature on juniper woodland distribution throughout the West. They noted that in the late 1800s, the wetter climate of the Little Ice Age, together with fire suppression and grazing, may have caused juniper expansion. Young and Evans (1981) noted that junipers younger than 50 years of age are highly susceptible to wildfire, and postulated that juniper expansion is a direct result of fire suppression. But Miller and Wigand (1994) noted, "Historic expansion occurred primarily within the more mesic sagebrush steppe communities rather than downslope into the drier Wyoming big sagebrush (*Artemesia tridentata spp. wyomingensis*) communities as it did during the prehistoric past" (p. 472). Thus, as the juniper woodlands of the Powder River Basin abut Wyoming big sagebrush communities, it is unlikely that current distribution of juniper woodlands in the Powder River Basin are unnaturally dense..

Some hypothesize that juniper woodlands can have a measurable effect on the hydrology of the lands where they are found, but this hypothesis is poorly supported by scientific evidence. In Oregon, Wigand (1987) studied pollen records and concluded that juniper woodlands expanded with the onset of greater precipitation and high water tables from 4000-2000 B.C. Conversely, drought causes contraction of juniper woodlands (Miller and Wigand 1994). This suggests that the distribution of juniper woodlands is at least in part dependent on changes in climate. Eddleman and Miller (1982) found that junipers have a significant effect on the upland hydrologic cycle through increased interception of rain and snow and increased transpiration, but that impacts to subsurface flow to riparian aquifers were questionable. Belsky (1996) asserted that pinon-juniper removal does not increase water yield, and that juniper removal does not always result in increased forage production. With these findings in mind, and given the biological importance of juniper woodlands, intensive management of or reductions in juniper woodland habitat types is not warranted.

Fire in Sagebrush Steppe

Fire is a natural process which confers many benefits to ecosystems in arid lands. Young and Evans (1981) pointed out that it is very difficult to reconstruct fire histories in juniper woodland and sagebrush steppe habitats. Gruell (1985) researched the journals of frontier travelers, and turned up only a single record of wildfire from southern Wyoming, near present-day Fort Steele. He found, "There is a dearth of reports [of fires] from sparsely vegetated regions in the drier, sagebrush valleys" (p. 102). Thus, it would appear that wildfires are uncommon in the sagebrush

steppes of Wyoming. Baker (2006) also found that fire was infrequent in sagebrush habitats, and argued that fires should be suppressed in areas where cheatgrass invasion is a potential issue.

Fire in Coniferous Forests

Wildfire is widely acknowledged to be the primary architect of patch dynamics in coniferous forest ecosystems. Fires are an integral (an some would argue, necessary) ecosystem process in the coniferous forests that make up a small fraction of BLM lands in the Powder River Basin, chiefly along the flanks of the Big Horn Mountains. Fire increases landscape diversity and determines patterns of forest succession on a landscape scale (Romme and Knight 1982, Romme and DeSpain 1989, Morrison and Swanson 1990). Subalpine forest landscape patterns are driven by large, infrequent fires, while lowland woodlands of Douglas fir and ponderosa pine are characterized by frequent, smaller, lower-intensity fires that do not affect the forest canopy (Veblen 2000). But due to political opposition to forest fires throughout the 20th century, the natural role of fire in maintaining ecosystem function has been largely ignored. Hutto (1995, p.1042) summed up the political landscape as follows: "The importance of stand-replacement fires in this forest system should give the maintenance of such fires a high priority in land-management goals but, instead, the historical effort has been to eradicate such fires from these systems."

Dillon and Knight (in prep.) found that presettlement fire history in subalpine areas on the neighboring Medicine Bow National Forest was characterized by many small fires punctuated by a few widespread fires, a pattern that has been corroborated by Kipfmueller and Baker (2000). Baker and Kipfmueller (2001) concluded that although the landscape of the Medicine Bow National Forest was strongly influenced by fire, it contained large patches of connected forest with few high-contrast edges. On the stand level, fire-free intervals on the subalpine forests of southern Wyoming were found to be 300-600 years (Romme and Knight 1982). It is important to note that fire patterns and frequency are not constant across landscapes, and may vary widely on a regional scale (Morrison and Swanson 1990, Wallin et al. 1996). Dillon et al. (2005) hypothesized that wildfires have always been less frequent in the Medicine Bow Mountains than in Yellowstone.

In lowland ponderosa pine forests, Arno (1980) noted that fire return intervals ranged from 5 to 20 years, while maximum fire-free periods for individual trees ranged from 20 to 31 years. In cases where ponderosa pine forms open savannas, unnaturally dense stands of ponderosa pine have resulted from fire suppression (Aplet 2000, Dillon and Knight in prep) as well as cattle grazing (Madany and West 1983, Belsky and Blumenthal 1997). The flammulated owl, an old-growth ponderosa obligate, requires open canopies for foraging (Reynolds and Linkhart 1987b). The reduction of ponderosa pine savannas due to fire suppression has likely had negative impacts on this species. However, it is important to note that there are some cases where ponderosa pine naturally forms dense stands that experience infrequent, stand-replacement fires (Shinneman and Baker 1997).

A number of natural factors can affect fire frequency and intensity. Fire can be encouraged by drought, windthrow events, or forest pathogen outbreaks (Tinnin 1984, Rogers 1996). Successional stage also affects susceptibility to fire. Zimmerman and Laven (1984) suggested

that for lodgepole pine, very young and very old stands are the most susceptible to stand-replacement fires. Romme and DeSpain (1989) found that lodgepole pine stands become more susceptible to fire as they approach 300 years of age. Koch (1996) suggested that mountain pine beetle outbreaks created the fuel needed to sustain large fires, thus driving the patch dynamics in some parts of the northern Rockies. It is important to note that climactic conditions are the primary factor in determining the timing and extent of large-scale wildfires; fuel loads are a secondary factor (DellaSala et al. 1995, Dillon and Knight in prep.).

Fire can have a corresponding effect on other natural agents that drive patch dynamics. Fires provide temporary immunity from beetle outbreaks (Veblen et al. 1994), and wipes out dwarf mistletoe (Zimmerman and Laven 1984, Hawksworth and Johnson 1989, Kipfmueller and Baker 1998). Thus, the interrelationship between fires and other natural landscape disturbances is often a complex one.

Interior forest birds are adapted to wildfire; Taylor (1973) found that interior species returned to burned landscapes 25 years after the blaze. Burns are preferred foraging areas for elk (Roppe and Hein 1978, Davis 1977) and deer (Campbell et al. 1977). Old growth stands may persist through burns (Morrison and Swanson 1990). Burns benefit small mammal species (Campbell et al. 1977). A regular cycle of natural wildfire is important for maintaining fire-dependent species such as black-backed woodpecker (Hutto 1995, Hansen and Rotella 2000) and Lewis' woodpecker (Linder 1994). Although some nutrients are lost during fire, calcium and magnesium levels in the soil may be higher in burned areas (Campbell et al. 1977).

Gorte (1995) noted that damage from wildfires is typically overstated, and offered the following synopsis:

> " Mature conifers often survive even when their entire crowns are scorched; a few species, notably lodgepole pine and jack pine, are serotinous--their cones will only open and spread their seeds when they have been exposed to the heat of a wildfire. Grasses and other plants are often benefitted by wildfire, because fire quickly decomposes organic matter into its mineral components (a process that, in the arid West, may require years or decades without fire), and the flush of nutrients accelerates plant growth for a few growing seasons. Few animals are killed by even the most severe wildfires; rather, many animals seek out burned sites for the newly available minerals and for the flush of plant growth. And erosion is typically far worse along the fire control lines than from the broad burned areas."

Thus, contrary to historic agency dogma, wildfires offer many ecological benefits and positively affect long-term forest health. The view that wildfires are a threat to our forest is a byproduct of an ignorance that, in light of the wealth of scientific knowledge now available to forest managers, should no longer be countenanced.

Human-caused fires

Before the settlement period, Native Americans intentionally set fires to clear away forest and drive game animals (Veblen 2000). Barrett and Arno (1982) found empirically that areas that received heavy use by Native Americans had fires much more frequently than similar remote areas. Thus, presettlement wildfires would have occurred more often than would be expected from natural causes (Gruell 1983, Arno 1983). Arno (1983) went as far as to suggest that natural fires alone may not sufficiently maintain the disturbance mosaic of forested ecosystems in presettlement times, due to the added influence of fires set by indigenous peoples. In the 1800s, the arrival of settlers and explorers sparked a marked increase in wildfires. Prospectors set fires to make prospecting easier (Veblen 2000); in the Medicine Bow National Forest, widespread fires were linked to fur trappers (von Ahlefeldt and Speas 1996) and the activities of woodstoves, sawmills, and railroad sparks (Dillon and Baker, in prep.). It is likely that the widespread fires of this Expansion Era period have given rise to a modern forest that differs radically from the natural forest conditions of presettlement times.

The Effects of Fire Suppression

A number of studies suggest that the federal policy of fire suppression has been very effective at reducing the number and extent of natural wildfires over the past century (e.g., Barrett and Arno 1982, Baker 1994). Baker (1994) found that fire suppression during the 20th century reduced natural wildfires even in roadless parts of the Medicine Bow National Forest. Many ponderosa pine forests are adapted to frequent, low-intensity fires that do not "crown out." Fire suppression in park-like stands of ponderosa pines has led to unnatural increases in stand density and the development of ladder fuels, increasing the likelihood of stand-replacement fires (Arno 1980). Huff et al. (1995, p.36) noted that "[i]t has long been recognized that fire exclusion has allowed unnatural fuel accumulations to occur..." In the montane zone (where stand- replacement fires are the norm), fire suppression has radically increased fire intervals, leading to patch coalescence and reduction in heterogeneity and spread of forest types (Veblen 2000). This policy has translated directly to a marked increase in large-scale wildfires in recent decades (Agee 1997). In this way, past fire suppression policies has disrupted natural patterns and processes, resulting in a more flammable forest.

Fire suppression also leads to more homogeneous forests that are more susceptible to the spread of dwarf mistletoe (Kipfmueller and Baker 1998) and parasitic insects (Schmid and Mata 1992, Veblen 2000). Zimmerman and Laven (1984, p. 123) stated that "...a continuation of this policy [fire exclusion], in the absence of alternative methods of regulation, will allow rapid and progressive dwarf mistletoe spread and proliferation." The irruption of mountain pine beetles in ponderosa pine forests in the Laramie Peak area noted by von Ahlefeldt and Speas (1996) may have been a direct result of fire suppression. Thus, while outbreaks of mistletoe and beetles are normal in the Rocky Mountains, fire suppression has upset the natural balance of outbreaks and has resulted in a forest where these outbreaks are less localized and more widespread.

Yellowstone National Park makes a useful case study for the ecological effects of fire suppression in an unmanaged landscape. In Yellowstone National Park, Romme and Knight (1982) found that fire suppression has led to denser coniferous forests, a decrease in aspen, and an increase in sagebrush in meadow areas. Houston (1973) attributed the spread of forests and reductions in grasslands to fire suppression. Thus, the long-term absence of fire resulted in

fundamental changes in landscape pattern. As a result of fire suppression, the mosaic of stands aged until old, flammable stands dominated the landscape, leading to the widespread fires of 1988 (Romme and DeSpain 1989). Thus, fire suppression by itself may destabilize the natural cycles that determine landscape pattern.

In sum, fire suppression has had a number of unintended consequences, potentially including the creation of forests more susceptible to large, intense fires. It has destabilized the pattern of insect and disease outbreaks, making forests more susceptible to widespread (rather than localized) outbreaks of insects, parasites, and diseases. It has altered natural patterns of succession and landscape structure. And in the end, fire suppression has fundamentally changed forest characteristics in a way that makes widespread wildfire more likely than ever before. Modern science has demonstrated irrefutably that fire suppression in coniferous forests is ecologically unsound and ultimately counterproductive; the time has come to abandon this misguided policy in favor of a managed natural fire approach.

A Natural Fire Policy

There is little evidence to suggest that pursuing a let-burn policy on the on forested BLM lands would lead to catastrophic wildfires. DeSpain and Sellers (1977) pointed out that during the early years of the let-burn policy in Yellowstone, most wildfires were small. This would likely be the case on the forests surrounding the Powder River Basin as well, because these forests are patchy in nature and often separated by large expanses of meadow slopes. Since stand conditions in this region make it less susceptible to extensive wildfire, now is an excellent time to initiate a natural fire policy, so that a more natural mosaic of stand ages and fuel loadings can develop before vast sweeps of the forest become acutely susceptible to fire. Even in the wake of the 1988 Yellowstone fires, Manfredo et al. (1990) found that a majority of the public supports let-burn and prescribed fire policies, both nationally and in Wyoming. Finally, according to Gorte (1995), "most fire experts agree that, because of fuel types and loadings, topography, and temporary weather conditions...some fires simply cannot be stopped and some cannot even be influenced." With the help of federal programs to educate the public on the benefits of natural fire, the natural fire policy would likely be viewed by the surrounding communities as a beneficial policy over the long term.

Fuels Management

There has been a great deal of attention given to the buildup of fuels on public lands during recent years. Many timber harvest programs have been put forward under the guise of fuels management. However, the use of salvage logging, clearcutting, and thinning to reduce fuel loads do little to reduce the odds of large-scale fire, because fire behavior is modulated by climactic conditions, not fuel loads (DellaSala et al. 1995). In addition, large-scale wildfire is an integral part of the subalpine forest ecosystem, and thus the buildup of fuels in subalpine forests is a natural occurrence that is necessary to maintain natural cycles of forest succession. Huff et al. (1995) also stated that heavy fuel accumulations are a natural occurrence in some forest types. Thus, thinning of subalpine forests to reduce fuels is a pointless and counterproductive effort, and should be avoided except at the urban-forest interface.

Forest thinning and clearcutting have been advocated in recent years for reducing wildfire risk by reducing standing biomass and creating firebreaks. DellaSala et al. (1995) point out that fires spread readily through clearcuts and firebreaks when weather conditions are dry and windy, and the opening of forest canopies can speed the drying of flammable materials. On a national scale, studies show that logging does not decrease the acreage of forest burned in a given year. Gorte (2000a) found that "acres burned in any particular year appear to be at most weakly related to the volume of timber harvested," and went on to note that "for 1980-1999 and 1987-1999, ...*fewer* acres burned in association with lower timber harvests, contrary to the hypothesis" (emphasis in original). Finally, Gorte (1995) noted that "there appears to be very little research documenting widespread reduction in wildfire damages from fuel treatment."

But because only the large boles are removed and fine fuels remain, logging does little to reduce fire risk. According to Gorte (2000a), "[t]imber harvesting removes the relatively large diameter wood that can be converted into wood products, but leaves behind the small material, especially twigs and needles. The concentration of these 'fine fuels' *increases* the rate of spread of wildfires" (emphasis in original). Gorte (2001) noted that "the limbs and tree tops -- "slash" -- left after logging can exacerbate wildfire risks...timber sales may have limited utility for removing small-diameter and low quality trees, because of the buyer's need to process and sell the biomass at a profit." The same limitation applies to thinning to reduce fire risk. Gorte (2000b) reached the following conclusion: "Mechanical treatments are generally most effective at eliminating fuel ladders, but as with timber cutting, do not reduce the fine fuels on the sites without additional treatment (*e.g.*, without prescribed burning)." Similar conclusions were reached by the Sierra Nevada Ecosystem Project (SNEP 1997):

> "Timber harvest, through its effects on forest structure, local microclimate, and fuels accumulation, has increased fires severity more than any other recent human activity. If not accompanied by adequate reduction of fuels, logging (including salvage of dead and dying trees) increases fire hazard by increasing surface dead fuels and changing the local microclimate. Fire intensity and expected fire spread rates thus increase locally and in areas adjacent to harvest." Thus, non-prescribed-fire fuel reduction programs may actually *increase* the risk of high-intensity wildfires.

In some ponderosa pine forests at low elevations, stands which formerly were thinned by periodic ground fires have grown unnaturally dense as a result of fire suppression. Some experts believe that mechanical thinning may be required before fire can be returned to its natural role in ponderosa pine forests (e.g., Covington 1993, Aplet 2000). However, Sackett et al. (1993) demonstrated that thinning could be accomplished effectively through prescribed burning, even in dense stands. We recommend that prescribed fire be used preferentially for thinning ponderosa pine stands. Any thinning should emphasize harvest of smaller trees that serve as ladder fuels and retain the largest members of the forest overstory, following the recommendations of Romme et al. (2000). Before ponderosa pine stands are treated by any form of thinning, historical records should be searched and on-site research needs to be conducted to ascertain whether or not an open-canopy savanna was the presettlement condition of the stand.

Soils

In arid lands like those of the Powder River Basin, soils are often thin and of low productivity to start with. According to the Society for Range Management, sustainability for grazing depends mainly on conservation of the soil (Thurow and Taylor 1999). In a study in the Curlew Valley on the Idaho-Utah border, James and Jurinak (1978) found that soil nitrogen limits plant growth in Great Basin shrubsteppe ecosystems. Livestock grazing is the land use that potentially has the most widespread effects on soils. According to Miller et al. (1994), "Long term heavy grazing can gradually deplete soil nutrients. The greatest loss of nutrients may result from alteration of plant community structure which influences overland flow, erosion, infiltration rates, and nutrient turnover rates." Thus, to protect the soil, overgrazing must be prevented. It is imperative that land management practices in the Powder River Basin protect soil productivity in order to ensure the productivity of the ecosystems that the soils support.

It is likely that current levels of erosion and soil loss in the Powder River Basin exceed pre-settlement levels. Raindrop splash and sheet erosion are the largest causes of soil loss worldwide (Pimintel et al. 1995). Mannering (1981) found that the average rate of soil loss across the nation is 1 mm per year. And while soil erosion rates of 1 mm/yr are generally considered "acceptable" by land managers, soil formation usually occurs at less than 0.1 mm/year (Thurow and Taylor 1999). Pimintel et al. (1995) asserted that a $5 per hectare investment in erosion control on rangelands would leverage $5.24 in saved costs for each dollar spent. Some have advocated cattle trampling as a means of breaking up soil microtopography and decreasing water runoff. But Weltz and Wood (1986b) found that livestock trampling reduces microtopography rather than increasing surface roughness. Livestock grazing can influence soil compaction, erosion, and water infiltration rates. Erosion increases with increasing grazing levels, while soil infiltration rate decreases (Jones 2000). Weltz and Wood (1986b) found that erosion increases with grazing intensity, regardless of grazing system.

The effects of livestock use on water infiltration has been studied for many different grazing regimes. Abdel-Magid et al. (1987a) found that trampling could halve the soil infiltration rate. In a separate study, Abdel-Magid et al. (1987b) found that there was no clear pattern between grazing systems in terms of effects on water infiltration rate, and that hypothetical benefits from short-duration grazing breaking up physical soil crusts were not realized. Gifford and Hawkins (1978) noted that infiltration rates for ponderosa pine communities on granitic soils recover fully after 6 years, while infiltration rates on grasslands were still recovering after 13 years of rest from grazing. According to Gifford and Hawkins (1978), moderate and light grazing both negatively affect infiltration rate, but are difficult to differentiate from each other on the basis of impacts on infiltration rate; heavy grazing has a significantly greater impact than either. Bohn and Buckhouse (1985) found that infiltration levels increased in control exclosures, indicating recovery from previous heavy grazing.

Soil compaction is a severe impact, since plant productivity is impaired on compacted soils (Clary 1995). Various grazing systems have been heralded as solutions to the impacts of livestock use on soils. For intensive grazing systems, one study found that effects on soil compaction and decreased water infiltration are greater during the winter months, when plants

are dormant (Warren et al. 1986). Bohn and Buckhouse (1985) posited that rest-rotation grazing favored retention of hydrological parameters of soils, but found that soils subjected to deferred-rotation and season-long grazing showed a decrease in infiltration and an increase in compaction and sediment production. But Weltz and Wood (1986a) found that moderate continuous grazing was superior to heavy continuous grazing and short duration grazing in terms of lowering the increase in soil compaction. In the end, stocking rates probably have more influence on soil parameters than grazing system type.

Soil compaction, whether from livestock, vibroseis trucks, off-road vehicles, or heavy equipment associated with energy development, can remain long after activities have ceased. The findings of Knapp (1992) suggest that 100-130 years are required for complete loosening to occur for abandoned roads. The speed of recovery will be faster in areas of high precipitation and frequent freeze-thaw cycles, and slower in areas that are more arid or which have fewer freeze-thaw cycles. We urge the BLM to adopt standards that minimize soil compaction in the first place, rather than putting the emphasis on reclaiming damaged soils after the fact.

According to the Wyoming Standards for Healthy Rangelands, adopted statewide by the BLM in 1997, Standard #1 prescribes stable soils with good infiltration rates and minimal runoff. It prescribes a number of possible indicators including water infiltration rates, soil compaction, erosion, soil micro-organisms (which might include biological soil crusts), vegetative cover, and bare ground/litter. This standard was further elucidated to achieve adequate energy flow and nutrient cycling through the system. FLPMA requires the BLM to harmonize its management with state policies and directives, and we urge the BLM to do so with regard to maintaining soil quality. We urge the BLM to develop clear and practical standards and guidelines under its new RMP to achieve the goals set forth in the Wyoming Standards for Healthy Rangelands, and apply these standards not only to grazing but to all other activities permitted by the Buffalo Field Office.

Riparian Areas

Riparian areas are of critical importance in a biological sense, due to their high productivity and diversity of life forms. Riparian areas are important corridors for the movements of animals and dispersal of plants, and the high diversity of microsites and the complex, high-frequency disturbance related to flooding and channel movements leads to greater species diversity in riparian areas over upland sites (Gregory et al. 1991). Franzreb (1987) observed that riparian habitats are centers of bird diversity and abundance in ecosystems throughout the West. According to Bock et al. (1993b), "Migratory landbirds inhabiting riparian vegetation in western North America are particularly vulnerable to disturbance" (p. 299). In Wyoming, 19% of reptile species, 55% of amphibians, 21% of birds and 20% of mammals are dependent on riparian habitats (Gerhart and Olson 1982). Thus, riparian areas of high biological concern should receive special protection under the new RMP, which should include explicit standards to manage these areas to achieve Properly Functioning Condition as outlined in the Rangeland Reform practices currently in force for all BLM lands.

The maintenance of natural hydrographic patterns and processes is crucial to maintaining riparian communities. According to Ohmart (1996), "Natural floods play a vital role in the functioning and health of riparian systems" (p. 249). Thus, BLM-permitted activities with the potential to alter streamflows or retard flooding should be avoided.

Livestock Grazing and Riparian Habitats.
Livestock overgrazing is one of the principal concerns when maintaining riparian areas in Properly Functioning Condition. Armour and Elmore (1994) reported, "Problems from overgrazing are particularly acute in the West, where lush vegetation is confined to stream corridors. Livestock tend to concentrate in these areas, especially in the hot seasons, where they can overgraze and damage habitat" (p. 11). According to a 1988 report by the U.S. General Accounting Office, an overwhelming majority of riparian habitat in the West was in degraded condition (GAO 1988a). Ohmart (1996) reported, "my experiences are that almost all riparian areas are in unacceptable condition" (p. 257). In a study in Colorado's North Park, Schulz and Leininger (1990) found that after 29 years, a grazing exclosure held 5.5 times more woody plant cover, larger and older willows, twice as much leaf litter, and one-fourth the bare ground of the surrounding grazed riparian area.

Due to more succulent vegetation and easy access to water, cattle often concentrate in riparian areas, leading to heavy damage to these important habitats. In Oregon, Bryant (1982) found that cattle used riparian zones disproportionately, regardless of aspect, during early summer, while use of uplands increased in late summer. Armour and Elmore (1994) summarized potential impacts of grazing in riparian areas as follows: "Damage includes (1) loss of riparian vegetation by changing the composition and quantity of streamside vegetation and altering channel morphology, (2) lowering the groundwater table and decreasing summer stream flows, and (3) increasing summer water temperatures and winter icing." p. 11. The BLM's grazing policies and practices should discourage the concentration of cattle in the riparian zone, and we recommend the requirement that herders be present to move cattle away from riparian areas on allotments where Properly Functioning Conditions are not being met.

Numerous studies have found that livestock grazing in riparian areas reduces woody vegetation (Green and Kaufman 1995). In the Ferris Mountains, Hubert et al. (1985) found that abundance of riparian shrubs, overhanging vegetation, and overhanging bank cover were negatively correlated with grazing intensity. Kauffman et al. (1983) found that after herbaceous vegetation is depleted by grazing, cattle turn to browsing, which sometimes exceeded 100% of the current year's growth. Taylor (1986) found that riparian bird counts were 5-7 times higher on exclosure versus grazed transects, and 9-11 times higher than on heavily grazed and dredged transects. According to Giesen and Connelly (1993), livestock grazing in riparian areas should be managed or eliminated to minimize destruction of hardwood shrubs and trees needed for sharp-tailed grouse winter habitat. Under the new RMP, standards should be put in place to protect healthy woody vegetation in riparian areas, and to restore it in areas that have become degraded.

The pattern of grazing may have a significant effect on efforts to maintain riparian areas in Properly Functioning Condition. Bryant (1985) found that season-long grazing had the greatest negative impact on riparian vegetation. Late season grazing may result in less disturbance to

riparian communities (Green and Kaufman 1995). Clary (1995) made the following recommendation for grazing in riparian areas: "If utilization guidelines are used, those rates that do not exceed 30% of the annual biomass production will likely maintain production the following year" (p.24). Riparian areas should be the focus of monitoring efforts, as these areas can become ecologically impaired before upland habitats begin to show signs of damage.

Methods of Protecting Riparian Habitats

Placing salt blocks in upland areas is not an effective means of drawing cattle use away from riparian areas. Bryant (1982) found that salt placement and alternate water sources did not influence cattle preference for riparian habitats, and came to the following conclusion: "These cattle used the salt when convenient but did not alter behavior patterns to obtain it" (p. 784). Thus, the BLM should not rely on the placement of salt blocks as a means to draw livestock away from riparian habitats.

The use of riders to herd cattle away from riparian zones has been shown to be an effective method to achieve the restoration of degraded riparian zones. According to Kauffman and Kreuger (1984), "The most successful riparian management alternative on public lands to date has been intensive livestock management by permit holders…Herding livestock on a somewhat daily basis has been successful in limiting the number of livestock that visit streambottoms and improving utilization of upland areas" (p.435). On Huff Creek, a tributary of the Thomas Fork in western Wyoming, deferring grazing until August and providing a range rider to move cattle out of the riparian zone resulted in a 377% increase in trout population, improvement in bank stability, and 214% increase in cover (GAO 1988a). Interpreting the results of this project, the U.S. General Accounting Office concluded, "The study noted that careful control of the cattle herd by the range rider was essential for success" (Ibid., p.28). But Roath and Kreuger (1982) found that some cattle concentrated exclusively in riparian areas, and that cattle establish individual home ranges and herding them away from these ranges will not prevent their rapid return.

A change in grazing regime may also lead to the restoration of Properly Functioning Condition in some cases. Bryant (1985) found that while rest from grazing showed the greatest increase in riparian vegetation, short-duration grazing elicited a threefold increase in vegetation in riparian areas. Productivity was enhanced when no more than 70% of the forage was removed annually (Ibid.).

Rest from grazing can also result in the restoration of degraded riparian zones. According to Ohmart (1996), "The best way to manage riparian habitats is not to graze them" (p. 270). For example, in Bone Draw, a tributary of the Big Sandy River, removal of grazing resulted in "expansion of the riparian zone, stream bank water recharge and stabilization, extension of perennial water flows, and improved sage grouse, antelope, and waterfowl habitat. Also, as a result of the project, trout weighing up to 4 pounds were making an annual spring run of up to 100 miles of the Big Sandy and Green Rivers and into Bone Draw" (GAO 1988a, p. 56). In eastern Oregon, Case and Kaufman (1997) found significant increases in the structure and density of riparian hardwoods after only 2 years following livestock removal. Rickard and Cushing (1982) found that a small spring stream in sagebrush steppe in eastern Washington

recovered its willow vegetation within 10 years following the cessation of grazing. Brady (1989) found that after a 16-year absence of grazing, the plant community achieved a rich and diverse balance, with increases in plant diversity and overall vegetation cover. For optimal riparian zone recovery, Case and Kaufman (1997) recommended complete protection from grazing for the first 5-10 years following livestock removal.

Recovery of riparian areas may be rapid following cessation of grazing. In their eastern Oregon study, Case and Kaufman (1997) found that following removal of cattle after more than a century of heavy grazing, riparian shrubs and trees recovered quickly both inside and outside game exclosures. This indicates that riparian areas can recover even while grazing by wild ungulates continues, when an area is rested from domestic livestock grazing. In a study in Canyonlands National Park, Kleiner (1983) found that after ten years following removal of grazing, annual grasses has substantially decreased and biological soil crusts had increased. Clary et al. (1996) found that removal of grazing and reduction to moderate levels allowed streamside willows to recover, while heavy grazing prevented willow recovery. In this study, spring grazing regimes promoted willow recovery much more than autumn grazing.

Aquatic Systems

The BLM must take a hard look at maintaining aquatic ecosystems from top to bottom. This should include monitoring of and concern for not only fish species of concern but also aquatic invertebrates and plants. Harding et al. (1998) reported that preservation of entire watersheds may be key to maintaining aquatic biodiversity, beyond merely protecting riparian buffer strips. The new RMP should include a comprehensive strategy for limiting impacts to aquatic systems, including numeric standards on levels of hydrographic change (through both depletions and additions), change in water quality (both turbidity and chemical composition), and aquatic indicator species that can serve as the "canary in the coal mine," triggering changes in management activities before an ecological disaster can occur.

In particular, the discharge of coalbed methane wastewater is a concern in this regard. Coalbed methane wastewater can have a high degree of solutes, including salts, heavy metals, and other pollutants. In cases where SAR is greater than 6 and Electrical Conductivity exceeds 1333, impacts can occur to aquatic ecosystems, fishes, riparian soils and vegetation, and/or irrigated lands. Even in cases where wastewater is fully treated to remove pollutants, changes in flows, flow timing, and turbidity resulting from CBM discharge can alter ecosystems in ways that interfere with the natural life cycles of fishes and other aquatic organisms.

The maintenance of natural levels of silt in waterways is an important consideration when managing aquatic habitats. Berkman and Rabeni (1987) found that siltation decreased the distinction between pool, riffle, and run habitat, adversely affecting benthic insectivores. Activities which can radically increase siltation include road-building, energy development, strip mining, clearcutting, and overgrazing.

Riparian vegetation is an important source of nutrient inputs to aquatic ecosystems, provides shade, and filters sediment and debris from entering stream systems (Kauffman and Kreuger 1984). Riparian vegetation causes soil aggradation (buildup) and raises the water table, which

can turn intermittent streams into permanently flowing streams (Elmore and Beschta 1987). Thus, the maintenance of riparian habitats is also key to maintaining fully functioning aquatic systems.

Grazing affects aquatic systems by increasing siltation, increasing water temperatures, creating wider, shallower channels, reduction in vegetation and overhanging banks that yield cover to fishes (Kauffman and Kreuger 1984). Rinne (1988) found that overall biomass of stream macroinvertebrates was greater in grazed stream sections, but that sensitive taxa were entirely eliminated from grazed stream reaches. Harding et al. (1998) reported that past impacts to riparian areas remained a strong predictor of aquatic diversity long after riparian areas recovered, and "large-scale and long-term agricultural disturbances in a watershed limit the recovery of stream diversity for many decades" (p. 14844). The ecological problems associated with impacts to aquatic ecosystems make the maintenance of riparian areas in Properly Functioning Condition even more crucial.

Healthy streams have a deep and narrow cross-section, with roots of trees and shrubs to provide bank stability (Ohmart 1996). In a study on the northern flank of Wyoming's Ferris Mountains, Hubert et al. (1985) found that stream channel widening and shallowing increased with increasing grazing intensity. Parker et al. (1985) reported that grazing in riparian areas, along with climate change and beaver removal, was a factor in accelerating erosional downcutting of stream channels and the lowering of water tables. Siekert et al. (1985) found that summer and fall grazing in Wyoming's Powder River Basin had the effect of making intermittent stream channels wider and shallower, but spring grazing did not cause stream channel degradation. But Marlow and Pogacnik (1985) found that streambank damage was greater when soils were saturated, and cautioned that spring grazing should be deferred until riparian soils had dried. Because there is no uniform trend, seasonal timing of grazing should be examined on a case-by-case basis.

Riparian vegetation can increase fish population numbers and viability. Wesche et al. (1985) asserted that riparian vegetation contributes significantly to the amount of cover available in smaller trout streams, and increases the carrying capacity of these streams. Stuber (1985) found that trout populations were higher inside grazing exclosures, and estimated that fishing opportunities inside the exclosure were roughly double that of grazed stream reaches. Damage to aquatic systems due to overgrazing often has long-lasting impacts. On the north slope of the Ferris Mountains, Hubert et al. (1985) found that while riparian vegetation recovered rapidly following exclosure construction, brook trout populations were very slow to recover. Thus, in order to maintain healthy fisheries, the BLM must maintain healthy riparian areas.

Cattle concentrations along streams can significantly increase the bacterial contamination of waterways. In an arid setting, Buckhouse and Gifford (1976) found that fecal coliform in intermittent waterways did not increase due to cattle grazing, and that only the feces themselves and an area 1 meter around them are subject to contamination. These researchers concluded that "unless the feces in or adjacent to a streambed there is little danger of significant bacterial contamination resulting from livestock grazing on semiarid watersheds similar to those included in this study" (Ibid., p.112). In a study in the Colorado Front Range, Johnson et al. (1978) found

that grazing by cattle in the riparian zone significantly elevated the fecal coliform and fecal streptococci counts in the stream. After removal of the cattle, fecal streptococci and fecal coliform counts dropped to insignificant levels. Atwill (1996) noted that calves are readily infected with cryptosporidium and shed the oocysts, but asserted that the evidence for role of cattle in spreading cryptosporidium is unproven. The BLM should monitor levels of contamination in heavily grazed areas, particularly near human settlements and important recreation areas.

Groundwaters

The BLM must prevent impacts to both the quantity and quality of groundwaters, in order to preserve ecosystem and economic values such as wellwaters, springs and seeps, and inputs to stream systems. In the grassland environment managed by the Buffalo Field Office, the availability of surface- and groundwater is perhaps the linchpin holding the entire ecosystem together. Hyporheic, or groundwater, systems have their own unique faunas and nutrient dynamics. Hyporheic communities include both detritovores and predators, all living in the waters that flow far underground. Boulton et al. (1991) reported that hyporheic communities include both detritovores and predators; during this study, copepods, ceratopoginid larvae, nematodes, water mites, and oligochaete worms were collected within 2 days of rehydration in previously dry hyporheic sediments.

Groundwater and surface streams are intimately interconnected from a hydrologic standpoint; groundwater in the upper layers upwells directly into stream and river channels or into floodplain springbrooks (Brunke and Gonser 1997). Groeneveld and Griepentrog (1985) found that the depletion of subsurface aquifers led to the decline of riparian vegetation, which in turn in turn led to increased bank erosion. These researchers concluded, "The slow drainage by aquifers which intersect streamcourses serves to maintain channel flow during dry periods and to support the plant species which structure the productivity and character of the riparian ecosystem. This balance may be particularly sensitive to alteration" (p. 44). Benson (1953) found that water inputs to the Pigeon River, Michigan through groundwater upwelling actually controls populations of brook and brown trout by determining the location of spawning habitats. Boulton et al. (1991) recommended that analysis of hyporheic communities should be included in analyses of stream ecosystems.

Groundwater supports its own unique biological component of microorganisms and detritus which contributes important nutrient inputs into streams and rivers at upwelling zones, sustaining high levels of aquatic biodiversity (Brunke and Gonser 1997). Ford and Naiman (1989) found that nutrients, particularly carbon and nitrogen, carried by groundwater are important inputs to stream systems, and that these nutrients are rapidly utilized within the hyporheal zone (sub-sediment) or at the sediment/water interface. Hyporheic fungi and bacteria are an important food source for aquatic invertebrates, some of which may also inhabit the hyporheic zone (Barlocher and Murdoch 1989). Dissolved organic carbon in groundwater is rapidly immobilized upon reaching the hyporheic zone of streams. According to Fiebig and Lock (1991), "We conclude that groundwater can contribute substantial amounts of DOC [dissolved organic carbon], both high and low molecular weight, to a stream ecosystem. The stream bed is the site at which much

of this material could be initially immobilized and made available to the stream trophic structure" (p.45).

Some groundwater aquifers may be as much as 35,000 years old, with negligible modern recharge (e.g., Phillips et al. 1986). If such aquifers are the source of well water, springs, or surface streams, then their depletion through activities such as coalbed methane extraction will potentially have long-term effects including (but not limited to) the desertification of entire watersheds, the loss of wildlife populations dependent on water sources, and the long-term degradation of downstream rivers and streams in communication with the depleted aquifer.

Managing for Biodiversity

The maintenance of biodiversity must occur on a regional scale. In some cases, individual projects may not measurably decrease plant and animal diversity on a local scale, but if rare species with specialized habitat requirements disappear from the landscape, the overall regional biodiversity goes down. This relationship is particularly important when considering the effects of broad-scale habitat conversion and fragmentation. According to Sisk and Battin (2002), "Historically, biologists and planners have focused on alpha (local) diversity, which is often high near habitat edges. As conservation planning has shifted to larger areas, and scientists have assessed regional and global patterns in biodiversity, the focus on species diversity has shifted to the gamma (regional) level, which may be lower in fragmented landscapes due to the loss of edge-avoiding species" (p. 32). Thus, the new RMP should include a standard requiring the maintenance of appropriate habitat to support the viability of all native species throughout their native habitats.

Preserving the biodiversity of rodents is an important consideration in maintaining the prey base for carnivores and raptors, and in maintaining overall ecosystem function. In the Great Divide Basin, rodents consume 3.3% of net annual primary productivity (Maxell 1973). According to Maxell (1973), rodent diversity increases with increasing plant cover diversity; sagebrush grasslands and late-successional communities had the highest rodent diversity. Germano and Lawhead (1986) found that rodents increased in abundance with increasing patch complexity. The BLM should investigate population trends of rare or declining rodents and manage to protect their viability.

SPECIES OF SPECIAL CONCERN

The use of disturbance-sensitive indicator species to monitor the impacts of human activities has been performed by the Forest Service, and holds great promise on BLM lands as well. According to Rothwell (1993),

> "[The use of indicator species] can and should be done in rangelands. As an example, pronghorn and sage grouse, although strongly dependent on shrubs, require a wide variety of seasonal habitats, and gross management can be directed at their needs. On a finer scale, species such as the Brewer's sparrow or sage thrasher could be used to direct management for shrubby habitats while species like the grasshopper sparrow, vesper sparrow, or lark bunting could be used to direct management for grassy areas or grassland types. Similarly, mule deer and

> sharp-tailed grouse can be the focus for macro habitat management in mountain foothills while the towhees and species that require more open habitats can guide micro management" (p. 399).

We encourage BLM to monitor population trends of species sensitive to management activities as a means to tell when adaptive management changes are required.

In addition to such indicator species, there are a number of species on the BLM Sensitive Species List, the WGFD Species Watch List, watch lists of globally imperiled and locally rare species tracked by the Wyoming Natural Diversity Database, and federally listed species under the protection of the Endangered Species Act, all of which merit special conservation concern and attention. These species are of special concern because they are currently rare, are experiencing significant declines in overall population or distribution, or both. Some are at risk for global extinction. The new RMP must include standards that guarantee the viability, and if needed, the recovery of these species.

WGFD (1998) has set forth recommendations for allowing habitat-disturbing activities and mitigation for these activities if allowed. Federal Candidate Species and Native Species Status 1 and 2 receive a mitigation category of "Vital," for which habitat directly limits populations and restoration may be impossible; habitat function must be maintained if habitat modification is allowed to occur. These include all WGFD Native Species Status 1 and NSS 2 category species. Habitats such as Crucial Winter and Crucial Winter Relief Ranges also receive a mitigation category of "Vital."

Native Species Status 3 receive a mitigation category of "High," for which WGFD recommend no net loss of habitat function through enhancement of degraded habitat when a habitat disturbing project is proposed. Big game winter-yearlong ranges and parturition areas also fall under the "High" reclamation category, demanding non net loss of habitat function. Furthermore, for Endangered or Threatened Species, WGFD recommends exclusion of any habitat impacting activity. For these species, "The Commission recognizes that some wildlife or wildlife habitats are so rare, complex and/or fragile that mitigation options are not available. Total exclusion of adverse impacts is all that will ensure preservation of these irreplaceable habitats" (Ibid., p. 4). We concur wholeheartedly, and point out that FLPMA carries a legal requirement for the BLM to manage its lands in accord with state directives such as the WGFD Mitigation Policy.

Finally, there are a number of species that through game animal status or other reasons are of high importance to the public, and the new RMP must also maintain the viability of these species throughout the Powder River Basin.

Passerine Birds

The maintenance of avian biodiversity is best approached at the ecosystem scale. Germano and Lawhead (1986) found that bird diversity was highest in pinyon-juniper scrub and lowest in grassland, with sagebrush and shadscale-greasewood showing intermediate values. In one study, bird diversity was positively correlated with vertical habitat diversity but not patch heterogeneity

(Germano and Lawhead 1986). The new RMP should have as one of its goals to maintain the viability and distribution of all avian species native to the region.

The western populations of the yellow-billed cuckoo have been classified as Threatened under the ESA, and Hunter et al. (1987) classified the yellow-billed cuckoo as a partial riparian obligate. According to Laymon and Halterman (1987), the yellow-billed cuckoo is native to willow-cottonwood woodlands less than 1300 m in elevation, larger than 10 hectares in extent, and wider than 100m. Yellow-billed cuckoos use willows for nesting but cottonwoods for feeding (Ibid.). The new RMP should include provisions to monitor cottonwood gallery woodlands for yellow-billed cuckoo, and to manage these woodlands for retention and recolonization of this bird.

Welch (2002) compared paired plots throughout the West and concluded that the burning of sagebrush reduces avian abundance and diversity. Birds found only in unburned sagebrush sites included American kestrel, Brewer's sparrow, broad-tailed hummingbird, sage grouse, mountain bluebird, sage sparrow, sage thrasher, and Swainson's hawk, while burrowing owl was among bird found only on burned sites (Welch 2002). Prescribed burn projects should be conducted in a manner that does not threaten the viability of sagebrush obligate passerines.

Sage Grouse

Wyoming sage grouse populations are some of the largest left in the nation and are relatively stable (showing a 17% decline from 1985-1994); nonetheless, sage grouse populations have experienced major declines rangewide in recent decades (Connelly and Braun 1997) and in Wyoming in recent years. WGFD (2000) reported that since 1952, there has been a 20% decline in the overall Wyoming sage grouse population, with some fragmented populations declining more than 80%; Christiansen (2000) reported a 40% statewide decline over the last 20 years. These declines have continued over the past 8 years. These declines can be attributed to habitat loss (due to agriculture, mining and energy development, reservoirs, roads, and buildings), habitat fragmentation (due to fences, powerlines, roads, and reservoirs), habitat degradation (due to overgrazing, changes in fire regime, and mechanical and chemical sagebrush control efforts), drought, predation (the importance of which is controlled by the amount and quality of sage grouse habitat), and hunting (Braun 1998). Recent studies have showed marked declines by sage grouse populations affected by oil and gas development in the Powder River Basin. It is crucially important that the new Powder River Basin plan provides for the maintenance and recovery of sage grouse populations, because this bird is headed for the Endangered Species List if population losses continue.

A number of raptors and medium-sized mammalian carnivores prey on sage grouse. Sage grouse nest predators include bobcats, golden eagles, red fox, badgers, common ravens, and coyotes (Heath et al. 1997). Hulet et al. (1986) found that the Uinta ground squirrel was the most important nest predator in their southern Idaho study area. The maintenance of appropriate habitat and adequate cover, particularly on nesting and brood-rearing habitats, is important to ensure that predation rates do not increase to abnormal levels. In addition to maintaining cover, it is important to avoid the construction of tall structures that serve as raptor perches and concentrate predation pressure, like powerlines and gas condensate tanks, near these habitats.

Sage Grouse Habitats

To ensure the viability of sage grouse populations, it is important to consider nesting, brood-rearing, and winter habitats (Call and Maser 1985). Connelly et al. (2000) proposed comprehensive guidelines regarding the management of sage grouse, focused around the conservation of breeding/nesting habitat, late summer brood-rearing habitat, and wintering habitat. We recommend that these guidelines be implemented in the forthcoming RMP, with the modification of a 3-mile NSO and no surface disturbance/vegetation treatment buffer for sage grouse leks in order to protect the leks themselves as well as adjacent nesting habitat.

Breeding and Nesting Habitats

Autenreith (1985) considered the lek site "the hub from which nesting occurs" (p. 52). Grouse exhibit strong fidelity to individual lek sites from year to year (Dunn and Braun 1986). During the spring period, male habitat use is concentrated within 2 km of lek sites (Benson et al. 1991). Young males may establish new leks in order to take part in breeding (Gates 1985). Because leks sites are used traditionally year after year and represent selection for optimal breeding and nesting habitat, it is crucially important to protect the area surrounding lek sites from impacts.

The maintenance of high-quality sagebrush steppe habitats, particularly nesting and wintering habitats, is necessary to maintain sage grouse viability on the landscape scale. Sage grouse are dependent on sagebrush steppe habitats, and sage grouse distribution is closely linked with the distribution of big sagebrush (McCall 1974). Numerous studies have shown that female sage grouse show strong fidelity to specific nesting areas from year to year (Berry and Eng 1985, Fischer et al. 1993, Lyon 2000). Fischer et al. (1993) concluded, "Because Sage Grouse hens appear to seek suitable habitat within a relatively small area, nest-area fidelity may reduce nesting if large areas of nesting habitat are destroyed" (p. 1040). Thus, it is important to foster sagebrush growth at levels useful to sage grouse and to avoid activities that destroy suitable sagebrush habitat.

The optimum height and cover of sagebrush for sage grouse nesting habitats varies from region to region. In their eastern Oregon study, Call and Maser (1985) reported that sagebrush between 30 and 60 cm made the best nesting habitat, while a range of 15-80 cm was suitable for nesting. In the foothills of the Sierra Madres, shrub height at nest sites averaged 22 cm (Klott and Lindzey 1989). In other studies, nesting habitat is typified by greater shrub height and shrub cover (Wallestad and Pyrah 1974, Sveum et al. 1998). Dunn and Braun (1986) found that grouse selected areas with taller shrubs and more homogeneous sagebrush densities, and closer distance to wooded or meadow edges. But in Idaho, Klebenow (1969) found that sage grouse did not nest in areas where sagebrush cover exceeded 35%. Within suitable nesting habitat, nest sites tend to be located under taller-than-average shrubs, particularly sagebrush (Hulet et al. 1986).

Mesic meadows and surface waters are focal points of sage grouse activity during certain times of year. Mesic sites associated with springs, seeps, and streams are critical for sage grouse on a yearlong basis, and assumes even greater importance as brood rearing habitat (Autenreith et al. 1982). Call and Maser (1985) stated, "We believe that free water is an essential component of sage grouse habitat", but noted that "[s]age grouse may do well in the absence of free water

where they have access to succulent vegetation." (p. 4). Oakleaf (1971) found that the presence of surface water was an important factor that increased the value of meadows as grouse rearing habitat. Thus, management for sage grouse should include special emphasis on protecting wet meadows, springs, and seeps.

Habitat attributes have a direct effect on sage grouse population dynamics. Connelly et al. (1991) found that nest success was higher for birds nesting below sagebrush (53%) versus other shrubs (22%), and hypothesized that avian predation was the key to nest success. In central Washington, Sveum et al. (1998) found that sagebrush cover at successful nest sites averaged 51%, and height averaged 64 cm, while at depredated nests cover and height averaged 70% and 90 cm, respectively. Wallestad and Pyrah (1974) found that sagebrush cover exceeded 15% for all nest sites, and cover of sagebrush was positively correlated with nest success. Several studies have shown that successful nest sites have greater cover of tall grass (Gregg et al. 1994, Sveum et al. 1998). With this in mind, Holloran (1999) recommended leaving residual grass heights greater than 12 cm following removal of livestock in autumn. Thus, not only sagebrush height and density but also understory grass cover are important to maintain in sage grouse nesting areas.

Early and Late Brood Rearing Habitats

Sage grouse may move some distance from nesting sites for early and late brood rearing. In western Wyoming, Lyon (2000) found that sage grouse moved an average of 1.1 km from the nest site for early brood-rearing, and late brood-rearing habitats averaged 4.8 km distant from the early brood-rearing areas. In Bates Hole, Holloran (1999) found that early brood rearing habitats are typified by decreased sagebrush cover and height and increased forb abundance, and movement to riparian sites occurred as uplands became dessicated. This pattern of movement and habitat selection is echoed in the findings of Oakleaf (1971). In western Wyoming, wet meadows, springs, seeps, and other green areas within sagebrush steppe were important for early brood-rearing, while late brood rearing focused on irrigated hay meadows, wet meadows, and drainage bottoms which remained green when early brood rearing habitats were withering (Lyon 2000). This researcher found that most recruitment loss occurred during the early brood rearing stage, and that this may be a limiting factor in sage grouse populations (Ibid.). In Nevada, Oakleaf (1971) found that meadows with succulent forbs, while occupying only 2.3% of grouse home ranges during the brood rearing period, were disproportionately important as brood-rearing habitat. In central Washington, Drut et al. (1994b) found that during late brood-rearing, habitat use shifted from low sagebrush to big sagebrush sites, with heightened use of meadows and lakeshores. Brood-rearing habitats should thus be identified and managed to maximize sage grouse recruitment success.

The availability of forage with a high nutritional content is an important factor determining brood success. Broods require forbs, insects and cover for growth, concealment and shade (Autenreith 1985). The diet of sage grouse chicks is dominated by insects in the first week of life, with forbs becoming more important as time progresses (Call and Maser 1985). Oakleaf (1971) reported that succulent forbs dominated the diets of brood-rearing hens and juveniles until the chicks reached 11-12 weeks of age. Drut et al. (1994a) found that in the area with high sage grouse productivity, insects and forbs made up 80% of chicks' diets, while sagebrush buds made up 65% of diets in the area of low sage grouse productivity. These researchers reached the

following conclusions: "Substantially lower consumption of forbs and invertebrates and increased reliance on sagebrush may affect chick growth and survival, which would be reflected in long-term differences in productivity between areas. Insects are a critical nutrition source for developing chicks" (p. 93). Dunn and Braun (1986) argued that meadows, as important forb-producing areas, should be preserved. Thus, the BLM should manage sage grouse brood-rearing habitat to maximize high-quality forage for chicks.

Wintering Habitats

Non-migratory sage grouse winter on their nesting and brood-rearing habitats, while migratory populations may travel some distance to winter on traditional wintering areas. For non-migratory populations, nesting habitat and wintering habitat are one and the same (e.g., Wallestad and Pyrah 1974). In a western Wyoming study, however, sage grouse were migratory and traveled at least 35 km to separate wintering grounds (Berry and Eng 1985). In Colorado's North Park, Beck (1977) found that grouse migrated 5-20 km away from breeding areas during winter. In a southeastern Idaho study, Connelly et al. (1988) found that some adult sage grouse moved more than 60 km to winter range, and some juveniles moved more than 80km, despite the availability of suitable wintering habitat nearby. In some cases, sage grouse may be widely dispersed during mild winters but concentrate during severe winters (e.g., Autenreith 1985).

Sage grouse may be keying in on several habitat variables when selecting appropriate wintering habitat. In the southern Red Desert, Kerley (1994) found that wintering sage grouse moved to tall sagebrush stands on steep south-facing slopes, where the sagebrush were exposed above the snow. Conversely, Beck (1977) found that in North Park, Colorado, 66% of sage grouse wintered on slopes of less than 5%, while only 13% of sage grouse use occurred on slopes greater than 10%. In Montana, Eng and Schladweiler (1972) found that 82% of winter sage grouse sightings occurred in canopy cover greater than 20%, and a preference was shown for dense stands on lands with little slope. The BLM must identify sage grouse wintering habitats within the planning areas and emplace strong measures to protect them from vegetation treatments and industrial projects.

Researchers appear to be unanimous in their recommendations that sage grouse winter habitat be protected from disturbance. Kerley (1994) recommended, "Because shrub stands used during winter (category 3 stands) make up a small proportion of available habitats, these patches on south facing slopes, as well as other traditional wintering sites, should not be treated [to remove or reduce shrubs]" (p.113). Connelly et al. (2000) concurred, recommending against habitat manipulation in sagebrush stands of 10-30% canopy cover heights of at least 25 cm to protect winter habitats. According to Beck and Braun (1980), "Areas of winter concentrations of sage grouse need to be documented and afforded maximum protection" (p. 564). Lyon (2000) recommended that sage grouse wintering habitats be placed off-limits to oil and gas development. Thus, in the Powder River Basin, the BLM needs to rapidly identify sage grouse winter concentration areas and place the areas off-limits to surface disturbance and vegetation treatments.

Vegetation Treatments

Because the sage grouse is dependent on sagebrush, sagebrush treatments are likely to have major impacts on sage grouse population viability. Call and Maser (1985) asserted that the spraying of sage grouse nesting habitats is deleterious because it reduces nest cover from avian predators and suppresses forbs that are important in the sage grouse diet. According to Kerley (1994), "shrub stands of 20-40% cover are needed for successful nesting and this shrub coverage should be maintained on identified breeding complexes [within 3.2 km of leks]" (p. 113). Wamboldt et al. (2002) stated:

> "Natural or prescribed burning of sagebrush is seldom good for sage-grouse. This assessment recommends that fires within sage-grouse habitat be avoided in most cases, and should be allowed only after careful study of each local situation. The evidence also indicates that habitat loss due to fire may well be the most serious of all the factors contributing to the decline of sage-grouse" (p.24).

Heath et al. (1997) went even farther: "Based on our results, we recommend no reduction or control of sagebrush in areas containing between 18-30% live sagebrush canopy coverage within 4.5 km of leks" (p.50). According to Beck and Braun (1980),

> "At present we do not know the relative value of a small versus large strutting ground to the population. Therefore we should afford equal merit to all and strive to maintain the adjacent habitats, especially areas with sagebrush (Artemesia) suitable for nesting and brood rearing" (p. 563).

Biodiversity Conservation Alliance has commissioned a study by Wyoming Wildlife Consultants to determine the effects of past habitat treatment types in the Bighorn Basin on sage grouse populations. This study is scheduled to be completed by December 2008, and we will provide the results of this study to the BLM for its consideration in designing standards and guidelines for habitat treatment projects.

Call and Maser (1985) stated that spraying should not occur within the breeding complex (which they defined as within 2 miles of a lek), and should also be forbidden in known grouse winter ranges. Taking into account the negative effects of vegetation treatments on sage grouse nesting and lekking areas, and uncertainty in the overall extent of sage grouse nesting habitat surrounding lek sites in the Powder River Basin, the BLM should prohibit vegetation treatments within *3 miles* of sage grouse lek sites.

Strip Mining

Coal mining can impact sage grouse populations through major local decreases in recruitment (Braun 1986); local distribution patterns and decreases in lek use are the principal effects, with disturbance, rather than habitat loss, being the primary factor (Remington and Braun 1991). In the Powder River Basin, there is quite a bit of coal mining. Most of the best sage grouse habitat that rings the eastern edge of the Powder River Basin corresponds with the outcrops of the best coal deposits, with a strong likelihood that a major expansion of this type of mining with threaten the viability of sage grouse populations. Klott (1987) recommended that areas near sage grouse

leks be avoided for the purposes of strip mining. We concur, and ask the BLM to withdraw lands within 3 miles of a sage grouse lek from lands suitable for surface mining.

Road Development

Road development can lead to lek abandonment (e.g., Braun 1986). In western Wyoming, Lyon (2000) found that for sage grouse leks within 3 km of oil and gas developments, grouse hens successful at raising their broods selected habitats farther from roads than unsuccessful hens. This finding indicates that habitats near roads experience reduced brood survivorship. Thus, we seek a moratorium on all road-building within 3 miles of a lek site.

Oil and Gas Development

Oil and gas development poses perhaps the greatest threat to sage grouse viability in the region. In a study near Pinedale, sage grouse from disturbed leks where gas development occurred within 3 km of the lek site showed lower nesting rates (and hence lower reproduction), traveled farther to nest, and selected greater shrub cover than grouse from undisturbed leks (Lyon 2000). According to Lyon (2000), impacts of oil and gas development to sage grouse include (1) direct habitat loss from new construction, (2) increased human activity and pumping noise causing displacement, (3) increased legal and illegal harvest, (4) direct mortality associated with reserve pits, and (5) lowered water tables resulting in herbaceous vegetation loss. Pump noise from oil and gas development may reduce the effective range of grouse vocalizations (Klott 1987). Thus, lek buffers are needed to ensure that booming sage grouse are audible to conspecifics during the breeding season. Connelly et al. (2000) recommended, "Energy-related facilities should be located >3.2 km from active leks" (p. 278). But Clait Braun (2005), the world's most eminent expert on sage grouse, recommended even larger NSO buffers of 3 miles from lek sites, based on the uncertainty of protecting sage grouse nesting habitat with smaller buffers. See Attachment 1. Thus, areas within 3 miles of a sage grouse lek should be put under year-round "No Surface Occupancy" stipulations.

Sage grouse mitigation measures have been demonstrated to be ineffective at maintaining this species at pre-development levels in the face of oil and gas development by Holloran (2005) and Walker et al. (2006). In both of these studies, comparable levels of development led to significant declines in sage grouse populations. Holloran (2005) found that, for the Pinedale Anticline and Jonah Fields of western Wyoming, current population trends predicted extirpation of sage grouse in developed areas within 19 years of the date of the study. Walker et al. (2006) found an 85% decline of sage grouse populations in the Powder River Basin of northeastern Wyoming since the onset of coalbed methane development there. Under both studies, the BLM had implemented and required mitigation measures identical to those that commonly apply in the Powder River Basin today. Walker et al. (2006) concluded:

> Seasonal restrictions on drilling and construction do not address impacts caused by loss of sagebrush and incursion of infrastructure that can affect populations over long periods of time. Regulatory agencies may need to increase spatial restrictions on development, industry may need to rapidly implement more effective mitigation measures, or both, to reduce impacts of CBNG development on sage-grouse populations in the PRB.

Attachment 2 at 2. Furthermore,

> Strong support for models with negative effects of CBNG at both the 0.8-km and 3.2-km scales indicate that the current restriction on surface infrastructure within 0.4 km is insufficient to protect breeding populations.

Id. at 18. In the end,

> Our analysis indicates that maintaining extensive stands of sagebrush habitat over large areas (6.4 km or more) around leks is required for sage-grouse breeding populations to persist. This recommendation matches those of all major reviews of sage-grouse habitat requirements (Schroeder et al. 1999, Connelly et al. 2000*b*, Connelly et al. 2004, Crawford et al. 2004, Rowland 2004). Our findings also refute the idea that prohibiting surface infrastructure within 0.4 km of the lek is sufficient to protect breeding populations and indicate that increasing the size of no-development zones around leks would increase the probability of lek persistence…. Timing restrictions on construction and drilling during the breeding season do not prevent impacts of infrastructure (e.g., avoidance, collisions, raptor predation) at other times of the year, during the production phase (which may last a decade or more), or in other seasonal habitats that may be crucial for population persistence (e.g., winter).

Id. at 21.

For sage grouse, Holloran (2005) demonstrated that wells sited within 1.9 miles (during the post-drilling, post-construction production phase) caused negative impacts on sage grouse. Walker et al. (2006) demonstrated negative effects on sage grouse lek populations when wells were sited between 0.5 and 2 miles of the lek. Attachment 2 at 2. Under current BLM statewide policy for sage grouse, wells could be sited as near as 0.25 mile from a lek site. *See* FEIS at Table 2-6. In the context of the Atlantic Rim CBM project, the U.S. Fish and Wildlife Service also voiced its disapproval for these mitigation measures:

> The Service is very concerned that authorization of this project, as proposed, will significantly affect the population of greater sage-grouse that occurs in this area of Wyoming. Adverse affects to sage-grouse may occur through the long-term loss of sagebrush habitat, fragmentation of habitat, and noise associated with project activities. The Service does not support a 0.25-mile protective buffer around sage-grouse leks as a mitigation measure, nor do we support a 2-mile buffer to protect nesting habitat…. Additionally, recent information from a doctoral dissertation on the impacts of oil and gas development to greater sage-grouse in the Pinedale Anticline found that as development increased, lek activity declined up to 100 percent (Holloran 2005)…Additionally, Holloran concluded that stipulations placed on oil and gas development in the Pinedale Anticline, which

> are identical to those proposed for the Atlantic Rim development, were insufficient to maintain sage-grouse breeding populations in natural gas fields.

Attachment 3 at 3. Holloran (2005) also found that well densities exceeding 1 well per 699 acres had a negative impact on grouse. State agencies recommend that well densities not exceed one site per square mile in cases where sensitive habitats cannot be avoided altogether. Thus, in the absence of mitigation measures capping well density at this figure, oil and gas development would be expected to have deleterious effects on nesting sage grouse despite the standard mitigation measures for sage grouse. Stronger mitigation measures are clearly necessary.

For the Cow Butte/Wild Cow Wildlife Habitat Management Area under the BLM's proposed Rawlins RMP, BLM conceded that stipulations for sage grouse are inadequate to maintain viable populations:

> The development of oil and gas wells surrounding the ¼-mile buffer around grouse leks would reduce the amount of habitat available for nest site selection. The birds would be required to either nest in less optimal locations or space their nests more closely. Increased noise resulting from CBNG [coalbed methane]-related traffic would possibly affect the ability of female grouse (both greater-sage and Columbian sharp-tailed) to locate leks, potentially reducing the reproductive viability of the species. CBNG development within the Cow Butte/Wild Cow area would reduce the number of male grouse inhabiting leks within or adjacent to coalbed natural gas development. It would also increase fragmentation of plant communities used by grouse, degrading both nesting and brood-rearing habitat. The ability of these birds to move to adjacent, less disturbed habitat is extremely limited because of oil and gas development to the west and increasing elevation and snowpack to the east. Thus probable development would threaten sustained use of the area by sage grouse.

Rawlins RMP FEIS at 4-332. The same principles apply in the Powder River Basin.

The adequacy of the current small NSO buffers for sage grouse leks has been repeatedly refuted in the scientific literature. Beck (2006:4) stated, "Results suggest that no surface occupancy within 0.4 km is not adequate to avoid lek abandonment or other negative influences on prairie grouse populations, and also indicates that surface occupancy may need to be at least 1.6 km from leks to avoid declines or abandonment" (internal ref. omitted). Attachment 5.

A west-wide panel of state fish and wildlife agency personnel examined the state of the science on sage grouse conservation, and had this to say about the current suite of oil and gas lease stipulations:

> Much of the greater sage-grouse habitat in MZ-1 and 2 has already been leased for oil and gas development. These leases carry stipulations **that have been shown to be inadequate** for protecting breeding and wintering sage-grouse

> populations during full field development. New leases continue to be issued utilizing these same stipulations.

Attachment 6 at 2, emphasis added, internal citations omitted. BLM must not continue to apply mitigation measures that have been uniformly rejected as inadequate by the scientific community and wildlife management agencies.

A Blueprint for Sage Grouse Conservation and Recovery by Dr. Clait Braun, arguably the world's leading expert on sage grouse conservation provides recommendations for sage grouse conservation, was submitted to the BLM during the planning process but was ignored by BLM. *See* Attachment 1. Dr. Braun's recommendations constituted a reasonable alternative based on the best available science that would place a moratorium on the constructions of well, roads, and other infrastructure for the important nesting habitat that occurs within 3 miles of a sage grouse lek. BLM should consider the implementation of these recommendations in at least one of the agency's alternatives, and adopt these recommendations as standards in the new RMP.

Livestock Grazing

Livestock grazing can influence sage grouse habitat suitability, particularly overgrazing which can reduce understory grasses below critical thresholds and alter the density of sagebrush. In their study on sage grouse in eastern Oregon, Call and Maser (1985) made the following basic assumption: "Where there are conflicts between sage grouse and livestock on public lands, it may be essential to give priority to sage grouse if they are to continue to exist on these areas" (p. 3). According to Autenreith et al. (1982), heavy livestock grazing during the sage grouse nesting or brood rearing seasons is deleterious. According to Gregg et al. (1994), "Land management practices that decrease tall grass and medium height shrub cover at potential nest sites may be detrimental to sage grouse populations because of increased nest predation....Grazing of tall grasses to <18 cm would decrease their value for nest concealment....Management activities should allow for maintenance of tall, residual grasses or, where necessary, restoration of grass cover within these stands" (p.165).

The potential conflict between livestock grazing and sage grouse is intensifies near water sources due to the importance of these areas to sage grouse. Heavy cattle grazing near springs, seeps, and riparian areas can remove grasses used for cover by grouse (Klebenow 1982). According to Call and Maser (1985), "rapid removal of forbs by livestock on spring or summer ranges may have a substantial adverse impact on young grouse, especially where forbs are already scarce" (p. 17). We support the BLM's current policy of fencing off natural springs and placing livestock water sources outside the fences rather than at the spring itself.

Holloran (1999) documented that livestock disturbance caused a sage grouse hen to abandon her nest in one case. Call and Maser (1985) noted that nest desertion is most prevalent in the vicinity of sheep bedgrounds, and reached the following conclusion: "There is no indication that livestock are a serious factor in the destruction of nests, although desertion of nests because of livestock activities is frequent under certain conditions" (p. 17). In addition, the presence of livestock in nesting habitats can cause problems for sage grouse. Livestock drives could also negatively impact sage grouse populations during the nesting season. According to Call and

Maser (1985), "Hens abandon their nests with little provocation during the egg-laying period (mid-April through early May). Yearling hens are prone to abandon their nests even when disturbed during incubation. The impact of a livestock drive could, therefore, be great because yearling hens are usually the largest reproductive age class" (p. 18). For allotments where sage grouse nesting is known to occur, shifting on-off dates (if necessary) could minimize the chances of impacts to nesting sage grouse, and livestock drives should be routed to avoid sage grouse leks during the strutting and nesting seasons.

Off-Road Vehicle Use

Certainly, off-road vehicle use in sage grouse nesting habitats has negative consequences for the grouse. Call and Maser (1985) made the following recommendations concerning off-road vehicle use and sage grouse:

> "Organized motorcycle or four-wheel drive races across sage grouse nesting habitat, however, can cause substantial loss of production from direct destruction of nests, from abandonment of nests during egg-laying, from destruction of young chicks, or from all three. If sage grouse production is a management goal, then it is wise to postpone such races until after the first of September when the birds are old enough to fly out of harm's way" (p. 19).

We concur, and urge the BLM not only to avoid the proliferation of new roads and user-created vehicle routes in nesting habitats but also to schedule events away from nesting habitats and avoid scheduling them during the nesting period.

Insecticide and Herbicide Spraying

In addition to destroying the insects and forbs required by sage grouse broods, the spraying of insecticides and herbicides may cause direct mortality of sage grouse. In a Montana study, Wallestad (1975) found that treatment of 24% (751 acres) of suitable sagebrush habitat around one lek resulted in a 50% reduction of cocks, while treatment of 11% (640 acres) of suitable habitat around a second lek showed no change in sage grouse numbers; during the same time period, sage grouse numbers at control leks with no sagebrush treatment increased over 300%. Klebenow (1970) found that spraying of nesting habitat caused a long-term cessation of nesting activity in the area. Blus et al. (1989) found that the spraying of two types of insecticides over grouse was fatal to 78% of grouse, and hypothesized that insecticides have played a role in region-wide sage grouse declines. Standards should be issued preventing the spraying of insecticides in sensitive sage grouse habitats during periods where these habitats are occupied.

Lek Buffers

Current BLM nest buffers of ¼ mile for controlled surface disturbance and 2 miles for seasonal stipulations are grossly inadequate to maintain sage grouse viability in the Powder River Basin planning area. The lek buffer must be based not only on maintaining the lek but also the nesting habitat that surrounds the lek. In addition, seasonal prohibitions that prohibit only construction activities near leks are pointless: If roads or wells are built near leks during the off-season, the resulting regular vehicle traffic will have major negative impacts when the sage grouse are present, effectively circumventing any mitigative value of delaying construction activities.

As a rule, breeding and nesting activity are concentrated in the habitats adjacent to the lek site. In a Montana study, Wallestad and Schladweiler (1974) found that no male sage grouse traveled farther than 1.8 km from a lek during the breeding season. But following breeding, males may make long migrations to distant summer ranges (Connelly et al. 1988). Hulet et al. (1986) found that 10 of 13 hens nested within 1.9 miles of the lek site during the first year of their southern Idaho study, with an average distance of 1.7 miles from the lek site; 100% of hens nested within 2 miles of the lek site during the second year of this study, with an average distance from lek of 0.5 mile. In Montana, Wallestad and Pyrah (1974) found that 73% of nests were built within 2 miles of the lek, but only one nest occurred within 0.5 mile of the lek site.

But in Bates Hole, Wyoming, Holloran (1999) found that average nesting distance from lek site was 3.25 km for adults and 5.27 km for yearlings. Wakkinen et al. (1992) cautioned that leks were poor predictors of sage grouse nest sites; although 92% of sage grouse nested within 3.2 km of a lek in this study, sage grouse did not necessarily nest near the same lek where breeding took place.

Lyon (2000) pointed out that quarter-mile lek buffers were insufficient to maintain the viability of grouse populations. Connelly et al. (2000) recommended that sage grouse habitat should be protected within 3.2 km of lek sites under ideal habitat conditions, within 5 km when habitat conditions are not ideal, and within 18 km where sage grouse populations are migratory. Furthermore, these researchers stated that in areas where 40% or more of the original breeding habitat has been lost, all remaining habitat should be protected.

But Beck (1977) cautioned that protection of lek sites only is insufficient to maintain sage grouse winter habitats. And Connelly et al. (1988) later cautioned, "Protection of sagebrush habitats within a 3.2 km radius of leks may not be sufficient to ensure the protection of year-long habitat requirements" (p. 116). And Braun (2005) recommended even larger buffers of 3 miles from lek sites where surface disturbance and vegetation treatments should be prohibited, based on the uncertainty of protecting sage grouse nesting habitat with smaller buffers. Thus, areas within 3 miles of a sage grouse lek should be put under year-round stipulations preventing habitat alterations.

Monitoring

The number of active sage grouse leks can be a useful index of sage grouse population trends (Emmons and Braun 1984). Autenreith et al. (1982) provide a sound monitoring protocol which the BLM should adopt to monitor sage grouse trends. Aerial lek surveys should be undertaken each spring to determine presence/absence of grouse on known lek sites and to locate new lek sites, and a subset of leks should be censused at regular intervals at dawn throughout the breeding season to gain an index of population trend. It is important to note that the number of grouse at a lek site can vary greatly from day to day (Beck and Braun 1980), so repeat censuses will be needed to establish a mean value. Emmons and Braun (1984) pointed out that timing of lek counts may affect number of grouse observed, as lek attendance is not constant and males commonly move between leks. These researchers recommended that four separate lek counts be taken for each lek, about 10 days apart. Brood counts should be undertaken 11-13 weeks after the

peak of hatch using chick distress calls, and average number of chicks per hen should be derived, using both successful and nullparous hens.

Mountain Plover

The mountain plover is proposed for listing as Threatened under the Endangered Species Act, and its rangewide decline appears to be continuing. Wyoming (along with Colorado and Montana) is one of three states that encompass the majority of plover's breeding population (USFWS 1999); approximately 1,500 birds are estimated to occur in Wyoming (Long 2001).

Habitat Requirements

Low or sparse vegetation is a key habitat requirement for nesting plovers. Habitat requirements for plover consist of short vegetation, bare ground, and flat topography; habitat associations found within the Powder River Basin include plains, alkali flats, prairie dog towns, and low shrub communities, but rarely in association with surface water (Long 2001). Bare ground near objects such as rocks or dung are the nest sites of choice (Knopf and Miller 1994). Knowles et al. (1999) defined suitable habitat as "an area of at least 10 to 20 ha, with relatively level topography, and the vegetation is maintained at less than 10 cm…" Knopf and Rupert (1996) found that successful nesting plovers on the High Plains of northern Colorado used home ranges of 28-91 hectares of land. Plovers may move up to 2 km to early brood-rearing habitat immediately after egg hatching (Knopf and Rupert 1996). In the Wyoming Basins region, the availability of the low vegetation that constitutes high-quality plover habitat is largely based on low soil quality, low precipitation, and wind scour, and patches of high-quality habitat are likely to remain persistent from year to year (Beauvais et al. 1999). In particular, we wish to ensure that any nesting plover populations in the Powder River Basin area receive adequate conservation attention.

Importance of Prairie Dogs to Plover Viability

Mountain plovers are often found closely associated with prairie dog colonies of all species. Kotliar et al. (1999) listed the mountain plover as a species that is dependent on prairie dog colonies for its persistence, with abundances higher on prairie dog colonies, habitat selection for prairie dog colonies, reproductive fitness higher on colonies, and population declines occurring when prairie dogs decline. An analysis of pre-settlement records of mountain plover occurrence in Montana indicates that this species was closely associated with prairie dog colonies even before the arrival of EuroAmerican settlers (Knowles et al. 1999). Knowles (1999) went so far as to state that prairie dog colonies are "necessary to provide suitable habitat for mountain plovers" on Montana's Great Plains, and termed prairie dogs "necessary for the long-term persistence of mountain plovers" in that region (Knowles 1999). This study also found that even small areas of active colonies are important plover habitat. In Wyoming, the distribution of plovers has been linked with the widespread occurrence of prairie dogs (Oakleaf et al. 1996).

The reduction in prairie dog colonies has been directly implicated as an important cause of mountain plover declines rangewide. Knowles et al. (1999) found that the disappearance of prairie dogs due to plague and/or recreational shooting also led to abandonment of nesting habitat by plovers, and plover numbers increased on sites where prairie dog populations were expanding. According to the U.S. Fish and Wildlife Service (1999), "Further loss of prairie dog

towns within the current breeding range of the mountain plover would be detrimental to plover conservation. Conversely, the conservation of the mountain plover can be enhanced by implementing strategies to increase the distribution and abundance of prairie dogs on breeding habitat" (p. 7594). Thus, the conservation of prairie dog colonies is a prerequisite to maintaining viable populations of mountain plover.

Effects of Management Activities and Industrial Development

Grazing and other activities detrimental to other species may benefit plovers in some cases. Areas of heavy grazing, whether by sheep, cattle, bison, or other ungulates, may be favorable for mountain plover nesting habitat (Knowles et al. 1999). Because the important effect is the creation of substantial areas with little or no vegetation, one may infer that heavy grazing by wild horses could also create favorable plover habitat. Wallis and Wershler (1981) noted that inadequate grazing may be detrimental to nesting plovers on the High Plains. But livestock grazing is far from universally beneficial to mountain plovers. Wallis and Wershler concluded that patchiness in grazing intensity was of greatest benefit, and that even distribution of cattle and uniform overgrazing may be detrimental to plover habitat. Winter and spring grazing create more favorable habitat conditions for mountain plover than does summer grazing (Knowles et al. 1999).

Other management activities may also influence plover viability. On the Great Plains of Colorado, where wildfires are a natural occurrence, prescribed burning has been shown to increase the attractiveness of habitat to nesting plovers (Svingen and Giesen 1999). Knowles et al. (1999) also stated, "prairie dog eradication, carefully regulated summer grazing of cattle, and agricultural conversion of rangelands all appear to be detrimental to mountain plover conservation."

Oil and gas development in nesting concentration areas is a direct threat to mountain plover population viability. The U.S. Fish and Wildlife Service found that the Seminoe Road Coalbed Methane project in south-central Wyoming "is likely to adversely affect the proposed mountain plover," stating that wellfields are likely to become an "ecological trap," attracting feeding plovers to roadways where they become susceptible to vehicle-related mortality, or alternately increased vehicle traffic could drive plovers away from preferred nesting areas (Long 2001). The USFWS (1999) added that vehicle traffic on roads could lead to stress and chick abandonment. These officials noted that any human disturbance that significantly modifies adult behavior could cause death to chicks, which can die in as little as 15 minutes due to exposure to sun at temperatures greater than 81° F. Long (2001) noted that construction equipment and permanent structures inherent to oilfield development constitute a radical increase in raptor perches that could result in increased predation pressure. In addition to these problems, wellfield development can lead to increased invasion rates of non-native weed species, which can have serious impacts on plover nesting habitat by decreasing the availability of bare ground (Good et al. 2001). It was formerly believed that mountain plover nesting occurrences in close proximity to oil and gas wells in northeastern Utah constituted evidence that oil and gas development is compatible with the needs of nesting plovers. As the Utah population of plovers is now extirpated, this interpretation of the data no longer is considered to hold any water.

Wind-power developments can be equally harmful to plover nesting habitats. According to Johnson et al. (2000), nesting plovers abandoned the southern third of the Foote Creek Rim during wind farm construction activities in 1998, abandonment of the southern half of the Foote Creek Rim in 1999, and overall reductions in use of this area heavily impacted by roads and wind turbines during previous years, was likely related either to construction activities or reduced habitat effectiveness due to the presence of roads, trenches, or other project-related impacts.

The BLM has historically mapped and surveyed for plover nesting areas on a catch-as-catch-can basis, limiting efforts to lands slated for imminent development projects. A broader and more comprehensive survey of nesting plovers by trained personnel is needed throughout the planning area. The Wyoming Game and Fish Department has made the identification of plover nesting areas one of its highest conservation priorities (Oakleaf et al. 1996). Wind speeds greater than 18 m.p.h., as well as precipitation or sunny days warmer than 86 degrees F, can radically decrease census effectiveness, as these weather conditions cause plover to crouch in the lee or shade of shrubs and essentially become invisible (Knowles et al. 1999). Depending on climate shifts from year to year, abundant vegetation associated with favorable growing conditions can decrease plover observation distance from 400m to 100m at the same site (Knowles et al. 1999). In Montana, surveys must be completed prior to mid-July fledging dates, and observability is higher during courtship and brood-rearing periods than it is during incubation of eggs (Knowles et al. 1999). Mountain plover nesting concentration areas should be managed as Areas of Critical Environmental Concern with No Surface Occupancy stipulations required.

Raptors

Raptor populations are on the rebound following declines based largely on insecticide spraying, predator poisoning programs, and shooting in the 1960s and 1970s. Raptors of special concern include the golden eagle, prairie falcon, peregrine falcon, ferruginous hawk, merlin, and burrowing owl. Bald eagle roost sites are also a conservation concern in the Powder River Basin. Because they require large natural areas for survival, raptors may be good umbrella species for the protection of entire ecological communities (Burnham and Holroyd 1995).

Importance of Cliff Habitats

Cliffs provide important nesting substrates preferred by a broad spectrum of raptors. A study near Medicine Bow, Wyoming found that cliffs provided the single most important nesting habitat for raptor species in the region, and 93% of all prairie falcon nests were found on cliffs, despite the comparative rarity of this landform in the Medicine Bow area (MacLaren et al. 1988). In a Utah study, prairie falcons and golden eagles nested exclusively on cliff sites (Smith and Murphy 1982). Thus, in terms of value to nesting raptors, areas with cliff topography may be of heightened conservation importance.

Importance of Prairie Dogs to Raptor Populations

Prairie dogs can be an important mainstay of raptor diets. In a study near Medicine Bow, Wyoming, white-tailed prairie dogs made up 38% of the biomass in the diets of prairie falcons, 18% for golden eagles and red-tailed hawks, and 22% of ferruginous hawk diet biomass (MacLaren et al. 1988). Prairie dog colonies are also important to the survival of raptor

populations on their wintering areas. Jones (1989) studied winter raptor aggregations on the High Plains of Colorado "Aggregations of ferruginous hawks, red-tailed hawks, and bald eagles were frequently observed in the vicinity of prairie dog colonies." p. 256. In this study, golden eagles, ferruginous hawks, and red-tailed hawks were observed taking prairie dogs, while bald eagles and northern harriers competed for the captured prairie dogs. Declines in prairie dog colonies as a result of a plague epidemic resulted in a more than 60% decline in wintering bald eagles, ferruginous hawks, and red-tailed hawks (Ibid.). Numbers of wintering ferruginous hawks also declined dramatically following a crash in prairie dog populations in New Mexico (Cully 1991). Thus, full recovery of prairie dog populations would be the optimal outcome for maintaining and recovering raptor populations.

Effects of Management Activities and Development on Raptors

The primary impact to raptor populations is direct disturbance of raptors on the nest, leading to reductions or loss of viability for eggs or nestlings. Disturbance of nesting raptors may cause nest abandonment, damage to the eggs, subject eggs or nestlings to cooling, overheating, or dehydration leading to mortality, prevent young nestlings from receiving sufficient feedings to remain viable, and cause premature fledging (Parrish et al. 1994). Thus, the BLM should establish adequate nest buffers (on the order of 2 miles in diameter) around nest sites, preventing all construction of developments (such as wells and roads) that would lead to future disturbance of nesting raptors through focusing human activities in these areas. Seasonal restrictions are insufficient; a well or road constructed outside the nesting season is still likely to lead to nest abandonment or reductions in recruitment due to disturbance from vehicle traffic that does occur during the nesting period.

The overall landscape-scale effects of widespread industrialization threaten the viability of raptor populations through habitat loss and fragmentation. Nest buffers currently in force are unlikely to safeguard the viability of native raptors in the Powder River Basin; a more conservative approach is needed in order to safeguard raptor viability in this region. White and Thurow (1985) stated: "We would prefer to see ecosystems kept intact (cf. Wagner 1977) rather than divided into isolated islands set aside for nesting raptors, because aspects of general land use other than restricted areas also affect the health of raptor populations" (p. 21). Thus, not only should nest buffers be implemented, but the overall integrity of the landscape should be maintained (or improved in areas where it is currently degraded) in order to better provide for raptor viability.

Powerline Corridors

Powerline towers are likely to concentrate raptor nesting and perching activities, to the potential detriment of prey species. Transmission towers may be particularly attractive as nest sites for ravens, and Steenhof et al. (1993) reported that 133 pairs of ravens had colonized transmission towers on a single stretch of powerline in Idaho during its first 10 years of existence. Gilmer and Wiehe (1977) found that nest success for ferruginous hawks was slightly lower for transmission towers than other nest sites, and noted that high winds sometimes blew tower nests away. Steenhof et al. (1993) also found that transmission tower nests tended to be blown down, but found that nest success was not lower on towers for ferruginous hawks and was significantly higher on towers for golden eagles. In North Dakota, Gilmer and Stewart (1983) found that ferruginous hawk nest success was highest for powerline towers and lowest for nests in

hardwood trees. Thus, although powerlines can be designed to reduce impacts to raptors, these corridors should be sited more than 2 miles away from prairie dog colonies and sage grouse leks to prevent major impacts to these sensitive prey species.

Wind Power Development
We have attached the report, *Wind Power in Wyoming: Doing it Smart from the Start* for your review and incorporation in the revised RMP. Attachment 4. This report includes a comprehensive review of the scientific and technical literature as well as outlining which lands should be excluded from wind power development, which lands should be available for development once certain Best Practices are put in place, and which lands have no identified resource conflicts and would be most favorable for wind energy development. We incorporate this report by reference into the comments, and this report constitutes BCA's comments and recommendations for the Powder River Basin plan revisions. Please respond to the issues raised in this report through the NEPA process.

Effects of Livestock Grazing
Effects of livestock grazing on raptors vary by species. Kochert (1989) examined the effects of livestock grazing on raptors and found that grazing can decrease the amount of nesting substrate, change populations of rodents (causing declines in many groups), and alter the vulnerability of prey species. He further pointed out that few prey species tolerate intensive long-term overgrazing. Bock et al. (1993b) reported that golden eagles probably respond positively to grazing in shrubsteppe habitats, but ferruginous hawks, Swainson's hawks, red-tailed hawks, and northern harriers probably respond negatively. It is likely that overgrazing is the greatest threat to those raptors sensitive to grazing impacts.

Golden Eagles
Golden eagles, their nests and young are strictly protected under the Bald Eagle Protection Act (16 USC 668a-d). This species is very popular with the wildlife viewing public, and conversely has historically suffered from shooting as well as poisoning directed at terrestrial predators. The maintenance of viable golden eagle populations should be an important consideration in the new RMP.

Conservation efforts should focus on protecting nest sites and important foraging areas, such as prairie dog colonies. Golden eagles are highly territorial. Even when surface-disturbing activities such as strip mining are located away from golden eagle nest sites, the destruction of important foraging habitats, such as prairie dog colonies, within the territory of nesting pairs can be a major problem for the viability of nesting golden eagles (Tyus and Lockhart 1979). In New Mexico, plague-related declines in prairie dog abundance from 30 per hectare to less than 1 per hectare triggered a decline in the nesting population of golden eagles (Cully 1991). Thus, golden eagle protection is linked with the maintenance and recovery of prairie dog colonies.

Ferruginous Hawks
The ferruginous hawk has been experiencing declines across the continent for the past 30 years, although Wyoming is often viewed as a stronghold for the species. The ferruginous hawk has been petitioned for listing under the Endangered Species Act in the past, and more recently it has

been identified by the Wyoming Game and Fish Department as a Species of Special Concern (Oakleaf et al. 1996).

Prey Base

The ferruginous hawk has been identified as a species dependent on prairie dogs, and ferruginous hawk populations have shown declines in response to prairie dog population declines (Kotliar et al. 1999, and see Jones 1989). Olendorff (1993) pointed out that prairie dogs and ground squirrels were the most important prey in some areas, while hares and rabbits predominated in the ferruginous hawk diet in others. In several studies from central Utah, ferruginous hawks were found to be highly dependent on jackrabbits as prey, and hawk population fluctuations were closely tied to the rise and fall of jackrabbit populations (Woffinden and Murphy 1977, Smith and Murphy1978). The proximate cause of this hawk population decline was linked to a decrease in nesting effort and an increase in nomadism in ferruginous hawks following the jackrabbit decline (Woffinden and Murphy 1989). In southeastern Idaho, a jackrabbit population crash was also implicated in a decline of the ferruginous hawk population (Powers 1976).

In contrast, a study on the Canadian high plains found that ferruginous hawk population density and fledging success were consistently correlated with the abundance of Richardson's ground squirrels, and negatively correlated with poisoning efforts (Schmutz and Hungle 1989). On the plains of South Dakota, thirteen-lined ground squirrels dominated the ferruginous hawk diet, while meadowlarks, pocket gophers, and jackrabbits also played important roles (Blair and Schitoskey 1982). In southwestern Idaho, Steenhof and Kochert (1985) found that ferruginous hawks were heavily dependent on Townsend's ground squirrels, and that squirrel declines linked to drought resulted in depressed nest success for the local ferruginous hawk population. In southern Wyoming, ferruginous hawks have a fairly diverse diet. In a study near Medicine Bow, MacLaren et al. (1988) found that jackrabbits contributed 48% to the ferruginous hawk diet biomass, white-tailed prairie dogs 22%, and Wyoming ground squirrels 16%.

Secondary prey may attain paramount importance during prey declines, droughts, and other stochastic events. Secondary prey species become critical to maintaining hawk population numbers when primary prey species crash (Olendorff 1993). Smith and Murphy (1978) found that ferruginous hawk diets shifted increasingly to rodents as jackrabbits became scarce. Thus, it is important to maintain both primary and secondary prey bases to guarantee ferruginous hawk viability over the long term.

Nesting Habits

Ferruginous hawks use the same nest from year to year and also build alternate nests within the same territory (Smith and Murphy 1978). In the Centennial Valley of Montana, where cliffs and suitable ground nesting sites are unavailable, ferruginous hawks commonly nest in aspens and willows (Restani 1991). In eastern Washington, ferruginous hawks nested primarily on basalt outcrops and in junipers (Bechard et al. 1990). In central Utah, Smith and Murphy (1978) noted cliff, rock outcrop, and tree nest sites (particularly juniper). Also in Utah, Smith and Murphy (1982) found that ferruginous hawks nested most often in junipers (53% of nest sites) but also used rock outcrops (24%) and ground nests (14%). A subsequent study in the same region found 66% of nests in juniper trees, 32% on rock outcrops, and 2% on the ground (Woffinden and

Murphy 1983). In North Dakota, small clumps or rows of hardwood trees were the most common ferruginous hawk nest sites, while ground nests atop rugged moraines made up 22% of the nest sites and powerline towers accounted for 18% of ferruginous hawk nests (Gilmer and Stewart 1983). On the plains of South Dakota, Blair and Schitoskey (1982) found that all ferruginous hawks built ground nests, most of them in rough terrain. Similarly, in southeastern Idaho, all ferruginous hawk nests were ground nests built atop bluffs with the exception of a single juniper nest (Powers 1976).

Ground-nesting ferruginous hawks can be quite susceptible to predation. Foxes and coyotes have been documented as important predators of ferruginous hawk ground nests (Blair and Schitoskey 1982). The availability of elevated topographical features may be important to nest success for this species. Ferruginous hawks will also nest on man-made structures. Niemuth (1992) documented ferruginous hawks nesting on the roof of an abandoned shed as well as on an idle center-pivot irrigation apparatus in Wyoming.

Effects of Development

Ferruginous hawks are among the most sensitive of all raptor species, and are prone to nest abandonment if disturbed (Parrish et al. 1994). Nest abandonment, egg mortality, parental neglect, and premature fledging are common results of disturbing ferruginous hawk nests (White and Thurow 1985). Smith and Murphy (1978) noted that increased human access is a primary threat to the viability of ferruginous hawk nest success. For their central Utah study, these researchers found that "in all instances of nesting failure where the cause could definitely be determined, humans were at fault" (p. 87). White and Thurow (1985) found that walking disturbance and vehicle use had the greatest effect on ferruginous hawk nest success, while vehicle use had the greatest flushing distance. Instead of becoming habituated, most hawks in this study increased their flushing distances with repeated disturbance (ibid.). In addition, disturbed nests averaged one less offspring fledged per nest when compared to undisturbed control nests. Oakleaf et al. (1996) pointed out that the cumulative effects of oil and gas development may impact large areas of ferruginous hawk habitat.

White and Thurow (1985) recommended quarter-mile nest buffers during years of prey abundance, but noted that sensitivity to disturbance increased when prey were scarce, and recommended that nest buffers be "considerably larger" during years of prey scarcity. Although Olendorff (1993) recommended buffer zones of only ½ mile for ferruginous hawk nests, he recommended much larger buffers during periods of prey scarcity. Because it is impractical to move roads away from nest sites when prey bases decline, the appropriate way to ensure the persistence of ferruginous hawks at traditional nesting sites is to use large buffers within which ground-disturbing activities are prohibited. Cerovski et al. (2001) reviewed the issue of appropriate nest buffers and recommended a 1-mile buffer, kept free from human disturbance. Thus, under this Alternative, 1-mile buffers prohibiting surface disturbance should apply to ferruginous hawk nest sites as well as all other raptor nest sites.

Burrowing Owl

Nationwide, the burrowing owl is a species on the decline. As of 1997, over half of the agencies across North America tracking burrowing owl population trends reported declining populations,

while none reported increasing populations (James and Espie 1997). Burrowing owl populations are highly susceptible to stochastic disturbances such as drought, and thus may decline more rapidly than would be predicted on the basis of demographic factors alone (Johnson 1997). In Wyoming, data suggest an overall population decline, with 17.5% reoccupancy of historic sites, but the spotty quality of historical data makes comparisons difficult (Korfanta et al. 2001). The burrowing owl has been identified as a species of concern by both the BLM and the Wyoming Game and Fish Department. Predation is believed to be the major factor in the decline of burrowing owl populations in Canada, and habitat fragmentation serves to increase predation risk in burrowing owls (James et al. 1997, Hjertaas 1997).

Dependence on Prairie Dog Colonies

Burrowing owls are in a select group of wildlife most closely tied to prairie dog colonies, and prairie dog burrows are preferred nest sites for burrowing owls. Thompson (1984) reported that owls preferred abandoned prairie dog burrows in the early stages of succession. Green and Anthony (1989) found that nest burrows lined with dung were less susceptible to predation, perhaps explaining this unusual behavioral attribute. On the Great Plains, Sidle et al. (n.d.) found that burrowing owls actively selected for active prairie dog towns, and showed much lower usage of towns that had been decimated by plague, shooting, or poisoning. Desmond and Savidge (1999) found that burrowing owl nest success was positively correlated with density of active prairie dog burrows, and recommended preserving prairie dog colonies to maintain the viability of burrowing owl populations. And in the Columbia Basin, where prairie dogs are absent, burrowing owls nested in badger burrows, but as a result were subjected to badger predation (Green and Anthony 1989). Thus, the ongoing loss of prairie dog colonies has undoubtedly been a prime factor in the decline of the burrowing owl.

Thompson (1984) found that burrowing owls near Casper were associated with white-tailed prairie dogs, while near Torrington they were associated with black-tailed prairie dogs. But in eastern Wyoming, fewer than half of the nesting burrowing owls were associated with active prairie dog towns (Korfanta et al. 2001).

Hunting Habits

Burrowing owls hunt most actively during the twilight hours (Thompson 1984). In the Columbia Basin, pocket mice are the primary mammalian prey (Green and Anthony 1989). In Wyoming, insects are the most frequent prey item, but small mammals dominate the dietary biomass (Thompson 1984). Due to the importance of insects (particularly grasshoppers) in the diets of burrowing owls, the widespread use of pesticides would most likely result in impacts to burrowing owl viability.

Effects of Livestock Grazing

Bock et al. (1993b) reported that burrowing owls probably respond positively to grazing in grassland habitats, but negatively in shrubsteppe habitats. The BLM should bear these trends in mind when drafting individual Allotment Management Plans.

Monitoring
As a BLM Sensitive Species, annual monitoring efforts should be directed at burrowing owls to gain an index of population trend. Haug and Didiuk (1993) reported that 57% of burrowing owls responded to recorded calls in their study, and that the "tall and white" stance adopted in response to calls made detection easier. These researchers recommended a series of three surveys at 5-7 day intervals during the nesting season to monitor population trends. These monitoring protocols should be established as requirements under the new RMP.

Prairie Dogs
Virtually the entire area managed by the Buffalo Field Office is habitat for the black-tailed prairie dog. White-tailed prairie dogs have declined to 5% of their native range in North America, and the survival of remaining populations is threatened by habitat destruction and modification, sylvatic plague, recreational shooting, poisoning, oil, gas, and mineral extraction, fire suppression, overgrazing, off-road vehicle use, noxious weeds, and climate change. They have been petitioned for listing under the Endangered Species Act, and the USFWS has determined that significant biological information is available suggesting that listing may be necessary. In the Powder River Basin, prairie dog colonies are reduced from historic distributions, and are in need of protection and recovery.

Prairie Dogs are Ecosystem Regulators
Prairie dogs are fundamental regulators of ecological processes within the area occupied by active colonies. According to Miller et al. (1990), "Prairie dogs have been implicated as ecosystem regulators that influence primary productivity, species composition, species diversity, soil structure, and soil chemistry by their burrowing and grazing" (p. 765). Hansen and Gold (1977:213) concluded, "This study, compared with previous research, provides evidence that blacktail prairie dgs [sic] are an important ecosystem regulator as they disturb the soil, increase plant diversity (Gold 1976), increase animal diversity, and cause a decrease in primary production of the areas they use." Agnew et al. (1986) labeled prairie dogs as ecosystem regulators, maintaining shortgrass habitats. As regulators of ecosystem processes, prairie dogs are keystone species in shrubsteppe and grassland habitats.

On the High Plains, Ingham and Detling (1984) found that root-eating nematodes were more abundant and root biomass lower on a heavy-grazing prairie dog site, while available soil nitrogen was higher on the prairie dog colony. Holland and Detling (1990) subsequently found that nitrogen mineralization was highest in active prairie dog colonies and lowest in uncolonized grassland. Root biomass is lower within prairie dog colonies that on uncolonized sites (Holland and Detling 1990). In Wyoming's Shirley Basin, Schloemer (1991) found that white-tailed prairie dog burrowing improves growing conditions for sagebrush by increasing snow entrapment, water infiltration, and deep percolation. Kotliar et al. (1999) concurred that the prairie dog clearly functions as a keystone species in the ecosystems it inhabits, creating habitat through its burrow networks, altering vegetation patterns, and providing an important prey base.

The Prairie Dog Ecosystem is Crucial to Many Wildlife Species
According to Miller et al. (1990), "Ecologically, the prairie dog ecosystem is an oasis of species diversity on the arid plains" (p. 764). Sharps and Uresk (1990) found that 134 vertebrate wildlife

species are associated with prairie dog colonies in western South Dakota. In a comparative study which incorporated Wyoming sites, Clark et al. (1982) found that white-tailed colonies showed a greater number of associated vertebrate species (83 species) than either black-tailed or Gunnison prairie dogs; larger towns had a greater species diversity than smaller towns.

Agnew et al. (1986) found that avian density and species richness were significantly greater on High Plains prairie dog colonies. On the High Plains, Hansen and Gold (1977) found that desert cottontails were abundant on prairie dog towns but scarce elsewhere. O'Meila et al. (1982) found that rodent biomass (excluding prairie dogs) was almost twice as great on prairie dog towns than off; this higher rodent abundance was echoed in the results of Agnew et al. (1986). Goodrich and Buskirk (1998) demonstrated that badgers have a heavy dependence on white-tailed prairie dogs in Wyoming. The importance of prairie dogs as prey for raptors has been noted in many studies (e.g., Tyus and Lockhart 1979, Campbell and Clark 1981, MacLaren et al. 1988, Jones 1989, Cully 1991, Kotliar et al. 1999).

Many rare and declining species, notably black-footed ferret, mountain plover, burrowing owl, ferruginous hawk, and swift fox are dependent on prairie dogs for their own persistence (Kotliar et al. 1999). Based on study of the last remaining wild ferret population that was extirpated near Meteetsee, Forrest et al. (1985) reported that black-footed ferrets are confined almost exclusively to prairie dog colonies. In Wyoming, other species associated with white-tailed prairie dogs that are of particular note due to special status or management concern include the eastern short-horned lizard, northern plateau lizard, Great Basin gopher snake, midget faded rattlesnake, prairie falcon, merlin, sage grouse, burrowing owl, sage thrasher, Brewer's sparrow, sage sparrow, swift fox, and pronghorn (Clark et al. 1982).

Habitat Selection and Colony Attributes

In the Red Desert, Maxell (1973) found that prairie dogs were restricted to sagebrush-grass communities with shrub height less than 12 inches and cover less than 40%, on loam and clay textured soils. In the Shirley Basin, Orabona-Cerovski (1991) found that average plant cover on towns was 38%, with high amounts of bare ground. These preferences should be borne in mind when evaluating habitats for potential prairie dog recovery efforts.

The spatial distribution of prairie dog colonies is an important conservation priority. Clark et al. (1982) made the following observation for white-tailed prairie dogs in Wyoming: "Prairie dog colonies were found clumped in suitable habitat, and nearby colonies served as sources for colonizing animals" (p. 579). The dispersal ability of the white-tailed prairie dog is not great; Orabona-Cerovski (1991) found that less than 1% of juvenile males and 3% of juvenile females dispersed more than 200m from their natal burrows. Thus, maintaining a few isolated colonies is by far inferior to maintaining colony complexes with a high degree of connectivity to facilitate dispersal.

Clark et al. (1982) found that burrow densities for white-tailed prairie dogs averaged 25.8/ha, versus 32/ha for the black-tailed and Gunnison. But Campbell and Clark (1981) found that individual white-tailed colonies were as large and dense as black-tailed colonies, but white-tailed colonies were even more numerous and dense on the landscape. This was probably related to site

productivity rather than any intrinsic propensity to create dense colonies by either species, as the white-tailed site in this study was located on moist, high-quality soils while the black-tailed site was on drier uplands (Ibid.). Burrow densities in the Shirley Basin ranged from 50-190/ha (Orabona-Cerovski 1991). In the southern part of the Rawlins Field Office, Smith et al. (1981) found burrow densities ranging from 12/ha to 42/ha, with an average of 27/ha, while a later survey (Smith et al. 1982) found burrow densities ranging from 13-68/ha, with a mean of 36/ha.

The Myth of Prairie Dogs as Meaningful Competitors for Livestock Forage

Hansen and Gold (1977) noted that the diets of prairie dogs and cattle are broadly similar, and that prairie dogs do reduce the amount of available forage. But O'Meila et al. (1982) found that although prairie dogs reduced the available forage quantity for cattle, cattle on prairie dog plots failed to show a statistically significant decrease in weight gain over control animals. These researchers concluded, "The statistically similar steer weight gain performances during the green-herbage period indicates that sufficient herbage was available to meet the demands of both steers and prairie dogs, even under a regime of heavy utilization" (p. 583). Knowles (1986) found a symbiotic relationship between livestock and prairie dogs: Prairie dogs selected areas disturbed by overgrazing to establish colonies, while livestock preferentially foraged on prairie dog colonies due to higher-quality of forage. Krueger (1986) found higher shoot nitrogen in prairie dog towns, indicating enhanced forage quality for all grazers.

Sylvatic Plague

Sylvatic plague is a major threat to the viability all species of prairie dog. Sylvatic plague has been documented in Sweetwater, Albany, Natrona, and Laramie Counties, and plague has been present continuously in the Shirley Basin since 1985 (Cully and Williams 2001). These researchers stated that "all 4 species of prairie dogs are highly susceptible to plague infections" (Ibid., p. 895). But plague outbreaks may spread more slowly in white-tailed colonies than in black-tailed colonies. According to Ubico et al. (1988), "The Meteetsee area has a short, cool summer season...a plague epizootic under these circumstances probably progresses more slowly over several years, although the end result of almost complete depopulation could be the same" (p. 404). Of course, the converse is also true. According to Cully and Williams (2001), the comparative low density of white-tailed prairie dog colonies slows the spread of plague, allowing the disease to persist for long periods of time, rather than wiping out a colony and dying out quickly as is the case with black-tailed prairie dogs. For black-tailed prairie dogs, Cully and Williams (2001) postulated that a 3 kilometer distance between colonies is enough to interrupt the spread of plague and assure the probable survival of neighboring colonies. There is currently no effective method to control the spread of plague in prairie dog colonies. Because prairie dogs in the Powder River Basin may already be stressed by endemic or epidemic levels of sylvatic plague, stronger conservation measures are needed to prevent impacts from activities such as prairie dog poisoning and shooting that can in fact be controlled.

Conservation Measures

The ecological importance of prairie dogs, when paired with their low and declining population levels and imminent threats to colony viability, make the compelling case that strong measures must be put in place to protect and restore prairie dogs in the Powder River Basin. Large prairie dog colonies, plus a half-mile buffer, should be withdrawn from all surface-disturbing activities

with minerals leased only under "No Surface Occupancy" provisions. We recommend that poisoning of prairie dogs not be permitted on public lands. We further recommend that shooting be prohibited on BLM lands, not only to reduce impacts on prairie dogs but also to reduce the potential for lead poisoning of hawks and eagles and other species which prey on or scavenge prairie dogs (see Pauli and Buskirk 2007).

Monitoring

Currently, the most recent comprehensive data on prairie dog distribution is from the 1980s; new colony surveys are needed to determine where conservation efforts should be focused and which colony sites require restoration efforts. Forrest et al. (1985) admonished, "All prairie dog colonies should be accurately and consistently mapped" (p. 28). Martin and Schroeder (1979) noted that aerial photography failed to identify many active colonies; these researchers recommended winter photography after snowfall as providing the best visibility of prairie dog colonies. The new RMP should require surveys to determine the spatial extent as well as periodic sampling protocols to index population trends within the major colonies.

Black-Footed Ferrets

The black-footed ferret was once found throughout the Powder River Basin, and indeed the last wild ferret population in the world was found near Meeteetsee. Today, Wyoming's only reintroduced population resides in the Shirley Basin, far to the south. According to Oakleaf et al. (1992), "The precarious status of black-footed ferrets is a direct result of habitat fragmentation through prairie dog (Cynomys spp.) eradication in the North American midwestern prairies" (p. i). Thus, ferret viability is closely tied to the population status of its prey species, prairie dogs.

Candidate Sites for Ferret Reintroduction

Based on minimum viable population estimates for ferrets, viable ferret populations require prairie dog colonies of at least 3000 hectares, with a 4000-6000 hectare size being a more optimal minimum (Forrest et al. 1985). These researchers recommended that only towns with burrow densities greater than 10/ha be considered "colonies" for the purpose of reintroduction, and that intercolony distances should not exceed 20 km to facilitate ferret interchange. Past studies indicate that there may be sites matching these criteria within the Powder River Basin, and such sites would be of primary conservation concern. The BLM should manage all prairie dog complexes of sufficient size to support ferret reintroduction specifically to enhance the reintroduction capability of these complexes.

Swift Fox

The swift fox was determined to be "warranted but precluded" for listing under the Endangered Species Act by the U.S. Fish and Wildlife Service in 1995 (60 Fed. Reg. 31663). The swift fox is listed as a Species of Special Concern by the Wyoming Game and Fish Department, and is protected from intentional take by state regulations (Oakleaf et al. 1996). This species has been listed as dependent on the prairie dog for its persistence, and that its populations decline when prairie dogs decline (Kotliar et al. 1999). After a substantial absence, small populations of swift fox recolonized their native range in Montana during the 1970s (Moore and Martin 1980).

Comparatively little is known about swift fox biology and habitat requirements. Swift foxes pair for life and have one litter per year (Kilgore 1969). Dens are complex warrens with multiple tunnels and entrances, and prairie dog burrows may be enlarged into swift fox dens (Kilgore 1969). Uresk and Sharps (1986) found that swift fox dens tend to be constructed on or near hilltops. In one study, swift fox home ranges averaged 32 km^2. The diet of swift fox in various parts of its range is dominated by prairie dogs, grasshoppers, and beetles (Uresk and Sharps 1986), small rodents, including prairie dogs (Kilgore 1969), mainly lagomorphs (particularly jackrabbits) with some prairie dogs (Zumbaugh et al. 1985), and may include carrion and plant matter (Hines and Case 1991).

Threats to Swift Fox Viability

According to Kahn et al. (1997: 17), "Swift fox are frequently observed along roadways, which may increase the rate of animals being killed specifically by vehicles. Factors such as road density, miles traveled and driver speed may increase the rate of swift fox mortalities." Kilgore (1969:525) noted, "The chief mortality factors to which swift foxes are subjected are those associated with the activities of man. These foxes are frequently killed crossing highways and county roads, shot by hunters or farmers, and killed by farm implements." Swift fox are also particularly vulnerable to poisoning programs targeted at rodents or other carnivores (Kilgore 1969, Uresk and Sharps 1986). In their conference opinion on the Seminoe Road Coalbed Methane Project, the USFWS recommended that activities which might disrupt denning swift fox be prohibited between March 1 and July 31 (Long 2001). Denning areas should be identified and protected from any activities that threaten the viability of swift fox populations.

Beavers

Beavers are architects of stream ecosystem function. Ohmart (1996) asserted that beavers are a keystone species in small-order streams, creating habitats used by many other species. Beaver dams also are arbiters of fundamental hydrologic change, creating ponds, raising the water table, reducing stream velocities during flood events, and reducing the suspended solids in a stream (Parker et al. 1985). Parker et al. (1985) highlighted Muddy Creek in southern Wyoming as an example of erosional downcutting that resulted from beaver removal.

The restoration of beavers to their native habitats has many benefits for aquatic ecosystems. Apple (1985) reported that the restoration of beavers resulted in dissipation of streamflow energies and raising of water tables along Sage Creek in the Rawlins Field Office. In this study, the combination of beaver reintroduction and rest from grazing resulted in a 20% increase in avian species richness. We encourage the BLM to reintroduce beaver to streams where it once occurred.

Deer and Elk

Mule deer and elk are important game species in the Powder River Basin. These game animals contribute importantly to the Wyoming economy, both from hunting and wildlife viewing visitors. The Powder River Basin includes important winter range for deer and elk populations that summer in the surrounding mountains, as well as resident populations. BLM (2007) provided a credible review of the impacts of oil and gas development on elk; we encourage the BLM to consider this literature review in drafting the EIS for the Powder River Basin plans.

Protections to maintain the viability of elk and mule deer are needed in the Powder River Basin, an these protections should be focused on crucial winter ranges, migration corridors, crucial winter yearlong ranges, severe winter relief ranges, and calving areas identified by the Wyoming Game and Fish Department.

Effects of Livestock Grazing

Loft et al. (1991) found that moderate to heavy cattle grazing pushed deer out of riparian habitats and into upland shrub communities that deer avoid when cattle are absent. These researchers noted that these habitat shifts could substantially impact deer populations, concluding that "high quality forage may be limiting on Sierra Nevada summer ranges grazed by cattle, thus contributing to suboptimal nutrition for female deer and their offspring" (p. 24). Elk avoid areas where livestock stocking rates are high (Knowles and Campbell 1982), so standards and guidelines should be authored such that livestock are not present in calving areas during the calving season or crucial winter ranges between November 15 and April 15. But in some cases, overgrazing by cattle and horses may improve winter range for mule deer (Hubbard and Hansen 1976, Reiner and Urness 1982) and elk (Reiner and Urness 1982) through stimulating shrub productivity. In the final analysis, livestock grazing should be managed in a way that does not reduce or impair the viability of elk and mule deer populations.

Winter Ranges

These areas will address specific habitat needs of plant and wildlife species, particularly crucial winter, migration, and birthing areas used by elk, deer, and bighorn sheep. Prescribed burning has been shown to improve browse quality on winter ranges (Bunting et al. 1984, Gruell et al. 1984, Cook 1990), and thus management objectives will be attained preferentially through prescribed burning. Thomas et al. (1988) asserted that hiding and thermal cover are critical components of elk winter range, and that patches of cover greater than 200m wide are more effective than smaller blocks. With this in mind, extensive security areas comprised of forested habitat must be retained on winter ranges.

In general, natural processes should prevail on winter ranges, and natural disturbances should be allowed to proceed unhindered by management. Limited extractive activities may be allowed in these areas if (and only if) they are consistent with maximizing the habitat capabilities of terrestrial and aquatic wildlife.

There may be some habitat partitioning between elk and mule deer on winter ranges. According to Oedekoven and Lindzey (1987), wintering mule deer in southwestern Wyoming favored draws, flats, and ridgelines, while wintering elk selected ridges, hilltops, and steep topography. In this study, mule deer used lower elevation sagebrush grasslands preferentially, while elk preferred to remain at high elevations until deep snows pushed them down.

Elk

Elk are grazers, and their summer range requirements center around forest opening and edge habitats (Marcot et al. 1994). Compton (1974) found that elk in southern Wyoming concentrated their summer use in subalpine parks, and found heavy autumn use in aspen cover types. Strickland (1975) noted that subalpine and mid-elevation parks formed the primary summer

range of elk. Davis (1977) found that elk on the Medicine Bow N.F. used natural parks and burns preferentially over clearcuts, and that burns contained cover that was critical to elk use, which is unavailable in clearcuts. Large clearcuts tend to be of little use to elk, because elk tend not to venture farther than 600 feet from cover (Reynolds 1966, Hershey and Leege 1976). Because parks and burns are more important than clearcuts as summer range, the let-burn approach in coniferous habitats will do more to maintain and enhance elk summer range than a continuing reliance on clearcutting to provide openings in forested habitats.

Several studies have shown that closed-canopy forests are required by elk for thermal cover during summer (Patterson 1996, Millspaugh et al. 1998, Cooper and Millspaugh 1999). Hiding cover may be an important or even limiting factor in predominantly open habitats; Patterson (1996) found that in a study area where woodlands made up only 8% of the landscape cover, wooded habitat was the most important variable determining elk distribution. According to this study, the average size of woodland patches used by elk was 9 times greater than average patch size, and elk preferred thermal cover of trees during summer. For this reason, the BLM should restrict the logging or other reduction of wooded patches in the primarily open areas in the Powder River Basin that are elk habitat.

A number of studies have shown that elk avoid open roads (Grover and Thompson 1986, Rowland et al. 2000). Edge and Marcum (1991) found that elk use was reduced within 1.5 km of roads, except where there was topographic cover. (It is important to note that much of the Great Divide planning area has very little topographic variation, and thus provides little topographic cover). Gratson and Whitman (2000) found that hunter success was higher in roadless areas than in heavily roaded areas, and that closing roads increased hunter success rates. On the Black Hills, elk chose their day bedding sites to avoid tertiary roads and even horse trails (Cooper and Millspaugh 1999). Cole et al. (1997) found that reducing open road densities led to smaller elk home ranges, fewer movements, and higher survival rates. The reduction of road densities on the winter ranges as a whole and the maintenance of low road densities in important habitat areas would aid in maintaining healthy elk populations. BLM should ensure that road densities never exceed one mile per square mile in important big game habitats.

Crucial elk winter ranges in the Powder River Basin occur along the lower-elevation fringes of the mountains, in areas dominated by ponderosa pine, limber pine, and Douglas fir savannas as well as basin shrub communities. In the Laramie Range, elk on winter ranges preferred the ponderosa pine savanna type (Butler 1972). Grasses are preferred winter forage, but shrubs are used when snow conditions render grasses unavailable (Butler 1972). Elk concentrations on winter ranges may have significant effects on the growth and density of preferred shrubs. Elk foraging on winter ranges has been shown to depress growth and prevent reproduction of aspen in Rocky Mountain National Park (Baker et al. 1997, Suzuki et al. 1999). Elk fidelity to winter ranges is not constant, and use of winter range may shift from year to year (Van Dyke et al. 1998). With this in mind, both existing critical winter range and potential winter range should be managed to enhance its value to elk.

On winter ranges, elk are highly susceptible to disturbance. They are so sensitive to human disturbance that even cross-country skiers can cause significant stress to wintering animals

(Cassirer et al. 1992). Ferguson and Keith (1982) found that while cross-country skiers did not influence overall elk distribution on the landscape, elk avoided heavily-used ski trails. Disturbance during this time of year can be particularly costly, since the metabolic costs of locomotion are up to five times as great when snows are deep (Parker et al. 1984). The regular vehicle traffic associated with oil and gas fields constitutes a significantly higher threshold of disturbance, and thus would cause even greter stress to the animals. Thus, all human activities should be prohibited on elk winter ranges between November 15 and April 30.

Several studies have shown that elk abandon calving and winter ranges in response to oilfield development. In mountainous habitats, the construction of a small number of oil or gas wells has caused elk to abandon substantial portions of their traditional winter range (Johnson and Wollrab 1987, Van Dyke and Klein 1996). Drilling in the mountains of western Wyoming displaced elk from their traditional calving range (Johnson and Lockman 1979, Johnson and Wollrab 1987). Powell and Lindzey (2001) found that elk avoid lands within 1.5 kilometers of oilfield roads and well sites in sagebrush habitats of the Red Desert. Migration corridors may in some cases be equally important to large mammals and are susceptible to impacts from oil and gas development (Sawyer et al. 2006). Thus, winter range areas should be withdrawn from the surface disturbances associated with oil and gas development, and leased only under "No Surface Occupancy" stipulations.

Mule Deer

Mule deer are an important game animal in the Powder River Basin. They use forest habitats, but are primarily associated with openings, edge areas, and montane shrub communities. Mule deer are primarily browsers in this region, with a diet dominated by shrubs (Compton 1974, Strickland 1975). Mule deer typically summer in montane forests and woodlands and use foothills areas for spring and fall transitional ranges, but typically winter in the low basins on BLM lands.

Riparian areas are the primary summer range of mule deer in montane habitats (Compton 1974). Strickland (1975) found that riparian areas and clearcuts were important summer ranges on the Medicine Bow N.F., and that coniferous forest was utilized primarily for cover. Davis (1977) found that mule deer on the Medicine Bow used clearcuts and natural parks about equally, and used burns more heavily than clearcuts. Wallmo et al. (1972) found that clearcuts and roadsides could be temporarily important foraging habitats for mule deer, but pointed out that forage available in clearcuts declines after 10 years post-cut, as saplings begin to crowd out understory plants. Mule deer avoid parts of clearcuts that are farther than 300 feet from cover, and thus large clearcuts have limited use as mule deer summer range (Strickland 1975). Compton (1974) found that mule deer on the western slope of the Sierra Madres summered on desert shrub, mountain shrub, and aspen communities.The BLM should manage summer ranges for the benefit of mule deer populations.

Compton (1974) postulated that mule deer populations on the Medicine Bow N.F. are limited by the availability of winter range. For the Medicine Bow, many critical mule deer winter ranges are in surrounding basins outside the boundary of Forest Service lands (Strickland 1975). This is likely to be the case in the Powder River Basin as well. Ponderosa pine savanna is a favored

winter range where it is available, such as in the Laramie Range (Butler 1972). Welch (1968) found that on yearlong ranges, south and southeast exposures were most important to mule deer, and bitterbrush was a key browse species. The most important winter forages for Wyoming mule deer are bitterbrush, big sagebrush, and rabbitbrush (Butler 1972, Strickland 1975). Welch (1968) found that cattle grazing decreases the abundance and productivity of bitterbrush. Bunting et al. (1984) found that periodic burning may be necessary to maintain the presence of bitterbrush in ponderosa pine savannas. The presence of cattle has been found to decrease deer use on yearlong ranges (Welch 1968). A study by Loft et al. (1991) found that at moderate to high levels of grazing intensity, female mule deer and the fawns were displaced from preferred riparian habitats and onto suboptimal upland habitats. This study also found that female mule deer have a high degree of home range fidelity, and will not move to other areas even when their core habitats are heavily impacted.

The ability of mule deer to forage effectively on winter ranges in a stress-free environment is the key to maintaining viable populations in this region. Winter mortality has claimed up to 80% of the adult mule deer population of southeastern Wyoming, and also depresses fawn production during the following spring (Strickland 1975). On winter ranges, mule deer are easily disturbed by snowmobile traffic and even nonmotorized visitors (Freddy et al. 1996). This can be a critical factor, because metabolic costs of locomotion in snow can be five times as great as normal locomotion costs for mule deer (Parker et al. 1984). Thus, due to the sensitivity of mule deer to disturbance on winter ranges and the crucial nature of winter range performance to maintaining healthy deer populations, mule deer winter ranges must be with drawn from all road construction and development, particularly oil and gas development, which would increase the level of human disturbance on these winter ranges.

For mule deer on the Pinedale Anticline winter ranges, subject to the same stipulation, displacement from crucial winter ranges has been total during most years. Researchers funded by BLM and industry recorded a 46% drop in mule deer populations wintering on the Pinedale Anticline winter ranges ***while seasonal stipulations were in full force and effect***, with no corresponding decline for nearby populations unaffected by gas development; populations have not rebounded to date (Sawyer et al. 2006). It appears that during especially severe winters, snow conditions force mule deer to use traditional winter ranges even if they have been subjected to heavy oil and gas development, and population losses are the result. *Id.* These researchers concluded,

> In gas fields like the PAPA [Pinedale Anticline] where well pad densities may reach 16 or more per section (2.58 km^2), the number of producing well pads and associated human activity may negate the potential effectiveness of timing restrictions on drilling activities as a means to reduce disturbance to wintering deer. Mitigation measures designed to minimize disturbance to wintering mule deer in natural gas fields should consider all human activity across the entire project area and not be restricted to developing wells.

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(Sawyer et al. 2006, p. 4-20). In the Powder River Basin, we request that BLM develop stipulations for crucial winter range that result in no net loss of habitat function pursuant to the WGFD Mitigation Policy.

Pronghorns
Pronghorns are a unique species, which evolved on the plains and steppes of North America. This species is so unique that it has been given its own Order, Antilocapridae, distinct from the cervids and the bovids that comprise the remainder of native ungulate species in North America. It evolved in wide-open habitats; it possesses great speed and endurance, but is a very poor jumper. Wyoming is the last stronghold of this species, once commonplace throughout the desert and plains environments throughout North America. It is a favorite with hunters and wildlife viewers alike. The wide-open spaces of the Powder River Basin are a haven for major concentrations of pronghorn, which must be granted adequate protection to assure the continued survival and vigor of the native herds, and to assure that the natural patterns of their migrations are not further altered.

Diet
In a Red Desert study, Taylor (1972) found that forb use made up 29% of the diet in spring and summer versus 62 and 69% for browse, respectively; browse use in fall and winter rose to 97% of the antelope's diet. In this study, grass use peaked at 9% in spring and otherwise hovered around 2%. Taylor concluded that competition with cattle for grass is therefore low. Another Red Desert study showed that sagebrush made up 95% of antelope winter diets, but only 77% of the summer diet (Olsen and Hansen 1977). Yoakum (1986) reported that rabbitbrush was also a highly preferred forage. Taylor (1972) reported that sagebrush and rabbitbrush were the most important antelope forages in both summer and winter. In addition to the importance of shrubs in the pronghorn diet, shrubs provide cover important for the survival of newborn fawns (Yoakum 1986). But Kindschy et al. (1982) reported that pronghorns avoid areas where sagebrush is tall.

Another Red Desert study showed that pronghorns consumed only 1.2-1.5% of the net annual primary productivity, but ingested 8.7-10.9% of the net annual primary productivity in concentration areas (Maxell 1973). Kreuger (1986) found that pronghorns foraged more efficiently on prairie dog towns, and that forage quality was higher in nutrients on prairie dog sites. Proghorn crucial winter ranges and migration corridors will need to be protected from conversion to industrial landscapes.

Vagrant lichens can be an important forage for pronghorns.Vagrant lichens that disperse via wind require continuous habitats; they are negatively affected by habitat fragmentation, particularly roadside ditches that collect these lichens in areas unsuitable for growth and survival (Rosentreter 1997). In several instances vagrant lichen habitats have become so fragmented that some taxa are threatened with extinction (Ibid.).

Competition with Domestic Livestock and Wild Horses
Schwartz et al. (1977) observed that pronghorns are more selective and take in higher quality diets than either cattle or bison, allowing them to coexist. These researchers concluded:

> "[The] botanical and chemical dietary divergence between bison and pronghorn may indicate evolutionary interspecific niche separation and dietary selection strategies between small and large ruminants. It can partially explain the coexistence of large herds of bison and pronghorn...on the pristine prairies of

North America. It also suggests, as does empirical experience, that antelope can coexist on rangelands more successfully with cattle than with sheep" (p. 167).

A study from New Mexico showed that pronghorns have an annual diet dominated by forbs (51-99%), while cattle diets are dominated by grass (48-97%) and domestic sheep diets were roughly equally weighted toward grass and forbs (40-50%, Beasom et al. 1982). Dietary overlap between pronghorns and domestic livestock is greatest in winter (58% overlap for sheep and 29% overlap for cattle, *ibid.*). McNay and O'Gara (1982) found only a 2.3-2.9% overlap between the diets of pronghorns and cattle on spring ranges. The presence of cattle can drive off parturient pronghorns and their fawns from fawning areas (McNay and O'Gara 1982). Wild horses have a lower degree of dietary overlap with pronghorn, approximately 13%, with horses concentrating heavily on grasses while pronghorns used shrubs and forbs (Meeker 1982). Olsen and Hansen (1977) found that in the Red Desert, antelope did not show meaningful competition with other grazers. But Taylor (1975) reported that during severe winters, cattle will forage on browse, increasing competition with antelope.

Potential competition between pronghorns and domestic sheep is a much more important consideration. Clary and Beale (1983) found that pronghorns avoided areas grazed by sheep, and noted that winter sheep grazing severely depletes pronghorn forage until spring greenup. Even moderate winter grazing by domestic sheep can have deleterious effects on pronghorn winter ranges (Clary and Holmgren 1982). Taylor (1975), made the following recommendations regarding grazing on pronghorn winter ranges: "Winter sheep use, especially, should be avoided; however, moderate grazing by cattle during summer months would not materially reduce winter carrying capacity for pronghorns" (p.48).

While competition for forage between pronghorns and cattle or wild horses is rarely an issue, access to water may be a focal point for conflict between these species. Taylor (1972) reported that antelope are quite wary and easily disturbed when watering. In the Red Desert, pronghorns avoid water sources when they were crowded with domestic cattle or wild horses (Miller 1980). Water developments that minimize crowding may be beneficial for pronghorns.

Predator-Prey Relationships

Barrett (1984) reported that in Alberta, coyotes and bobcats caused a 50% mortality rate annually on pronghorn fawns over a 10-year period, but the population grew dramatically over this period despite this high predation rate. Beale and Smith (1973) reported a similar fawn mortality rate of 42% as a result of predation in Utah. Bobcats were also the most important fawn predator in this study, followed by coyotes and golden eagles. Beale and Smith noted that predator control efforts directed at coyotes may cause increases in the numbers of bobcats, which are more effective predators on fawns.

Pronghorn Winter Range

Winter range is critically important to pronghorn populations, as its availability and quality is likely the strongest determinant of population dynamics. Barrett (1982) reported that during a severe winter in Alberta, overall pronghorn mortality was 48.5%, with fawns and adult males taking particularly heavy losses. This same study documented that pregnant female pronghorns

resorbed their fetuses when conditions were poor. Deep winter snows also decrease the survival rate of fawns born the following spring (Cook 1984). Emergency supplemental feeding in ineffective in promoting pronghorn survival during severe winter weather (e.g., Julian 1973, Barrett 1982). Thus, it is critically important to be sure that the winter ranges are maintained in the best possible condition.

Ryder (1983) studied pronghorn winter range along Separation Creek, and found that pronghorns selected winter range at a landscape scale, rather than on a microsite basis. This study found that pronghorns used both sagebrush and greasewood habitat types in winter, and that most of the pronghorn winter use was on greasewood flats and along Separation Creek, with windblown ridges receiving increasing use during deeper snow years (ibid.). In the Powder River Basin, Cook (1984) reported that winter range areas were characterized by greater shrub cover (specifically Wyoming big sagebrush), greater topographic diversity, but lower shrub height. Ryder (1983) concluded that optimal winter range would possess varied topography to allow shelter from wind and offer areas with wind-blown vegetation.

Vagrant lichens may be important pronghorn winter forage on windblown benches during severe winters (Thomas and Rosentreter 1992), and these lichens are significantly reduced through trampling by cattle and eliminated by domestic sheep grazing. The relationship between pronghorns and vagrant lichens may be commensal, as pronghorns may also assist in the dispersal of vagrant lichens (Rosentreter 1997).

Although vagrant lichens have apparently been studied little in Wyoming, they are widespread in other cold-desert shrubsteppes in the Great Basin province. In Wyoming, occurrences have been recorded for *Aspicilia fruticulosa* in Uinta County (Rosentreter 1993), for *Dermatocarpon reticulatum* in Yellowstone National Park and the Powder River Basin (Rosentreter and McCune 1992). Dermatocarpon species have been found in sagebrush steppe habitats associated with pools of standing water in winter and spring for the interior Columbia River Basin (Rosentreter and McCune 1992). Surveys should be undertaken to identify the occurrence and distribution of vagrant lichens of the taxa *Aspicilia*, *Dermatocarpon*, *Masonhalea*, and *Xanthoparmelia* , occurring in cold deserts in the western U.S. (Rosentreter 1993) within the lands managed by the Buffalo Field Office, particularly in cold desert shrubsteppe habitats and on windblown ridges. Rosentreter (1997) proposed a number of management recommendations for conserving vagrant lichen populations, and we endorse these recommendations. Further study of the distribution and abundance of vagrant lichens on pronghorn winter ranges in the Powder River Basin is needed.

Antelope migration routes become critically important during severe winters that occur periodically in the Powder River Basin. During the severe winter of 1971-72, snows were so deep that no brush remained exposed, and antelope in the Washakie Basin migrated to winter ranges across the Colorado state line (Julian 1973). North of Interstate 80 during the same winter, a major storm concentrated both domestic sheep and antelope in the Shamrock Hills, aggravating competition between these two species (Taylor 1975). Deep and crusty snows cause antelope to flounder, and increase predation by coyotes, which can run along atop the snow crust (Julian 1973). During such severe winters, the crucial winter relief habitats rise to paramount importance for herd survival.

Thomas and Rosentreter (1992) recommended limiting livestock grazing to low levels in crucial pronghorn winter range. Cook (1984) noted that densities of pronghorns on winter ranges were lowest in areas of "severe" oil and gas development. This result indicates that oil and gas development tends to drive pronghorns away from winter range areas.

Fences

Barbed-wire fences are known to be a major impediment to pronghorn migration and dispersal. Taylor (1975) reported, "Fences were an important factor preventing optimum range use by antelope" in the Red Desert (p. 1). He added that "[u]npublished department data indicate that the wintering areas have been reduced by roughly one half because of fences" (p.2). Bruns (1977) found that fences are major impediments to winter travel, as are roadways with high traffic volume. During the severe winter of 1971-72, fences impeded antelope movements to crucial winter relief ranges: Some 1500-2,000 antelope were trapped by the highway fence beside what is now U.S. 191 near Farson before the fence was cut, allowing them to proceed; hundreds of antelope were trapped in fenced pastures outside Evanston, and open gates apparently were insufficient to allow them to escape (many died despite supplemental feeding); and 66 antelope were found dead beside the railroad right-of-way fence outside Granger (Julian 1973). Julian concluded, "The lack of fences, mainly high net wire fences in Southwestern Wyoming, probably prevented antelope losses from being higher" (p. 10). Fences also aid coyotes in catching pronghorns (e.g., McNay and O'Gara 1982), potentially inflating predation losses.

Taylor (1975) recommended that "Fences which cross migration routes should be removed or at least modified to allow ready passage by pronghorns under adverse weather conditions..." (p. 47). Bruns (1977) recommend a minimum clearance of 46 cm and a barbless lower strand for fences. Rosentreter (1997) recommended that fences which could affect pronghorn dispersal be modified so that the bottom wire is smooth (not barbed) and is kept more than 60 cm (24 inches) above the ground. There should be no new fence construction, illegal fences should be removed, and all remaining fences should at least conform to antelope passage requirements set forth by WGFD.

Native Cutthroat Trout

A number of studies point out that roads are one of the most important causes of trout habitat degradation, and that habitat damage a water quality degradation are unavoidable consequences of road construction (Rhodes et al. 1994, Henjum et al. 1994, NMFS 1995, USFS and USBLM 1997a,b). This damage persists over the long term and is difficult to reverse (Furniss et al. 1991, Rhodes et al. 1994, NMFS 1995, Espinosa et al. 1997). Habitat damage resulting from road construction also has the indirect effect of granting competitive advantages to introduced species at the expense of native trout (Behnke 1992, Duff 1996). Road construction effects can also increase water temperatures (Meehan 1991), which can help brook trout to permanently displace native cutthroats (Behnke 1992). As a result of these factors, a number of scientists agree that reductions in the extent of road networks are essential to protecting and restoring trout habitats (Henjum et al. 1994, Rhodes et al. 1994, USFS and USBLM 1997a). This is a particularly

important consideration when evaluating potential oil and gas projects in watersheds that contain populations of native cutthroat trout.

Dams and Diversions
Many federal projects have potentially disastrous effects on aquatic ecosystems when cumulative impacts are examined. Frissell and Bayles (1996, p.231) summed up the current state of affairs as follows: "For aquatic systems in the west, the management crisis arises from the cumulative and persistent effects of thousands of miles of roads, thousands of dams, and a century of logging, grazing, mining, cropland farming, channelization, and irrigation diversion." In Colorado, Ryan (1994) noted that water diversion led to downstream dewatering during low-flow years, which may lead to inadequate depths or excessive temperatures that threaten the survival of populations of aquatic species. Wesche (1987, p. 14) assessed the effects of the Rob Roy dam on the stream channel dynamics of Douglas Creek in the Medicine Bow Mountains, and stated that "it can be estimated that natural processes will require upwards of 50 years to bring the channel back into equilibrium with the flow regime." Moratoriums on new water diversion projects and the maintenance of minimum flows in streams affected by existing diversions will ensure that existing populations of this trout will have sufficient water to survive. In addition, coalbed methane wastewater ponds, which interrupt natural ephemeral waterways and serve as breeding areas for West Nile Virus-carrying mosquitoes, should not be permitted.

In addition, rigorous standards are needed for all existing water developments in order to sustain adequate habitat for viable populations of aquatic species downstream. Spring flushes of water are needed to remove silt deposited during artificially reduced summer flows; flushing flows at appropriate levels should occur during spring runoff in order to scour spawning gravels and prevent silt buildup that is harmful to both invertebrate and fishes (Lockwood and DeBrey 1988). Small tributary streams are the preferred habitat of Colorado River cutthroat fry, and dewatering these stretches during summer threatens fry survival (Rahel and Bozek 1989). These researchers also pointed out that low winter flows on the mainstem of the North Fork threaten the winter survival of fingerlings. Collection of water from small tributary streams should be prohibited between June and October, and all water collection should be prohibited between December and March, in order to meet the needs of juvenile trout. Jesperson (1981, p.78) concluded that, "It is imperative that adequate instream flows be required in all streams proposed for water diversion in the future." Thus, minimum bypass flow levels must be guaranteed for all trout-bearing streams to maintain the habitat effectiveness at 80% throughout the year to meet the need of adult fish.

PROTECTING HISTORIC AND CULTURAL RESOURCES
Historical and cultural features should be thoroughly evaluated in accordance with BLM Information Bulletin 2002-101, with special attention given to historical and cultural sites that deserve long-term conservation (such as historic trails and ruins) or those features that may be important for traditional use, particularly by Native American groups. The settings for historic trails and sites must be diligently protected through 5-mile buffers in which oil and gas could be leased only under No Surface Occupancy stipulations. Waivers of this protective measure should be allowed only in cases where all impacts of oil and gas development (including wells and associated roads) or other industrial intrusions are rendered completely invisible through