From:	Elaine York
To:	jasonrobinson@utah.gov; allison@wildutahproject.org; Burns, Casey - Salt Lake City, UT; "cmccarthy01@fs.fed.us" (cmccarthy01@fs.fed.us); "randy_larsen@byu.edu" (randy_larsen@byu.edu); steven_petersen@byu.edu; "terry.messmer@usu.edu" (terry.messmer@usu.edu); "Wayne Martinson" (wmartinson@xmission.com); Jimi Gragg; scubaplant@yahoo.com; lorien.belton@usu.edu; traciallen@blm.gov; Karl Fleming (karl_fleming@fws.gov); Knight, Robert N CIV USA IMCOM; Amy_Defreese@fws.gov; rnaeve@blm.gov; rchi@blm.gov; Bekee_Hotze@fws.gov; Laura_Romin@fws.gov; russellnorvell@utah.gov; Betsy Herrmann
Cc:	Joel Tuhy; Joan Degiorgio; Gen Green; Chris Montague
Subject:	1 of 2 - misc. documents (greater sage-grouse meeting, May 13, 1-5 pm, TNC)
Date:	Tuesday, May 14, 2013 12:57:09 PM
Attachments:	2009_0816_GrazingInGrouseHabitat_WY.PDF

Hi,

Clint McCarthy has sent three documents as promised in yesterday's greater sage-grouse meeting (see attachments) – one attached to this email (7 MB), and I'll send the other 2 documents (2 MB and 1 MB) in a separate email so this isn't too large.

Additionally, Allison Jones has forwarded a document for you via Dropbox. I will place this in a new Dropbox folder so expect an email from Dropbox.

Thanks to each of you for attending the meeting! I'll be sending the meeting notes soon.

Best,

Elaine

Elaine York
West Desert Regional Director

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From: Elaine York
Sent: Wednesday, April 24, 2013 12:58 PM
To: jasonrobinson@utah.gov; allison@wildutahproject.org; Burns, Casey - Salt Lake City, UT; 'cmccarthy01@fs.fed.us' (cmccarthy01@fs.fed.us); 'randy_larsen@byu.edu' (randy_larsen@byu.edu); steven_petersen@byu.edu; 'terry.messmer@usu.edu' (terry.messmer@usu.edu); 'Wayne Martinson' (wmartinson@xmission.com); Jimi Gragg; scubaplant@yahoo.com; lorien.belton@usu.edu; traciallen@blm.gov; Karl Fleming (karl_fleming@fws.gov); Knight, Robert N CIV USA IMCOM; Amy_Defreese@fws.gov; rnaeve@blm.gov; rchi@blm.gov; Bekee_Hotze@fws.gov; Laura_Romin@fws.gov; russellnorvell@utah.gov
Cc: Joel Tuhy; Joan Degiorgio; Gen Green; Chris Montague; Pauline Blanchard; Larisa Bowen; Dave Livermore
Subject: Please calendar: greater sage-grouse meeting, May 13, 1-5 pm, TNC

Hi all,

Please calendar Monday, May 13, 2013, 1-5 p.m. MDT for our next greater sage-grouse meeting in TNC's conference room at 555 East South Temple, Salt Lake City, Utah. If you have any suggestions for topics to be included on the agenda, please send them my way. I'll send a draft agenda as we near that date.

Best to you,

Elaine, TNC, (801) 238-2320

From: Elaine York
Sent: Wednesday, April 03, 2013 3:34 PM
To: jasonrobinson@utah.gov; allison@wildutahproject.org; Burns, Casey - Salt Lake City, UT; 'cmccarthy01@fs.fed.us' (cmccarthy01@fs.fed.us); 'randy_larsen@byu.edu' (randy_larsen@byu.edu); steven_petersen@byu.edu; 'terry.messmer@usu.edu' (terry.messmer@usu.edu); 'Wayne Martinson' (wmartinson@xmission.com); Jimi Gragg; scubaplant@yahoo.com; lorien.belton@usu.edu; traciallen@blm.gov; Karl Fleming (karl_fleming@fws.gov); Knight, Robert N CIV USA IMCOM; Amy_Defreese@fws.gov; rnaeve@blm.gov; rchi@blm.gov; Bekee_Hotze@fws.gov; Laura_Romin@fws.gov; russellnorvell@utah.gov
Cc: Joel Tuhy; Joan Degiorgio; Gen Green; Chris Montague; Pauline Blanchard; Elaine York; Larisa Bowen; Dave Livermore
Subject: Doodle poll: next greater sage-grouse meeting (May or June date)

Hi GrSG enthusiasts,

We'd like to schedule our next almost quarterly greater sage-grouse meeting in May or June. Could you each respond to the Doodle poll (link below) by Wednesday, April 17, 2013? When I have the poll results I'll send another email to confirm the time. As usual, the meeting will be held in The Nature Conservancy's conference room, 555 East South Temple, Salt Lake City, Utah. The topic…….conservation actions to benefit the greater sage-grouse. I'll send a draft agenda as we near the meeting date. If you have a recommendation for the agenda - topic for discussion or presentation - please send it my way.

http://www.doodle.com/itg5vrb884ic2kuf

Many thanks!

Elaine

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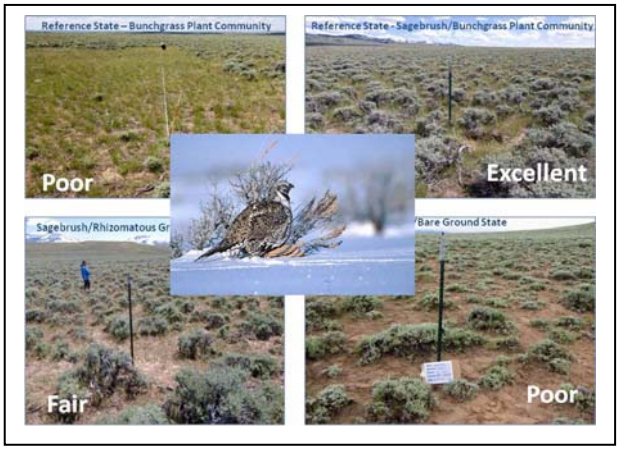
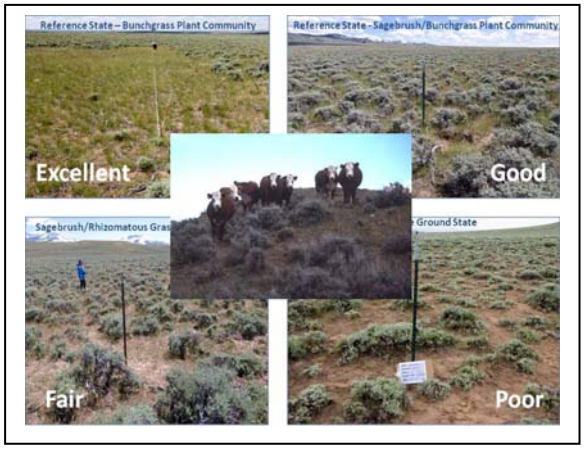
Grazing Influence, Management and Objective Development in Wyoming's Greater Sage-Grouse Habitat

With emphasis on Nesting and Early Brood Rearing

August 16, 2009





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Grazing Influence, Objective Development and Management in Wyoming's Greater Sage-Grouse Habitat

With Emphasis on Nesting and Early Brood Rearing

A. Introduction

This document provides a synthesized discussion of current knowledge regarding the interface between grazing and sage-grouse, so landowners, range managers and wildlife managers can develop achievable objectives and viable grazing management strategies in sage-grouse habitat.

The document's emphasis is cause and effect relationships associated with grazing, and how they affect sage-grouse nesting and early brood rearing habitat. This emphasis is selected because the authors believe inaccurate assumptions regarding plant succession in sagebrush habitat are a continuing source of confusion. Furthermore, because much of the literature is dedicated to describing sage-grouse habitat characteristics such as the height and density of sagebrush, which are largely unaffected by grazing of herbaceous vegetation, many range managers are uncertain regarding how to address sage-grouse habitat issues on upland ranges. While grazing has a pronounced effect on riparian habitats, recent publications, notably Technical Reference 1737-20 – Grazing Management Process and Strategies for Riparian –Wetland Areas, appear to adequately address these issues.

This document is the product of a series of meetings, field trips and peer reviews initiated in the spring of 2007. It contains the authors' collective understanding of ecosystem function in Wyoming sagebrush habitat, and their management recommendations. Most examples in the document are based on a Sandy Ecological Site (as defined by the National Resource Conservation Service) in the Platte River Valley near Saratoga Wyoming with 10-14 inches of precipitation. This site it is highly representative of sagebrush ecosystem function in Wyoming, and Dr. Mike Smith at the University of Wyoming has a long term study correlating herbaceous production to precipitation on that site. The authors recognize that much of the material in this document is observational in nature and the reader is invited to apply this material in that context.

A substantive body of literature regarding sage-grouse is currently available. The publication *"A Synthesis of Livestock Grazing Management Literature Addressing Grazing Management for Greater Sage-Grouse Habitat in the Wyoming Basin – Southern Rocky Mountains Ecoregions,"* accessible at http://sagemap.wr.usgs.gov/docs/Literature%20Synthesis.doc, identifies over 300 papers. A listing of previous work that influenced the material in this document, along with recommended sources for further study is found in Appendix A.

B. Background

The sage-grouse literature consistently suggests intact sagebrush ecosystems are essential during all seasonal periods, and a sagebrush canopy in conjunction with robust herbaceous understory is the key to quality breeding (e.g., nesting and early brood-rearing) and summer seasonal habitats. While grazing management has limited effect on sagebrush, grazing management is important because it affects the height and density of herbaceous material available for hiding cover and food.

Over the long term, grazing management will affect plant community composition. Understanding how grazing affects plant succession, and identifying what can and cannot be achieved with grazing management is a critical first step to developing coordinated livestock grazing and sage-grouse habitat objectives. At issue is how grazing affects site progression in sagebrush plant communities, and how site progression affects sage-grouse habitat. Most sagebrush sites in Wyoming are capable of producing a Sagebrush/Bunchgrass plant community that maximizes the height and density of the herbaceous vegetation component. This paper addresses how the Sagebrush/Bunchgrass plant community is produced and maintained. Establishing achievable long term goals based on state and transition models is a critical first step in synchronizing sagebrush plant community objectives with grazing management strategies.

Because sage-grouse nesting generally begins prior to the onset of the growing season, residual vegetation from the previous year dictates available hiding cover. Consequently the paper also addresses management of annual standing crop.

The term "grazing" in this document presumes that herbivory is targeting the herbaceous component of the sagebrush plant community. The term "browsing" is used when herbivory targets the sagebrush itself. Cattle, wild horses, and elk are common grazers. Domestic sheep, deer and antelope tend to graze during the growing season and browse during the fall and winter. The emphasis of this document is grazing, with management of cattle as the focus.

C. Sage-Grouse Habitat Review

Any discussion of grazing influence, management and objective development relating to sage-grouse must be predicated on the habitat requirements of the species (Table 1).

Table 1. Sage-Grouse Habitat Description

Seasonal Habitat Component	General Sage-Grouse Habitat Description
Across the Landscape	Sage-grouse are a landscape-scale species typically inhabiting large, interconnected expanses of sagebrush. The species relies on sagebrush-dominated landscapes with varying sagebrush canopy covers, densities and heights, age classes, patch sizes, and moisture availability. Sage-grouse population persistence is linked to functioning sagebrush-steppe habitats. The dependence of the species on sagebrush through all seasonal periods has been well documented and cannot be over-emphasized.
Lekking (Late February to May)	Leks are typically located in natural or man-made openings within sagebrush communities. Sagebrush immediately surrounding lek sites (generally within 0.6 miles) is used for feeding, resting and cover from weather and security from predators when the birds are not on leks. The presence of early greening forbs (broad-leafed flowering plants) improves hen nutrition during this pre-laying season which increases nest initiation, hatching success and chick survival.

Seasonal Habitat Component	General Sage-Grouse Habitat Description
Nesting (April to mid-June)	In the contiguous habitats found across much of central and southwest Wyoming, about 75% of hens nest within 4 miles and about 66% nest within 3 miles of the lek where they are bred. Females may have to search a larger area to find suitable nesting conditions in fragmented habitats. Females choose nest sites in the same general area every year, usually within 0.5 miles of the previous year's nest. Hens tend to select an average 23% live sagebrush canopy cover and a height of 13 inches. Tall, dense residual grass (previous year's growth) in nesting habitat improves hatching success. In general, timing of use and utilization levels appear to have the greatest impact on the herbaceous component of sage-grouse nesting and early brooding habitats. Grazing during the late spring nesting period influences the herbaceous cover and height necessary to conceal hens on their nests. Grazing during the summer, fall or winter influences the residual cover and height of the standing crop important for nesting females the following spring. *(Managing grazing in nesting and early brood-rearing habitats is the emphasis of this document.)*
Early Brood-Rearing (June to mid-July)	Almost 90% of chick loss occurs prior to chicks being capable of strong flight at around 3 weeks of age. On average, young chicks in Wyoming are reared within 1.2 miles of the nest. A diverse mosaic of vegetation is important. Early brood-rearing habitat has more open patches (10-15% live sagebrush canopy cover) containing more forbs. Denser sagebrush patches in close proximity to these more open areas are important for chick protection from predators and weather. Chick survival is tied to an abundance of insects such as ants, beetles and grasshoppers as well as forbs, which provide food for sage-grouse and habitat for insects.
Late Brood-Rearing (Mid-July to mid-September)	As forbs and other food plants mature and dry out, sage-grouse seek areas still supporting green vegetation. Sage-grouse do not necessarily require open water during the summer. Selected summering areas include: riparian areas, irrigated hay fields, upland seeps and springs and high elevation meadows. Sagebrush stands closely associated with these feeding areas provide important security cover, and are used during loafing and roosting periods. Sage-grouse mortality is not high during the summer unless West Nile virus is present. Livestock distribution patterns are directly linked with water availability. Therefore impacts to riparian habitats are the primary influences of livestock to sage-grouse late brood-rearing and summering habitats. High utilization levels in areas with limited water availability and summer grazing on riparian habitats decrease forage

Seasonal Habitat Component	General Sage-Grouse Habitat Description
Late Brood-Rearing (*continued*)	productivity. These impacts to the vegetation may reduce summer habitat quality for sage-grouse. However, sage-grouse select grazed meadows rather than ungrazed exclosures. Grazing may increase the quality of the forb resource (by interrupting and delaying maturation) and increased accessibility to low-growing food forbs (by producing patchy small openings) sought by sage-grouse during the summer.
Fall (Mid-Sept. to Oct.)	Fall habitat is varied and weather dependent. Forbs and insects decrease in availability so the amount of sagebrush in the diet increases. Fall habitats are those used during migration to winter areas, the timing of which depends on temperatures and snow depth.
Winter (Nov. to Feb.)	During the winter, the primary requirement of sage-grouse is sagebrush exposed above the snow. Exposed sagebrush is used for feed and cover; sage-grouse feed almost exclusively on sagebrush in the winter. Winter ranges are typically characterized by large expanses of dense sagebrush on flatter land with south to west-facing slopes or windswept ridges. During deep snow periods, steeper drainages with taller sagebrush may be the only areas with exposed sagebrush and will be used. Winter habitat may be limiting in deep snow areas such as Jackson Hole or during deep snow years, however, in most areas and years, sage-grouse will gain weight over the winter. The potential impacts of livestock grazing to winter habitats are limited to effects to the sagebrush overstory. Repeated heavy winter browsing or trampling of sagebrush by livestock can reduce sagebrush vigor and productivity. Conversely, grazing during the spring at high utilization rates may increase sagebrush density.
Migration	Sage-grouse populations are defined by 3 migratory patterns: (1) non-migratory, where sage-grouse do not make long-distance movements between or among distinct seasonal ranges; (2) one-stage migratory, where sage-grouse move between two distinct seasonal ranges such as distinct wintering areas and integrated breeding and summering areas; or (3) two-stage migratory, where sage-grouse move among three distinct seasonal ranges such as distinct wintering, breeding and summering areas). Birds belonging to one or more of these types of populations may reside in the same geographic region during one or more seasons. An important step to determining the seasonal ranges in an area is identifying the migratory nature of a population.

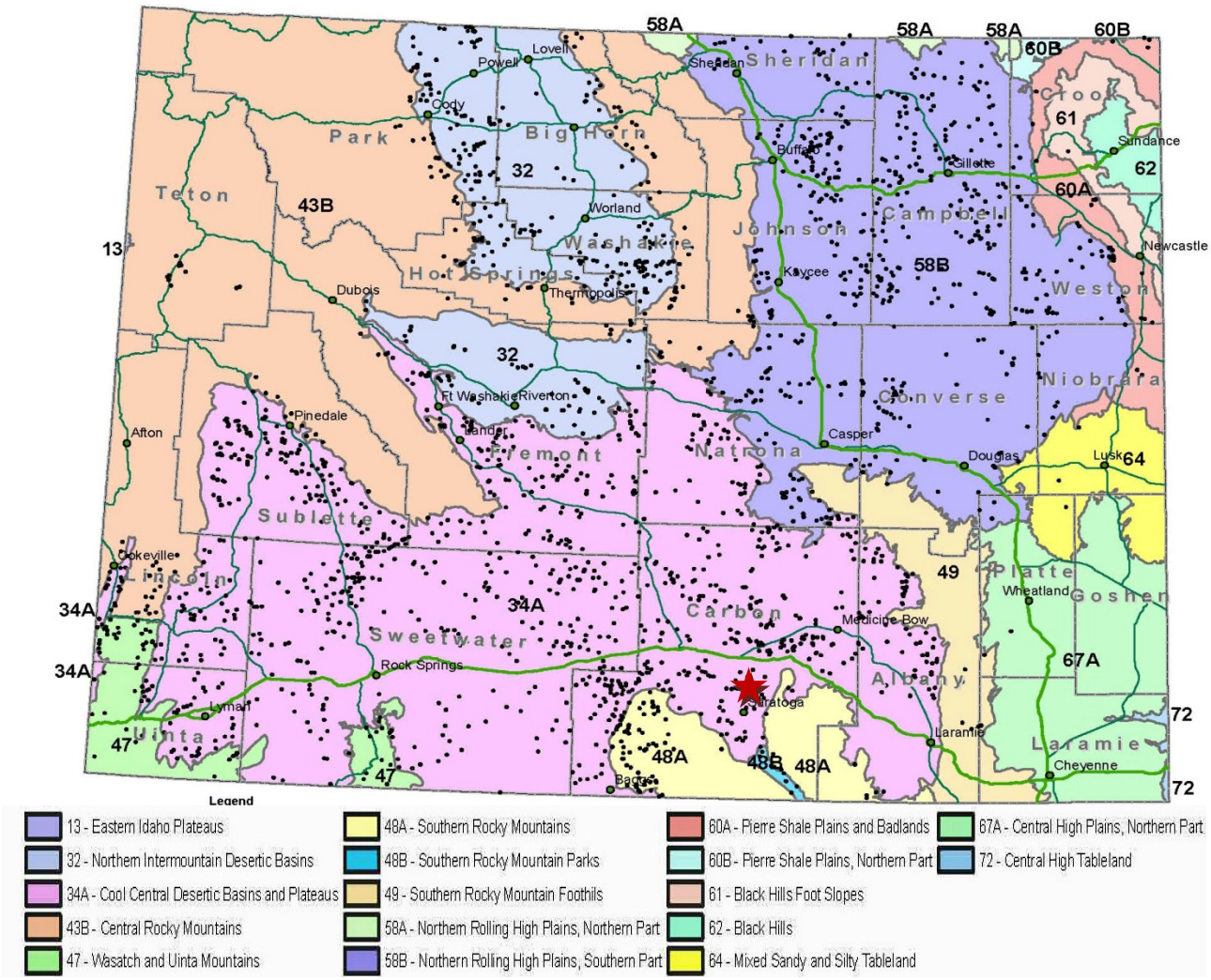
D. Wyoming Sagebrush Habitat Characteristics

1. Ecological Sites

Figure 1 shows the Major Land Resource Areas (MLRAs) in Wyoming, as developed by the National Resource Conservation Service – United States Department of Agriculture. Dots indicate known sage-grouse lek sites. The star identifies the location of the Platte River site frequently referred to in this document.

MLRAs are geographic areas with similar elevation, topography, geology, climate, water, soils, biological resources and land use. For example MLRA 32 has a much longer growing season than MLRA 34A due primarily to lower elevations. MLRA 34A is notable because it probably contains the most intact large tracts of sage-grouse habitat remaining. More detailed information regarding Wyoming MLRAs may be found at: http://soils.usda.gov/survey/geography/mlra/

Figure 1 – Major Land Resource Areas of Wyoming



Each MLRA contains a set of "Ecological Sites" describing the land capability and function based on precipitation zones, soil factor differences determining plant production and composition, the hydrology of the site, and the functioning of the ecological processes of the water cycle, nutrient cycles, and energy flow. Different ecological sites will exhibit significant differences in:

- Plant species
- The relative proportion of species
- The total annual vegetation production

Additional information on ecological sites may be found in Chapter 3 (190-VI, NRPH, rev. 1, December 2003) Ecological Sites and Forage Suitability Groups USDA-NRCS National Range and Pasture Handbook (http://www.glti.nrcs.usda.gov/technical/publications/nrph.html)

Appendix B groups the 71 ecological sites in the Cool Central Desertic Basins and Plateaus MLRA (34A) into five categories based on the sagebrush habitat they provide. These categories are:

- *Ecological Sites that provide key Big Sagebrush Habitat.* Wyoming big sagebrush is dominant in the 7-9 inch precipitation zone. Mountain big sagebrush is increasingly common as precipitation increases. Sandy sites tend to feature needle-and-thread as the primary cool season bunchgrass, whereas loamy sites tend to feature bluebunch wheatgrass. Clayey sites feature Indian ricegrass and, in some circumstances, green needlegrass, but clayey sites are relatively uncommon. Spiny hopsage replaces big sagebrush on many Sands ecological sites. Some sites (such as Shallow Loamy) do not support sagebrush canopies associated with sage-grouse habitat in the 7-9 inch precipitation zone; however, they do provide suitable sagebrush canopies in the 10-14 inch precipitation zones.

- *Ecological Sites with Heavy or Shallow Soils.* Many ecological sites support big sagebrush, but not in contiguous stands. Smaller species of sagebrush such as black or low sagebrush often occupy these sites rather than Wyoming or mountain big sagebrush.

- *Ecological Sites with Salty Soils.* These sites do not support big sagebrush. Upland sites feature Gardner's saltbush and bud sage. Saline lowland sites feature greasewood, often mixed with basin big sagebrush when soil salinity is not too severe.

- *Ecological Sites with Basin Big Sagebrush.* Areas generally known as overflow sites, where terrain provides enhanced access to moisture, support stands of basin and silver sagebrush. Basin big sagebrush is featured on clayey overflow sites where silver sagebrush is seldom found.

- *Ecological sites with Riparian Characteristics.* Riparian sites are typically too wet to support big sagebrush.

2. Sagebrush and Herbaceous (grass and forb) Interaction and Competition

A discussion of how grazing affects site progression in sagebrush habitat is predicated on an

understanding of the climatic factors that dictate the interplay between sagebrush and the herbaceous component. Sagebrush and the herbaceous understory engage in indirect competition for moisture and direct competition for space. Figure 2, taken east of Lander Wyoming, shows sagebrush occupying the concave locations in the landscape where snow accumulates. The shallower soil sites do not support contiguous stands of sagebrush. This pattern is typical in Wyoming.

a. Competition For Moisture

The sagebrush tap root system allows plants to draw moisture from multiple layers in the soil profile while the herbaceous component draws moisture primarily from surface layers. Consequently, sagebrush is found in areas where dormant season moisture seeps deep into the soil profile. In most Wyoming big sagebrush habitat, snow pack melts in late winter, and by the time temperatures are optimal for herbaceous growth, dormant season moisture is no longer available in the surface layer. Consequently, the herbaceous component of Wyoming big sagebrush communities depends almost entirely on spring precipitation, primarily occurring in April and May. Appendix C contains charts correlating herbaceous production to the timing of precipitation at the Platte River Site featured in this paper. When sufficient moisture falls, especially in late winter, to wet the soil profile below the grass roots, sagebrush will have a competitive advantage. Conversely, when moisture is readily available at the soil surface during the growing season the competitive advantage shifts to the herbaceous plant community. As a result, sagebrush becomes a lesser component of plant communities on sites such as windblown ridges, where effective winter precipitation is limited.

Figure 2 – Sagebrush Occupation Pattern

b. Competition for Space

On sites where snow accumulates, sagebrush and the herbaceous plant community compete directly for space. Sagebrush cover naturally increases with time to a level in equilibrium with the site's precipitation and snow conditions. On sandy and loamy upland sites in the 10-14 inch precipitation zone, sagebrush canopy cover will stabilize at a level somewhere less than 35 percent. This canopy cover develops independent of the health of the herbaceous plant community. Once the sagebrush canopy reaches its potential (the site becomes fully occupied), herbaceous community niches become limited. Sagebrush does not kill the herbaceous component. In many places sagebrush actually protects grass plants from grazing pressure. However, a cool season bunchgrass grass plant (such as needle and thread) protected by sagebrush canopy was almost certainly in place before the sagebrush overstory developed. The sagebrush/bunchgrass plant community is persistent. However individual cool season bunchgrasses lost from a fully occupied sagebrush site generally remain bare ground, or are replaced by other species.

E. Plant Succession in Sagebrush Habitat

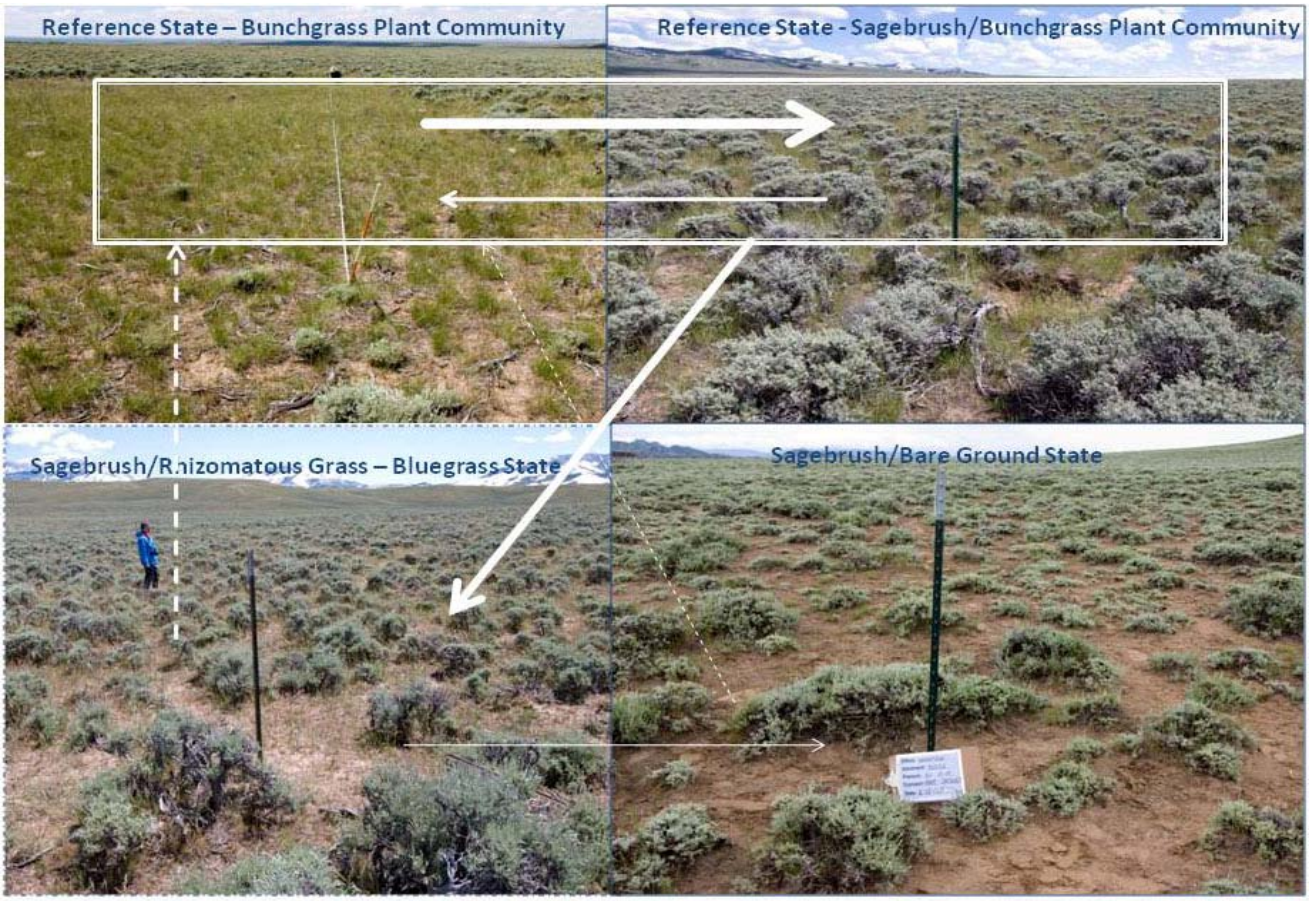
State and transition models describe plant succession in sagebrush plant communities. State and transition models are of keynote importance because some "states" offer far more sage-grouse nesting and brood-rearing habitat value than others. The publication, a "Unified Framework for Assessment and Application of Ecological Thresholds" by Briske et al. (2005), is the recommended starting point for anyone interested in studying state and transition model concepts.

1. Platte River State and Transition Model

The following discussion evaluates four plant communities in three "states" observed near the town of Saratoga in Wyoming's Platte River Valley. All four photos depict a Sandy ecological site in the 10 to 14 inch precipitation zone, with near identical potential to produce vegetation. Appendix D provides larger pictures and plant cover data for the four plant communities addressed.

Arrows on the model indicate transitional pathways of plant succession. The size of the arrows depicts the relative ease of transition between the plant communities depicted in the diagram. Bold solid arrows depict progressions that occur with time and various types of grazing. Light-solid arrows depict changes that require disturbance. Dashed arrows depict changes that require disturbance and may take generations to occur.

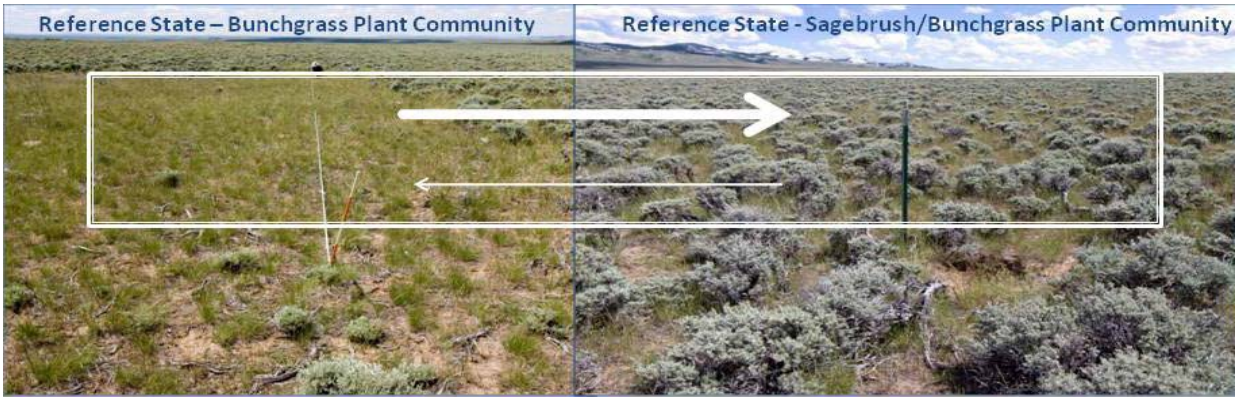
Figure 3 – A Platte River State and Transition Model



a. The Reference State

Figure 4 below, illustrates the two plant community Reference State. These two communities (Bunchgrass, Sagebrush/Bunchgrass) are identified as a single state because the change from the Bunchgrass plant community to the Sagebrush/Bunchgrass plant community does not entail crossing an "ecological threshold." On the Platte River site, sagebrush will advance on the bunchgrass plant community with time alone. Grazing management can affect the speed of the progression because pressure on the herbaceous community can create more sagebrush germination sites. However, independent of grazing management, sagebrush canopy cover will eventually advance to a level commensurate with climatic conditions. Grazing does not hinder young sagebrush plants from growing and occupying more space on the landscape. Consequently, because the Bunchgrass plant community is transitional and does not persist in the absence of disturbance, it is not identified as an independent "state."

Figure 4 – The Reference State



The Reference State is not two discrete plant communities. Rather it encompasses the gradient where a Bunchgrass plant community (the product of disturbance) gradually becomes a Sagebrush/Bunchgrass community as sagebrush colonizes the site one plant at a time. The key concept is that the cool season bunchgrasses precede the sagebrush on the site progression model. While the Sagebrush/Bunchgrass community is part of the ecological potential, site progression is not linear, and this plant community is not **the** climax. The Sagebrush/Bunchgrass plant community can persist indefinitely, but not all site progression pathways lead to the Reference State. All of the states presented in the model are a persistent climax plant community that is the product of its history. The term "Reference State" is used to identify the state to which all other states are normally compared.

i. Bunchgrass Plant Community (Reference State)

Description - Following disturbance that removes the sagebrush canopy on a healthy sagebrush site, the initial plant community is primarily herbaceous. Needle and thread in conjunction with bluebunch wheatgrass, and Indian ricegrass represent the large cool season bunchgrasses that can dominate herbaceous production on sandy sites in the Wyoming Basin. A host of smaller grasses such as thickspike wheatgrass, prairie junegrass, mutton bluegrass and Sandberg bluegrass also comprise a substantial part of the plant community**.** The site depicted had 2.4% cover of forbs.

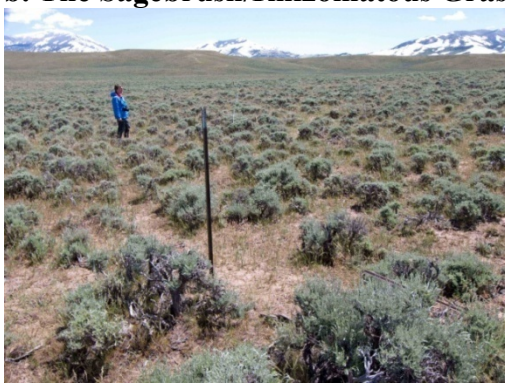
Values - The Bunchgrass community provides ideal forage for livestock, especially cattle, but lack of sagebrush sharply limits sage-grouse habitat. Winter habitat for sage-grouse is virtually absent.

ii. The Sagebrush Bunchgrass Plant Community (Reference State)

Description - The Sagebrush/Bunchgrass community forms when sagebrush advances on the transitional Bunchgrass community. This plant community is the product of a Bunchgrass community with an overstory of sagebrush. The site depicted had 4.6% canopy cover of forbs, which was the highest of the four sites sampled.

Values - This Sagebrush/Bunchgrass community is regarded as the preferred community for sage-grouse habitat because it provides an optimum mix of sagebrush and herbaceous understory. The big bunchgrass species such as needle and thread provide the tallest herbaceous material the site can produce, thus enhanced vertical structure, while the bunched nature of the growth form provides enhanced horizontal structure. Both structural components are important to protect nesting birds and young chicks. Additionally, this is the stage in the successional path that offers the most biological diversity of shrubs, grasses, and forbs. This diversity in the plant community is important to provide diverse insect communities for chicks during early brood-rearing. This plant community provides ample forage for livestock and high quality breeding, summer and winter habitat for sage-grouse.

b. The Sagebrush/Rhizomatous Grass-Bluegrass State



Description - The Sagebrush/Rhizomatous–Bluegrass state features a sagebrush canopy with an herbaceous plant community dominated by rhizomatous grasses and bluegrasses. Rhizomatous grasses, notably thickspike and western wheatgrass, are more resistant to grazing than the "big bunchgrasses" such as needle and thread. Rhizomes are underground roots that can sprout to form new plants. This is a grazing resistant reproduction strategy compared to the bunchgrasses that must reproduce from seed. Bluegrasses and prairie junegrass are technically bunchgrasses, but they have a low growth form relative to the big bunchgrasses, so it is more difficult for grazing pressure to accrue the high levels of utilization that deplete root systems. The two most common bluegrasses are Sandberg and Mutton Bluegrass. Rhizomatous species, bluegrasses and junegrass are "ecological equivalents" from a grazing/sage-grouse habitat perspective. They do not offer the production or structure associated with the "big" bunchgrass species such as needle and thread.

Values – Because of the spatial extent of rangelands in the Sagebrush/Rhizomatous Grass-Bluegrass State, this state is exceptionally important. When management promotes health and vigor of the herbaceous community, this state produces an acceptable volume of herbaceous cover, and can meet the breeding season habitat requirements outlined by the

sage-grouse management guidelines specified by Connelly et al. (2000). When depleted, breeding habitat quality diminishes and only winter range values are available to sage-grouse. This state produces less forage than the Sagebrush/Bunchgrass State, but with quality grazing management, the state offers reasonable herbaceous productivity.

c. Sagebrush/Bare Ground State

Description - This easily described state is almost entirely comprised of sagebrush. Rabbitbrush is also present on this Platte River Site. Residual herbaceous vegetation occurs primarily in locations protected by the shrub canopy or cactus. The site depicted had 1.2% canopy cover of grass - primarily crested wheat.

This relatively stable state will persist indefinitely. The large amount of bare ground tends to persist because sagebrush canopy increases only to the site's potential.

Even though the site has a lot of bare ground it does not offer open niches that herbaceous vegetation can easily exploit. Seed sources and potential parent herbaceous plants are rare or absent. At this point in the successional progression, even light stocking will put heavy pressure on remaining herbaceous plants.

Values – Lack of forage and biological diversity severely diminishes the ecological and economic value of sites occupied by this state. Values are restricted to limited opportunities in the winter for both sage-grouse and browsers such as antelope and domestic sheep.

2. Vegetation Management Objective

The sagebrush and herbaceous cover associated with the Sagebrush/Bunchgrass plant community in the Reference State provides an optimal mix for sage-grouse habitat, along with excellent forage for livestock (Table 2). This plant community also produced the highest forb cover on the four Platte River Sites. Maintenance of the Sagebrush/Bunchgrass community through carefully considered grazing management is the key to managing grazing for sage-grouse habitat values. The table below shows the sagebrush, herbaceous and forb cover for the four plant communities described. Complete data regarding the plant cover for these communities is included in Appendix D.

Table 2. Species Cover

Plant Community	Sagebrush Cover	Herbaceous Cover	Forb Cover
Bunchgrass Plant Community (Reference State)	0.2	42.8	2.4
Sagebrush/Bunchgrass Plant Community (Reference State)	21.2	23.2	4.6
Sagebrush/Rhizomatous Grass – Bluegrass State	29.4	9.6	3.4
Sagebrush/Bare Ground State	33.6	1.8	0.6

3. Grazing Influence on Sagebrush Site Progression

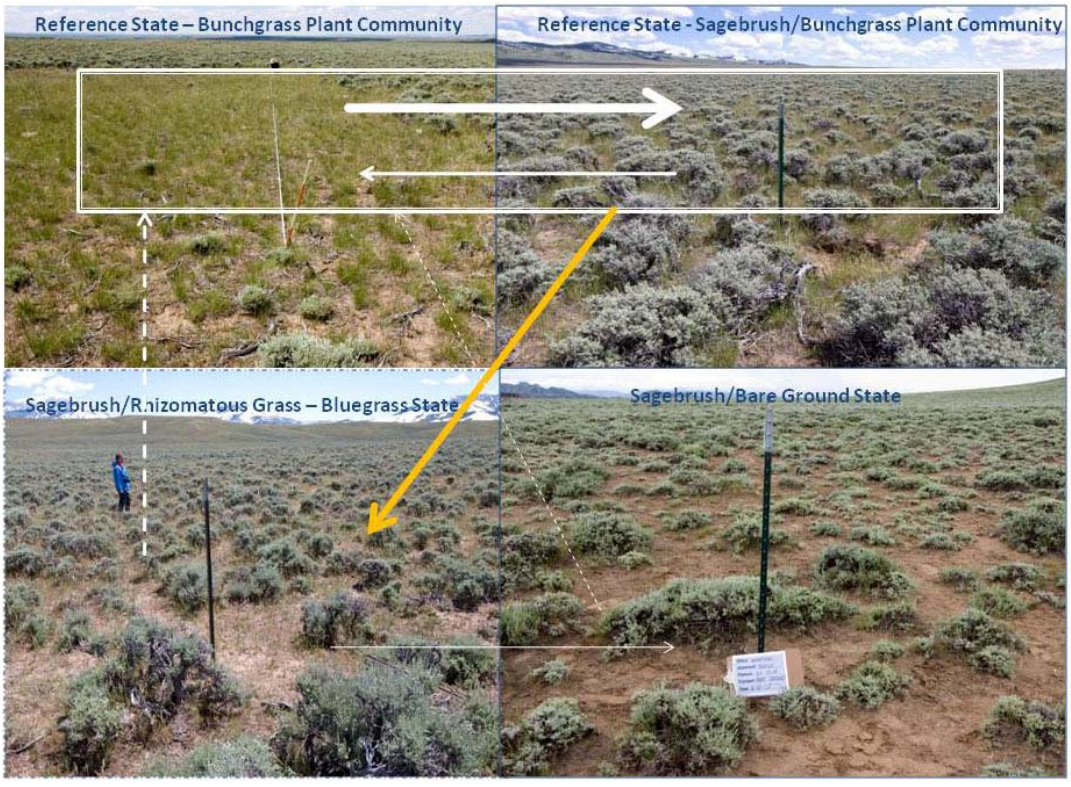
The Platte River sequence in Figure 3 is not the only plant succession process occurring in sagebrush habitat. Appendix E provides a collection of different situations known to occur in Wyoming. The actual state and transition model prepared by the NRCS for a sandy ecological site with 10-14 inches of precipitation includes a transition to an upland sedge state that does not occur on the Platte River Site. Managers wishing to adapt the concepts in this paper to other sites may need to work from different state and transition models.

However, sagebrush habitat in Wyoming tends to offer a "common thread" of keynote importance. Optimal sage-grouse habitat is invariably the product of a Sagebrush/Bunchgrass combination. Grazing is of critical importance because it can serve as a driver to transition a site from one ecological state to another. Invariably sites that produce a Sagebrush/Bunchgrass plant community can transition to an alternative plant community that is more grazing resistant, but is less productive, and offers lesser amounts of hiding cover for sage-grouse. On the Platte River site the grazing resistant alternative is the Sagebrush/Rhizomatous Grass-Bluegrass State. Sagebrush/Blue Grama and, Sagebrush/Upland Sedge are also common grazing resistant states in Wyoming.

a. The Key Transition

The major influence of grazing on sage-grouse habitat within the context of the Platte River Model is the potential to cause a transition from the Reference State to the Sagebrush/Rhizomatous Grass-Bluegrass State. The yellow arrow in Figure 5 calls attention to this key transition.

Figure 5 - The Influence of Grazing – the Key Transition



A plant community in the Reference State can be presumed to be healthy and vigorous, because unhealthy sites in the Reference State do not persist. Rather they transition to the Sagebrush/Rhizomatous Grass-Bluegrass State. As noted, the latter state is substantially more grazing resistant than the former. Continuous heavy grazing is likely to cause this transition. Grazing management as described in Section F is needed to prevent this key transition, and maintain the Sagebrush/Bunchgrass plant community in the Reference State. The Sagebrush/Rhizomatous Grass-Bluegrass State is common in the Wyoming Basin for two reasons. First, the successional path readily progresses to this state and second, this is an exceptionally stable state that persists under most management scenarios. Given season-long grazing, most spring ranges with access to water have progressed to, and are currently in, the Sagebrush/Rhizomatous Grass-Bluegrass State. Since the Sagebrush/Rhizomatous Grass-Bluegrass type often does not produce an herbaceous community sufficient to carry low intensity fires (especially at lower precipitation zones), stand conversion from fire is relatively rare.

By contrast, except for small areas in the immediate vicinity of water developments the Sagebrush/Bare Ground State is relatively rare. The resiliency of the Sagebrush/Rhizomatous-Bluegrass State more or less precludes the formation of the Sagebrush/Bare Ground State unless grazing animals are provided supplemental feed or fenced into inadequate pasture. Because this state will not sustain grazing animals, it probably seldom occurred in the natural progression. In a natural landscape grazing animals would die or walk away before a site progressed to this state. The near lack of herbaceous material nearly eliminates wildfire, so these sites seldom "turn over."

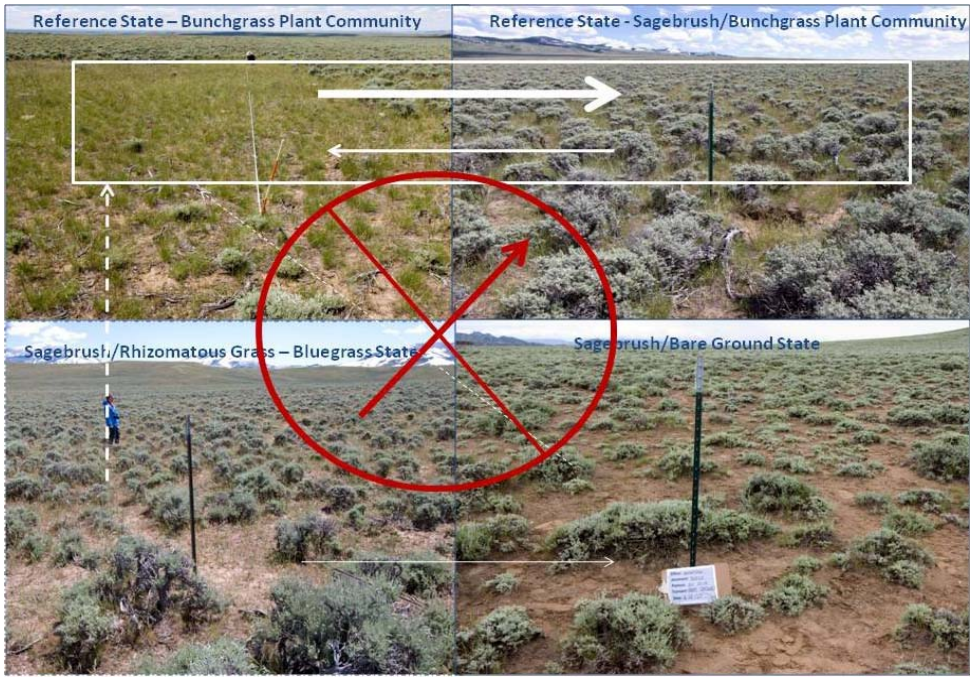
Browsing (especially in the fall and winter) may target the sagebrush component of a plant community. In this circumstance browsing may serve as a source of disturbance that pushes a plant community towards the Reference State. See part 4 of this section, Disturbance to Vegetation – Reinitiating Site Progression.

b. The Backwards Transition

An impediment to improving sage-grouse habitat is the presumption that the "backwards transition" shown in Figure 6 is commonplace.

The backwards transition entails the direct change in the plant community from the Sagebrush/Rhizomatous Grass –Bluegrass State to the Sagebrush Bunchgrass community in the Reference State. Appendix F provides a discussion of how committed to this presumption the range management profession has been.

Figure 6 – The Backwards Transition



Because the Sagebrush/Rhizomatous Grass–Bluegrass State is so predominant, and because the Sagebrush/Bunchgrass Plant community in the Reference State offers a substantive upgrade in both the quality of the sage-grouse habitat and forage availability, this objective is often sought. However, this seldom occurs without a disturbance driver. The backwards transition is rarely achieved from grazing management alone, even in areas where heavy or unmanaged grazing was originally responsible for the "key transition" from the Reference State to the Sagebrush/Rhizomatous Grass–Bluegrass State.

The Sagebrush/Rhizomatous Grass – Bluegrass State offers few open niches that can be exploited by improved grazing management. The existing plant community fully occupies the site. Sagebrush is a long lived species and adds an interspecific competition that limits the ability of the big bunchgrasses to invade. The grazing resistant grasses that dominate the herbaceous component of this state will not relinquish their position in the landscape to the big bunchgrasses do solely to grazing management improvement.

The Fourteenmile exclosure (Figure 7), built north of Rock Springs, Wyoming in the 1960's, is one of many exclosures scattered across Wyoming demonstrating that the backwards transition (Figure 6) does not occur when grazing pressure is removed. Sites in the Sagebrush Rhizomatous Grass-Bluegrass State generally exhibit their stability in exclosures. Some have speculated that these exclosures demonstrate that grazing does not affect rangeland composition and productivity, or that hoof action is necessary for rangeland health. More accurately, changing grazing management or eliminating grazing on sites in the Sagebrush Rhizomatous Grass-Bluegrass State has a limited effect. **It is critical that range managers and sage-grouse habitat biologists do not predicate their habitat management strategy on the presumption that the backwards transition is readily achievable through grazing management.**

Figure 7 – The Fourteenmile Exclosure

The Fourteenmile exclosure also serves to illustrate the effect of browsing. In the Fourteenmile example, fall - winter sheep and antelope browsing targets the sagebrush rather than the herbaceous component of the community. Browsing is a form of disturbance that can cause the "backwards transition." There is more herbaceous production outside the exclosure. Inside, the sagebrush community expanded to its potential canopy coverage, as expected, and the absence of grazing did not result in a transition to the Reference State.

c. A Cumulative Impact Hypothesis

A commonly asked question relates to the declining numbers of both livestock and sage-grouse. How can sage-grouse habitat loss be attributed to livestock when sage-grouse were more numerous when livestock numbers were also more numerous? While grazing is only a part of the habitat fragmentation issues adversely affecting sage-grouse, at least part of the answer may lie in four core premises. (1) The Sagebrush/Bunchgrass community in the Reference State offers the most sage-grouse habitat value. (2) The Sagebrush/Bunchgrass community in the Reference State readily transitions to the Sagebrush/Rhizomatous Grass-Bluegrass State. (3) Many ranges have been converted from sheep to cattle – and cattle are more likely to trigger the "key transition." (4) Sites that transition from the Reference State to Sagebrush/Rhizomatous Grass-Bluegrass States persist even after grazing management is improved. In combination, this suggests that even though livestock numbers are lower, and grazing management in Wyoming has steadily improved, the acreage transitioning from the Sagebrush/Bunchgrass community in the Reference State to the Sagebrush/Rhizomatous Grass-Bluegrass State is still accumulating.

Assuming that concept is correct, conversions of sheep to cattle, and new water developments in tracts occupied by plant communities in the Reference State may contribute

to this accumulation. Therefore these two actions must be accompanied by very carefully considered grazing management as articulated in Section F. The presence of the Sagebrush/Bunchgrass plant community indicates long term high quality grazing management. Any proposed change in grazing management on these sites warrants careful consideration.

d. Vigor

Plant vigor in all states is readily affected by grazing. Figure 8 illustrates a Big Horn Basin site where the Sagebrush/Bunchgrass Plant Community in the Reference State features bluebunch wheatgrass. The photos in Figure 8 document change over a five year period from 1994 to 1999. Grazing management was changed from annual spring use to a five pasture short duration system, with two rest treatments over a five year period. This result shown in the photos is not due to precipitation events. While both photos depict a Sagebrush/ Bunchgrass plant community, the difference is increased vigor in the 1999 photo. Between 1996 and 2005 the production of bluebunch wheatgrass changed from 100 to 400 pounds per acre. The result is improved habitat for sage-grouse and higher forage production for livestock.

Figure 8 – Grazing Management 1994 to 1999

1994

1999

Two changes occurred. First, while bluebunch wheatgrass plants were a primary component of the herbaceous plant community in 1994, they were of low health and vigor. Improved grazing management increased the vigor of the bluebunch wheatgrass plants. Second, while the sagebrush cover remained largely unchanged, the bluebunch plants were able to displace the snakeweed that was a big part of the 1994 plant community.

e. Thresholds – The Key Priority

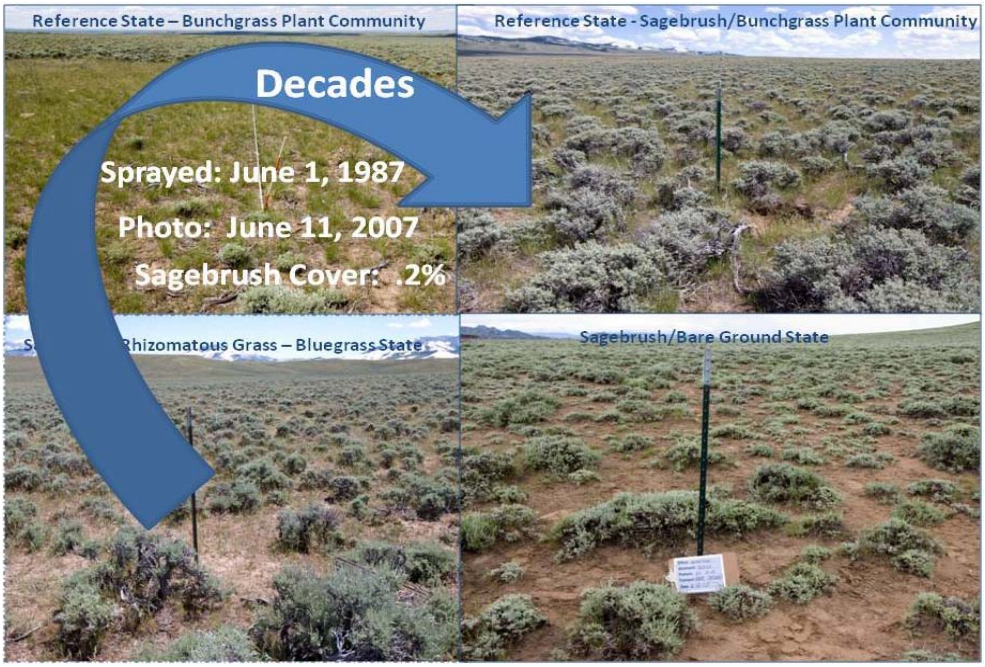
The Big Horn Basin example illustrates the risk of crossing transition thresholds. This site has the potential to transition to a Sagebrush/Blue Grama State. Had improved grazing management been deferred until after this site had transitioned to a Sagebrush/Blue Grama State, this level of success could not have been achieved. Blue Grama would not have yielded space to bluebunch wheatgrass in response to improved grazing management in the manner depicted by the photos. The action taken on this site was both well considered and

timely. Prioritizing improved grazing management on sites at risk of transitioning is more effective than trying to promote change after an adverse transition has occurred.
When the Key Transition and the Backward Transition are considered in aggregate, a key priority emerges. Preventing the Key Transition is perhaps the most important action a range manager can take with regard to grazing management in sage-grouse habitat. Poorly managed Sagebrush/Bunchgrass sites are rare because they transition to a more grazing resistant alternative state. When this transition is imminent, the range manager has a final opportunity to improve management and maintain the Reference State. Once a site transitions from the Reference State to a more grazing resistant alternative state, a disturbance that entails an interim loss of sagebrush and sage-grouse habitat may be needed to restore the Reference State. **Addressing an at-risk Sagebrush/Bunchgrass site is the most cost effective range management action in sage-grouse habitat.**

4. **Disturbance to Vegetation – Reinitiating Site Progression**
The state and transition model illustrates the need for disturbance to achieve the desirable progression from the Sagebrush/Rhizomatous Grass-Bluegrass State to the Sagebrush/Bunchgrass plant community in the Reference State. A key provision of the model is to differentiate between transitions that can occur through time alone, the transitions that can be driven by grazing, and the transitions that require disturbance.

If the objective is to convert Sagebrush/Rhizomatous Grass-Bluegrass plant communities to Sagebrush/Bunchgrass plant communities, the path must often progress through the Bunchgrass plant community as shown by Figure 9. This progression requires open niches for cool season bunchgrasses to exploit and these niches are a product of disturbance.

Figure 9 - Actual Successional Path from Sagebrush/Rhizomatous Grass-Bluegrass to Sagebrush/Bunchgrass-sprayed.



Although this document describes the need for periodic disturbance to promote succession to the Sagebrush Bunchgrass plant community, Table 3 demonstrates that even a properly executed sagebrush treatment will reduce sage-grouse habitat for many years before the beneficial aspects of site progression accrue.

Table 3 identifies the progression of sagebrush following fire in sites in the southeast region of Wyoming's Bighorn Basin. The data indicates that the recovery of sagebrush is highly variable, but in general, quite slow. The speed of the progression increases with elevation, and these are all relatively high elevations sites. In the table the "m" or "wy" designation on the "Burn Name" indicates mountain or Wyoming big sagebrush subspecies. Seven of the 10 sites evaluated are mountain big sagebrush, and the Wyoming big sagebrush sites are at the upper edge of the Wyoming big sagebrush precipitation range. Recovery of sagebrush is not linear. Once a population of potential parent plants is established, the pace of sagebrush recovery increases. Nevertheless table 3 demonstrates that following fire, sagebrush and sage-grouse habitat is not present for many years, and on some sites sagebrush recovery is very slow. **Consequently, this document does not advocate, and should not be cited as justification for wide-scale treatments as a sage-grouse management tool.**

Table 3. Sagebrush Canopy Cover Pre and Post Prescribed Burn (McWilliams 2006)

	Pre Burn		Post Burn			
Burn Name	Burn Date	% Canopy	Date	% Canopy	% Canopy July 2009	Years
Blue Creek - m	May 1984	51	Aug 2002	4.0	5.0	26
Bobbys Pasture - wy	Sep 1985	23	Nov 2006	8.0	9.0	24
Blue Creek - m	Oct 1985	46	2001	5.0	4.0	24
Chicken Pill #1 - wy	Sep 1987	27	Nov 2006	0.1	0.2	22
Southside - m	Sep 1987	37	Nov 2006	0.0	5.0	22
Grass Point - wy	Oct 1988	22	Nov 2006	0.0	0.0	21
OTA Pasture - m	Oct 1988	13	2001	2.0	5.0	21
Lick log - m	Sep 1989	30	Nov 2006	15.0	28.0	20
Twenty-one creek - m	Oct 1992	32	Jul 2002	0.0	0.0	17
Double H - m	Sep 1995	40	Dec 2006	5.0	5.0	14
Dawn Spring - m	Oct 1996	21	Aug 2002	9.0	11.0	13
Urwin 21 - m	Sep 1997	8	2002	9.0	15.0	12
Double H willow - m	Sep 1998	45	Dec 2006	5.0	25.0	11
Double H willow - m	Sep 1998	50	Dec 2006	19.0	42.0	11

When sagebrush habitat was vast and unbroken, periodic disturbance served to enhance and rejuvenate individual stands. Given the current fragmentation of sagebrush habitat, the potential value of the transition from Sagebrush/Rhizomatous Grass-Bluegrass State to the Sagebrush/Bunchgrass Plant Community in the Reference State may or may not be worth the interim loss of sage-grouse habitat associated with the treatment. In many cases, managing grazing for high plant vigor in the Sagebrush/Rhizomatous Grass-Bluegrass State may be the

best option. Given the recommendations of the Wyoming sage-grouse habitat management guidelines, no more than 20% of the nesting, early brood-rearing and wintering habitats (combined) in a landscape should be treated at any one time, and subsequent treatments should be deferred until initially treated habitats have again recovered to at least 12% canopy cover in Wyoming big sagebrush and 15% in mountain big sagebrush dominated areas (Bohne et al. 2007). A small scale case by case disturbance regime conducted over the long-term is therefore recommended. When chemicals are used to reduce sagebrush canopy, the herbicide application should be researched carefully prior to implementation in relation to site-by-site objectives. Extreme caution and discretion should be employed, especially on drier sites, sites where cheatgrass may invade, or sites with limited potential to produce sagebrush such as the interface between the Wyoming Basin and the Great Plains. Comprehensive reviews of the literature pertaining to sagebrush and sage-grouse response to different treatment options (including fire) can be found in Rowland (2004) and Howard (1999).

If a treatment is planned to enhance forage volume, or achieve any of the advantages associated with the Reference State, the following sage-grouse habitat issues should be specifically considered. Sage-grouse biology suggests that manipulating large proportions of available sagebrush habitats, or manipulating wintering or nesting habitats has the greatest potential to result in population declines. The following discussion provides a basis for why manipulations that remove large amounts of sagebrush over large areas, especially in areas of limited nesting or wintering habitat, should be avoided. All types of manipulations (e.g., prescribed fire, mowing, and herbicide treatment) are generalized unless otherwise noted.

• **Nesting -** Some research has found that sage-grouse hens restrict their nesting use of manipulated areas to remaining patches of live sagebrush, while others have found similar nesting densities in treated and untreated areas. Sage-grouse have been documented nesting under non-sagebrush shrubs in treated habitats, but these selected areas were structurally similar to untreated habitats in terms of overall shrub cover. Research in Idaho documented lower nest success for females using non-sagebrush sites, while research in southwestern Wyoming reported no difference in nest success probabilities for nests inside versus outside burn boundaries. However, regardless of where females choose to nest, research suggests that manipulation of large amounts of available nesting habitat is likely to restrict the amount of area with suitable structural conditions, which may negatively influence nesting success within and near manipulated areas.

• **Early Brood-Rearing -** Prescribed fire in Idaho resulted in no change to forb cover but insect abundance decreased, suggesting that brooding habitat quality was negatively influenced. However, some studies have documented that sage-grouse broods neither selected nor avoided treated habitats. Brooding females in burned habitats in southwestern Wyoming moved shorter distances from their nests compared to those brooding in unburned areas, suggesting that brood-rearing habitat may have been enhanced by burning. Furthermore, sage-grouse using burned habitats were most commonly observed less than 60 meters of either side of the burned/unburned edge from May-August. In contrast, broods in Idaho did not use treated areas for 2 years post-treatment.

• **Winter -** Sagebrush removal on winter range can significantly reduce the availability of tall sagebrush that provides critical cover and food, especially during severe winters. Research in Idaho has documented substantial declines of sage-grouse populations and winter use of treated areas following the removal of approximately 60% of the sagebrush cover in a winter habitat area.

5. A Disturbance Presumption

The Platte River Model (Figure 3) presumes that succession following disturbance is set back to a point where sagebrush is absent. This presumption is used to simplify the scenarios, and isolate the effect of grazing as a key driver in plant community shifts that affect sage-grouse, but the presumption is not always true. Fire sets back succession to bare soil, but in many areas of the Wyoming Basin fire is infrequent because fuels are insufficient to carry wildfire. Drought, insects, heavy browsing or disease can serve to reduce the sagebrush canopy. An extended series of dry winters and wet springs can also disrupt a stable state and promote an increase in bunchgrasses.

The Reference State is not two discrete communities but the entire gradient between the Bunchgrass plant community and the Sagebrush/Bunchgrass plant community. Several treatment approaches offer the opportunity for a site to transition from the Sagebrush/Rhizomatous Grass-Bluegrass State into the Reference State at a point other than "no sagebrush." In an effort to depict this, progression arrows in the model (Figure 3) go to the edge of the Reference State box, rather than to one of the two plant communities presented inside the box. In some cases, carefully targeted livestock management can be used to provoke levels of browsing sufficient to remove sagebrush and restart the successional progression. Heavy browsing of sagebrush by wildlife and domestic sheep can open niches and cause transitions between states. Feeding livestock on sagebrush areas in the winter can reduce the sagebrush canopy. A comprehensive discussion of treatment alternatives is beyond the scope of this paper. Sedgwick (2004) includes extensive literature describing sagebrush rangeland response to different treatments.

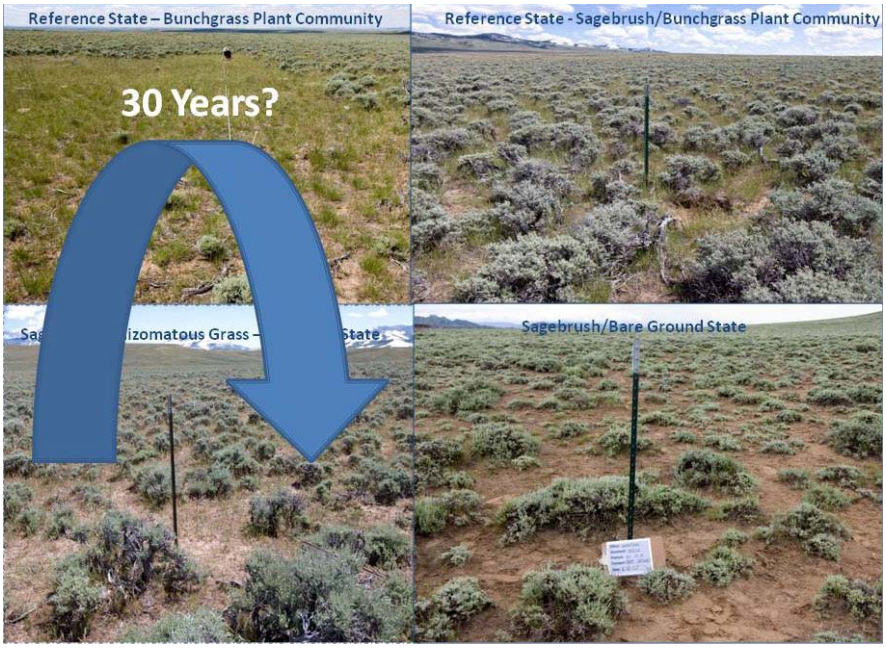
6. Grazing Influence on the Pace of Succession

This paper is predicated on the assumption that sagebrush canopy cover will stabilize at a level somewhere less than 35 percent on sandy and loamy ecological sites in the 10-14 inch precipitation zone. Grazing will not affect this outcome, but grazing does affect the pace of this progression. Herbaceous vegetation hinders (but does not prevent) the advance of sagebrush by occupying potential sagebrush germination sites. Consequently, healthy herbaceous plants slow the advance of sagebrush. The development of a Sagebrush/Bunchgrass plant community is the product of slow succession within the Reference State, where sagebrush slowly forms a canopy over a bunchgrass plant community.

Heavy continuous grazing depletes the grass community and enhances the opportunities for sagebrush to progress on the site. Figure 10 illustrates the probable result when a site in the Sagebrush/Rhizomatous Grass – Bluegrass State is burned, and post fire management is inappropriate. The site progresses back to the Sagebrush/Rhizomatous Grass – Bluegrass State rather than advances to the Sagebrush/Bunchgrass community. This is a worst case

scenario for sage-grouse. All sage-grouse habitat is lost from the treated site while the sagebrush is absent. By the time the sagebrush returns, the site has reformed with the Sagebrush Rhizomatous Grass – Bluegrass Community. From a sage-grouse habitat perspective much is ventured, and nothing is gained. The authors do not recommend using grazing as a tool to accelerate the advance of sagebrush on a treated site.

Figure 10 – Much Ventured/Nothing Gained



Grazing management is particularly important the first two growing seasons following disturbance. Deferment in this period allows the cool season bunchgrasses to capitalize on the open niches created. In some circumstances a residual population of cool season bunchgrasses was protected from grazing by shrubs. These plants are vulnerable following treatment, and must be protected by grazing management. Appendix G is a Wyoming BLM Instruction Memorandum addressing grazing management following sagebrush treatment. While the emphasis of this document is cattle grazing, treated areas draw grazing pressure from all herbivores. Project design should consider the possibility of an unplanned escalation of use by wild horses or elk.

7. Succession Variables Preceding Disturbance

The actual site progression will depend on the plant community in place prior to disturbance, and the grazing management following disturbance. Disturbance opens niches for cool season bunchgrasses to exploit, but they must be present on the site to take advantage. Appendix D shows that the Sagebrush/Rhizomatous Grass-Bluegrass State sampled on the Platte River Site had 0.6% cover of the big bunchgrasses. This residual base is probably enough to support a conversion to a bunchgrass community following disturbance. Cool season bunchgrasses are aggressive and successful in colonizing sites following disturbance when niches are open.

Sagebrush/Bare Ground State will not transition to Bunchgrass plant community in a single transition (disturbance) event. Figure 3 shows only a faint dashed line from the Sagebrush/Bare Ground State to the Reference State. This conversion may take several cycles of disturbance followed by excellent grazing management as described below. This process could take hundreds of years.

F. Grazing Management

Grazing influence on sage-grouse habitat is a function of both long-term management to promote desirable plant communities and annual management of the standing crop to provide cover for sage-grouse habitat. With few exceptions leaving adequate residual forage will provide for both long and short term objectives.

1. Long Term Management for Plant Heath

The key to managing for the Sagebrush Bunchgrass Reference State is to provide for the plant growth requirements of the cool season bunchgrasses. This long standing objective is thoroughly addressed in the literature (Ganskopp 1988, Caldwell et al.1981).

a. Key Factors

The timing and intensity of grazing are the two key factors that will affect plant health.

• **Timing** refers to when the plant is grazed. Annual growth of herbaceous vegetation in Wyoming big sagebrush habitat is generally concentrated in a four to six week period in the spring. During this season the plants are exchanging nutrients between the roots and the leaves. Each spring when suitable temperature and moisture conditions first coincide, plant growth is initiated from root reserves. Subsequent growth is largely fueled by the production of photosynthesis from the leaves. Repeated grazing in this critical period causes plants to reinitiate growth from root reserves multiple times, without sufficient energy capture from photosynthesis. Cool season bunchgrasses require periodic opportunity to photosynthesize without interruption from grazing. Without this opportunity these plants do not build healthy root systems. Consequently the key consideration of grazing management in sagebrush habitat is to assure that the cool season bunchgrass growth cycle is not interrupted repeatedly by heavy defoliation.

The critical growing season is the period the seedstalk is elongating, and seeds are developing. Grazing during this period has the greatest negative effect. The amount of remaining soil moisture available when the grazing occurs will dictate the actual impact to the plant. If ample soil moisture remains, and the plant is not re-grazed, the plant may sufficiently recover in the same year. However, the length of growth period in semi arid rangelands that produce sagebrush is generally too short to support a recovery of grazed plants in the same year. Grazing strategies generally must allow for uninterrupted growth in subsequent years.

Essentially, healthy grass plants are resilient to grazing pressure. "Overgrazing" is the long term product of repeated use without offering plants an opportunity to recover. Plants that have the opportunity to regrow following grazing are able to grow healthy root systems. Consequently they are less vulnerable to a future grazing event. Cool season bunchgrasses

that are not provided the opportunity to recover from grazing will become smaller, and eventually yield their space to more grazing resistant species.

• **Intensity** refers to the level of utilization the plant receives. There is no specific section on stocking in this paper because the presumption is that stocking will be established to achieve established utilization goals. Use levels are important because grazing systems seldom compensate for heavy utilization. Except in specialized circumstances, no more than moderate utilization is recommended.

Using the Landscape Appearance Method described in the Wyoming Rangeland Monitoring Guide, 41 to 60% utilization on key species could be equated with a moderate utilization level. This is described as, *"The rangeland appears entirely covered as uniformly as natural features and facilities will allow. 15-25% of the number of current seedstalks of herbaceous species remain intact. No more than 10% of the number of low-value herbaceous forage plants have been utilized."*

Moderate utilization generally results in <35% use on total herbaceous vegetation and <60% use of key species. Moderate use levels provide a patchy appearance to the observer as seen in Figure 11. When looking at plants in the immediate vicinity, the utilization is readily apparent. However ungrazed seedstalks and herbaceous production is readily apparent across the landscape.

Figure 11 - Moderate Utilization

Moderate utilization is important even when the timing of grazing is excellent because residual cover: 1) impedes run-off, 2) enhances infiltration into soils, and 3) helps retain organic material in the soil. All three factors increase the effectiveness of the precipitation.

Table 4 shows percent litter cover found in the four Platte River communities addressed in Figure 3.

Table 4. Litter Cover

Plant Community	Persistent and Non-Persistent Litter Cover %
Bunchgrass Plant Community (Reference State)	39.8
Sagebrush/Bunchgrass Plant Community (Reference State)	26.6
Sagebrush/Rhizomatous Grass – Bluegrass State	18.8
Sagebrush/Bare Ground State	13.4

The Reference State clearly offers the most opportunity for soil development. In this manner good grazing management has a cumulative positive effect. Plant litter and residual cover may also serve to provide an insulating effect that helps moderate the harsh environment associated with sagebrush sites in the Wyoming Basin. Independent of the timing of precipitation, moderate utilization is still a key factor in the long-term maintenance and development of the plant community.

The Landscape Appearance Method in the Wyoming Rangeland Monitoring Guide describes 61 to 80% (equating to heavy utilization) as, *"The rangeland has the appearance of complete search. Herbaceous species are almost completely utilized, with less than 10% of the seedstalks remaining."* In Figure 12 the only visible herbaceous material is protected by sagebrush or cactus plants. From a plant growth perspective, cool season bunchgrasses can take that level of use only if it occurs infrequently and outside the critical growing season.

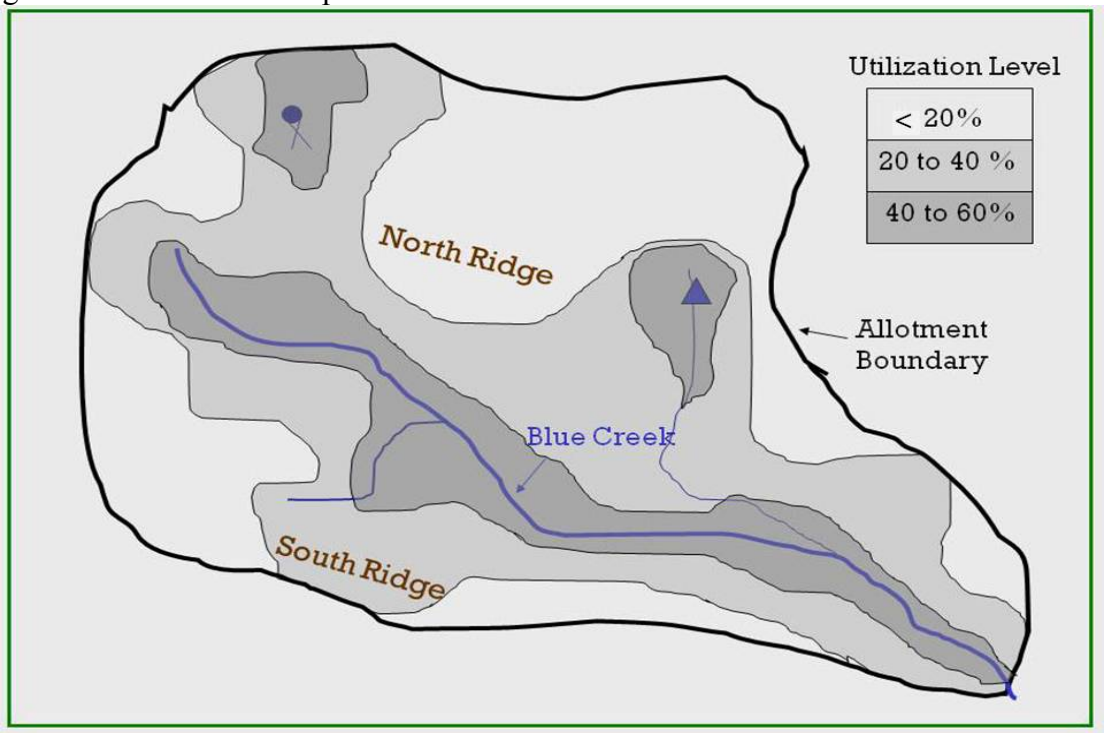
Figure 12 – Heavy Utilization

b. Grazing Use Pattern

To be meaningful, these utilization objectives must be applied to locations preferred by livestock. Figure 13 shows a schematic of a pasture with a typical use pattern featuring the heaviest use on gentle terrain near water sources. Some places in the landscape, such as the immediate vicinity of stock tanks, guarantee a concentration of animals that precludes a fair analysis of utilization. However, grazing management must be designed to meet plant growth requirements in the areas that livestock prefer. No grazing strategy can accept over utilizing the areas the livestock themselves prefer, in an effort to force utilization elsewhere. In areas with rough terrain or incomplete water availability, applying moderate use levels as the pasture average will assure the preferred ranges are over utilized.

The interagency Technical Reference 1734-3 "Utilization Studies and Residual Measurements" provides numerous methods for assessing levels of grazing use.

Figure 13– Use Pattern Map



Long Term Management for Plant Heath Summary - The timing and intensity of grazing will dictate plant vigor and whether grazing pressure will cause a transition from the Reference State to the Sagebrush/Rhizomatous Grass-Bluegrass State. While grazing systems seldom compensate for heavy use, no single utilization percentage can be identified as a measure of rangeland health. If a pasture has not been used in several years, the intensity may not be important with regard to long term plant health. If a pasture is used every year during the critical growing season, even moderate use may be too much. The acceptable volume of use will change based on how often the plant is grazed, how heavily the plant is grazed, and the season the plant is grazed.

c. Designing grazing strategies to meet the plant growth requirements of cool season bunchgrasses.

Grazing strategies should be designed to control timing and intensity. A ranch with one pasture can control timing and intensity once. A ranch with three pastures can control timing and intensity three times. The rationale for grazing management is that simple. Properly interpreting timing is predicated on an accurate analysis of the plant growth seasons. Figure 14 shows a graphic representation of seasons for the Platte River Site. These seasons, with their corresponding vulnerabilities and resiliencies, can vary from place to place and even pasture to pasture on a ranch with variable elevations. It is recommended that this table be constructed for each climatic region of a management unit as a first step in developing a grazing management plan. These seasons should serve as the core building blocks for designing grazing strategies.

Figure 14 – Platte River Site Seasons*

Upland Season	Winter			Early	Critical Growing	Late					Winter	
Month	J	F	M	April	May	June	July	Aug	Sep	Oct	N	D
Riparian Season	Winter			Early		Hot				Late	Winter	

Monthly Percentages of Cool Season Bunchgrass Growth

Month	J	F	M	April	May	June	July	Aug	Sep	Oct	N	D
				15	60	25						

* Upland seasons prepared for Cool Season Bunchgrasses on a Sandy Site in SE Wyoming with 10-14 inches of precipitation. Riparian Seasons are generalized for the region.

• **Upland Early Season –** Approximately April 1 to May 15

Figure 15 suggests that 15% of the annual growth occurs in April, and 60% occurs in May. Given the presumption that the bulk of the growth attributed to May occurs late in the month, there is 4 to 6 week period from late March through early May, where only around 20% of the annual growth occurs. Since the critical growing season does not emerge until the latter part of May, the period features green growth without vulnerable plants.

Timing -Intensity –Grazing Strategy Analysis:

Timing – Slow plant growth limits the potential for re-grazing growing plants. Because the critical point in the growing season is still upcoming, opportunity for regrowth is maximized.

Intensity – Excellent livestock distribution caused by cool weather reduces potential for heavy utilization on individual plants. Grazing use may be targeted on the upland sedges and bluegrasses that tend to green up earlier than the cool season bunchgrasses.

Grazing Strategy – Because upland sedges and bluegrasses tend to have greened up and the cool season bunchgrasses less advanced, utilization of cool season bunchgrasses will be low. Consider taking advantage of the opportunity this season offers. Review the photos in Appendix D, and note the advanced curing of the herbaceous vegetation on the Sagebrush/Rhizomatous Grass-Bluegrass State relative to the Sagebrush/Bunchgrass photo. Given a fixed stocking rate with regard to Animal Unit Months, extending the season to include this grazing period can serve to reduce the total number of head. Consequently adding this season can reduce the grazing pressure on forage plants during the critical growing season that follows. Given the cost of hay, taking advantage of this season can be a profitable way to reduce grazing impacts. Livestock distribution during this season, in combination with limited vulnerability of cool season bunchgrasses, precludes the need for rotational livestock movement. Pastures can be used every year during this season if they are periodically afforded the opportunity to regrow in the upcoming critical growing season. This season is traditionally avoided because the range is not "ready." If a range operation has the ability to control timing and intensity in the upcoming critical growing season, this upland early season is an opportunity to allow cost effective grazing with minimal environmental problems.

Note: There are specific short term standing crop issues associated with grazing and sage-grouse habitat during the early season. Essentially hiding cover from the previous year is being consumed during nesting and early brood rearing. See section F.2 (page 35) of this document for a discussion of standing crop issues.

• **Upland Critical Growing Season** – Approximately May 15 to June 15
The critical growing season features completion of growth, reproduction, and transfer of nutrients from leaves to roots. Rapidly warming temperatures promote a sudden commitment of root reserves to the leaves. Indications that the critical growing season is under way include:
→ visible rapid growth of green grass in the pasture,
→ the emergence of a 4th leaf from an individual shoot, and
→ the emergence of seed stalks.

Cool season Bunchgrasses are vulnerable to grazing pressure during this season. Figure 15 illustrates that as much as 70% of the annual growth will occur between early May and Mid June. By late June plants have replenished and developed their root systems with energy derived from the photosynthetic process.

Timing -Intensity-Grazing Strategy Analysis:
Timing – Rapid plant growth enhances the potential for re-grazing growing plants. Livestock distribution declines as temperatures increase. Plants in preferred locations, such as gentle terrain near water are likely to be re-grazed if livestock are in a pasture for more than 7 to 10 days. By the end of this season, cool season grasses are entering dormancy and opportunity for re-growth is gone. This opportunity must be provided in a subsequent year.

Intensity –The chance of heavy use of preferred species in preferred locations increases as the critical growing season progresses.

Grazing Strategy - Livestock must be somewhere during this critical season. Where vegetation objectives are not being met, and grazing management changes are planned, seek a strategy that offers deferment in this critical growing season in at least two of three years. This is particularly important where new water sources are proposed. The need for deferment in two out of three years is based on the observation that, assuming that use levels are moderate or more, two pasture systems that feature critical growing season deferment every other year are generally ineffective. Repeated or heavy use of cool season grasses in this season virtually assures that a site in the Reference State will transition to the Sagebrush/Rhizomatous Grass-Bluegrass State. Light or moderate use levels may be appropriate depending on the frequency of use and the opportunity to regrow delivered by the grazing strategy. It is critical that this season be managed by the actual growth of the plants in the current location and year, rather than the approximate dates used to plan the strategy.

• **Upland Late Season –** Approximately July 15 to October 31
Once the critical growing season ends, plant growth requirements are no longer at issue. Most forb species are dormant and ungrazeable at this point. When temperatures cool in early September regrowth of grass is common, but this growth is brief and relatively unimportant for plant growth requirements.

Timing -Intensity –Grazing Strategy Analysis:
Timing – Timing is excellent because the growing season is over.

Intensity – Utilization remains a concern. Residual vegetation at the soil surface remains important.

Grazing Strategy - Seek good distribution of grazing animals. Utilization levels often begin to rise as calves increase their intake of forage. This is particularly true for ranch operations that feature early calving strategies. However, cooler temperatures in the fall promote better distribution, especially when re-growth is present.

• **Upland Winter Season –** Approximately November 1 to March 31
Timing -Intensity –Grazing Strategy Analysis:
Timing – Timing is excellent because the plants are dormant.

Intensity – Utilization remains a concern. Residual vegetation at the soil surface remains important.

Grazing Strategy – Good distribution is the main objective.

d. Long Term Plant Growth Issues - Designing Grazing Strategies to meet riparian plant growth requirements
A comprehensive description of grazing related riparian issues is beyond the scope of this document, because the emphasis of the document is sagebrush habitat. Interagency Technical Reference 1737-20 is recommended for addressing grazing strategies in riparian areas. However, a brief analysis of the riparian seasons is identified in Figure 15.

• **Riparian Early Season** – Approximately April 1 to June 15
Cold water and the tendency for cold air to concentrate in lowlands results in riparian vegetation remaining dormant after adjacent uplands have greened up.

Timing -Intensity -Grazing Strategy Analysis:
Timing – Because the main growing season is still upcoming, opportunity for re-growth is maximized.

Intensity – Cool temperatures, dormant riparian vegetation, and the opportunity to graze green plants on adjacent uplands virtually eliminates grazing use in riparian areas early in this season. Warmer temperature in the latter stages of this season, in conjunction with the gradual green up of riparian zones, will gradually result in increasing use of riparian areas.

Grazing Strategy – Livestock do not select riparian habitat during this season, (especially the early portion). Take advantage of the opportunity to use riparian pastures at this time of year. Grazing riparian pastures in the riparian early season can provide important deferment for nearby upland pastures.

• **Riparian Hot Season** – Approximately June 15 to September 15
Grazing animals, particularly cattle, concentrate in riparian areas during the hot season. This season advances gradually as June progresses. By mid June cattle are concentrating in riparian areas in mid day. July and August form the core hot season; cattle may use riparian zones exclusively. In September, cattle begin foraging out in morning and evening, but remain concentrated in riparian zones during the hotter portions of the day.

Riparian issues are of critical importance because long term heavy use of riparian vegetation will affect not only the vegetation, but the site itself. Heavily rooted native vegetation protects the site from runoff events, traps sediments and supports high water tables. Loss of this vegetation can result in erosion, and a corresponding loss of site integrity associated with a decline in the height of the water table. Declining water tables cause a reduction in the acreage of riparian habitat available, which adversely affects habitat for many species, including livestock and sage-grouse.

Timing -Intensity-Grazing Strategy Analysis:
Timing- Riparian areas, by definition, retain access to water and do not require a short critical growing season to complete their growth cycle. While sedges have only limited ability to re-grow following grazing, the extended growing season provides a level of resiliency not associated with the adjacent uplands.

Intensity- The resiliency associated with riparian zones is offset by the preference of cattle to use these areas. Preference for riparian areas accrues gradually as temperatures rise and accelerates in mid-summer as vegetation in adjacent uplands cures. This concentration on riparian areas is based on three factors including: 1) easy access to water, 2) an unwillingness of cattle to travel in hot weather, and 3) cattle preference for green vegetation in comparison with dry upland vegetation. Heavy use by cattle when they have access to riparian areas in

the hot season is virtually certain. Use levels on riparian trees, shrubs, and herbaceous plants can be severe, unless the grazing period is limited.

Grazing Strategy – The extreme preference for riparian areas by cattle requires that access to riparian areas must be controlled. The difference in phenology is particularly important. Because grazing animals prefer green forage to cured forage, development of upland water sources does not always result in drawing grazing animals away from riparian zones. In some cases, cattle preference for riparian habitat can be so strong in late summer that distribution is almost entirely impaired and upland vegetation is virtually unused. These preferred sites can be a negative for livestock performance. Consider riparian pastures that provide only carefully controlled livestock (cattle) access to high value riparian areas during the hot season. Seek a strategy where cattle have access to riparian areas during the hot season only one year in three.

• **Riparian Late Season –** Approximately September 15 to October 31
Freezing weather ends the riparian growing season even when moisture is available for plant growth.

Timing -Intensity-Grazing Strategy Analysis:
Timing - By the end of this season vegetation is entering dormancy so timing is not at issue.

Intensity - Cooler weather improves livestock distribution especially when freezing temperatures eliminate the contrast between green riparian vegetation and cured uplands. Grazing and browsing pressure in this season is highly variable. Declining preference for riparian vegetation by livestock may or may not occur. Grazing use of the herbaceous community generally declines, but browsing of woody vegetation may continue or even accelerate. Preference for riparian herbaceous vegetation is not nearly as strong if the plants have had an opportunity to mature.

Grazing Strategy - Riparian zones may or may not require special consideration in this season. Leaving residual vegetation for streambank protection is particularly important late in the season on systems where high spring peak flows are expected.

• **Riparian Winter Season –** Approximately November 1 to March 31
Timing -Intensity -Grazing Strategy Analysis:
Riparian plants are entirely dormant and winter conditions exist through March. In some situations riparian areas are lightly used. Heavy browsing of woody riparian vegetation, exceeding 100% of the previous growing season leader growth, is possible. Some feed supplements are known to promote winter use of woody riparian vegetation by cattle.

2. Annual Management of the Standing Crop

The photo on the left shows a fence line contrast south of the Sweetwater River in central Wyoming that functions according to the Platte River model shown in figure 4.

Both sides of the fence feature a Sagebrush/Bunchgrass Plant Community in the Reference State.

Obviously the stand in the distance offers more residual hiding cover for grouse nesting.

Managing for the Sagebrush/Bunchgrass Plant Community addresses many but not all grazing issues. The potential exists to manage a site for its long-term forage plant health but fail to achieve sage-grouse habitat objectives. For example, late season and winter use may provide for long-term plant growth requirements, but fail to provide sufficient hiding cover for sage-grouse. Sage-grouse initiate nesting in April, prior to production of the current year's standing crop of herbaceous forage. Thus, residual grasses left from the previous year represent the initial cover available for nesting sage-grouse.

Moderate use is patchy so it entails some ungrazed plants in the landscape. Consequently, moderate utilization levels accrued after mid May will provide the standing crop necessary for sage-grouse nesting and early brood-rearing the following spring. While limited re-growth occurs in the fall, volume is generally insufficient to promote cover for sage-grouse habitat.

Evaluation of hiding cover must be a site-specific consideration. Ranch operations with a small amount of nesting habitat should consider special management for nesting and early brood- rearing areas. Light use of those tracts may be warranted. In areas with extensive habitat, operators should manage the standing crop so that all individual nesting areas have ample cover at least periodically. In areas where sage-grouse nesting is common, managing for the plant growth requirements of cool season bunchgrasses across the landscape should be adequate (i.e. moderate use). Well managed ranges with comprehensive grazing strategies that entail infrequent higher levels of use may be acceptable, provided that these higher levels of use occur in conjunction with ample standing crop cover in nearby pastures.

3. Project Infrastructure

In many circumstances, intensive grazing management strategies can result in high levels of economic productivity while providing for plant growth requirements. Multiple pastures offer better control of both timing and utilization levels. The down side of intensive grazing programs is the greater investment in infrastructure, such as fencing and water development, and increased labor cost to implement active management. High operating expenses can

require high stocking, which could be detrimental to sage-grouse. Furthermore, range project infrastructure can be a source of habitat fragmentation. Effective herding can substitute for a substantial portion of infrastructure if there are large enough herds to justify the full time personnel investment needed. The final approach should be based on an individual livestock operation's site specific strategy. From a sage-grouse management perspective, high intensity systems are only desirable if they are highly effective in promoting both rangeland health and short term nesting cover.

There are benefits and risks associated with any management action. Implementing a rotational grazing system can require construction of fences and/or water developments. However, sage-grouse can be killed or injured by fences and water troughs can cause drowning. Such losses can be largely avoided through the use of fence markers (Figure 15) and water trough escape ramps (Figure 16). Further information on these devices can be obtained through local Game and Fish or Conservation District offices.

Figure 15 – Visibility Markers for Fences

Figure 16 – Water Trough Escape Ramp

Not every fence is a problem; those that tend to cause problems are: 1) constructed with steel t-posts, 2) are constructed near leks, 3) bisect winter concentration areas, or 4) border riparian areas. Avoid building fences within at least ¼ mile (preferably 0.6 mile) of leks. New and existing fences in these areas should be surveyed for evidence of grouse fence strikes before installing permanent fence markers. In brief, surveys can be conducted by walking, driving or riding slowly (2-3 mph) along the fence looking for carcasses or concentrations of feathers on the ground and individual feathers caught on top wire barbs. Evidence of fence strikes do not last long due to weather and scavengers. The discovery of fence strikes is therefore cause for mitigation. Wood fence posts increase fence visibility but provide raptor and raven perches. Providing such perch sites should be avoided when feasible.

Many species of wildlife use water tanks and troughs. Escape ramps should be installed in all water troughs/tanks as a standard practice. It is imperative that the ramp be installed so it is encountered by animals swimming along the edge of the tank. These devices reduce unnecessary wildlife mortality and result in cleaner water for livestock. Water developments that include an overflow area provide water on the ground and lessen the need for wildlife to drink directly from the tank. Springs and seeps should be protected from livestock trampling to prevent damage to the spring, maintain water quality and enhance the growth of food forbs for sage-grouse and other wildlife. In areas where West Nile virus has been documented to be an issue, efforts should be made to minimize mosquito habitat. These areas are generally described as being lower than 6,000 feet elevation with considerable areas of standing water. Multiple cases of West Nile virus in sage-grouse have been documented since 2003 in portions of Sheridan, Johnson, Campbell and Fremont Counties in Wyoming. Minimize areas of standing water with emergent vegetation in late summer. Where such areas cannot be eliminated, consider treating them with biological larvicide.

The tradeoff between project infrastructure (which can be negative to sage-grouse) and improved grazing management (which is a positive to sage-grouse) must be assessed on a case-by-case basis.

4. Distribution

Given appropriate livestock numbers and season of use, insure a relatively good distribution of grazing over the area to prevent areas of overuse. Overuse typically occurs around water sources and riparian zones. Low stress herding techniques have proven effective in improving cattle distribution. The desire for effectiveness has to be tempered with consideration of the infrastructure cost and the cost/availability of skilled labor needed to achieve good distribution.

5. Evaluation, Monitoring and Assessment

Rarely does a grazing management strategy function exactly as planned. Success is a product of constant evaluation and adjustment. Operators need flexibility to avoid problems and capitalize on opportunities. For example, if a reservoir that seldom holds water fills, it may be advantageous to stock the affected pasture immediately rather than wait until the period originally intended. Similarly, if it becomes apparent that livestock will not use a pasture in the manner a plan envisions, the plan must be revised. Grazing management plans

should provide flexibility to respond to current information. Fixed systems that do not allow an operator to respond to site specific real time information seldom work.

Conversely, allowing livestock to drift into pastures scheduled for rest or deferment is a consistent source of failure to achieve vegetation objectives. Livestock in the wrong pasture will focus on their favorite species in their favorite locations. These animals will put nearly 100% of their grazing pressure on the exact plants the grazing plan is designed to protect. Grazing strategies often require additional capital outlay for projects and additional labor to run the plan. Small numbers of livestock in the wrong place can negate the value of a good grazing plan.

Trend, actual use, utilization and climate data interrelate to provide insight regarding the effectiveness of grazing management. Trend studies measure change over time. Utilization data may also be an operational key that drives decisions, such as pasture moves. Trend and utilization data are most useful if correlated to long term records of actual grazing use so a cause and effect relationship is established. Precipitation data, particularly when measured during the critical growing season, will help filter effects attributable to management - versus those attributable to climatic conditions. Temperature and wind are more difficult to correlate, but they can be equally important.

6. Drought Management

The Platte River site was selected, in part, because Dr. Mike Smith at the University of Wyoming has undertaken a long term study at that location correlating precipitation to herbaceous productions on that site. Appendix C contains a discussion of those results. Appendix A contains a reference to Dr. Smith's recommendations regarding drought management. Conditions vary from year to year, but the bulk of the herbaceous production on the Platte River site, occurs in May, and is the product of precipitation in late April. Repeated regression analysis runs identified April 12 to April 19 as the period where precipitation was most strongly correlated to production. If April stays cool and wet, the growing season may continue well into May. However, if April is hot and dry, subsequent precipitation will probably not affect the annual herbaceous production. When herbaceous vegetation begins to enter dormancy, the landscape changes from a rich green color to an olive green color; when this color change is apparent, the annual herbaceous production is in place.

The key point is that in most situations range mangers know by early May what the year's herbaceous production will be and, if necessary, drought planning can begin. Hopefully the long term grazing management is such that annual fluctuations in moisture will average out over the long term. However once the herbaceous plant community begins the process of entering dormancy, subsequent precipitation will be too late. Subsequent rains have hydrologic value, and they can provide benefits such as filling stock ponds, but the annual herbaceous production will not be affected.

G. Summary of Grazing Management in Sage-Grouse Habitat

The sage-grouse literature suggests that intact sagebrush ecosystems are essential during all sage-grouse seasonal periods, and that a sagebrush canopy in conjunction with a robust herbaceous understory is the key to quality nesting and early brood rearing habitat. While grazing management has a limited effect on sagebrush, grazing management is important because it affects the height and density of herbaceous material available for sage-grouse hiding cover.

State and transition models are useful for developing vegetation objectives because they describe plant succession in sagebrush habitats. Most sagebrush dominated sites in Wyoming are capable of producing an herbaceous understory featuring large cool season bunchgrasses such as needle and thread. This Sagebrush/Bunchgrass community provides the highest quality sage-grouse nesting and early brood rearing habitat available, as well as excellent livestock forage. As a result of its value for both sage-grouse and livestock, a primary objective of grazing management is to maintain existing stands of Sagebrush/Bunchgrass. Repeated heavy use of cool season bunchgrasses during the spring growing season will promote a transition from a Sagebrush/Bunchgrass plant community to a more grazing resistant state such as Sagebrush/Rhizomatous-Bluegrass. While the latter state can provide adequate habitat for sage-grouse and forage for livestock - if the individual plants are vigorous and healthy, the Sagebrush/Rhizomatous-Bluegrass state has substantially lower resource values than the Sagebrush/Bunchgrass plant community.

The transition from a Sagebrush/Bunchgrass plant community to a Sagebrush/Rhizomatous-Bluegrass state is not readily reversible. The state and transition model concept dispels the common range management presumption that a transition from the Sagebrush/Rhizomatous-Bluegrass state to the Sagebrush/Bunchgrass state can be achieved through grazing management alone. It is critical that range managers and sage-grouse biologists do not predicate their habitat management strategy on this presumption.

Generally, the conversion of a site from Sagebrush/Rhizomatous-Bluegrass to Sagebrush/Bunchgrass requires disturbance such as fire to create open niches large cool season bunchgrasses can exploit. The long term benefit of this sequence is offset by the absence of sagebrush for an interim period, and the corresponding loss of sage-grouse habitat. The decision to treat sagebrush must be a case by case decision, and this document does not advocate wide-scale treatments as a sage-grouse habitat management tool.

Grazing management on sage-grouse habitat is a function of both long-term management to promote desirable plant communities, and annual management of the standing crop to provide cover for sage-grouse. Addressing these two aspects of plant health requires managing both the timing and intensity (utilization) of grazing. In general, appropriately timed grazing with moderate utilization levels will maintain sites in the preferred Sagebrush/Bunchgrass plant community, and will promote plant vigor and sage-grouse values in the less-preferred Sagebrush/Rhizomatous-Bluegrass state.

Table 5. Summary of Grazing Management Recommendations by Seasonal Sage-grouse Habitat

Sage-Grouse Habitat Season	Grazing Issue
Mating-Leks	Avoid any new sources of disturbance such as range improvements on lek sites. Identify the location of leks through consultation with local biologists so they can be provided appropriate emphasis.
Nesting/Early Brood-Rearing	This topic is the emphasis of this document. Maintain the Sagebrush/Bunchgrass Plant Community wherever currently present. Manage for high vigor in all plant communities. Avoid repeatedly using cool-season bunchgrasses in the critical growing season and limit utilization to moderate levels to assure that the previous year's standing crop is available for hiding cover.
Late Brood-Rearing	Summer sage-grouse habitat is a product of riparian health. Avoid repeatedly grazing riparian areas in seasons when temperatures are high.
Winter	Grazing has limited effect on winter sage-grouse habitat unless use of sagebrush itself becomes severe. Avoid levels of browsing on sagebrush that would limit sage-grouse access to their food supply and cover. Additionally, avoid heavy use of herbaceous standing crop as this will adversely affect hiding cover the following year.

Table 6. Summary of Habitat Values and Grazing Management Recommendations by Vegetation Community

Vegetation Community	Sage-grouse Habitat Value	Livestock Habitat Value	Objective	Grazing Management Recommendations
Bunchgrass	Very Low– Lack of sagebrush limits sage-grouse nesting, brood-rearing and winter habitats.	Excellent – This is the maximum herbaceous forage production	Retain a carefully considered mosaic of bunchgrass and sagebrush / bunchgrass communities. Avoid a transition to the sagebrush / rhizomatous – bluegrass community.	Recognize that this plant community is the product of long term excellent grazing management. Carefully consider changes in management that would increase utilization or change the timing of grazing on these sites. Proper grazing management following disturbance is critical. Retain sufficient residual cover to provide sage-grouse hiding cover the following year. Employ planned grazing; periodic small scale disturbance such as occasional thinning or specialized small ruminant grazing of sagebrush will help maintain this desired state.
Sagebrush / Bunchgrass	Excellent - Mix of sagebrush and herbaceous understory is ideal for nesting and brood-rearing. Winter habitat values are also present.	Good for cattle. Excellent for sheep.		
Sagebrush / Rhizomatous Grass - Bluegrass	Variable – Stands with high vigor may offer good nesting and brood-rearing habitat. Quality of habitat is particularly dependent on climate, with wet years producing better production and habitat quality. Winter habitat values are present.	Fair	Avoid a transition to sagebrush / bare ground. Maintain high vigor and health of the existing herbaceous understory. Where appropriate, treat sagebrush to reestablish the bunchgrass plant community and foster progression the Sagebrush / Bunchgrass community.	Establish grazing strategies tailored to plant growth requirements of cool season grasses. Proper grazing management following disturbance is critical. Retain sufficient residual cover to provide sage-grouse hiding cover the following year. Avoid confining animals on inadequate pasture, or supplemental feeding to compensate for a lack of natural forage.
Sagebrush / Bare Ground	Low – Lack of herbaceous understory precludes nesting opportunity. Winter values are present.	Poor – Lacks herbaceous forage.	Rehabilitate and restore the site.	Restrict grazing in conjunction with restoration efforts until the site is ready to sustain grazing.

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Thanks to the following individuals who provided valuable comments on earlier drafts of this report:

- Bob Fowler – Bureau of Land Management
- Jeff Mosley – Montana State University
- Jack Connelly – Idaho Department of Game and Fish
- Rick Northrup and Michael R. Frisina – Montana Fish, Wildlife & Parks
- Ann Hild – University of Wyoming

Appendix A - Previous Work

For a listing of research documents on greater sage-grouse in Wyoming: http://gf.state.wy.us/wildlife/wildlife_management/sagegrouse/techdocs/index.asp

A Synthesis of Livestock Grazing Management Literature Addressing Grazing Management for Greater Sage-Grouse Habitat in the Wyoming Basin – Southern Rocky Mountains Ecoregions: http://sagemap.wr.usgs.gov/docs/Literature%20Synthesis.doc.

A synthesis of sage-grouse ecology and habitat use. Conservation Assessment of Greater Sage-Grouse and sagebrush habitats, chapters 3 and 4: *http://sagemap.wr.usgs.gov/docs/Greater_Sage-grouse_Conservation_Assessment_060404.pdf*

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The Bureau of Land Management's National Sage-Grouse Habitat Conservation Strategy of November 2004 specifies under part 1.4.3 that the BLM will, "Develop and issue livestock grazing BMPs to restore, maintain, or enhance the quality of sage-grouse and the sagebrush habitat." The document also provides under part 3.3.5 that the "BLM will provide training to ensure Bureau-wide understanding of sage-grouse habitat requirements and Best Management Practices (BMPs) across all disciplines."

The National Range and Pasture Handbook. Natural Resource Conservation Service. http://www.glti.nrcs.usda.gov/technical/publications/nrph.html

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The Wyoming Rangeland Monitoring Guide. 2001. Bureau of Land Management, the Forest Service, the Natural Resource Conservation Service, the University of Wyoming Department Of Renewable Resources, the University of Wyoming Extension Service, The Wyoming Department of Agriculture, and the Wyoming Section of the Society of Range Management. The purpose of the document was to encourage range monitoring by livestock producers.

Appendix B - Ecological Sites in the Green and Platte River Major Land Resource Areas (34 A)

Green River and Great Divide Basins; 7-9 Inch Precipitation Zone

Ecological sites that provide key big sagebrush habitat

Sands	Sandy	Loamy	

Ecological sites with heavy or shallow soils

Clayey	Dense Clay	Gravelly	Impervious Clay
Shallow Breaks	Shallow Clayey	Shallow Sandy	Shallow Loamy
Very Shallow			

Ecological sites with Salty Soils

Saline Lowland	Saline Lowland, Drained	Saline Subirrigated	Saline Upland
Shale			

Ecological sites that provide basin big sagebrush habitat

Lowland			

Ecological sites that provide riparian habitat

Subirrigated	Wetland		

Foothills and Basins West; 10-14 Inch Precipitation Zone

Ecological sites that provide key big sagebrush habitat

Loamy	Sands	Sandy	Shallow Loamy
Shallow Sandy			

Ecological sites with heavy or shallow soils

Coarse Upland	Clayey	Dense Clay	Gravelly
Igneous	Rocky Hills	Shallow Breaks	Shallow Clayey
Shallow Igneous	Shallow Loamy, Calcareous	Very Shallow	

Ecological sites with salty soils

Saline Lowland	Saline Lowland, drained	Saline Subirrigated	Shale
Saline Upland			

Ecological Sites that provide basin big sagebrush habitat

Lowland	Overflow	Clayey Overflow	

Ecological sites that provide riparian habitat

Subirrigated	Wetland		

High Plains South East; 10-14 Inch Precipitation Zone

Ecological sites that provide key big sagebrush habitat

Loamy	Sands	Sandy	Shallow Loamy
Shallow Sandy	Steep Loamy		

Ecological sites with heavy or shallow soils

Clayey	Coarse Upland	Dense Clay	Gravelly
Impervious Clay	Shallow Breaks	Shallow Clayey	Very Shallow
Rocky Hills			

Ecological sites with salty soils

Saline Lowland	Saline Loamy	Saline Subirrigated	Saline Upland
Shale			

Ecological sites that provide basin big sagebrush habitat

Lowland	Clayey Overflow	Loamy Overflow	

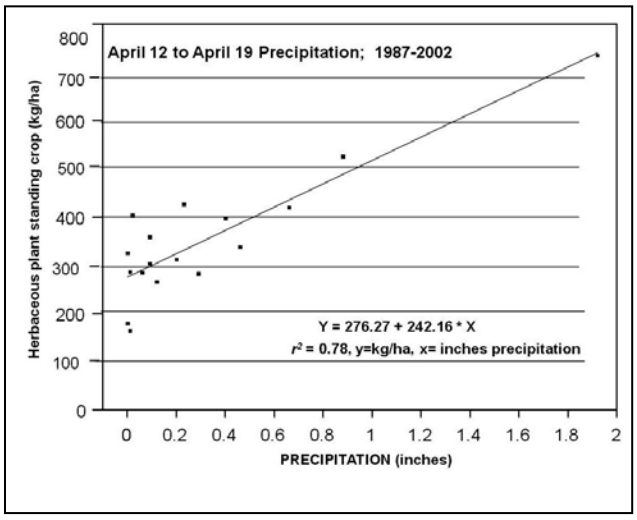
Ecological sites that provide riparian habitat

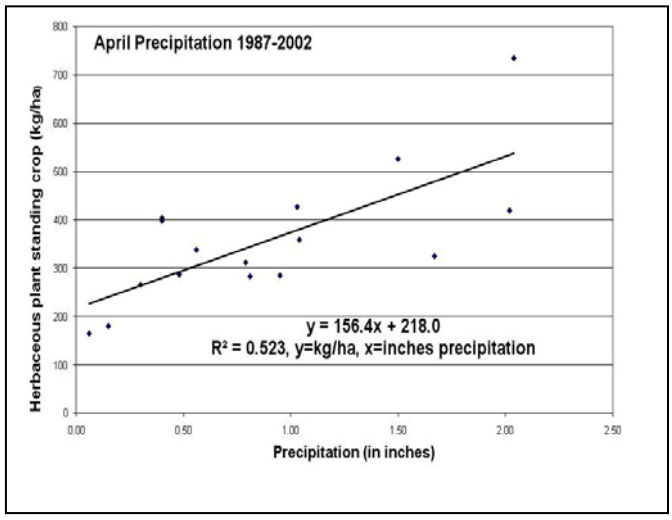
Subirrigated	Wetland		

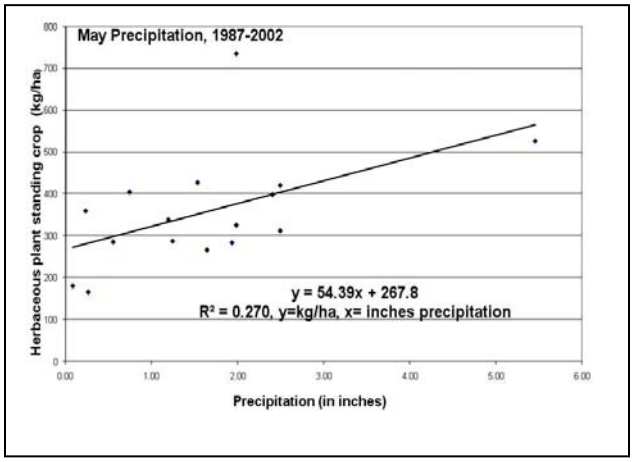
Appendix C - Precipitation and Plant Production Charts

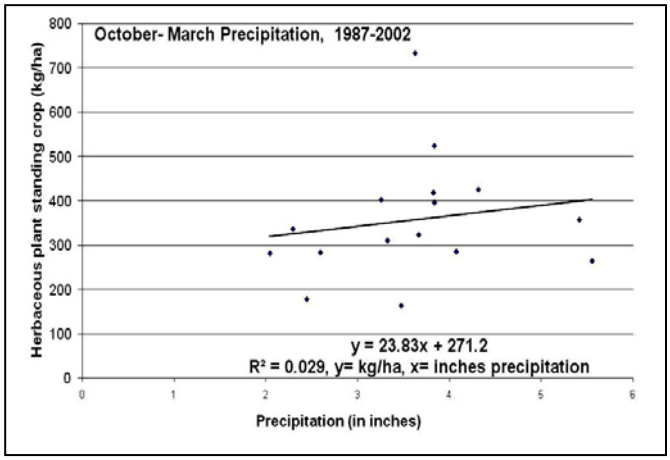
Since 1987, Dr. Mike Smith, professor of Range Management at the University of Wyoming has conducted production studies in sagebrush habitat at a Platte River site northeast of Saratoga Wyoming. The charts below are regression analyses designed to correlate the timing of precipitation to the herbaceous production. In the charts below R^2 is the percentage of the production that is correlated to the precipitation. The regression is of the form $y=a+bx$, where y = *kg/ha (=1.1 lb/ac)* of standing crop, a is the intercept, where the line would hit the vertical axis at zero precipitation during that particular period; bx is the constant b times x inches of precipitation that fell during the period. The charts indicate that winter precipitation has only a 2.9% correlation. The correlation for May is 27%, and April is 53%. Repeated trial and error regressions identified the highest correlation of 78% for the period of April 12th to April 19th.

This analysis demonstrates that the herbaceous production of the plant community is the product of early spring precipitation. Winter snow pack on these sites melts over an extend series of days in late winter-early spring where intermittent temperatures are warm enough to melt snow, but the overall climatic conditions are too cold to initiate growth. In most years, the top few inches of the soil profile is dry immediately prior to the onset of growth.









Appendix D – Platte River Site Data and Photos

The four plant communities (Bunchgrass, Sagebrush/Bunchgrass, Sagebrush/ Rhizomatous grass - Bluegrass, and Sagebrush/Bare ground) included in the Platte River State and Transition Model were sampled in June of 2007.

Cover was identified utilizing imaged based methods developed by the Agricultural Research Station in Cheyenne, Wyoming. Each transect was sampled with 20 ½ meter photos evenly spaces along a 100 meter tape. Twenty-five points per photo (for a total of 500 points per transect) were observed for each vegetation community in the following 26 categories.

Plant Associations & Button List - Sandy 10-14 High Plains Southeast Ecological Site

Group	Description	Examples:				
1	Unknown Grass					
a	Cool Season Bunchgrass	Needle & Thread	Indian Ricegrass	Squirreltail	Bluebunch Wheatgrass	
b	Rhizomatous & Poas	Thickspike Wheatgrass	Prairie Junegrass	Sandberg Bluegrass	Mutton Bluegrass	
c	Upland Grasslikes	Threadleaf Sedge				
d	Warm Season Grasses	Blue grama				
2	Forbs					
a	Broad Leaf Forb	Asters	Bluebells	Buckwheat	Clovers	hawksbeard
b	Cushion Forb	Phlox	Pussytoes			
c	Cactus					
d	Annual Forb	Alyssum	Annual Mustards			
3	Shrub					
a	Big Sagebrush	Wyoming Sage				
b	Winter Fat					
c	Rabbitbrush	Green Rabbitbrush				
d	Bitterbrush					
e	Other Shrubs	Fringed Sage	Horsebrush			
4	Invasive Weed					
a	Cheatgrass					
b	Invasive Forb	Knapweed	Leafy Spurge	Dalmatian Toadflax	Yellow Star This.	Hounds tongue
5	Moss/Lichen/Cryptograms					
6	Persistent Litter	Logs	Branches			
7	Non Persistent Litter	Grass Stems	Dry Forb Material	Leaves	Dung	
8	Rock					
9	Bare Ground					
10	Obstructed	Plot frame or tape in crosshairs				
11	Unknown					

Plant Community Cover Data

Group	Plant Description	Bunchgrass % Cover	Sagebrush / Bunchgrass % Cover	Sagebrush / Rhizomatous - Bluegrass % Cover	Sagebrush / Bare Ground % Cover
Grass	Unknown Grass	11.8	3.8	0.2	1.2
	Cool Season Bunchgrass	13.4	5.8	0.6	
	Rhizomatous Grass & Bluegrass	15.2	9	5.4	
Forb	Broad Leaf Forb	2.2	3.4	0.6	
	Cushion Forb		1	0.6	
	Annual Forb	0.2	0.2	2.2	0.6
Shrub	Big Sagebrush	0.2	21.2	29.4	33.6
	Winter Fat			0.2	
	Rabbitbrush				0.2
	Other Shrubs		0.4		
Weed	Cheatgrass		0.2		
	Moss/Lichen/Cryptogram		0.4	2.4	0.4
	Persistent Litter	6.4	4	2.6	1.8
	Non Persistent Litter	33.4	26.2	16.2	11.6
	Rock				
	Bare Ground	14.8	21.4	36	49.4
	Obstructed	0.6	0.6	0.6	0.2
	Unknown	1.6	2.4	2.6	0.8
	Totals	100	100	99.6	99.8

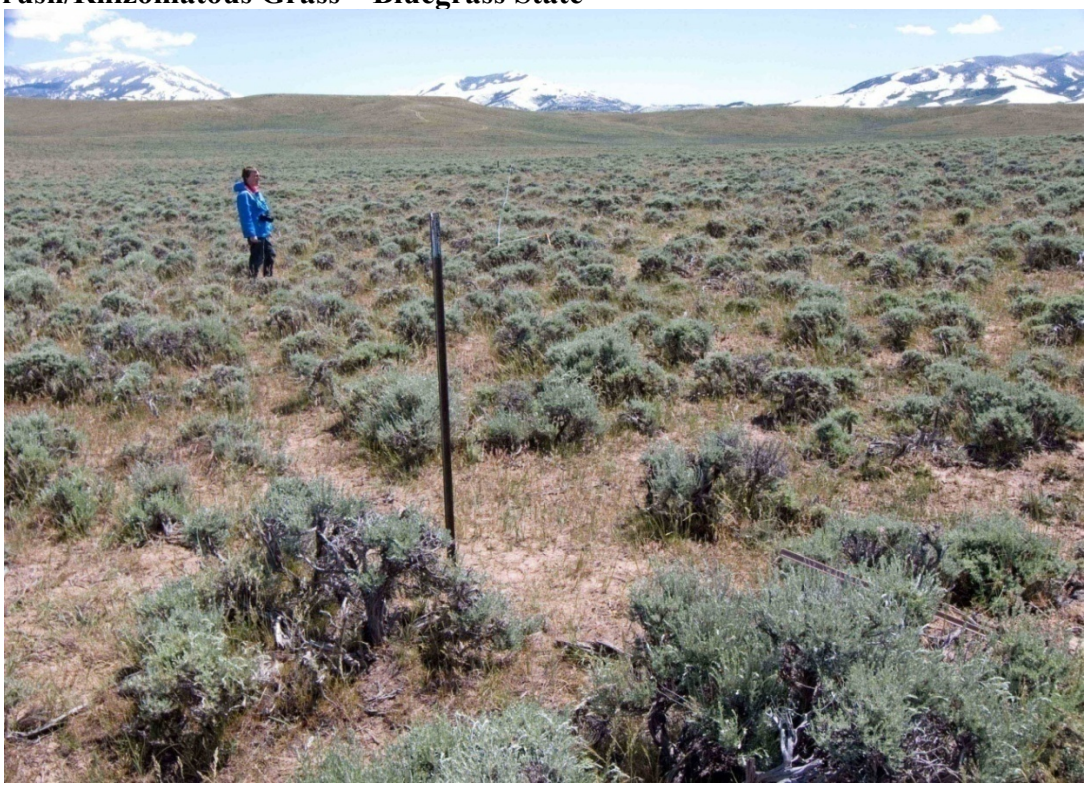
Summary Data

Group	Description	Bunchgrass % Cover	Sagebrush / Bunchgrass % Cover	Sage brush / Rhizomatous - Bluegrass % Cover	Sage brush / Bare Ground % Cover
1	Grass	40.4	18.6	6.2	1.2
2	Forbs	2.4	4.6	3.4	0.6
3	Shrub	0.2	21.6	29.6	33.8
4	Invasive Weed	0	0.2	0	0
5	Moss/Lichen/Cryptogram	0	0.4	2.4	0.4
7	Persistent Litter	6.4	4	2.6	1.8
8	Non Persistent Litter	33.4	26.2	16.2	11.6
9	Rock	0	0	0	0
10	Bare Ground	14.8	21.4	36	49.4
11	Obstructed	0.6	0.6	0.6	0.2
12	Unknown	1.6	2.4	2.6	0.8
	Totals	100	100	99.6	99.8
	Total Vegetation Cover	43	45	39.2	35.6

Bunchgrass Plant Community (Reference State)

Sagebrush/Bunchgrass Plant Community (Reference State)

Sagebrush/Rhizomatous Grass – Bluegrass State



Sagebrush /Bare Ground State

Appendix E
Variations to the Platte River State and Transition Model

The Platte River model was selected for analysis because it represents much of the sagebrush habitat in the Green and Platte River Valleys. However, not all sagebrush dominated sites in Wyoming progress in this manner. The Platte River State and Transition model is not identical to the model presented in the Sandy 10-14 inch ecological site guide. The state and transition model in the site guide includes additional scenarios that occur in the Major Land Resource Area, whereas the Platte River Model is specific to an individual location. This Appendix discusses some of the many variations to the Platte River model that Wyoming range managers, landowners and wildlife managers may encounter.

Loamy soils in Wyoming, such as the Bighorn Basin site below, generally function in accordance with the same state and transition model for sandy sites but feature bluebunch wheatgrass as the predominant cool season bunchgrass instead of Needle and Thread.

Loamy Soil
Sagebrush/Bluebunch Wheatgrass- **Sagebrush/Upland Sedge**

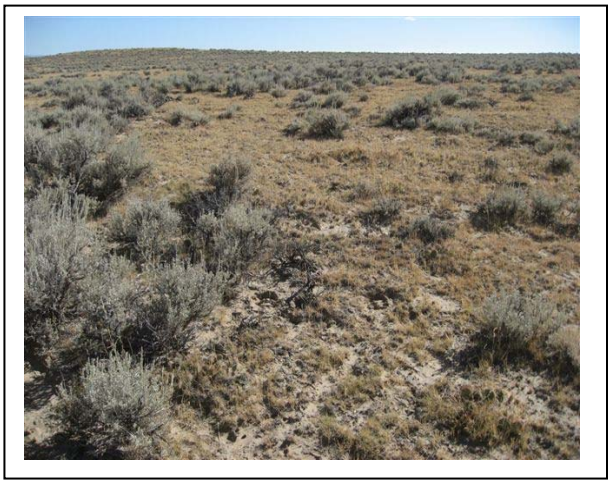
One key progression not represented on the Platte River State and Transition model is the potential transition to upland sedges. The shallow loamy site shown above is a harsh site near South Pass, which is dominated by cold windy conditions. The Sagebrush/Bunchgrass plant community (featuring Bluebunch Wheatgrass) will progress to a Sagebrush/Needleleaf sedge community if the grazing management does not meet the plant growth requirements of Bluebunch Wheatgrass. The Sagebrush/Rhizomatous Grass-Bluegrass state does not form.

Ecological sites represent stages along a continuum. There are not, for example, two kinds of loamy sites in Wyoming – one loamy and another shallow loamy. Rather there exists a gradient range of soil depth on loamy sites with two ecological sites assigned to represent that range of variability. The degree of soil salinity also forms a continuum. Lowland sites feature basin big sagebrush whereas saline lowland sites feature greasewood. Numerous sites in Wyoming have a degree of soil salinity that allows an intermingling of basin big sagebrush and greasewood. The photo, titled Sagebrush/Squirreltail, below shows a location in the Bighorn Basin where sagebrush intermingles with Gardner saltbush. It is the product of the edge between a loamy site

and a saline upland site. The herbaceous community is almost exclusively comprised of bottlebrush squirreltail. The Sagebrush Rhizomatous Grass-Bluegrass State does not form on this site.

Sagebrush/Squirreltail

Sagebrush/Blue Grama



Major Land Resource Area 32

MLRA 32 includes the Bighorn Basin and the arid lands immediately to the south in the vicinity of Boysen Reservoir. Some areas of the MLRA feature less than the seven inches of precipitation, and offer sagebrush canopies too light for substantive sage-grouse habitat. A review of figure 1 shows that most sage-grouse leks occur in the ring of foothills between the arid floor of the Big Horn Basin and the surrounding high country. Big Horn Basin sagebrush sites with less than 10 inches of precipitation face a risk more severe than their MLRA 34A counterparts. When subject to heavy or repeated critical growing season grazing Sagebrush/Bunchgrass sites progress to Sagebrush/Blue Grama States rather than the Sagebrush/Rhizomatous Grass-Bluegrass State. This state offers limited sage-grouse hiding cover and is exceptionally stable. It is exceptionally difficult to convert a Sagebrush/Blue Grama State to a Sagebrush/Bunchgrass. Blue Grama stands often have high concentrations of pricklypair cactus. Many stands of sagebrush at lower elevations in the Big Horn Basin have converted to cheatgrass, following a series of large wildfires, just after the turn of the century.

Major Land Resource Area 58B

MLRA 58B occurs east of the Bighorn and Laramie Mountain Ranges, so it has tendencies associated with the Great Plains. Sagebrush may not regenerate following treatment in a reasonable management time frame, apparently because winter snow cover is not frequent or persistent enough to protect seedlings from desiccation and/or herbivory. Sagebrush is common in MLRA 58B, but climatic conditions not as favorable for sagebrush in comparison with MLRA 34A. When intact, the Sagebrush-Bunchgrass community is similar to that described for the Platte River site, and the recommended management of these sites would be the same. However, Sagebrush/Bunchgrass communities in MLRA 58B can transition to Sagebrush-Rhizomatous Wheatgrass or Bluegrass, as well as Sagebrush/Blue Grama. Red threeawn may increase, and pricklypear cactus populations move somewhat independently depending on weather and insects.

Cheatgrass is a major threat in MLRA 58B. In summary, Sagebrush-Bunchgrass states in 58B, and sage-grouse nesting and brood rearing habitat, are more at risk in MLRA 58B than in MLRA 34A. Detrimental cheatgrass and blue grama states are more likely to occur in response to continuous or season long grazing and, consequently, sagebrush will recover from disturbance more slowly.

The 15 to 19 inch Precipitation Zone

Figure 1 shows that sage-grouse leks are common along the edge of the high elevation MLRAs such as 43B, 47, and especially the northwest Sierra Madre foothills in 48A. In the high mountain foothills, soil moisture from snowpack is retained until later in the year when temperatures become favorable for plant growth. This situation results in mountain big sagebrush communities that have canopies up to 55%, and successional progressions are much different than the Platte River Model. Generally, sagebrush is more resilient in this environment. It comes back following disturbance more quickly than lower elevation counterparts, and these sites are not as vulnerable as their low elevation counterparts to threats such as cheatgrass and blue grama. Robust high elevation grasses such as Columbia needlegrass, mountain brome, and Idaho Fescue are the preferred reference state species. Species such as needle and thread, that form the herbaceous component of the desired plant community at lower elevations, can be the product of repeated growing season grazing at higher elevations. Most sites will be dominated by heavy sagebrush and bluegrasses given heavy, continuous season long grazing for an extended period of years. In the absence of disturbance, these sites are subject to encroachment by conifer communities.

Cheatgrass

The text in this paper addresses the historic natural progression in Wyoming Basin Sagebrush communities and the way livestock grazing affects progression. Cheatgrass dramatically changes the site progression because it not only occupies space, but it also changes the fire regime. Increased fire frequency eliminates the sagebrush overstory and destroys the sage-grouse habitat. The relationship between cheatgrass and livestock grazing is unclear. It is intuitive that livestock grazing may provide niches for cheatgrass by reducing competition with native herbaceous plants. However, the landscape is ripe with examples where cheatgrass advanced in the absence of livestock. The photo below shows cheatgrass intermingling with a robust stand of green needlegrass. Green needlegrass is perhaps the most palatable species on Wyoming rangelands, and does not persist when grazing use levels are heavy, or grazing entails repeated use in the critical growing season. Regardless, the critical importance of cheatgrass infestations provide another reason to assure that rangelands are healthy. Adhering to the principals of the section *Designing Grazing Strategies around the plant growth requirements of Cool Season Bunchgrasses*, will provide the level of competition to cheatgrass that can be delivered through grazing management. Appendix D demonstrates that the Sagebrush/Bunchgrass community in the Reference State offered 44.4% vegetation canopy cover. None of the other plant communities in the state and transition model offer the same level of competition against cheatgrass. UW Cooperative Extension Service B-111.08 (Appendix A) is recommended for a review of Wyoming cheatgrass issues.

The potential for cheatgrass or other weedy species to invade a treated site must be considered during the planning stages of a proposed treatment. Increasing the amount of cheatgrass on a site has the potential to result in the permanent conversion of that site into one that does not provide conditions suitable for sage-grouse. Although we do not specifically address cheatgrass in this document, if the possibility exists for cheatgrass to proliferate on a site we strongly discourage treating that site. The Wyoming and region-wide sage-grouse habitat management guidelines caution against treating sage-grouse habitats prone to cheatgrass invasion unless adequate measures are in place to ensure perennial species dominate the understory following treatment.

Cheatgrass-Green Needlegrass

Conifer Encroachment

Conifer Encroachment

Encroachment of juniper and limber pine is an important aspect of site progression in some areas. In many situations, juniper (some pinyon pine occurs in Wyoming south of Rock Springs) is restricted to shallow soil sites where understory fuels limit fire occurrence. However, in the absence of disturbance, trees will colonize adjacent stands previously dominated by sagebrush. In some areas, notably the Absoroka front of the Big Horn Basin, limber pine rapidly encroaches on sagebrush habitat.

Appendix F
Percent Similarity Scoring and Condition Class Nomenclature

The percent similarity range scoring method – Chapter 4 National Range and Pasture Handbook – has long been used to score range condition. In the percent similarity scoring system, the dry weight of the existing plant community is compared to the "potential plant community" described in the ecological site guide. The site guides specify an allowable percentage for each ecological site and range managers score the plant community by assessing the overlap between the existing plant community and the allowable percentage in the site guides.

Consider how "Percent Similarity Index" scoring system works from the chart below. The four plant communities shown in the Figure 3 are scored using the Wyoming Sandy 10-14 inch precipitation zone, High Plains SE Range Site Guide. The dry weight percentages were estimated from the photos and canopy cover data.

Percent Similarity Scoring

Plant Community 1 (Bunchgrass)

Plant Species	Dry Weight Percentage	Site Guide Percentage	Condition Score
Needle and Thread	35	50	35
Thickspike Wheat	30	25	25
Prairie Junegrass	10	5	5
Mutton Bluegrass	10	5	5
Perennial Forbs	10	10	10
Sagebrush	3	10	3
Rabbitbrush	2	5	2
	100		85

Plant Community 2 (Sagebrush/Bunchgrass)

Plant Species	Dry Weight Percentage	Site Guide Percentage	Condition Score
Needle and Thread	25	50	25
Thickspike Wheat	15	25	15
Prairie Junegrass	10	5	5
Mutton Bluegrass	10	5	5
Perennial Forbs	5	10	5
Sagebrush	25	10	10
Rabbitbrush	10	5	5
	100		70

Plant Community 3 (Sagebrush/Rhizomatous Grass - Bluegrass)

Plant Species	Dry Weight Percentage	Site Guide Percentage	Condition Score
Needle and Thread	10	50	10
Thickspike Wheat	5	25	5
Prairie Junegrass	10	5	5
Mutton Bluegrass	5	5	5
Perennial Forbs	5	10	5
Sagebrush	55	10	10
Rabbitbrush	10	5	5
	100		45

Plant Community 4 (Sagebrush/Bare Ground)

Plant Species	Dry Weight Percentage	Site Guide Percentage	Condition Score
Crested Wheat	1	0	0
Thickspike Wheat	1	25	1
Sagebrush	93	10	10
Rabbitbrush	5	5	5
	100		16

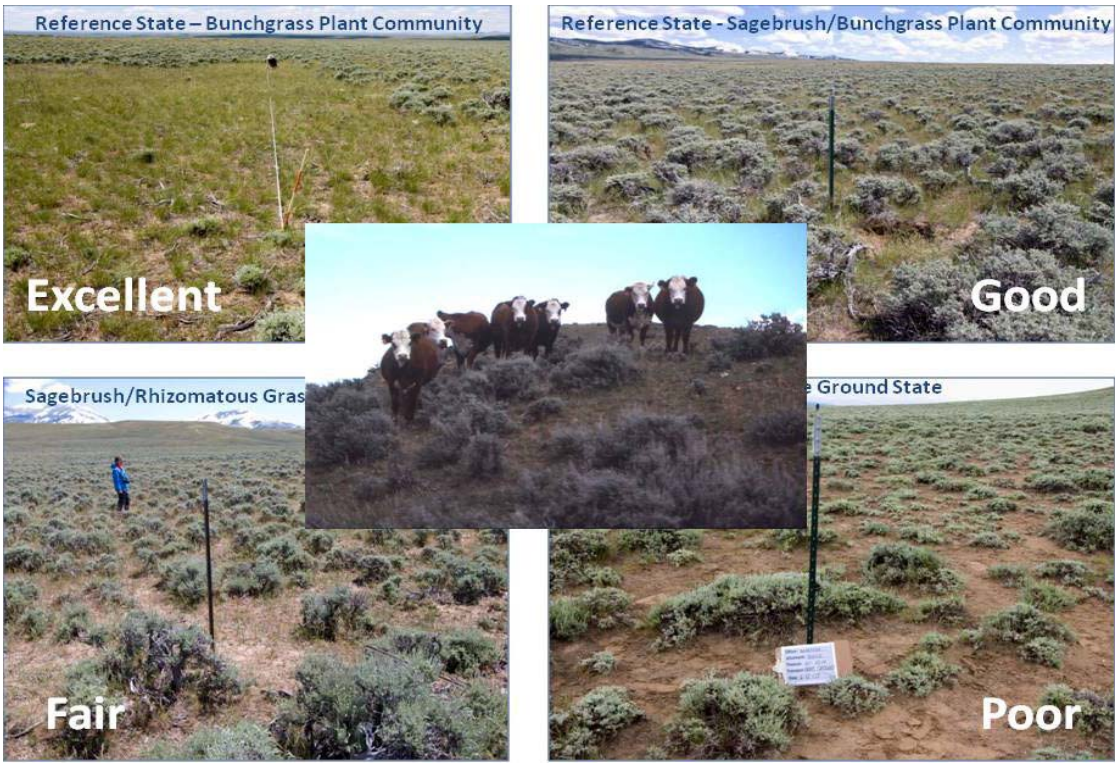
Initially the ecological site guides were a livestock grazing management tool, and the process was value laden for herbaceous forage. Percent similarity scoring system applied the terminology in the table below.

Condition Score	Rating Term
75 points or more	Excellent
50 to 74 points	Good
25 to 49 points	Fair
24 points or less	Poor

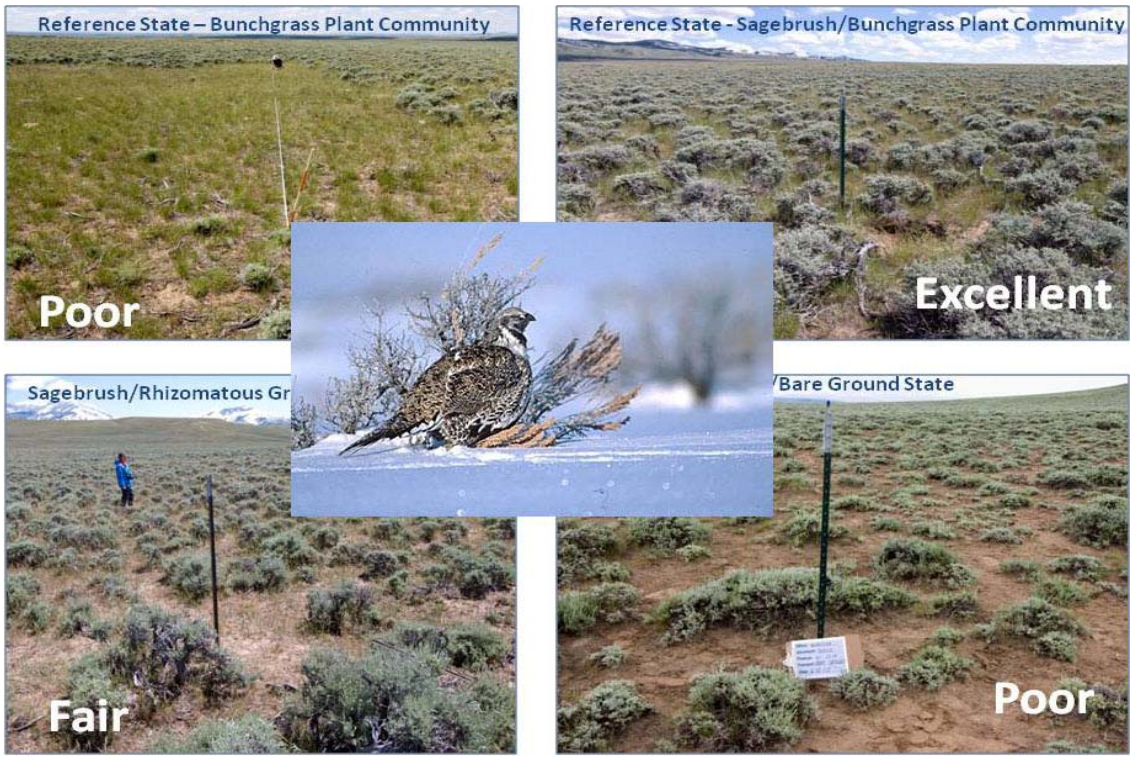
The approach was useful as a livestock management tool, because the ecological site guides had valuable information, including stocking rate recommendations indexed to the condition classes.

This effective livestock management tool failed as a means to address multiple use values and to report the status of public lands. Different species of animals prosper under different conditions, or stages of plant succession, and the terms excellent, good, fair, and poor did not represent the spectrum of public interest. The terms raise the question - excellent, good, fair and poor for what? The plates below illustrate the divergent habitat values for cattle and sage-grouse.

Cattle Condition



Sage-Grouse Condition

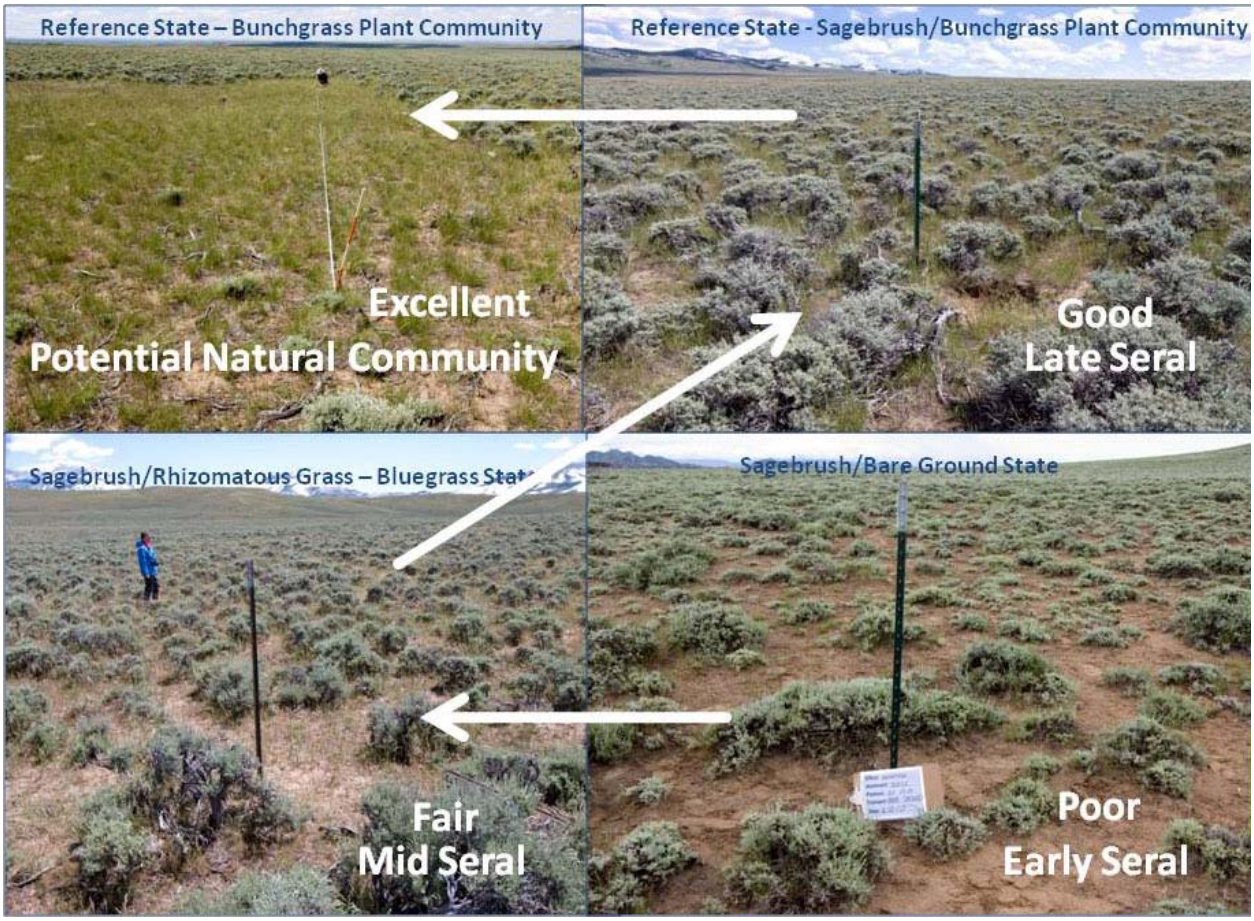


The table below was used to "fix" this value judgment problem. This revised terminology resulted in a change from value laden for herbaceous forage, to an entirely inaccurate description of the successional path in sagebrush. The scoring categories were never designed to match stages along a successional path.

Original Term		Revised Term
Excellent	→	Potential Natural Community
Good	→	Late Seral
Fair	→	Mid Seral
Poor	→	Early Seral

If the revised terminology were accurate, then succession would be expected to progress as shown below in "The Terminology Progression." Under this terminology, a stand of sagebrush would be expected to develop following a fire, and through time the herbaceous component would eventually dominate.

The Terminology Progression



The “terminology progression” above is obviously inaccurate. Sagebrush has more “invested” in above ground woody material than the herbaceous component of the plant community and takes longer to recover from fire. A stand of sagebrush that scores poor, because it has limited herbaceous understory, is anything but early seral. Furthermore, site progression in sagebrush is not linear. In the true model, the Bunchgrass site is transitional and the other three are all a potential natural community. Each is a product of its history.

This nomenclature has misleading connotations. Calling the “poor” plant community “early seral” suggests that it is poised for change. Given that presumption, it is logical to further presume that livestock grazing is suppressing a natural progression towards stands with increased herbaceous dominance. It is notable that the terminology progression includes the “backwards transition.” Given this terminology, it is little wonder that many believe such a sequence is standard.

Clearly the use of inaccurate successional terms has been a source of confusion on the interface between range managers, and sage-grouse habitat biologists. A more accurate expectation is a key step in aligning livestock and sage-grouse objectives. State and transition models provide a more accurate framework for addressing risks and opportunities associated with livestock grazing management. The National Resource Conservation Service has changed their ecological site guides to incorporate state and transition models that correctly assess sagebrush ecology. In the near future the Bureau of Land Management is planning to discontinue reporting the status of rangelands based condition classes. Rangelands will be evaluated based on the Standards of Rangeland health, and the report categories will provide for state and transition model concepts.

Appendix G - Memorandum: Livestock Management Following Vegetative Treatment

United States Department of the Interior
BUREAU OF LAND MANAGEMENT
Wyoming State Office
P.O. Box 1828
Cheyenne, Wyoming 82003-1828

In Reply Refer To:
1740 (930) P

January 13, 2005

Instruction Memorandum No. WY-2005-018
Expires: 09/30/2006

To: Field Managers and Deputy State Directors

From: Associate State Director

Subject: Livestock Management Following Vegetative Treatment

Purpose: The purpose of this Instruction Memorandum is to update Wyoming Bureau of Land Management (BLM) policy regarding livestock management following fire, chemical or mechanical vegetation treatment. The original policy was issued in Instruction Memorandum No. WY 2002-044, which expired September 30, 2004. This IM updates and reissues this policy.

Background: Current policy found in both the Interagency Burned Area Emergency Stabilization and Rehabilitation Handbook and the Emergency Fire Rehabilitation Handbook, calls for 2 growing seasons deferment following a wildfire. This approach is designed to strike a balance between protecting desired vegetation resulting from the treatment project, and supporting the operational needs of the BLM livestock permittees.

This policy addresses vegetation "treatments." The policy does not address reclamation following surface disturbing activities. This latter topic includes socio-economic issues and complex roles and responsibilities beyond the scope of the policy.

Policy: To promote and ensure successful establishment of the vegetation after treatment, livestock grazing will not be allowed for 2 complete growing seasons following treatment, except as provided for below. In many cases, existing management provides the required deferment. However, when pre-existing management provides for growing season use of treated areas, a signed agreement implementing this policy will be in place prior to any

vegetative treatment.

Wyoming BLM policy is to manage rangelands through cooperation and collaborative agreement whenever possible. However, it may be necessary to issue a decision under 43 CFR 4110.3-3 (b), or 43 CFR 4190 to achieve long term objectives. Instruction Memorandum No. 2004-224, *Additional Guidance for Making Wildfire Management Decisions Effective immediately or on a Date Specified in the Decision Document (commonly referred to as a "Full Force and Effect" Decision)*, provides recent guidance on this subject.

A growing season is considered complete at the time the desired vegetation sets seed. Seedling and young forage plants are vulnerable to uprooting, and have limited ability to recover from grazing. Policy implementation should be oriented to protecting these young plants while they are vulnerable. Two **growing seasons** deferment is not synonymous with 2 **years** rest. In many cases it is appropriate to graze treated areas during seasons other than the growing period within the first 2 years.

The 2 growing seasons deferment requirement may be adjusted based on environmental conditions and management objectives consistent with Wyoming's standards for healthy rangelands. Some examples of environmental circumstances that could be considered for an adjustment to the 2 growing seasons requirement might include:

- The health of the range, and quality of existing management prior to treatment. Rangelands in good ecological heath are more resilient than ranges with pre-existing rangeland health issues. Healthy ranges with long term quality management may not warrant changes in the long term approach. Conversely, 2 growing seasons deferment may be inadequate on rangelands where management prior to the treatment promoted pre-existing range health issues. In this latter case, 2 growing seasons policy should be combined with improvement in long term grazing management.

- Some treatments occur in areas lightly used by livestock because of terrain or distance from water. The treatment objective may be to draw increased livestock use into the area. In this circumstance, planned deferment under the policy may not be warranted. Conversely, if the treatment area occurs on level terrain near water sources, 2 growing seasons deferment may be inadequate.

- The 2 growing seasons requirement should be extended if drought conditions preclude expected recovery associated with 2 growing seasons deferment. The purpose of the 2 growing seasons policy is to provide plants the opportunity to establish or recover before they must cope with defoliation. If because of drought the plants are not afforded the opportunity to establish or recover, then the drought year shouldn't count as one of the 2 growing seasons under the policy. Conversely, in some years favorable rainfall can extend the growing season. In this case, plants may still be green when the treated pasture is scheduled for grazing use. To protect other pastures, it may be appropriate to use the treated pasture as planned.

- Some chemical treatments entail a delay between treatment and effect. In this circumstance deferment should be scheduled to accommodate the treatment objective,

- Some allotments contain only a very small percentage (e.g., < 25%) of Public Lands, often occurring in a scattered landownership pattern. From a practical standpoint, it is very difficult for the BLM to dictate any substantial management direction in these circumstances. Rigid enforcement of a 2-year deferment policy may be infeasible in these allotments.

Any adjustment that is being proposed must be thoroughly analyzed as a separate alternative in the original NEPA document prepared for the treatment project. It is to be compared to an alternative providing for 2 complete growing seasons deferment. Additional alternatives are optional. An interdisciplinary team will be used to prepare the NEPA document so that the final decision clearly satisfies the necessary "hard look" for environmental analysis/assessments.

Monitoring is crucial to the success of the treatment and will be implemented to evaluate progress towards meeting objectives.

Effective: This policy is effective immediately.

Further Information: Contact Jim Cagney, WSO Range Management Specialist, at 307-775-6194 or Vicki Herren, Fire Ecologist/Forestry Program Lead, at 307-775-6120.

/s/ Alan L. Kesterke