A Survey of Greater Sage Grouse (*Centrocercus urophasianus*)[1] Early Brood-rearing, Summer-Late Brood-rearing, and Winter Habitat Integrity in Six Utah Sage Grouse Use Areas

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[1] With support from the National Fish and Wildlife Foundation.

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1. ABSTRACT

Greater sage grouse (*Centrocercus urophasianus*) is a sagebrush-obligate bird whose populations in Utah, as throughout the West, have declined, along with sagebrush-steppe habitat.. As a contribution to a growing understanding of conditions currently available to greater sage grouse in Utah, 195 vegetation point-intercept line transects were recorded in early brood-rearing, summer-late brood-rearing, and winter habitats in six discrete areas of south-central Utah in 2006. All six areas are currently or recently utilized by small populations of greater sage grouse. The transects were variously placed (1) randomly; (2) on sites where sage grouse dropping pellets or greater sage grouse were present; or (3) for other specific, stated reasons. Cover, height, and species were documented for each transect, as well as animal scat and plant species within 3' of each transect. The most common sagebrush were mountain big sagebrush/ (*Artemisia tridentata* subsp. *vaseyana*) and black sagebrush (*A. nova)*. The data for each area and season were rated for suitability according to the Utah Division of Wildlife Resources greater sage grouse Ecological Integrity Table. Most areas assessed had desirable sagebrush vegetation and sufficient grass cover; and most (not all) unseeded areas had only minor presence of exotic plant species. Major habitat deficiencies were insufficient forb cover and forb/grass height, variously excessively or insufficiently dense sagebrush, and lack of mesic meadows/water. Livestock and/or wild ungulate grazing was the major activity contributing directly or indirectly (e.g., water developments, seedings, sagebrush removal) to habitat deficiencies in five of the six areas. On W. Tavaputs Plateau sites, oil and gas developments or wild horse use were dominant factors. Increased attention to forb understory of sagebrush communities is recommended.

2. INTRODUCTION

Greater sage grouse (*Centrocercus urophasianus*), North America's largest grouse, depend on a variety of sagebrush (*Artemisia* species; esp. *Artemisia tridentata* or big sagebrush) habitats through the year, with the presence of forbs and grasses critical during spring through fall, along with access to vegetation moisture and water.

This survey was undertaken to evaluate current early brood-rearing, summer late-brood-rearing, and winterng habitat conditions for several small populations of greater sage grouse (*Centrocercus urophasianus*) within six Utah public lands areas currently and/or historically used by sage grouse. While nesting habitat is likewise essential, this was not surveyed, due to uncertainty of Utah wildlife biologists as to actual nesting sites for these small populations. Lek sites (i.e., open areas surrounded by sagebrush) were not surveyed because they do not generally appear to be a major limiting factor for greater sage-grouse. However, the areas adjacent to known lek areas were observed for signs of early season use.

In the course of general investigations into habitat conditions on the Dixie, Fishlake, and Manti-La Sal National Forests (NFs) of southern and central Utah, the author could find little information on sagebrush understory (grass and forb) conditions on the Forests, as opposed to sagebrush percent cover.

While much attention is paid to whether sagebrush cover is excessively dense[2], less attention is being paid to the sagebrush community as a whole. However, just as a forest is more than trees, a sagebrush community is more than the density of sagebrush.

In 2005, the National Fish and Wildlife Foundation, with support from the Bureau of Land Management (BLM), offered grants related to sage grouse habitat. This required looking beyond National Forest lands to adjacent BLM lands. When the author inquired of Utah Division of Wildlife Resources (UDWR) regarding US Forest Service and BLM sites being used by sage grouse, the UDWR encouraged a look at W. Tavaputs Plateau as well, where UDWR manages some state land, and is interested in learning more about habitat conditions there.

This survey focuses on assessment of sagebrush, forb and grass presence and conditions in six areas, including sites on the Dixie and Manti-La Sal National Forests, Cedar City and Kanab Field Offices of the BLM, and UDWR lands on W. Tavaputs Plateau (Map 2).

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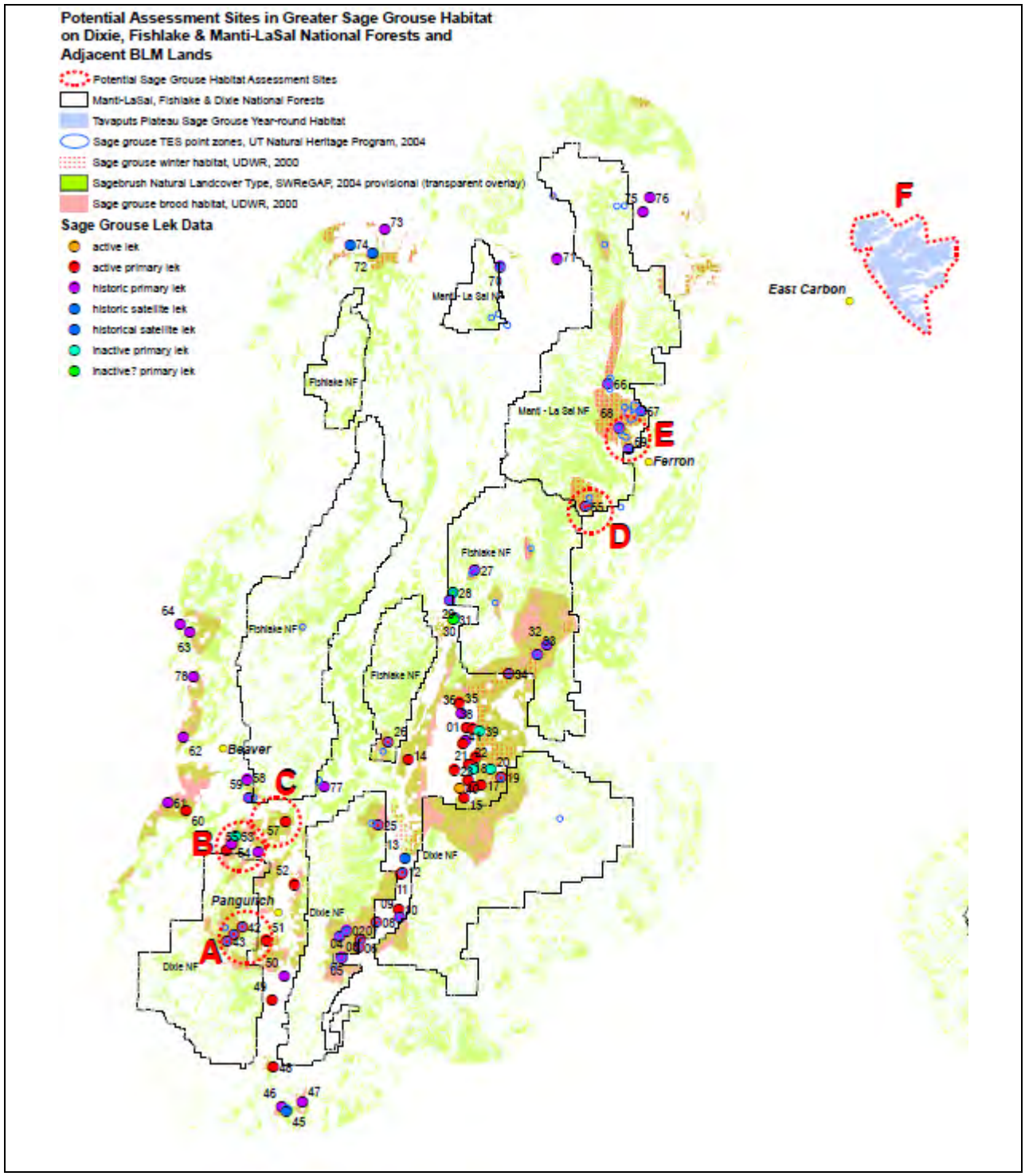
[2] For instance, the Record of Decision for a Final EIS on cattle grazing on 8 allotments in the Fishlake NF indicates that an upper limit of 15% sagebrush cover is based on "state-of-the-art" science, although no such science is referenced: "Generally, a cover exceeding 15% sagebrush with greater than 20% bare mineral soil exposed is determined to be functioning at risk (page 1-21). These parameters are based on state-of-the-art science and indicate a condition where treatments might be appropriate" (USDA 2007)

None of the six areas are currently supporting large populations of greater sage grouse. This survey attempts to contribute to an understanding of what habitat conditions are poor for greater sage grouse, and consequently what they need for recovery. At the same time, it is hoped that this survey will encourage greater attention to sagebrush as complex forb, grass, and shrub systems.



Map 2 Survey Areas A-F.

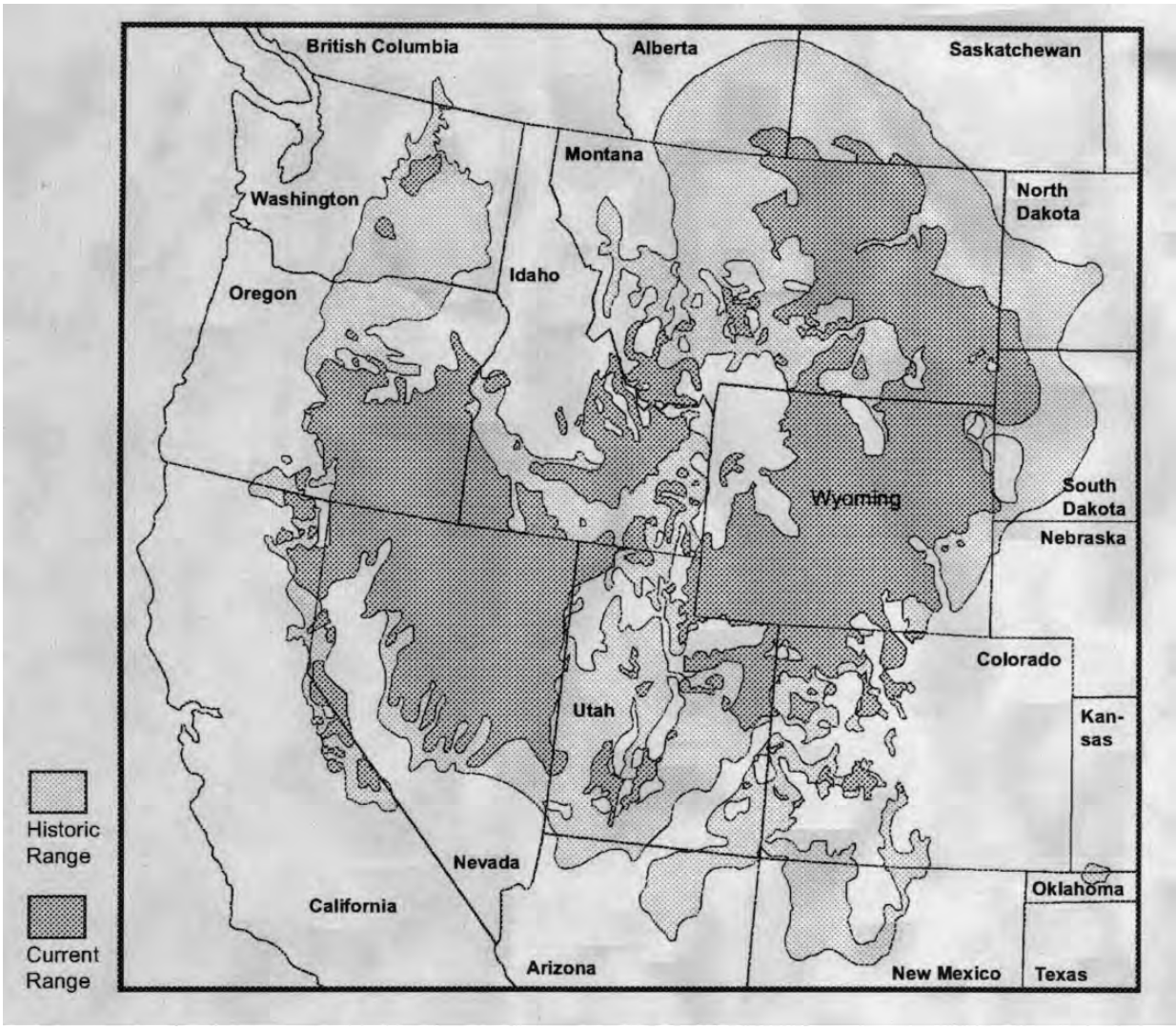
3. BACKGROUND

A. Greater Sage Grouse in the West and Utah

Greater sage grouse, *Centrocercus urophasianus*, has an obligate relationship with sagebrush and its understory plants, and is declining throughout the West and in most counties in Utah (Welch 2005; USGS 2006; see Map 1). It has been extirpated in five of the 16 states and in one of three Canadian provinces the grouse once inhabited (Braun 1998). Changes in sage grouse distribution have been due to loss and deterioration of their habitat (Braun, et al. 2005)

Within Utah, greater sage grouse is a state species of concern (UDWR 2006). Greater sage grouse populations are scattered throughout much of the state except most of the Colorado Plateau of southeast Utah. At least some greater sage grouse remain in 26 of the 29 Utah counties it once occupied. As of 2001, active leks were present in 20 counties, with approximately 3,250 counted males and an estimated breeding population of 12,999 birds ((UDWR 2001). Populations greater than 5000 breeding birds exist in only six counties: Box Elder, Carbon, Garfield, Rich, Wayne, and Uintah. The extent of occupied habitat has declined to approximately 40% of its historical extent (Beck et al. 2003).

Based on Utah's long-term sage-grouse monitoring program, Connelly, et al. (2004) were able to determine that greater sage-grouse continued to decline statewide from 1970-2000 and that Utah populations in the early 1970s were approximately two times higher than current populations (Map 1).



Map 1. Historic and current distribution of sage-grouse (map prepared by M.A. Schroeder).

Source: Braun, Clait E., John W. Connelly and Michael A. Schroeder. 2005. Seasonal Habitat Requirements for Sage-Grouse: Spring, Summer, Fall, and Winter. USDA Forest Service Proceedings RMRS-P-38.

B. Greater Sage Grouse Habitat

Greater sage grouse (*Centrocercus urophasianus*) force us to look at the sagebrush community wholistically, because over a year's time, sage grouse require a complex and diverse sagebrush system, which includes water, grass height, and forb presence, as well as sagebrush (Paige and Ritter 1999, Oliver 2006, Connelly, et al 2000).

Males display on leks in open areas surrounded by sagebrush or where sagebrush density is low. For nesting, hens select sagebrush stands with high canopy cover (15 to 40%) and often

choose one of the tallest shrubs in the stand (14-31" high) with high lateral cover. Canopy cover of 19-51% for grass and forbs surrounding the nest is preferred.

During early brood-rearing, sage grouse use wet meadows, springs, seeps, and other green areas close to the nest site in sagebrush. Sage grouse chicks eat insects attracted to forbs in the brood-rearing area and adults and maturing young include forbs and flower buds in their diet. Grass cover provides concealment and a warmer microclimate. Studies have found herbaceous cover of at least 20% and grass height of approximately 7" to be desirable.

During later summer (approximately July-September), sage grouse may need to move to higher-elevation or wetter sites in order to continue access to water and to forbs for food and moisture. Late brood-rearing coincides with a switch of young sage grouse from insects to forbs for food.

Wintering grouse feed almost exclusively on sagebrush that is above snow level, in patches of 10 to 40% cover, with the sagebrush 10"-12" above snow..

Thus, while sagebrush is necessary throughout the year, it is not sufficient during Spring, Summer or Fall, when access to water, grasses, and forbs – that is, a fully-functioning sagebrush community - are <u>also</u> necessary.

As noted by Connelly, et al. (2000), the presence of forbs is essential during late brood-rearing:

> Sage-grouse often use sagebrush habitats for late brood-rearing throughout the summer but select habitats based on availability of <u>forbs</u>. This is often accomplished by moving up in elevation or selecting sites where moisture collects and maintains <u>forbs</u> throughout the summer… The beginning of late brood-rearing also coincides with the change in diets of sage-grouse chicks from predominantly insects to <u>forbs</u> …
>
> Sage-grouse use a variety of sagebrush habitats and other habitats (e.g., riparian, wet meadows and alfalfa…fields) during summer. These sites typically provide <u>an abundance of forbs and insects</u> for hens and chicks…

With regard specifically to summer-late brood rearing habitats, Connelly et al. note, "Generally, these habitats are characterized by relatively moist conditions and <u>many succulent forbs</u> in or adjacent to sagebrush cover." Connelly et al. cite a dissertation in southeastern Idaho (Apa 1998) finding that "sites used by grouse broods [during summer] had twice as much forb cover as independent sites".

A difficulty associated with developing forb and grass cover elements within the Ecological Integrity Table may be differences in <u>potential</u> for forbs and grasses within different sagebrush habitats. For instance, black sagebrush and mountain big sagebrush are the two most common sagebrush types in the six areas surveyed for this report. Whether they differ in their potential for forb cover is not clear.

Knowledge of "potential" forb and grass cover, and perhaps particularly forb cover, is further limited by the near-ubiquitous use of sagebrush habitats for cattle grazing on most of these sites (and throughout the West), which can limit forb presence, both in the short- and long-term. Thus, our knowledge of the potential of various sagebrush types for forbs is limited by our lack of reference areas for sagebrush, in which livestock are not present, and wild ungulates are controlled by predators (see, e.g., Beschta and Ripple 2006; Beschta 2005 in relation to trophic cascades following removal of ungulate predators; and Ripple and Beschta 2005 re: the need for "refugia," as reference areas).

Water availability is mentioned only once, in a quote from Connelly et al, 2000 (at p. 16):

> Avoid developing springs for livestock water, but if water from a spring will be used in a pipeline or trough, design the project to maintain free water and wet meadows at the spring. Capturing water from springs using pipelines and troughs may adversely affect wet meadows used by grouse for foraging.

Water may in turn be linked to the availability of forbs during summer, i.e., the presence of mesic meadows, riparian areas, and untrampled depressions that provide forbs for use by greater sage-grouse. It is unclear whether greater sage grouse require open water if sufficient succulent forbs are available.

1. Early Brood-rearing Habitat

Table 1. displays Oliver's indicators for early brood-rearing habitat for greater sage grouse. Oliver's metric measurements have been converted to inches to match the metric used in this study:

Table 1. Ecological Integrity Table for Early Brood-Rearing Habitat					
Early Brood-Rearing Habitat	**Indicator**	**Indicator Rating**			
		Poor	**Fair**	**Good**	**Very Good**
	Grass cover >7" tall	<0.5%	0.5-5%	5-10%	>10%
	Cover type	-	-	-	upland sagebrush, sagebrush-grassland
	Mean sagebrush height	<11.8" or >31.5"	-	-	11.8-31.5"
	Sagebrush canopy cover	<15% or >25%	-	-	15-25%
	Mean grass and forb height (droop height)	<7"	-	-	>7"
	Perennial grass cover	<15%	15-20%	20-25%	>25%
	Forb cover	<10%	-	-	>10%
	Portion of indicated habitat type w/ suitable conditions for the above 5 indicators	<80%			>80%

2. <u>Summer-late/Brood-rearing Habitat</u>

Table 2. displays Oliver's indicators for summer-late brood-rearing habitat for greater sage grouse Oliver's metric measurements have been converted to inches to match the metric used in this study:

Table 2. Ecological Integrity Table for Summer-Late Brood-Rearing Habitat					
Summer-Late Brood-rearing Habitat	**Indicator**	**Indicator Rating**			
		Poor	**Fair**	**Good**	**Very Good**
	Cover type	-	-	-	upland sagebrush, sagebrush-grassland
	Mean sagebrush height	<15.7" or >31.5"	-	-	15.7-31.5"
	Sagebrush canopy cover	<10% or >20%	-	-	10-20%
	Total shrub cover	>25%			≤25%
	Mean grass and forb height (droop height)	<5.9"	-	-	>5.9"
	Portion of indicated habitat type w/ suitable conditions for the above 4 indicators	<40%			>40%

This ecological habitat integrity table for summer-late brood-rearing habitat does not provide a desirable percentage of forb cover, despite recognition that "Sage-grouse often use sagebrush habitats for late brood-rearing throughout the summer but select habitats based on availability of forbs" (Connelly, et al. 2000) The Bureau of Land Management's worksheet for rating greater sage grouse late brood-rearing habitat in Idaho (Sather-Blair, et al. 2000) states that late brood-rearing habitat is "suitable" for forb availability if "Succulent, green forbs are readily available in terms of distribution and plant structure." Late brood-rearing habitat is rated "marginal" for forb availability if "Succulent, green forbs are available though distribution is spotty or plant structure limits effective use."

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3. Winter Habitat

Table 3. displays Oliver's indicators for winter habitat for greater sage grouse. Oliver's metric measurements have been converted to inches to match the metric used in this study:

Table 3. Ecological Integrity Table for Winter Habitatt					
Winter Habitat	**Indicator**	**Indicator Rating**			
		Poor	**Fair**	**Good**	**Very Good**
	Portion of indicated habitat type w/ suitable conditions for the 2 indicators below	≤80%	-	-	>80%
	Mean canopy coverage of sagebrush above snow	<12% or >43%	12-22%	22-33%	33-43%
	Mean height of sagebrush above snow	<7.9" or >18.1"	7.9-11.4"	11.4-14.6"	14.6"-18.1"
	Mean height of sagebrush (total height of plant, no snow)	<16.1" or >22"	16.1-18.1"	18.1-20.1"	20.1-22"

4. Landscape Habitat

Oliver notes (Table 4) the following indicators for general sage grouse habitat at a landscape level, providing references for each row:

Table 4. Landscape Habitat Indicators For Sage Grouse (adapted from Oliver 2006)					
Key Ecological Attribute	**Indicator**	**Indicator Rating**			
		Poor	**Fair**	**Good**	**Very Good**
Landscape	General habitat (food, cover)	Cultivated fields (e.g., alfalfa, wheat, crested wheatgrass)	Scrub-willow; sagebrush savannas with juniper, ponderosa pine, or quaking aspen	Small sagebrush (e.g., low, black); forb-rich mosaics of low and tall sagebrush; riparian meadows; steppe dominated by native grasses and forbs	Large, woody, tall sagebrush (e.g., big, silver, and three-tip)
Habitat alteration, predation	Nonnative predators (cats, dogs) and native predators favored by human alterations of	Abundant	Common	Few	None

	habitat (red foxes, common ravens)				
Habitat degradation	Grazing	—	—	—	None
Habitat degradation (e.g., elimination of sagebrush)	Herbicide treatments	—	—	—	None
Habitat degradation (e.g., elimination of sagebrush and native grasses and forbs, invasion by exotic annual grasses such as cheatgrass)	Burning	—	—	—	None
Habitat degradation (e.g., elimination or reduction of sagebrush)	Mechanical treatments	—	—	—	None
Habitat	Invasive junipers and other conifers	Present, abundant, and encroaching sagebrush	Present, but few or not encroaching	Few and not encroaching	Absent
Habitat restoration (reseeding)	Seed mix	Non-sagebrush, nonnative species	"Species that are functional equivalents and provide habitat characteristics similar to those of native species" of sagebrush, forbs, and grasses	—	Native sagebrush, native forbs (especially legumes), native grasses (especially bunch-grasses)
Mortality	Fences, utility lines and poles	Many	—	—	None

4. METHODS

A. Selection of Areas

Initial selection of six areas for assessment was based on consultation with BLM, Forest Service, and UDWR (see Acknowledgments) for (1) areas currently or recently used by sage grouse (2) in south and central Utah (3) on or near the Dixie, Fishlake, and/or Manti-La Sal national forests; or BLM land near the Forests. Areas currently being assessed by Sage Grouse Working Groups (e.g., on Parker Mountain) were avoided in order to prevent duplication. Utah Division of Wildlife Resources land on W. Tavaputs Plateau was added because UDWR is interested in sage grouse populations in an area that is being explored and drilled for gas. Areas were further delimited on maps using UDWR 2000 maps of winter and brood-rearing habitat and Southwest ReGAP maps of Sagebrush Natural Landcover.

Two reconnaissance trips July 13-17 and July 29-31, 2005 to five of the six areas with Katie Fite, a wildlife biologist who has been observing sage grouse for 15 years, enabled the preparation of maps for pre-season reconnaissance in 2006. Reconnaissance in 2006 determined the apparent absence of sage grouse from Coyote Bench and the substitution of Dog Valley to the east.

B. Selection of Transects

Transects within each area were initially selected using aerials and topographic maps downloaded from the Utah Division of Water Rights (2006) web page. Transects were planned away from developments such as roads; away from juniper or other forests which could provide predator perches; near wetlands and springs (Summer-Late Brood-Rearing, or “Late”); and on south, southwest-facing slopes (Winter)

Where reasonable, pre-selected transects were used. Some pre-selected transects were not useable, for instance where pinyon-juniper has encroached on a site that was free of pinyon-juniper in the Utah Division of Water Rights aerial photographs or when developments have been constructed since the aerial photographs had been taken (e.g., in Stone Canyon Gas Field on W. Tavaputs Plateau). When some areas pre-selected were clearly lacking sage grouse use (e.g., Buckskin Valley, nearby areas of sage grouse use were sought (e.g., Bear Valley). On the other hand, some pre-selected transects were retained even though no sage grouse were present (e.g., a Buckskin Valley crested wheatgrass seeding; trampled mud pond on Green Hill). Transects were occasionally placed where sage grouse were seen flying (e.g., near Bare Wire Pond in South Horn or near the private pond in Dog Valley). When transects were selected in the field, the transects were placed in a location representative of the area.

Thus there is a general bias toward placing transects on sites actually being used by sage grouse, in order to understand the condition of the lands the grouse are trying to inhabit.
A total of 131 transects were surveyed.

C. Assessment of Transects

Transect assessment largely followed the line-intercept protocol described in Idaho BLM's sage grouse habitat assessment framework (Sather-Blair, et al. 2000).

After locating one end of the 100' transect, the compass direction of the transect was randomly selected by spinning the 0' stake (Early and Late) or using a random numbers table (Winter).

A digital photograph was taken of the transect at the 0', 25', 50', 75', and 100' point, with both the 0' and 100' photos recording the length of the transect, and the 25', 50', and 75' photos taken at approximately 2.5' above the ground, in order to focus more on understory conditions. All movements during the day were recorded as 'Tracks" on a GPS (Garmin Legend CX) and linked in the evening with each photo to its UTM (NAD CONUS 27; Zone 12), elevation, and time taken. Each photo was labeled with area (e.g., "A Early") and an abbreviated version of a note that had been written as to the purpose of each photo. Beginning with some "Late" transects, a photo was also taken of soil representative of each transect. Brief, only general notes were taken on soil appearance and/or compaction.

For Early and Late transects, a slender (3 mm) diameter pole was vertically placed every 2' along the transect, starting at 2. All plants physically touching the pole (up to three layers) were recorded, where possible, as species, from the top layer down. Many forbs and grasses have been grazed by ungulates (cattle, elk, deer, horses) and often had no other individuals nearby or nearby with flowers or seeding heads. In these cases, the genus or sometimes family (e.g., Asteraceae) was recorded.

Height of grasses and forbs was recorded at droop height (the highest point of the plant as it is naturally growing). If the point of contact of sagebrush with the pointer was dead, but live foliage was within 2' of the pointer, the sagebrush was counted as "live." If the point of contact was more than 2' from live foliage, the height was recorded, but in a separate cell. If the contacted sagebrush was wholly dead, its presence as a dead sagebrush was noted, but height was not recorded.

If no vegetation physically contacted the pointer, ground cover contacted by the pointer tip was recorded as bare, gravel (size?), rock, or litter.

Animal scat was recorded as present within every two-foot segment of the transect and within 3 feet of either side of the transect. Sage grouse droppings were recorded as single droppings, several droppings or a pile of droppings, check droppings, or caecal droppings. As deer and elk droppings were not always distinguishable, they were recorded as "wild ungulate". Other commonly recorded scat was rabbit and, on W. Tavaputs Plateau, horse.

After recording all point-intercepted vegetation, three people (Mindy Wheeler, Mary O'Brien and a volunteer) walked slowly back on both sides of the transect, recording the species name (or genus, family, or "forb") of any forb, shrub, or grass species that had not been intercepted by the pointer.

In addition, Mindy Wheeler recorded all sagebrush cover by line intercept, i.e., measuring shrub cover intercepted by the measuring tape by looking vertically down at the tape.) Any gap of 2" or larger was recorded as absence of shrub cover. This second measure of shrub cover was undertaken to compare the results of the line-point intercept method and the line intercept method of measuring shrub cover.

All transect vegetation, scat data, and line intercept data were recorded on a Hewlett Packard IPAQ and transferred to a computer at the end of each day.

Winter transects were similarly assessed and photographed, except that only sagebrush vegetation was recorded with the pointer, as it is sagebrush cover and food that is the central concern of sage grouse in winter.

If one transect was within 0.5 mile of the next transect, we walked between the transects, noting the presence, if any, of sage grouse scat, other animal scat, and other features such as water developments, patches of uncommon vegetation. Most sage grouse droppings locations were recorded as waypoints on the GPS, providing a sense of the intensity of sage grouse presence in and use of the area.

Table 5. 2006 Sage Grouse Habitat Assessment Transect Areas

Site	Spring Brood-Rearing	Summer-Late Brood-Rearing	Winter
A	Sage Hen Hollow (BLM) June 10-11	Little Valley (Dixie NF) July 2	Norton Hollow (Dixie NF) July 9
B	Buckskin Valley (BLM) June 12	Buckskin/Bear Valleys (BLM) July 3	Buckskin Valley (BLM) July 10
C	Dog Valley/Green Hill (BLM) June 13	Dog Valley/Green Hill (BLM) July 4	Dog Valley (BLM) August 10
D	Wildcat Knolls (M-LS NF) June 21-22	Wildcat Knolls (M-LS NF) August 20-21	Wildcat Knolls (M-LS NF) August 11
E	South Horn (M-LS NF) June 20	South Horn (M-LS NF) August 18-19	South Horn (M-LS NF) August 12
F	W. Tavaputs Plateau (UDWR)	W. Tavaputs Plateau (UDWR)	W. Tavaputs Plateau (UDWR)

	Cold Spring June 18-19	Cold Spring August 21-22	Sage Brush Flat, Stone Cabin Gas Field July 7-8

5. RESULTS

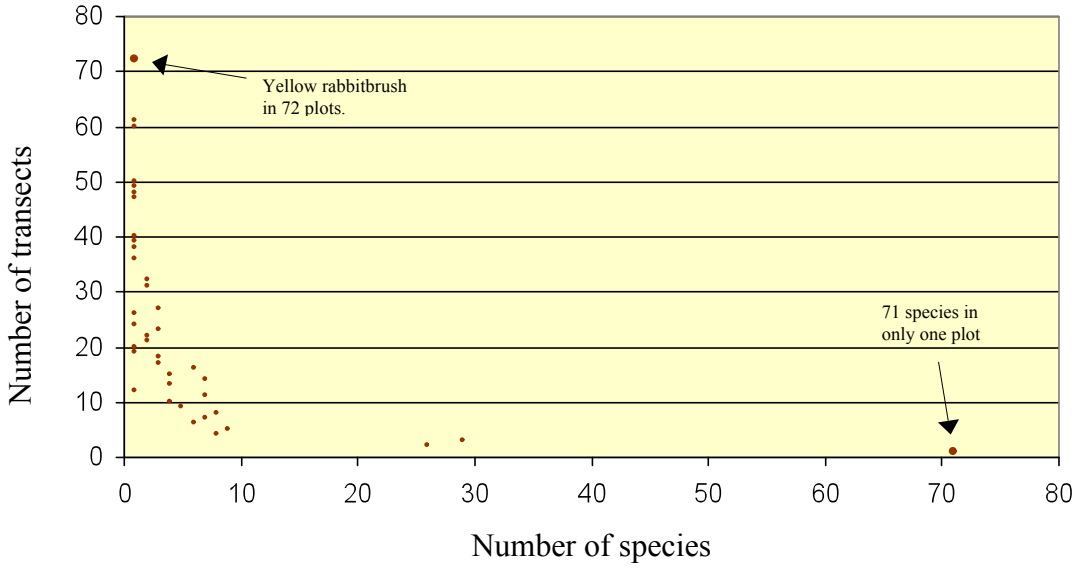
A. General Vegetation Results

At least 331 plant species were found within 3 feet of the 195 transects. Several *Erigeron* and *Aster* species were identified only to genus, but likely comprise several species. As shown in Fig. 1, 21% (71) of the species were encountered in only one of the 195 transects. The most commonly-occurring species was yellow (viscid) rabbitbrush (*Chrysothamnus viscidiflorus*), appearing in 72 plots. The ten species encountered most frequently after viscid rabbitbrush were (see Appendix A for Latin species names):

Mutton bluegrass
Mountain big sagebrush
Letterman's needlegrass (though rarely dominant)
Redroot buckwheat
1 or more unidentified *Erigeron* species
1 or more unidentified *Aster* species
Sulfur-flowered buckwheat
Squirreltail
Black sagebrush
Hollyleaf clover

Seventy-four percent of the 236 plant species were present in less than 10% of the transects, and 89% were present in less than 20% of the transects.

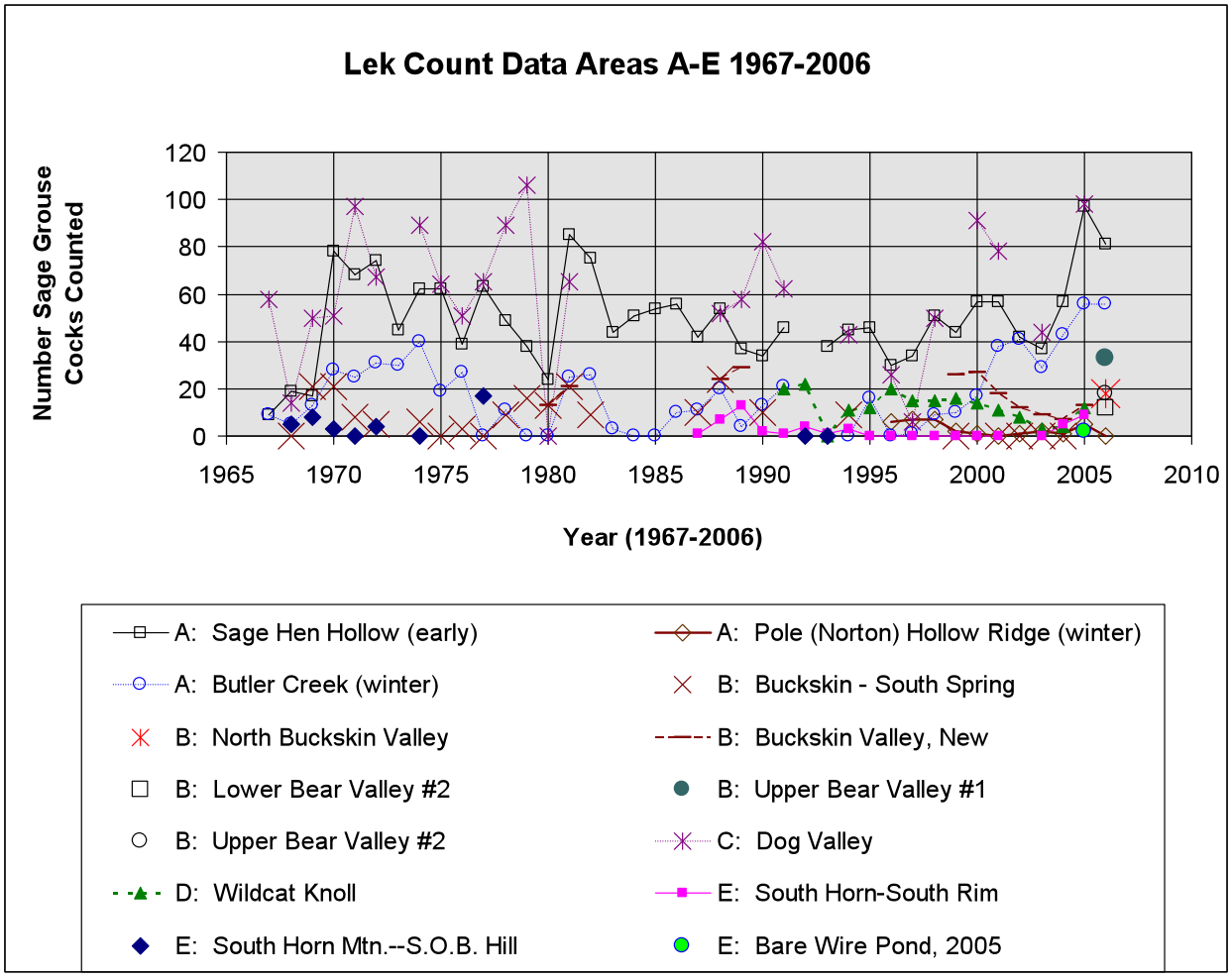
Fig. 1. Plant Species Presence in One or More Transects



B. Area Summaries

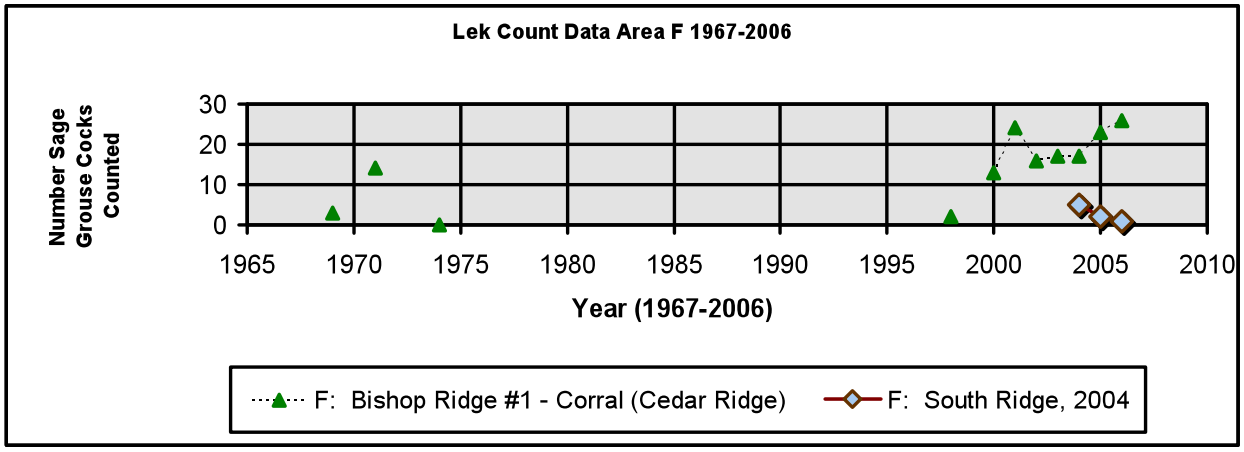
Prior to examining the six areas assessed, it is useful to consider the lek count data that has been gathered in these areas during the past 40 years [Need W. Tavaputs Plateau counts]. All of these lek counts are small.

Fig. 2a. Lek Count Data, Areas A-E, 1967-2006



Source: Data from Utah Division of Wildlife Resources, 2006

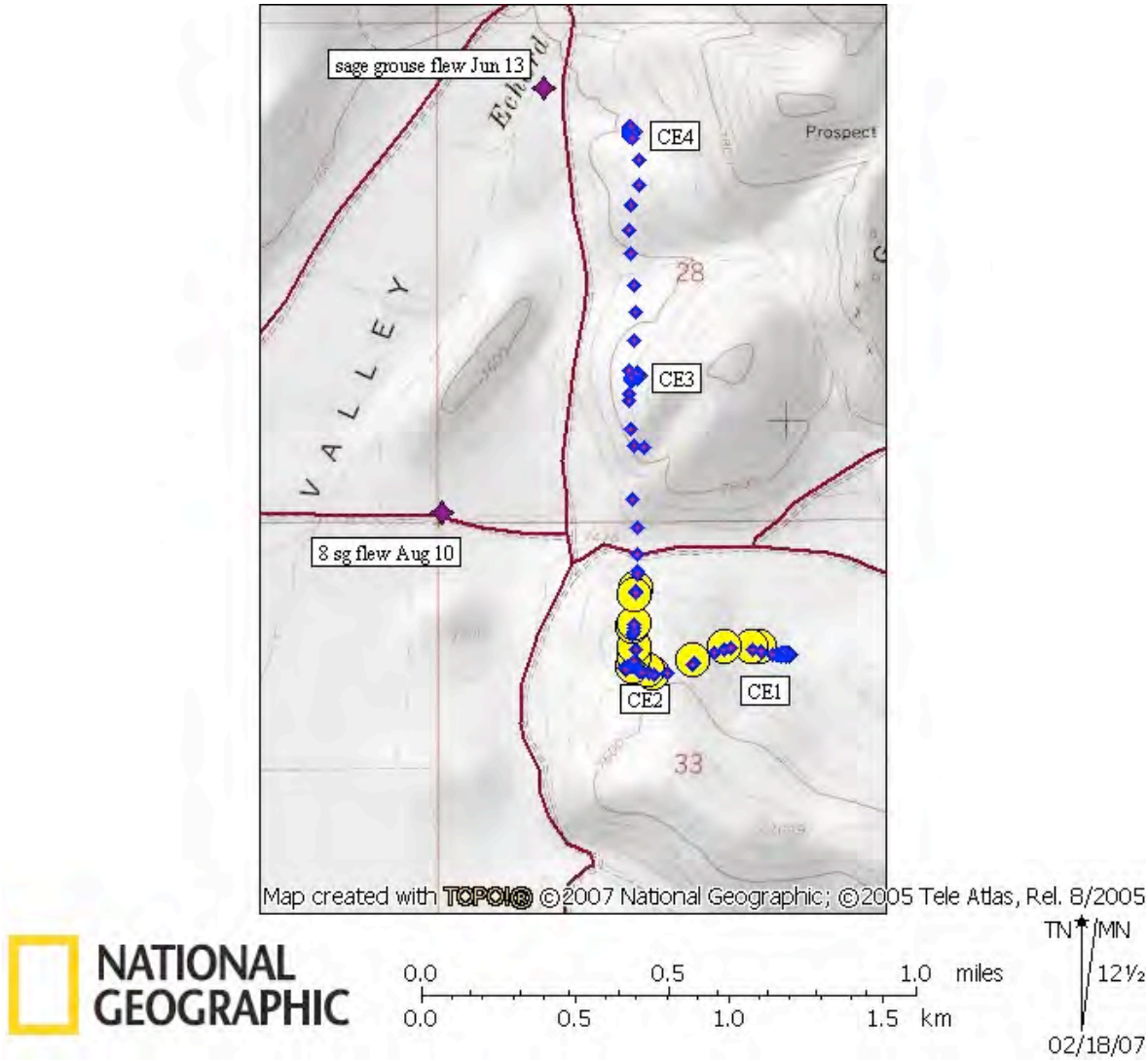
Fig. 2b. Lek Count Data, Area F, 1967-2006



Source: Data from Utah Division of Wildlife Resources, 2006

As indicated by sage grouse droppings, habitat use by sage grouse is often patchy, as shown in Map 3, a walking map of recorded sage grouse droppings in Dog Valley: Area C Early. Note the abundance, for instance, of sage grouse droppings sites recorded between Transects CE1, CE2, and the road, and the absence of droppings recorded across the road to Transects CE3 and CE4. Droppings were found at 6 locations along Transect CE1; 4 along CE2; 2 individual droppings along CE3 and none along Transect CE4.

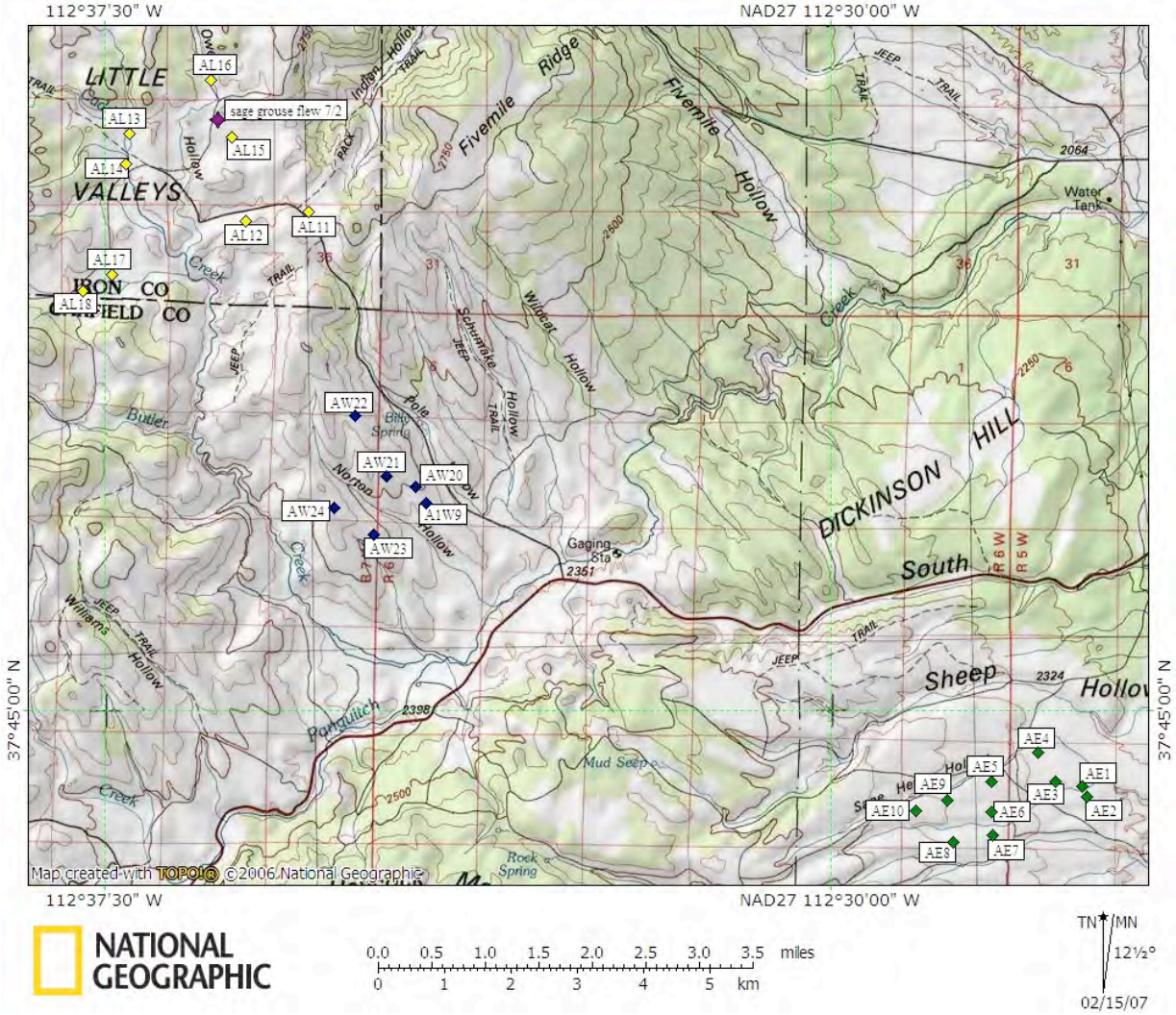
Map 3. Walking map: Sage grouse droppings variable within Dog Valley.
[Walking between C Early Transects CE1, CE2, CE3. Blue squares are GPS tracks. Yellow circles: Waypoints marked for sage grouse droppings.]



In the following summaries, the imprecise term "intensively grazed" is sometimes used. While the term is not particularly useful for the purposes of quantitative studies comparing grazing regimes, intensities, and other consequences of ungulate grazing, the phrase as used in these summaries refers to sites where a combination of obvious signs are present, such as when forbs and grasses in the open are rarely more than one to a few inches high, flowers have been consumed, plants are pedestaled, palatable shrubs are browsed back, riparian banks are trampled, creeks are incised.

Area A
Sage Hen Hollow, Little Valleys, Norton Hollow

Map 4. Area A: Sage Hen Hollow, Little Valleys, and Norton Hollow



Area A: Early Sage Hen Hollow

Sage Hen Hollow
BLM, Kanab Field Office
Quad Map: Hatch
County: Garfield
Elevation 7,700'- 7,900'
Lek Count Data:

Sage Hen Hollow (almost yearly counting 1967-2006)

Year	**1967**	**1977**	**1987**	**1997**	**2006**	**Highest 2005**	**Ave.**
# Cocks	9	63	42	34	81	97	50

Sage Hen Hollow, about 2.5 miles long, is one of a number of SE-trending narrow valleys with associated plateau uplands SSW of Panguitch. Black sagebrush and mutton bluegrass are the major vegetation types; forb diversity is not high.

Sage Hen Hollow is one of the two areas (Norton Hollow Winter habitat being the other) with the highest concentration of sage grouse droppings over a wide scale. When Sage Hen Hollow was surveyed in 2006, it had not been grazed for two years (2004-2005). It was grazed by 85 cattle for six months after the transects were taken in June 2006 (Carson Gubler, BLM, Kanab District, personal communication March 21, 2007). Some pronghorn are present, but sage grouse droppings are the most common animal Sage Hen Hollow is crossed by numerous ranch roads, but no industrial traffic.

Map 5. Walking Map: Extensive sage grouse use of Sage Hen Hollow

[Walking between A Early Transects AE4 and AE5. Yellow circles are waypoints marked for at least a single sage grouse dropping. A black star denotes a possible lek site – scattered droppings at a cleared area between two roads]

Area A: Late Little Valleys

Little Valleys
Dixie NF, Little Valleys Allotment
Quad Map: Fivemile Ridge
Elevation: 8,619'-8,786'

Little Valleys lies approximately 8.5 miles NW of and approximately 1,000 feet higher than Sage Hen Hollow. Caddy Creek is the major creek in this mesic meadow, which is heavily grazed by cattle and bisected by roads. Creeks are incised and banks trampled. Silver sagebrush and exotic Kentucky bluegrass is the major vegetation. Cattle dominate the animal scat, but some sage grouse droppings are present in small patches, e.g., between Transects AL14-16. Overall, sage grouse use appears light in Little Valleys, despite the presence of water. Sage grouse droppings are not common in the riparian areas.

While Little Valleys is mesic, sage grouse do not seem to be using it, at least in 2006.

Area A: Winter Norton Hollow

Norton Hollow
Dixie NF, Butler Creek Allotment
Quad Map: Fivemile Ridge
County: Garfield
Elevation: 7,300-8,251 elevation
Lek Count Data: Annual counts 1996-2006

Pole (Norton) Hollow Ridge Annual counts 1996-2006

Year	**1996**	**1998**	**2000**	**2002**	**2004**	**2006**	**Highest 1998**	**Ave.**
# Cocks	6	7	1	1	1	0	7	3

Butler Creek (w. of Norton Hollow) Almost yearly counting 1967-2006)

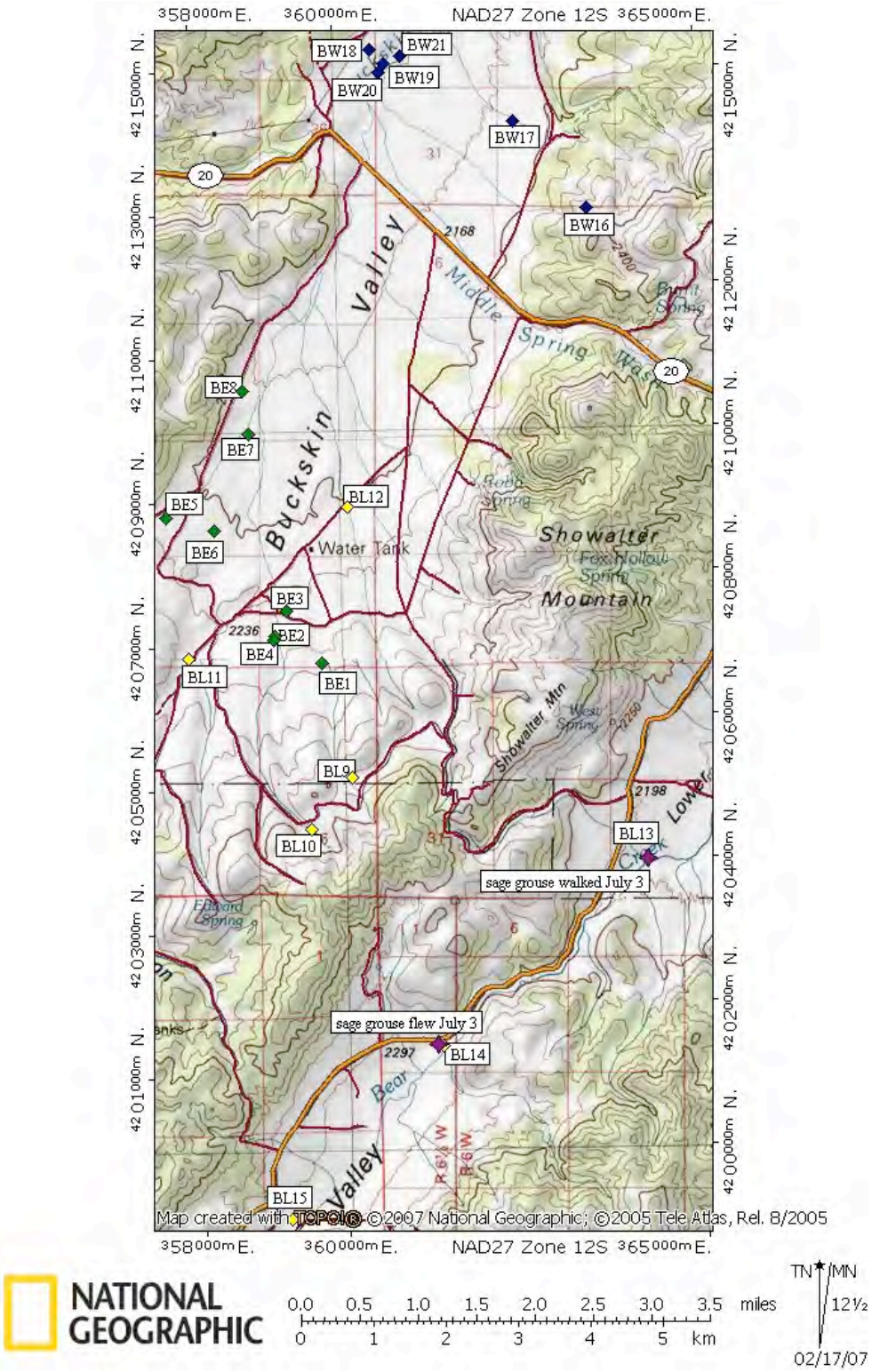
Year	**1967**	**1977**	**1987**	**1997**	**2006**	**Highest 2005-6**	**Ave.**
# Cocks	9	0	42	34	56	56	18

Norton Hollow lies midway geographically and elevation-wise between Sage Hen Hollow and Little Valleys. It is largely unroaded, lying SW of the roaded Pole Creek Hollow. Sage Hen Hollow and Norton Hollow are the two areas with the greatest concentration of sage

grouse use over a wide area. Black sagebrush and mutton bluegrass is the dominant vegetation, but as of July 9 in 2006, numerous native grasses including blue grama still retained seedheads and ridgetops used native grasses including blue grama w/ seedheads intact (July 9); the area surveyed may have been rested from cattle in 2006. Isolated aspen clones are heavily overbrowsed and grazed, with depleted understory, extensive bare ground, aspen ramets browsed to a few inches, and dense cattle scat. Rabbit droppings and wild ungulate scat are common on the slopes and ridges. Few forbs are present; some juniper encroachment is occurring on the gravelly, rocky and pebbly slopes.

Area B. Buckskin Valley/ Bear Valley

Map 6. Area B. Buckskin Valley/Bear Valley



Buckskin Valley/Bear Valley
BLM, Cedar City Field Office
Quad Maps: Burnt Peak (Early, Winter)
Little Creek Peak (Late)
County: Iron
Elevation: 6,950'-8,108'

Buckskin South Spring Spotty counting between 1969 and 2004; the lek apparently has been abandoned.

Year	1968	1978	1988	1974	1999	2004	Highest 1989	Ave.
# Cocks	0	9	4	24	0	0	24	8

Buckskin Valley New Spotty counting between 1980 and 2005.

Year	1980	1989	2000	2005	Highest 1989	Ave.
# Cocks	24	29	27	13	29	18

North Buckskin Valley		Lower Bear Valley #2	
Year	2006	Year	2006
# Cocks	18	# Cocks	12

Upper Bear Valley #1		Upper Bear Valley #2	
Year	2006	Year	2006
# Cocks	33	# Cocks	18

Buckskin Valley is a NE-trending valley approximately 8.5 miles long by 1.8 miles wide. It is bisected by Buckskin Wash, the water of which is largely captured by stock ponds and developments. The valley bottom has been seeded to exotic crested wheatgrass, as part of the Beaver Valley Cooperative Program between the BLM and the Beaver Valley Grazing Association. Mountain big sagebrush is the dominant native shrub, but crested wheatgrass is dominant on the valley floor and exotic cheatgrass is the major understory on the slopes of knolls in the area. Forbs and wildlife use are largely lacking.

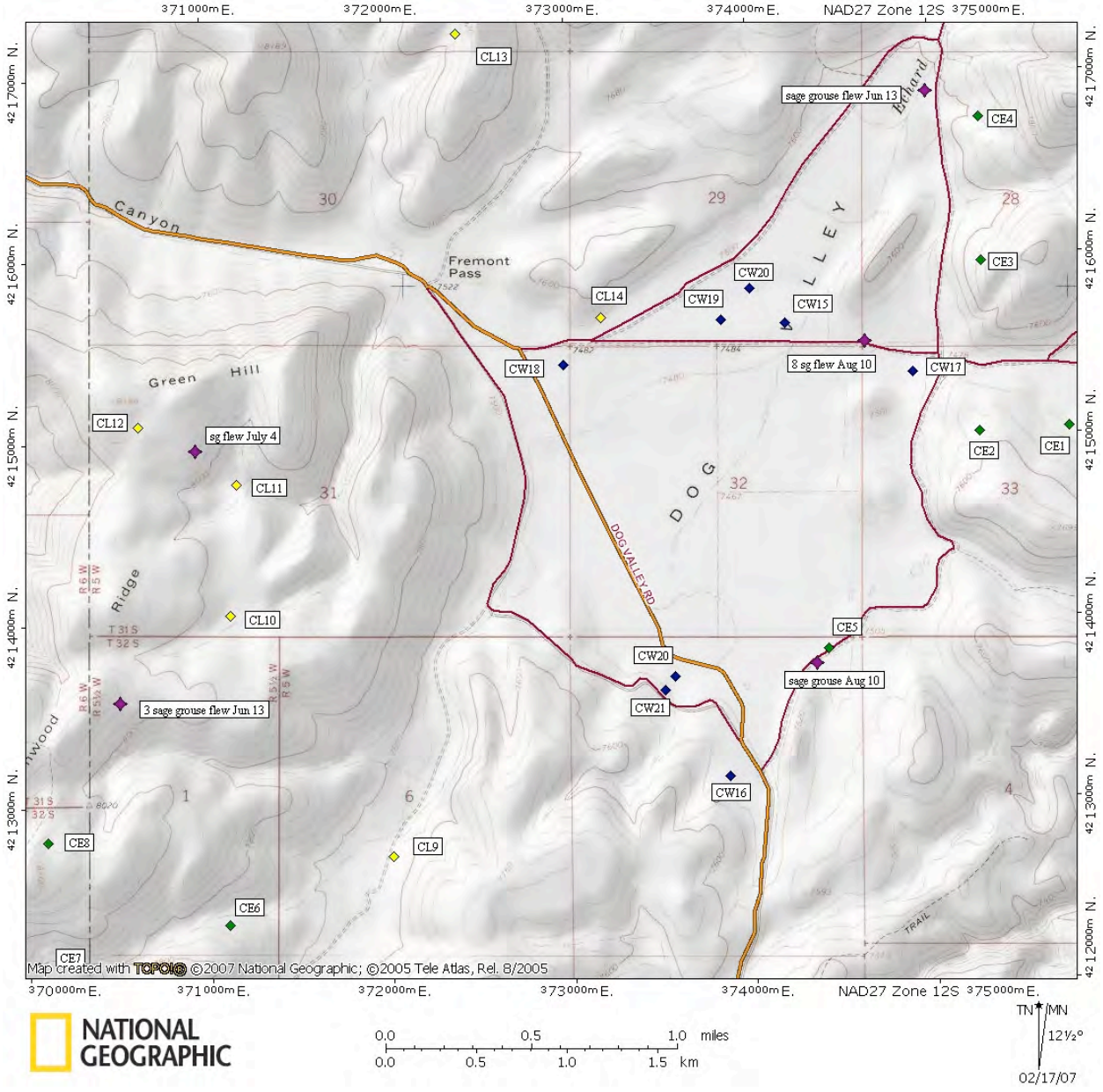
Most water is captured for livestock use, leaving trampled ponds, stock tank trickles and one small riparian area (Late Transect 12) to sage grouse. Cheatgrass and exotic bur buttercup are dominant around trampled stock ponds that are used by some sage grouse.

Late brood-rearing transects BL9 and BL10 are in a swale and meadow that were wetter in 2005, but were largely dry and heavily grazed and trampled in 2006. Only rare sage grouse droppings were seen. As a result of finding essentially no late brood-rearing sage grouse sign in Buckskin Valley, late brood-rearing transects BL 13-BL15 were placed in Bear Valley, approximately 4 miles SE of, parallel to, and wetter than Buckskin Valley. The two valleys are separated by Showalter Mt.

In three hours of driving and walking to pre-selected and potential winter transects on slopes in Buckskin Valley south of Hwy 20 cheatgrass was found, but not sage grouse use. Winter transects BW16-BW21 were placed north of Hwy 20 due to reports of winter sightings of sage grouse (Adam Bronson, UDWR, personal communication, May 2006). North of Hwy 20, sage grouse use appears concentrated in a narrow strip at the W edge of the valley bottom, among tall mountain big sagebrush. The eastern and central portions of the valley are old crested wheatgrass seedings and are used extensively by cattle; no sage grouse sign is present in the central and eastern portions of the valley

Area C. Dog Valley/Green Hill

Map 7. Area C. Dog Valley/Green Hilll



Dog Valley/Green Hill
BLM. Kanab and Cedar City Field Offices
Quad Map: Fremont Pass
County: Garfield
Elevation: 7,478’ -8,142’

Lek Count Data: Dog Valley (almost yearly counting 1967-2006)

Year	1967	1977	1988	1997	2005	Highest 1979	Ave.
# Cocks	58	65	52	6	98	106	60

Fig. 3. Dog Valley

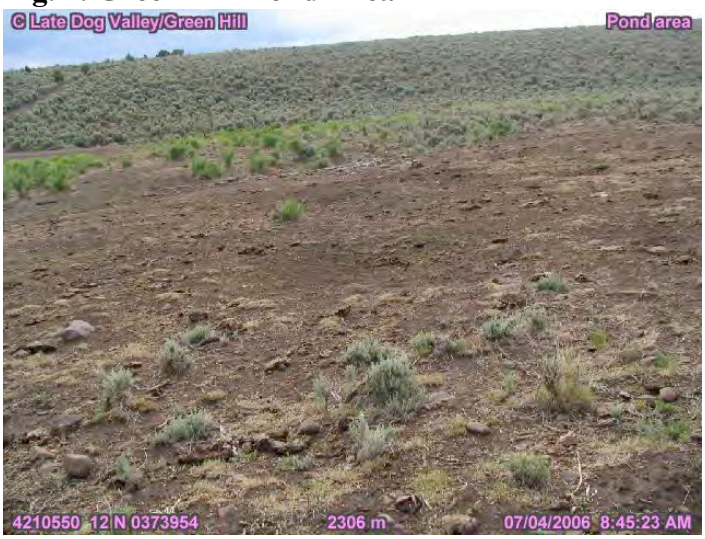
Dog Valley north of Hwy 20 and west of Hwy 89 is approximately 2.7 miles long and at its widest point approximately 1.6 miles wide.The central valley, including a pond, are privately owned, and the surrounding BLM land is grazed by four permittees' cattle as a common allotment (Carsen Gubler, BLM, personal communication, March 20, 2007)

Black sagebrush is dominant in the valley outside of the private land, with silver sagebrush and exotic Canada bluegrass in more mesic portions of the valley (e.g., Early Transect CE5). A few areas exhibit high forb diversity, e.g., (CL14, CE1-3) and are used by sage grouse, though the areas are grazed and the forbs small (e.g., ave. 2.4" tall at CE1). Forbs ave. 7.1" at CL14, but most are located only inside the black sagebrush). Many sites are nearly devoid of fobs.

Greater sage grouse use Dog Valley year round (leaving some years in winter when snow is deep, according to permittee Scott Harris, personal communication, July 4, 2006) and occurrences are heaviest in the vicinity of the private pond. It was difficult in some cases to distinguish between early, late, and winter habitat use, though Early Green Hill Transects DE7 and DE8 had fresh droppings and recent use; Early Dog Valley Transect DE5 was located where adult and young sage grouse had flushed; and Late Transect DL15 had numerous sage grouse droppings, but no forbs, indicating it might be a winter roosting site.

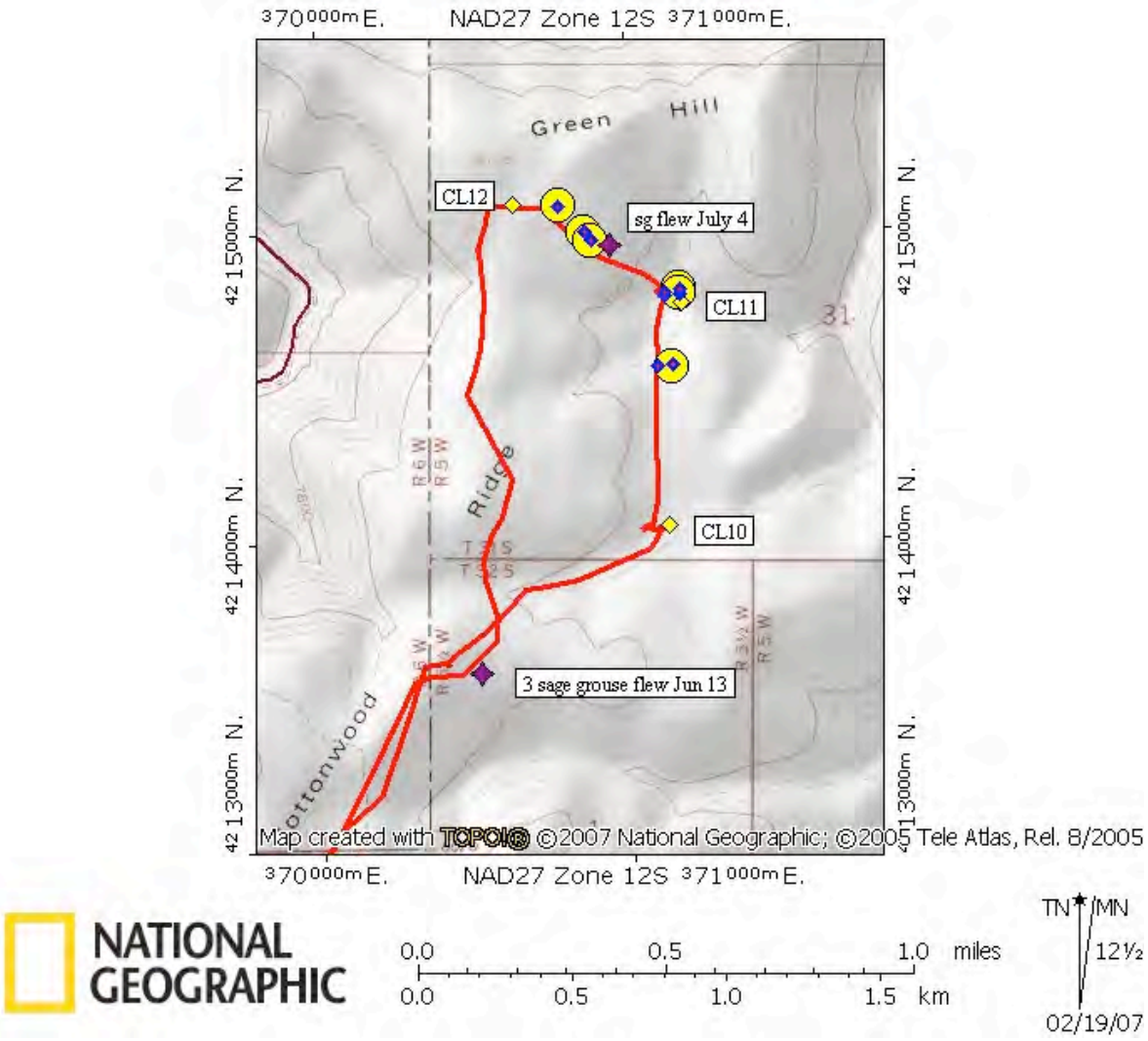
Rabbit and cattle use is intensive in Dog Valley.

Fig. 4. Green Hill Pond Area



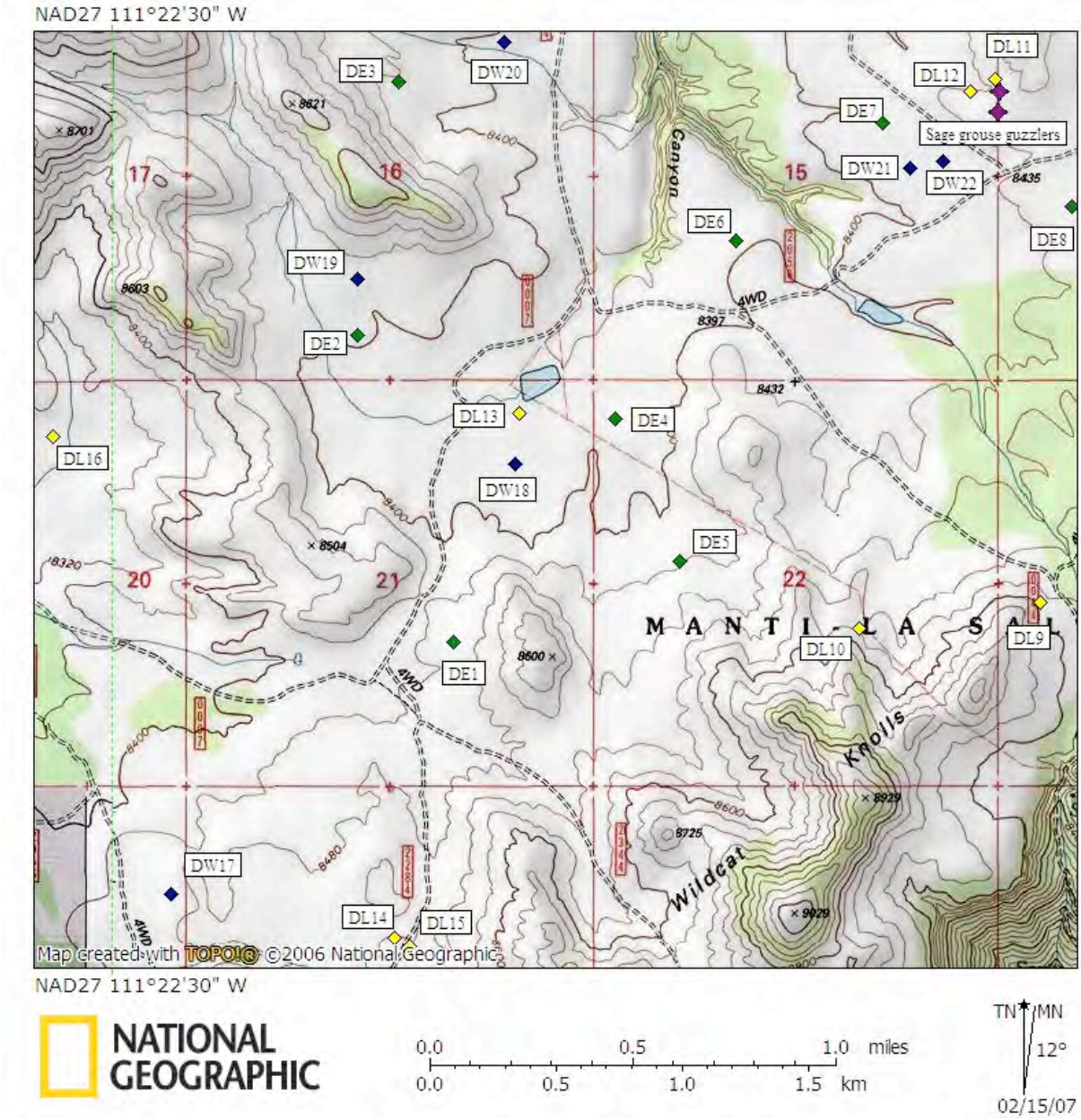
Green Hill lies immediately SW of Dog Valley, with mountain big sagebrush the dominant shrub small early brood-rearing sites were found on Cottonwood Ridge (CE7-CE8). A number of pre-selected Green Hill late brood-rearing sites identified on topographic maps as potential locations of water were trampled and no sage grouse use was evident (Fig 4). Extensive walking in the Green Hill area found only no to light sage grouse sign (Map 8). A 1,200 acre fire that burned in Fremont Canyon immediately west of Dog Valley and north of Green Hill was seeded to intermediate wheatgrass. Native shrubs other than mountain big sagebrush appear to have been largely eliminated. Little sage grouse use of the area.

Map 8. Walking Map: Light Use by Sage Grouse on Green Hill
[Walking between C Late Transects CL10-CL12. Red line is the walking route. Yellow circles are waypoints marked for at least a single sage grouse dropping.]



Area D. Wildcat Knolls

Map. 9 Area D. Wildcat Knolls



Wildcat Knolls
Manti-La Sal NF
Emery Allotment
Quad Maps: Emery West (Early)
Emery West and Accord Lakes (Late)
Emery West, Accord Lakes, and Flagstaff Peak (Winter)
Elevation: 8,297’-8,593’
County: Sevier

Lek Count Data:

Wildcat Knoll Annual counting 1991-2005

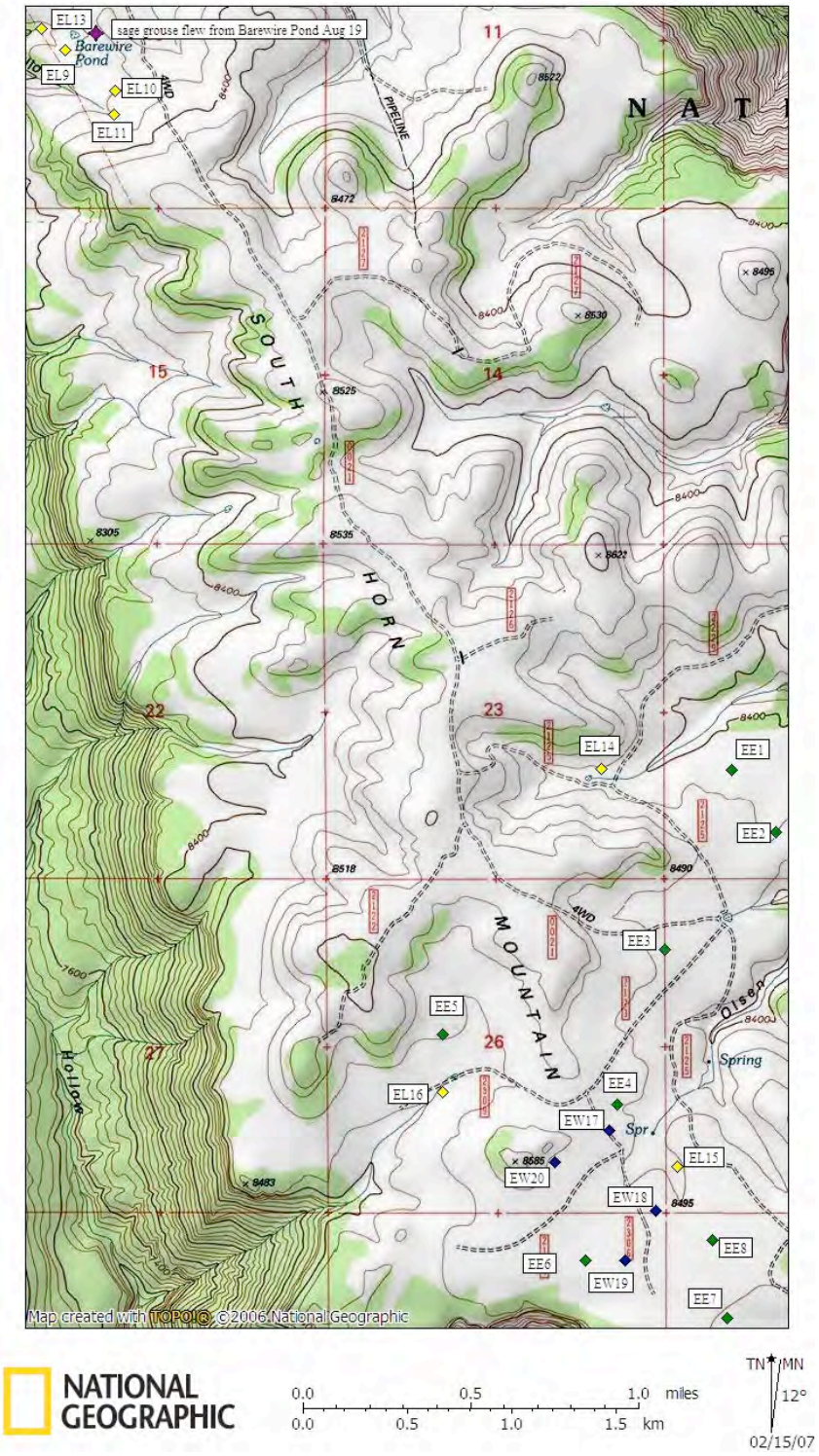
Year	1991	1996	2001	2005	Highest 1992	Ave.
# Cocks	20	20	11	12	22	12

Wildcat Knolls is a plateau with two large and numerous smaller knolls at the southern end of the Wasatch Plateau, bounded on the west by the North Fork Quitchapah Creek and on the east by Link Canyon. It is reportedly used year-round by sage grouse, but the area is intensively grazed by both cattle and elk and has been extensively altered for livestock. By June 22, 2006, for instance, cattle had grazed the vicinity of DE4 – DE6 and dry dust was rising from beneath their feet (see photo, DE6, Appendix B). Exotic crested wheatgrass and smooth brome seedings and sagebrush treatments dominate Wildcat Knolls. Mountain big sagebrush and black sagebrush are the naturally-occurring sagebrush.

Water is hauled to the Emery Allotment cattle from Quitchapah Creek despite the arid nature of Wildcat Knolls.Two side-by-side sage grouse guzzlers placed on the plateau by the SUFCO Mine (Arch Coal, Inc.) are fenced to 40” tall, but cattle were seen jumping the fence of and loafing by the 2 sage grouse guzzlers on June 21, 2006. Rabbit use is common in some crested wheatgrass seedings. Untreated areas such as DW22 would seem to be important to Wildcat Knolls sage grouse; sage grouse droppings are more common than in treated (see, e.g., DW21).

Area E. South Horn Mountain

Map 10. Area E. South Horn Mountain



South Horn Mountain
Manti-La Sal NF, Horn Allotment
Quad Map: The Cap
County: Emery
Elevation: 8,301'-8,631'
Lek Count Data:

South Horn (South Rim) Almost yearly counting 1987-2005

Year	1987	1992	1997	2001	2005	Highest 1989	Ave.
# Cocks	1	4	0	0	9	13	3

South Horn Mountain (S.O.B. Hill) Frequent counting 1968-1974 and then not until 1992-1993, by which time the lek apparently had been abandoned.

Year	1968	1970	1972	1974	1977	1992	1993	Highest 1989
# Cocks	5	3	4	0	17	0	0	17

Barb Wire Pond Single count

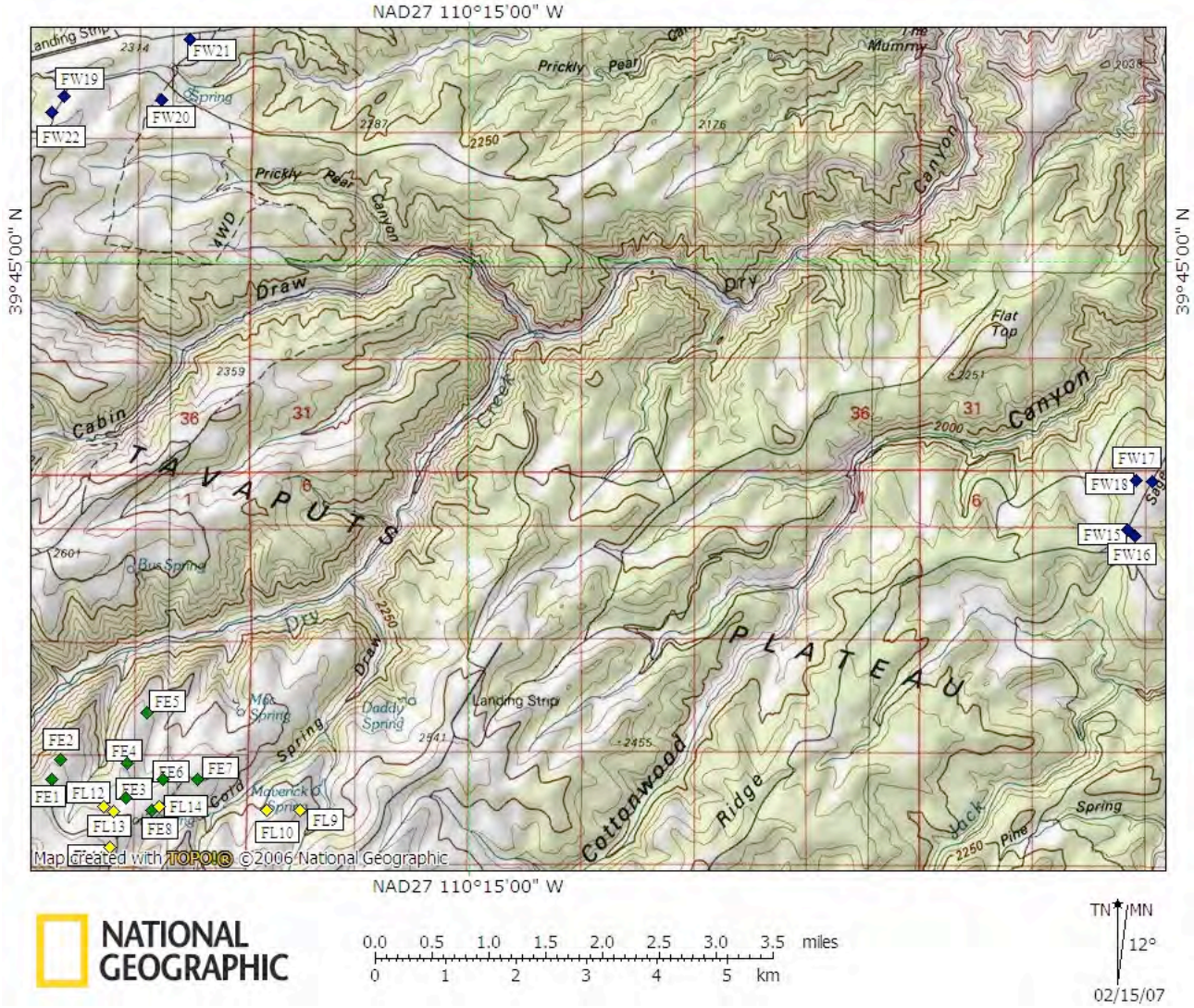
2005
2

South Horn Mountain is a plateau mountain on a southeastern edge of the Wasatch Plateau, bounded on the west by Biddlecome Hollow and on the east by Rock Canyon. Mountain big sagebrush is the dominant shrub; thickspike wheatgrass and mutton bluegrass are common native grasses, although other native grasses are present; forbs are not highly diverse.. Crested wheatgrass and smooth brome are present in some areas, but less so than on Wildcat Knolls. In an elk/cattle exclosure (E Late 13), needle-and-thread grass was common, with 20 native forb species w/in 3' of the transect.

Much of South Horn Mountain sage grouse use appears concentrated in the southernmost portion on mostly unroaded, open areas; and at Bare Wire Pond (for water) at the northern end. Extensive searching of other portions of South Horn for winter habitat revealed no sage grouse use on much of the plateau. The plateau is used widely by cattle and elk. Water courses are piped; some wildlife guzzlers are fenced; and the spring at Olsen Draw was sprayed with herbicide (see photos, E Late 15).

Area F. W. Tavaputs Plateau

Map 11. Area F. W. Tavaputs Plateau



W. Tavaputs Plateau
Utah Division of Wildlife Resources
Quad Maps: Bruin Point (Early/Late)
Currant Canyon (Winter)
County: Carbon County
Elevation: 7,213'- 8,798'
Lek Count Data:

Bishop Ridge #1 Counted all years but one, 1998-2006

Year	1998	2000	2002	2004	2006	Highest 2006
# Cocks	2	13	16	17	26	26

South Ridge Counted each year 2004 -2006

Year	2004	2005	2006	Highest 2004
# Cocks	5	>2	1	5

W. Tavaputs Plateau lies NE of the Roan Cliffs and drains eastward toward Desolation Canyon. It is a mixture of private and state land (UDWR). Early and Late transects were placed in the Cold Spring area; winter sites on Sage Brush Flat and Stone Cabin Gas Field.

The Cold Spring area is dominated by black sagebrush in some areas; mountain big sagebrush in others. Native grass cover is often dense, including thickspike wheatgrass, prairie junegrass, beardless wheatgrass, and mutton bluegrass. . Apparently little of the area has been seeded; exotic forbs and grasses were found only in Late Transect 13. Forb diversity is moderately high. The Cold Spring area is grazed largely by horses and wild ungulates (elk). As horse numbers increase, they are rounded up every five years;l in 2006 their numbers in the area were reduced from 250 to 80. This area has generally high grass cover; and, in some areas, high native forb diversity. Sage grouse use was light and scattered in 2006, but had been used much more during 2005 (Brad Crompton, UDWR, personal communication 2007).

Sage Brush Flat (W. Tavaputs Plateau, Winter) is mountain big sagebrush with some basin big sagebrush. Salina wildrye and squirreltail are common grasses. Sage Brush Flat has patches of numerous sage grouse droppings and moderately heavy rabbit use.

Stone Cabin Gas Field (W. Tavaputs Plateau, Winter) is grazed by cattle, wild ungulates and rabbits. Pinyon-juniper encroaches at many locations; roads and trucks and gas developments. Only light sage grouse use is present.

C. Early Brood-rearing Habitat

Table 6 assesses early brood-rearing habitat conditions in Areas A-F in light of Oliver's Ecological Habitat Integrity (Table 1). "Portion of habitat" suitable was not included, because the transects did not attempt to systematically sample each area on a quantitative basis.

Table 6. Ecological Habitat Integrity for Early Brood-Rearing Habitat, Areas A-F

Early Brood-rearing Indicator	A Sage Hen Hollow	B Buckskin Valley	C Dog Valley	D Wildcat Knolls	E South Horn Mountain	F West Tavaputs Plateau
Cover type						
Grass cover >7" tall	23.6%	19%	8.7%	7%	21%	10%
Mean sagebrush height	12.2"	29.5"	20.2"	11.4"	13.6"	10"
Sagebrush canopy cover	28.8%	35.5%	33%	18%	19.7%	25.5%
Mean grass and forb height (droop height)	8.7"	8.5"	6.3"	4.8"	8.1"	5.3"
Perennial grass cover	43.6%	19.8%[a]	23.8%	37%[b]	39.8%	42%
Forb cover	6.2%	8.2%	14%	4.2%	7%	21.2%

[a] Buckskin Valley grass cover is 36.8% before removing exotic annual cheatgrass.

[b] Wildcat Knolls native perennial grass cover is 26%; exotic perennials KY bluegrass, crested wheatgrass, and smooth brome account for 11%.

Very Good	Good	Fair	Poor

Forbs. A lack of forb availability was found. All of the sites rated poor for either forb cover (4 of 6 sites) or grass and forb height (3 of 6 sites). The two sites that rated very good for forb cover (Dog Valley and W. Tavaputs Plateau), rated poor for mean grass and forb height, although their grass height had been good (W. Tavaputs Plateau) or very good (Dog Valley), implying that it is the forb height that is poor.

With >10% forb cover considered "very good," and <10% forb cover considered poor, the following proportion of transects within each area had >10% forb cover:

A (Sage Hen Hollow)	0%
B (Buckskin Valley)	25%
C (Dog Valley)	50%

D (Wildcat Knolls) 13%
E (South Horn) 13%
F (W. Tavaputs Plateau) 88%

As shown in Fig. 5, forb heights generally decreased at Late brood-rearing sites as compared to Early brood-rearing sites. As noted at the right edge of Fig. 5, 11 plots had forbs averaging over 10" tall. It is interesting to note that of those 11 plots, only 3 had 10% forb cover (needed for early brood-rearing): Three had 4%; 3 had 6%; and 2 had 8%.

Some forbs are considered "food forbs" because they are preferred food for sage grouse chicks. Sather-Blair, et al. (2000) list 23 "preferred" forb species or genera for sage grouse in Idaho. Using that list, the six early brood-rearing sites rate as follows for presence of forbs that are potentially sage grouse food:

Table 7. Ecological Habitat Integrity for Nesting Habitat Food Forbs, Areas A-F

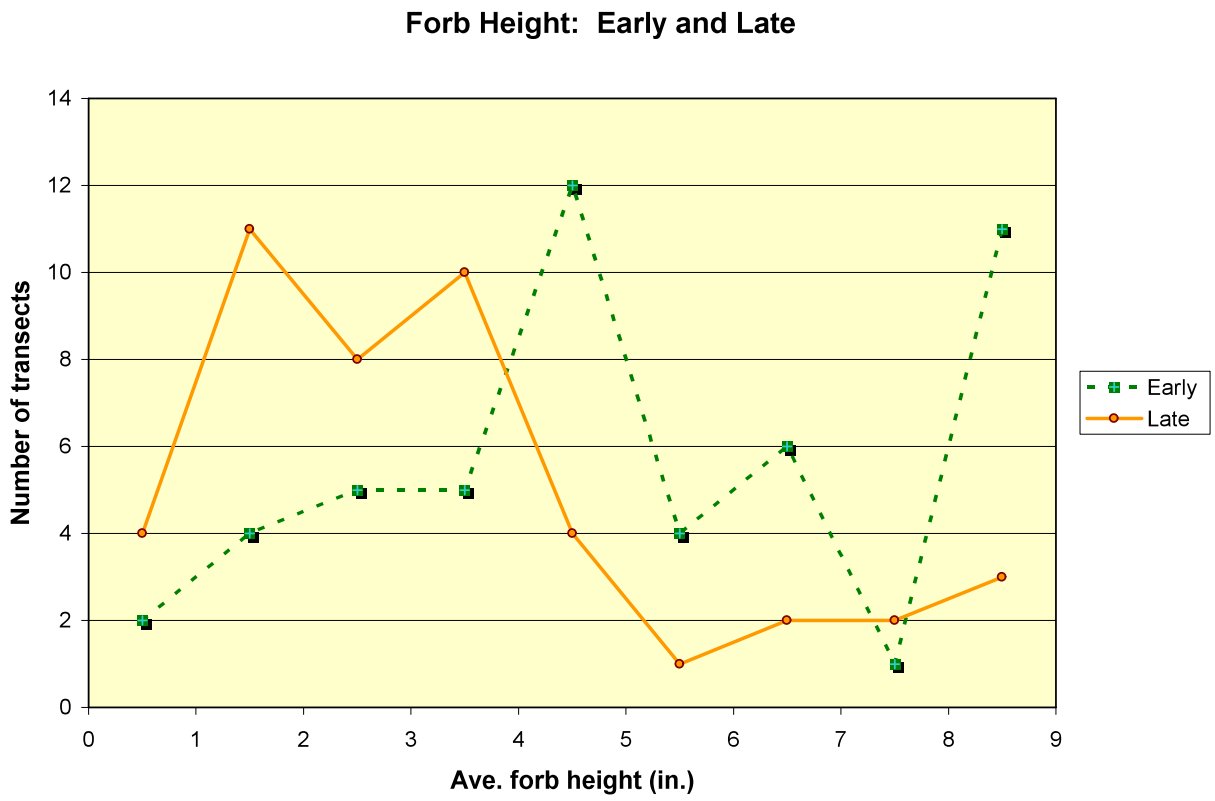
Early Brood-rearing Indicator	A Sage Hen Hollow	B Buckskin Valley	C Dog Valley	D Wildcat Knolls	E South Horn Mountain	F West Tavaputs Plateau (Cold Spring Area)
Food forb cover	4.4%	1.5%	8.75%	0.5%	5.2%	13%

Very Good >3%	Good 2-3%	Fair 0.5-<2%	Poor <0.5%

At least 19 forbs that are potential food for greater sage grouse ("food forbs") were encountered in the transects (Table 8.)

Table 8. Occurrence of Potential Food Forb Plants in Transects		
Common name	**Scientific name**	**Number of transects**
Hollyleaf clover	*Trifolium gymnocarpum*	28
Daisy/fleabane	*Erigeron* spp.	20
Lesser rushy milkvetch	*Astragalus convallarius*	19
Mountain phlox	*Phlox austromontana*	15
Longleaf phlox	*Phlox longifolia*	13
Aster	*Aster* spp.	11
Fiddleleaf crepis	*Crepis runcinata*	9
Dandelion	*Taraxacum officinalis*	5
Phlox	*Phlox* sp.	4
Milkvetch	*Astragalus* sp.	3
Taper-tip crepis	*Crepis acuminata*	3

Fig. 5 Forb Height: Early and Late Transects



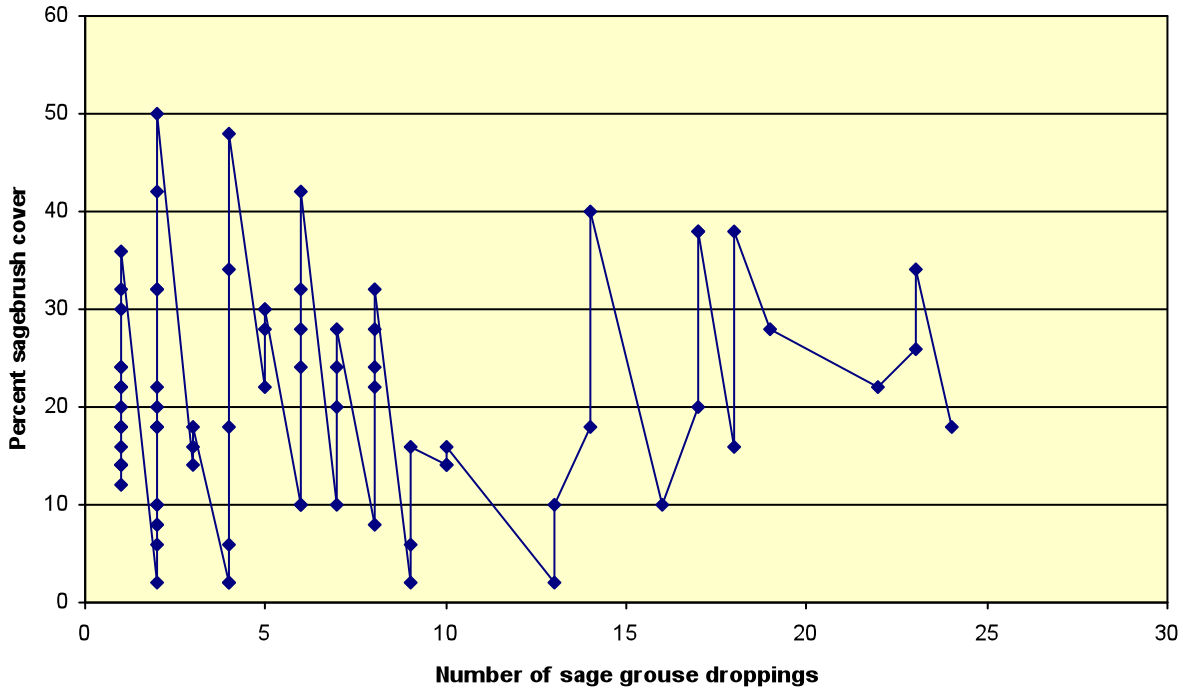
[Note: X-axis points are midpoints of the height ranges: 0.5 = 0-1";1.5 = 1.1"–2.0"; etc., and 8.5 = >8"]

Grass. Grass height rated "good" or "very good" for all sites and perennial grass cover rated "very good" for all but one area (Buckskin Valley at "fair").

Sagebrush. Three of the six areas exceeded early brood-rearing sagebrush cover thresholds of 25% (Sage Hen Hollow had 28.8% cover; Dog Valley 33%; Buckskin Valley 35.5%).

A simple comparison of sagebrush cover to sage grouse use (Fig. 6 with sage grouse dropping frequency as the indicator of sage grouse use) shows a range of low to high sage grouse droppings in both low and high sagebrush cover. (Transects that had no sage grouse droppings are not included in Fig.6) For instance, sagebrush cover ranging from 30% to 40% was associated with sage grouse droppings frequencies of 1 to 23. These droppings, of course, may variously be associated with nesting needs, early brood-rearing needs, late brood-rearing, or even, in the case of non-migratory populations, with winter use.

Fig. 6 Relationship of Sage Grouse Dropping Frequency to Sagebrush Cover



D. Summer-Late Brood-rearing Habitat

Table 9. assesses summer-late brood-rearing habitat conditions in Areas A-F in light of Oliver's Ecological Habitat Integrity for that use (Table 2). "Portion of habitat suitable" was not included, because the transects did not attempt to systematically sample each area on a quantitative basis.

Table 9. Ecological Habitat Integrity for Summer-Late Brood-Rearing Habitat, Areas A-F

Summer-Late Brood-rearing Indicator	A Little Valleys	B Buckskin Valley/Bear Valley	C Dog Valley	D Wildcat Knolls	E South Horn Mountain	F W. Tavaputs Plateau (Cold Spring Area)
Cover type						
Mean sagebrush height	11.9"	22.1"	15.2"	21.3"	19.9"	18.3"
Sagebrush canopy cover	23.8%	6%	22%	23.8%	22.2%	17%
Total shrub cover	24%	15.7%	33.5%	33%	26.8%	22%
Mean grass and forb height (droop height)	6.1"	4.7"	6.0"	4.4"	5.6"	6.8"

Very Good	Good	Fair	Poor

Forbs and grass. Three of the six sites rated "poor" for grass and forb height.

Although young sage grouse eat forbs for food and moisture content during this period, no threshold of forb cover is included in Oliver's table. As noted regarding the Summer-Late Brood-Rearing Table 2 in "Background" above, the Idaho BLM sage grouse habitat assessment notes that forb availability is suitable for late brood-rearing habitat if "Succulent, green forbs are readily available in terms of distribution and plant structure." (Sather-Blair, et al. 2000). The percentage forb cover for Late Sites A-F is as follows, although it is not known which would be used by greater sage grouse during summer-late brood-rearing.

Site A 30%
Site B 4%
Site C 4.4%
Site D 12.2%
Site E 5.2%
Site F 17.7%

Sagebrush. Four sites exceed the 20% sagebrush cover upper thresholds (although the highest average cover is only 23.8%) , and one (Buckskin Valley) falls below the lower 10% cover threshold. There are locations in Buckskin Valley, particularly on slopes, where the percent cover is higher, but sagebrush removal has occurred throughout most of the Valley for crested wheatgrass seedings for livestock. One site, W. Tavaputs Plateau meets the sagebrush cover criterion.

Two of the four sites that exceed the sagebrush cover criterion of 20%, fall below the sagebrush height criterion of 15.7": Dog Valley at 15.2" and Sage Hen Hollow at 11.9".

Oliver's table provides only for "very good" vs. "poor" ratings.

E. Winter Habitat

Table 10 assesses winter habitat conditions in Areas A-F in light of Oliver's Ecological Habitat Integrity for that season (Table 3). Our winter habitat assessment took place during the summer and the snow level varies with the year, so the ratings for canopy coverage would hold only if the sagebrush were all above snow; the ratings for sagebrush height would hold only if no snow were present.

Table 10. Ecological Habitat Integrity for Winter Habitat

Winter Habitat Indicator	A Norton Hollow	B Buckskin Valley (no. of Hwy 20)	C Dog Valley	D Wildcat Knolls	E South Horn Mountain	F W. Tavaputs Plateau (Sage Brush Flat and Stone Cabin Gas

						Field)
Mean canopy coverage of sagebrush above snow *[IF ALL SAGEBRUSH WERE ABOVE THE SNOW]*	24%	21%	36%	14%	8%	15%
Mean height of sagebrush above snow [*IF NO SNOW WERE PRESENT]*	6.6”	27.6”	13.8”	14.0”	17.2”	18.0”
Mean height of sagebrush (total height of plant, no snow)	6.6”	27.6”	13.8”	14.0”	17.2”	18.0”

Very Good	Good	Fair	Poor

None of the six sites rates “very good” or “good” for sagebrush height, with five of them averaging less than the lower threshold height of 18.1” and one (Buckskin Valley) exceeding the upper threshold height of 22”. However, if any of these sites are snow-free, four of the six areas have sagebrush that meet “good” or “very good” thresholds. Even if snow-free, one (Buckskin Valley at 27.6”) remains above the upper height threshold of 18.1”; and one (Norton Hollow, at 6.6”) is below the lower threshold of 11.4”.

Canopy coverage of four of the six areas is below the threshold of 22% for “good” or “very good” ratings.

Norton Hollow, however, was the winter site with the highest use by sage grouse in winter, according to sage grouse pellet presence.

F. Landscape Habitat

The ratings of GOOD, FAIR, POOR in Table 11 are based on Oliver (2006) descriptions for landscape integrity, but are necessarily subjective. Brief reasons are given for each rating. As well, although labels such as “W. Tavaputs Plateau” and “South Horn” are used, the terms refer only to the areas of the transects and sites actually observed within each Area.

Oliver’s general habitat table (2006) has been slightly altered for Table 11. The row for predators was left out, as that had not been examined in this assessment. Past burning and herbicide treatments have not yet been examined for this assessment, although some observations are made. A row for exotic species invasion has been added. Some brief comments

on water availability were included in the General Habitat row for food and cover, although Oliver does not mention that feature.

Table 11. Landscape Habitat Assessment: Areas A-C, D-F

[Note: references to transect reports in Appendix B are denoted by an Area letter, season letter, and transe
Area A, Early (brood-rearing), Transect 7]

Key Ecological Attribute	Indicator	A E = Early Sage Hen Hollow L = Late Little Valleys W = Winter Norton Hollow	B Buckskin Valley(1) /Bear Valley (2)	
Landscape	General habitat (food, cover)	E: GOOD Black sagebrush; native grasses and forbs L: FAIR Riparian meadows, but creeks incising and headcutting W:GOOD Black sagebrush; some mosaics; native grasses and forbs	(1) VERY GOOD to POOR Has some large, woody, tall sagebrush in patches, but the valley floor has been extensively "treated" and seeded. (2) FAIR: Riparian meadows are present, but have been degraded by KY bluegrass; baltic rush, and other grazing-resistant species. creeks deeply incised	VER mour
Habitat degradation	Grazing	E: GOOD Moderate wild ungulate L: POOR Bank trampling; stream widening; KY bluegrass/baltic rush favored; grasses uprooted W: GOOD-FAIR Little cattle use on some slopes and ridges, but destructive grazing in aspen clones (with implications for water availability). Heavy rabbit use (lack of predators?); heavy ungulates	(1) POOR. Intensively grazed and manipulated for livestock grazing. (2) FAIR: Heavily grazed, but is wetter than Buckskin Valley	(2) P cattle deple
Habitat degradation (e.g., elimination of sagebrush)	Herbicide treatments or Burning	E, L, W: VERY GOOD? No obvious herbicide treatments	POOR? (1) Herbicide treatments may have been undertaken (2) ?	?
Habitat degradation (e.g., elimination of sagebrush and native grasses and forbs, invasion by exotic annual grasses such	[Exotic species]	E: FAIR Cheatgrass is invading on slopes, e.g., SW-facing slopes along Sage Hen Hollow Road. L: POOR Invasion of KY bluegrass; Baltic rush (a grazing-induced riparian veg type (USGS 2001), few riparian forbs W: GOOD Good winter habitat on	(1) POOR Forbs essentially eliminated; cheatgrass and seeding of exotic crested wheatgrass in valley; KY bluegrass dominates trampled wetlands (2) FAIR-POOR Replacement of much of the native grasses by KY bluegrass, smooth brome	FAIR essen some diver espec CE2, areas creste mesic

as cheatgrass)		ridges but destruction of isolated aspen clones		
Habitat degradation (e.g., elimination or reduction of sagebrush)	Mechanical treatments	E, L, W: VERY GOOD? No evidence of mechanical treatments	(1) POOR Most of the valley appears to be subjected to repeated mechanical treatments for cattle	?
Habitat	Invasive junipers and other conifers	E, L: VERY GOOD W: POOR Encroachment of junipers in Norton Hollow (see photos Appendix B; AW21-22);	GOOD? Not much sign of conifer encroachment?	GOOD? Not much sign of encroachment?
Habitat restoration (reseeding)	Seed mix	GOOD? No obvious reseeding	(1) POOR Has been seeded with crested wheatgrass (2) POOR Has been seeded with smooth brome and crested wheatgrass	POOR 1999 fire in Fremont Canyon was reseeded to exotic intermediate wheatgrass; crested wheatgrass is also present.
Mortality	Fences, utility lines and poles	E: VERY GOOD L: GOOD; see fence (Appendix. C; Late Transect 7) W: VERY GOOD Few developments in immediate area	(1) POOR Poles near stock ponds; old fences (2) FAIR? Ranch fences	FAIR A high fence surrounds the private land in the center of the valley. Fencing is not extensive up in Green Hill.

Key Ecological Attribute	Indicator	D Wildcat Knolls	E South Horn Mountain	F W. Tavaputs Plateau Early Late Cold Spring Winter 1 Sage Brush Flat Winter 2 Stone Cabin Gas Field
Landscape	General habitat (food, cover)	GOOD-FAIR Black sagebrush and Mtn big sagebrush structure are naturally present, but extensive treatments for livestock.	GOOD Mountain big sagebrush and black sagebrush both separate and mixed. Water is primarily diverted to livestock or in closely-fenced guzzlers.	VERYGOOD. Black sagebrush and mountain big sagebrush.
Habitat degradation	Grazing	POOR Heavy cumulative grazing of wild ungulates and cattle remove most forbs and height of grasses (see photo in Appendix B, D E5 of a 32" mutton bluegrass growing protected in a mountain big sagebrush	POOR Heavy wild ungulate grazing is added to by cattle grazing,, water diversions and wetlands trampled by cattle.	FAIR Combined grazing by horses (a herd of 40 at FE4) and other wild ungulates (mostly elk). This may place high pressure on low water availability. Stone Cabin Gas Field grazed by cattle as well as wild ungulates.
Habitat degradation (e.g., elimination of sagebrush)	Herbicide treatments or Burning	POOR? Olsen Draw spring vegetation was killed by herbicide spraying, apparently by a permittee, as the Manti-La Sal NF indicates it did not propose or authorize the spraying. Extensive seedings of smooth brome and crested wheatgrass may have involved herbicides (e.g., Transect D-Winter 21, with dead mountain big sagebrush in an apparent treatment).	?	VERY GOOD? None apparent.
Habitat degradation (e.g., elimination of sagebrush and native grasses and forbs, invasion by exotic annual grasses such as cheatgrass)	[Exotic species]	POOR. Extensive seedings of crested wheatgrass and smooth brome. Native forbs are often only 2-4% cover.	GOOD. Mostly native grasses and forbs. Seedings of crested wheatgrass and smooth brome have not been as extensive as on Wildcat Knolls.	
Habitat degradation (e.g., elimination or reduction of	Mechanical treatments	POOR. Sagebrush has been extensively reduced on Wildcat Knolls	FAIR Sagebrush has not been reduced as severely as on Wildcat Knolls but forbs are largely depleted on South Horn Mountain An exception is 22 forb species found w/in 3' of the transect in an elk/cattle exclosure (EL13)F	EL GOOD Mechanical treatments not apparent W1 FAIR Roads and test drill disturbance. W2 POOR Extensive gas developments,

sagebrush)			(forb cover 10%).	roads, buildings, ditches.
Habitat	Invasive junipers and other conifers	GOOD – not apparent	GOOD. But a two-needled pine seedling in EL14 transect.	W1-2 POOR. Extensive pinyon-juniper encroachment on Sage Brush Flat and Stone Cabin Gas Field. Some pre-selected transects were not used because of recent encroachment.
Habitat restoration (reseeding)	Seed mix	POOR – Extensive past seedings of exotic grasses for livestock	FAIR. Some seeding of exotics – crested wheatgrass and smooth brome.	GOOD Exotic seedings not apparent.
Mortality	Fences, utility lines and poles	POOR See Fig. 7, below, of a fence and dead deer. A large corral is fenced. Water has been lost from E. Fork Box Canyon due to coal mining subsidence and so two side-by-side sage grouse guzzlers are fenced by a 40" tall fence, but cattle were seen to jump that fence in June 2006 to get to water (Fig. 8). Fences are not prominent at the southern end of Wildcat Knolls.	POOR Barewire Pond is depended upon by sage grouse, but it has extensive bare ground surrounded by a fence and a large tree provides perch for raptors (a dead young sage grouse was there in 2005). Fences are not prominent on South Horn Mountain	W1 GOOD. W2 POOR. Extensive gas drilling structures; noise; fences; truck traffic

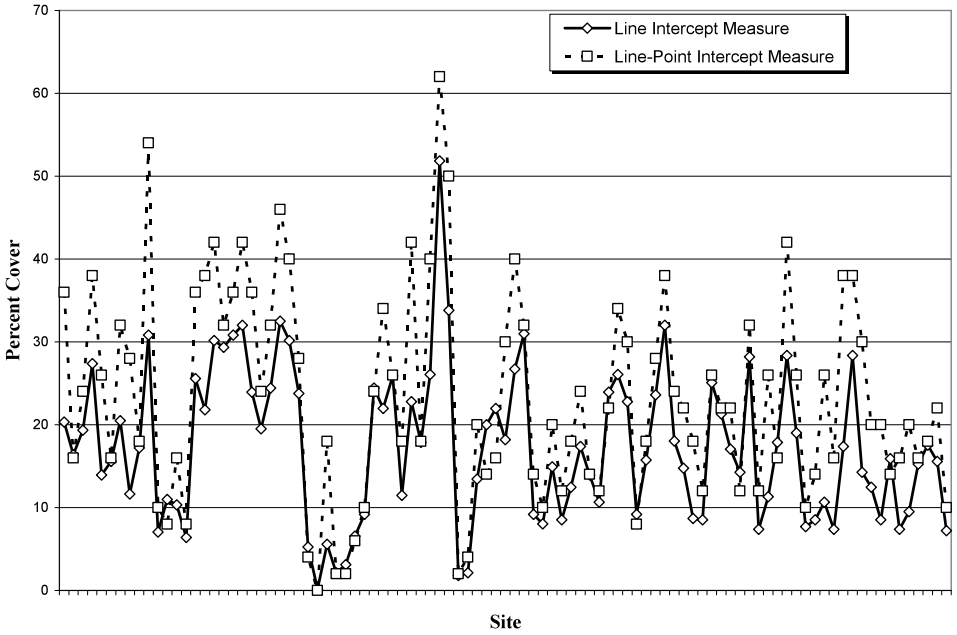
Fig. 7 Fence on Wildcat Knolls, near Box Canyon. Was the deer killed crossing it?

Fig. 8 Cattle inside and outside sage grouse guzzler fence, Wildcat Knolls (ht. 40")

G. Comparison of Line-Point Intercept and Line Intercept for Sagebrush Cover

The estimate of sagebrush cover by the line intercept method was nearly always higher than with the point intercept method Fig. 9. However, the two methods had a correlation of r=0.886 ($r^2 = 0.785$).

Fig. 9. Comparison: Sagebrush Cover Assessments Using the Line-Point Intercept and Line Intercept Methods



Examining the data for low cover area and higher cover areas separately lowered the correlation between the two methods as would be expected, since the range of the scores was reduced on both measures, but the relationships between the two measures did not differ significantly for the low cover and higher cover areas.

6. DISCUSSION

The transect locations were not entirely random. Some were pre-selected to represent the area reportedly being used by greater sage grouse, but many were placed where sage grouse had been present in order to capture conditions in the sites actually being used by the sage grouse. Some were placed in particular sites (e.g., two in crested wheatgrass seedings in Buckskin Valley, or a creek) to capture conditions in the area. Thus, each transect has its own story, as captured in Appendix B, which contains detailed vegetation data, photos, and a brief description of each transect.

All six areas surveyed are suitable habitat in terms of landscape vegetation type, primarily mountain big sagebrush and black sagebrush, with some silver sagebrush.

Lack of forb availability and height of combined understory grasses and forbs is the feature most lacking in the early brood-rearing areas, with none of the six areas rating "good" or "very good" for both of these features. Although three of six summer-late brood-rearing lacked sufficient height of grass/forbs, the summer-late brood-rearing table does not include forb presence (cover).

A survey of the photographs along the 131 transects in Appendix B reveals the virtual absence of flowers, even in June, on these lands. For instance, often a forb or grass recorded as present at 4" tall is in reality an extremely slender stem with no flowers that would attract insects for sage grouse chicks, and later no seedheads.. Were it not for Mindy Wheeler's extensive experience as a professional field biologist, many of the forbs (and grasses) would have been unidentifiable as species. That the short stature of the forbs and grass is not due to aridity alone is clear from the presence of much taller plants inside as opposed to outside sagebrush. See., e.g, the Appendix B photo for D Early Transect 5, Appendix B, of a 32" mutton bluegrass with seedheads inside the protection of a mountain big sagebrush).

Sagebrush canopy cover rated too high in three of the six early brood-rearing areas, and four of the six summer-late brood-rearing areas, but too low in one of the six summer-late brood-rearing areas and five of the six winter habitat areas.

Sagebrush cover exceeds the ecological integrity tables' thresholds on three of six early brood-rearing sites and four of six summer-late brood-rearing sites. However, desirable sagebrush cover is lacking on one summer-late brood-rearing sites, and in five of the six winter sites.

In seven of the eight cases in which sagebrush height is "poor" (i.e., two early, two summer-late, and four winter areas), the "poor" rating is due to insufficient height. Only on one winter area (Buckskin Valley), does the height exceed the upper threshold.

Thus the survey data do not indicate a simple "tall, dense sagebrush" problem – rather a "too dense" concern in some places; "too sparse" in others; and generally "too short" rather than

too tall. The lack of forbs in the open interspaces would indicate that it is not sagebrush that is preventing forb presence.

High levels of ungulate herbivory are the dominant reasons for encroachment of shrubs and other woody plants into semiarid grasslands and for changes in woody plant density (see, e.g., the literature review of Van Auken 2000). Connelly et al (2004) report that grazing of non-woody plants favors sagebrush density, citing (Reichenberger and Pyke 1990):

> In sagebrush grasslands, herbivory of herbaceous plants during the growing season tends to favor sagebrush growth until sagebrush becomes so dense that the competition of sagebrush restricts recovery of herbaceous plants …
>
> The release from livestock grazing should allow the full expression of vegetation height for hiding cover and nest protection. Improvements could be expressed in the next growing season, but might take 3 to 5 years for pre-existing plants to fully express themselves and 10 to 15 years for seed production and new plant recruitment to occur assuming the site is not fully occupied by other species

During our survey, most forbs were recorded beneath sagebrush where they were protected from ungulate grazing, rather than in the inter-spaces where they were subject to virtual removal by cattle and wild ungulates. Treating sagebrush for excessive cover absent relief from the grazing pressure would appear to only further reduce forb presence and further exacerbate sagebrush density on the landscape. Sage Hen Hollow (Early A) shows the least grazing pressure on forbs and grasses in terms of livestock sign, and forb/grass height), but its shrub cover exceeds the upper threshold of 25% by only 3.8%.

On the other hand, the potential of many areas within these sites to provide much more robust habitat for sage grouse is revealed by the relatively high diversity of native grass and forb species present (e.g., often 20 or more native forb species within 3' of a given transect).

Native vegetation predominates in the six areas with the exceptions of (1) riparian areas largely degraded to rhizomatous exotic Kentucky bluegrass and the increaser Baltic rush (e.g., in Little Valleys, Bear Valleys); (2) cheatgrass understory dominance in Buckskin Valley; and (3) the extensive exotic smooth brome and crested wheatgrass seedings in Wildcat Knolls, Buckskin Valley, and Bear Valley. Were this vegetation to receive relief from the intense grazing by cattle, elk, and horses, sage grouse would have available to them more insects, pollinators, hiding and loafing cover, water, and food.

Water availability appears to be of concern. Much of the surface water in these six areas is being diverted to pipes or through water developments to cattle. Every open creek, wet swale, or depression we saw during reconnaissance (2005) and the survey (2006) was trampled, denuded, or consumed. We saw no secure water for sage grouse. Even the two side-by-side guzzlers reserved for sage grouse on Wildcat Knolls due to loss of water from E. Fork Box Canyon were trespassed by cattle who jumped the new fence as we watched. Meanwhile, trucks

traveled through the sage grouse country to deliver water to the cattle. It would appear that a candid assessment of the adequacy of water supplies for sage grouse is in order.

The difficulty of assessing sage grouse habitat integrity is complicated by the fact that we are having to learn from diminished sage grouse populations. Even where sage grouse are currently present in Utah, the site's conditions may be limiting the potential for expanded populations of sage grouse. On the other hand, when sage grouse are not present in what appears to be suitable habitat, it is difficult to know the degree to which sage grouse are in fact limited on that habitat, or by habitat conditions for other seasons' needs, sage grouse population demographics, stochastic factors, or a combination of these and other factors.

The value of habitat integrity tables lies in the recognition that sage grouse choice of sites to strut, nest, raise broods, summer, and winter is governed by a complex of considerations. Such tables also allow us to iteratively learn about sage grouse perception of the world, as we observe them "breaking rules" (e.g., apparent successful use of short-stature black sagebrush by wintering sage grouse in Norton Hollow).

Water availability is not included directly in the Oliver's ecological integrity tables,, and yet sage grouse will be found in otherwise unsuitable habitat (e.g., lack of sagebrush cover, forbs, or grasses; or near a tree in which a predator may perch) in order to access water. An example is the presence of small numbers of sage grouse near Bare Wire Pond (Area E.).

Habitat that appears suitable in terms of vegetation and lack of developments may in fact be unsuitable if water is not available. For instance, according to the Ecological Integrity Table, much of W. Tavaputs Plateau would appear to be suitable habitat for summer- late brood-rearing use by sage grouse (see Table 9: Ecological Habitat Integrity for Summer-Late Brood-Rearing Habitat, Areas A-F), but the area lacks wet meadows.

Forb cover is not included in the summer-late brood-rearing habitat table, and yet forb presence does appear to be important in that season, according to the scientific literature.

A. Early Brood-rearing Habitat

Welch (2005) writes of brood-rearing habitat:

> From the available research, the ideal brooding habitat would consist of big sagebrush with a canopy cover of some 25 percent with a small creek running through it. The riparian zone about 50 feet wide would reduce the big sagebrush canopy cover to 0 and provide the needed forbs for the chicks to eat with the adjacent big sagebrush cover providing shading, loafing, escape, food, and a source of insects.

Similarly, in the restoration report for the Strawberry Watershed of Uinta National Forest (USDA 2004), the sage grouse need for increased riparian/wet meadow habitats is emphasized (see, e.g., p. 155). The report notes how 1939 research documented that Strawberry Valley sage-

grouse were loosely associated with riparian/wet meadow habitats for key aspects of their life history. Wet meadow and riparian habitats may be a key habitat in need of protection for sage grouse recovery in these six areas.

Habitat like this is not available to sage grouse in the six surveyed areas.

Sage Hen Hollow and Dog Valley have the largest (albeit small) lek counts among the six areas for 2005-2006 (81 and 98 respectively).

Dog Valley has good forb cover (14%), while its mean grass and forb height of 6.3" does not meet the threshold. This squares with the observation of good forb diversity in portions (not all) of Dog Valley and indicates that were cattle grazing pressure to be reduced or eliminated, Dog Valley could perhaps support an expanded population of sage grouse. The Dog Valley/Green Hill sage grouse are reportedly largely nonmigratory, using both Dog Valley and adjacent Green Hill (Becky Bonebrake, BLM and Scott Harris, permittee, personal communication).

Sage Hen Hollow forb cover of 6.2% is below the desired >10%, but its mean grass and forb height of 8.7" exceeds the threshold of desirable (>7"). This adequate height may be a result of its apparently light cattle grazing in 2006.

South Horn Mountain rates "very good" for every element of early brood-rearing except forb cover (7%), for which it is "poor." Cattle grazing combined with heavy wild ungulate grazing and water diversions limit forb cover.

Intensely-grazed Wildcat Knolls forb cover (4.2%) is less than half the suitable 10% cover and mean grass and forb height is only 4.8" (compared to a low threshold of 7"). Treatments, seedings and cattle grazing have taken their toll on Wildcat Knolls, and yet it and South Horn currently host the only two sage grouse populations on the Manti-La Sal NF.

Were it not for low forb cover (7%), South Horn Mountain rates "very good" for early brood-rearing habitat. There is high wild ungulate grazing pressure on South Horn Mountain. As noted above, South Horn Mountain is one of only two sage grouse population sites on Manti-La Sal NF, and it is reportedly fairly non-migratory. Attention to availability of a functioning forb community and water appear important for its conservation.

Buckskin Valley has "poor" forb cover. At first glance Buckskin Valley appears to have "very good" grass cover >7" tall, and mean grass and forb height, but (1) most of the valley bottom has been seeded to exotic crested wheatgrass and so Early transects were thus not located there; and (2) much of its grass cover over 7" tall and grass height for grass/forb height is due to exotics (cheatgrass, crested wheatgrass, smooth brome) that are not favored by sage grouse. Without those exotics it has only fair (11.2%) cover of perennial bunchgrasses.

West Tavaputs Plateau, grazed by wild horses, has the highest forb cover (21.2%) of all six areas, but its grass and forb height are 5.3" (below the 7" threshold), and its sagebrush averages 10" tall (slightly under the 11.8" lower threshold).

B. Summer-Late Brood-rearing Habitat

Buckskin/Bear Valley (Area B), Wildcat Knolls (D), and South Horn Mountain (Area E) all rate "poor" for mean grass and forb height of 7" (4.7", 4.4" and 5.6" respectively. In the Bear Valley transects, much of the perennial grass cover is exotic, rhizomatous Kentucky bluegrass, grazed close to the ground..

Little Valleys (a riparian meadow) and Dog Valley closely exceed the 5.9" grass/forb height threshold (6.1" and 6.0" respectively). Only W. Tavaputs Plateau (6.8") exceeds the indicator by almost an inch. Sage Hen Hollow and W. Tavaputs Plateau, two of the three sites with "very good" grass/forb height, are the only two sites not being grazed extensively by cattle.

All sites but W. Tavaputs Plateau rate "poor" for sagebrush canopy cover, with four (Sage Hen Hollow, Dog Valley, , Wildcat Knoll and South Horn exceeding the upper threshold of 20% cover (but none are over 23.8% cover) and one (Buckskin Valley/Bear Valley) lacking sagebrush cover (6.5%, below the 10% lower threshold).

W. Tavaputs Plateau is the only site to rate "very good" for sage grouse habitat on all Summer-Late Brood-Rearing Habitat indicators for ecological integrity. In 2005, dozens of sage grouse were observed using this Cold Springs ridge area (i.e., the area of the Early and Summer transects), but the sage grouse were largely absent from this area in 2006, and were instead using some private land areas on W. Tavaputs Plateau (Brad Crompton, UDWR, personal communication 2007). The 26 sage grouse cocks counted in 2006 at "Bishop Ridge #1" lek was the highest at that lek since counting began in 1998 with two cocks.

It is Summer-Late Brood-rearing Habitat that may be at particular vulnerability to lack of water. Lack of sufficient secure water may be cumulative with livestock consumption of forbs that contain moisture.

C. Winter Habitat

According to mean height of sagebrush, (Table 3), none of the six sites are considered suitable for winter use." The sagebrush height on seven average below 18.1", and Buckskin Valley (no. of Hwy 20) has sagebrush considered too tall. If, however, the current height of sagebrush is what is above snow, then only Norton Hollow (too short) and Buckskin Valley (too tall) are "poor."

One W. Tavaputs Plateau winter site is Sage Brush Flat, which contains numerous piles of sage grouse droppings. The other Tavaputs winter site is Stone Cabin Gas Field, which is being encroached upon by pinyon-juniper and gas extraction developments and truck routes and does not seem to host as many sage grouse. Trucking and drilling occur year-round on the Gas Field.

The southern end South Horn Mountain is reportedly used year-round by sage grouse, but only 9 cocks were counted on lek(s) in 2005.

Dog Valley has sufficient sage brush canopy cover for winter habitat, and, when snow is not heavy, sufficient height of sagebrush. It is used by greater sage grouse during some winters (permittee Scott Harris; Becky Bonebrake, BLM, Cedar City District, personal communications July 2006).

Wildcat Knolls , with "fair" sagebrush cover and "poor" sagebrush height, is reportedly used Wildcat Knolls year-round (Kevin Albrecht and Jeff Jewkes, Manti-La Sal NF, personal communication May 2006).

Norton Hollow is rated "unsuitable" for winter habitat due to the short stature of the black sagebrush there (6.6") and yet of the six Areas shows the most intense winter use in terms of piles of sage grouse droppings. This is an example of how the sage grouse may be "breaking the rules" and finding the short-stature black sagebrush suitable. On the other hand, this winter habitat may in fact be marginal, incapable of supporting a restored population of sage grouse. The 2006 lek count of 98 cocks approached the "high" count for this site of 106 in 1979.

Following the brief visit to the "new" lek site of Buckskin Valley north of Hwy 20, it is rated as unsuitable because of the "too-tall" sagebrush (27.6"). However, the tall sagebrush of BW21, one of the three winter transects located among scattered piles of sage grouse droppings, was a mixture of openings and tall and short sagebrush (unusual in this mostly "treated" valley (see photos in Appendix B).

D. Landscape Habitat

Table 11 in the Results section describes problems and potential of each of the various sites. The greatest potential for many of these sites lies in the fact that their natural vegetation cover is appropriate for sage grouse, and some of the areas (e.g., so. end of South Horn Mountain, Sage Hen Hollow, Norton Hollow, portions of W. Tavaputs Plateau) are fairly remote and experience little motorized traffic. For instance, UDWR has gated much of W. Tavaputs Plateau in the Cold Spring area, providing for wildlife security.
The area of the Stone Cabin Gas Field on W. Tavaputs Plateau is privately owned, and much has been/is being used for gas drilling and extraction as well as for cattle.

Another potential of many of these Areas is the comparative lack of pinyon-juniper encroachment, with the exceptions of some of Norton Hollow and Sage Brush Flat and Stone Cabin Gas Field on W. Tavaputs Plateau.

Many ratings of "poor" are the direct or indirect result of livestock grazing, which is the nearly ubiquitous use of all areas except the Cold Spring area of W. Tavaputs Plateau (where horses graze) : exotic seedings, sagebrush "treatments", water diversions, fences, herbicide use, bank and wetlands trampling, stream incision and headcutting, and lack of riparian vegetation

(e.g., willows). W. Tavaputs Plateau in the Stone Cabin Gas Field is impacted by oil and gas drilling and extraction activities as well as cattle grazing.

E. Comparison of Point Intercept and Line Intercept for Sagebrush Cover

It is not clear why the line-point intercept method would consistently provide a higher estimate of sagebrush cover than the line intercept method. Perhaps the line intercept method allows a person to
focus on the higher levels of cover while not noticing a small patch that would be intercepted by the pointer in the line-point intercept method.

As the line-point intercept method relies less on ocular judgment and more on mechanical interception of a pointer held at a regular (every 2' point) on the tape, it would appear to be more reliable.

A study by Wambolt et al. 2006) comparing point intercept and (ocular) line intercept found the former to yield lower rather than higher cover values for shrubs. In the Wambolt study, 3 cm rather than 2" was used as the maximum distance to live foliage for a point intercept to count as sagebrush intercept, and the ocular method did not subtract openings or dead material within the perimeter of the shrub. Wambolt et al. likewise concluded, however, that the ocular method appears to allow for greater subjectivity and, likely, less inter-rater reliability.

7. CONCLUSION

Despite their basic natural component of mountain big and black sagebrush, good native grass cover (with the exception of Buckskin/Bear Valleys and much of Wildcat Knolls), and predominantly native rather than exotic forbs, the uses of these six sites are not ideal for sage grouse and the small populations of sage grouse reflect that.

Sage Hen Hollow (Early brood-rearing habitat) and Norton Hollow (winter habitat) are valuable sites that are being used by sage grouse, and can continue to be used if Sage Hen Hollow's spring and summer forbs and grasses are not subject to livestock grazing until after seed set, and if Norton Hollow remains remote from developments.

Dog Valley seems to hold a great potential for increased use by sage grouse if cattle grazing were reduced on the BLM lands, water diversions lessened, and wet hollows protected from trampling. It retains a diversity of native forbs in some areas, and, with Green Hill adjacent, a variety of elevations.

At the north end of South Horn Mountain, where sage grouse gather, wild ungulate grazing/browsing is high and cumulative with cattle grazing and water diversions. At the south end, near Bare Wire Pond, cattle grazing is excessive, and sage grouse must venture into the open to obtain water. As a result, forb cover and forb/grass height are limiting on South Horn Mountain

Restoration of a native forb component and native grasses within old exotic seedings on Wildcat Knolls will be futile with the current heavy livestock grazing. Water appears limiting on Wildcat Knolls; and the subsidization of cattle grazing with water trucked in from Quitchupah Creek appears to be facilitating stress on a stressed landscape.

Little Valleys (summer-late brood-rearing habitat) will be progressively lost as a mesic meadow if the creeks continue to be trampled and incised.

Buckskin Valley and Stone Cabin Gas Field appear to be largely unsuitable for sage grouse use in the near future. Their natural capital has been thoroughly depleted by livestock/seeding and/or industrial developments.

Restoration and protection of riparian areas and wetlands in Buckskin Valley would provide much-needed water resources for sage grouse, but the extensive seedings of crested wheatgrass and invasion of cheatgrass are not easy to reverse.

The Stone Cabin Gas Field (W. Tavaputs Plateau) is simultaneously and cumulatively subject to the developments and noise of gas extraction, pinyon-juniper expansion, and cattle. Currently, only 60 of a planned 780 gas wells have been drilled in this area and Cottonwood While Sage Brush Flat (W. Tavaputs Plateau) currently supports winter use, a new series of gas developments is being planned for the private lands and perhaps on the UDWR lands as well in that area. UDWR requests for no trucking and drilling during winter and during

dawn and dusk generally are not accepted Ridge (Brad Crompton, UDWR, personal communication 2007).

It would seem to be useful to assess the potential for reducing wild ungulate pressure on South Horn, and to restore and protect water sources for sage grouse. Sage grouse use the remote South Horn for much of their activity and an assessment of potentials for less stress on the area might yield sage grouse expansion. Livestock grazing in the Bare Wire pond area is excessive and is causing erosion and depletion of understory.

As Knick et al. (2003) note in their review of conservation and research issues for sagebrush habitats for birds, "Manipulation of sagebrush landscape to increase forage production for livestock has dominated our perspective and shaped our use of sagebrush ecosystems." More recently, oil and gas development are increasingly dominating many of these manipulated lands

However, managing functionally large sagebrush areas for sage grouse recovery (i.e., "conservation") requires changing management emphases from sagebrush removal or thinning toward:

- minimizing large ungulate grazing of forbs during the spring and summer
- protecting and expanding riparian and wet meadow areas
- reducing water diversions

Conserving greater sage grouse will require restoration of both public and private lands for large, unfragmented blocks of fully-functioning sagebrush and riparian communities – shrubs, grass, and forbs.

At the same time, management of some of Utah's sagebrush lands to increase forb, grass, and water availability must address the sagebrush breeding habitat needs of other sagebrush-dependent species such as Brewer's sparrow, sage sparrow, and sage thrasher, all of which are of conservation concern because of declining populations (Knick et al. 2003). For instance, Brewer's sparrow breeds in dense patches of sagebrush approximately 4 feet in height (The Nature Conservancy 1999a). Sage sparrows breed in shrub clumps 3'-6' tall in patchy habitat with low percent grass cover to allow foraging on ground (Martin and Carlson 1998; The Nature Conservancy 1999b).). Pygmy rabbit, North America's smallest rabbit, finds dense (more than 33% cover)., tall (about 4 feet tall) sagebrush desirable (Green and Flinders 1980; Weiss and Verts 1984). These are different sagebrush heights than those desirable for greater sage-grouse, and thus require an even more complex, diverse sagebrush landscape.

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