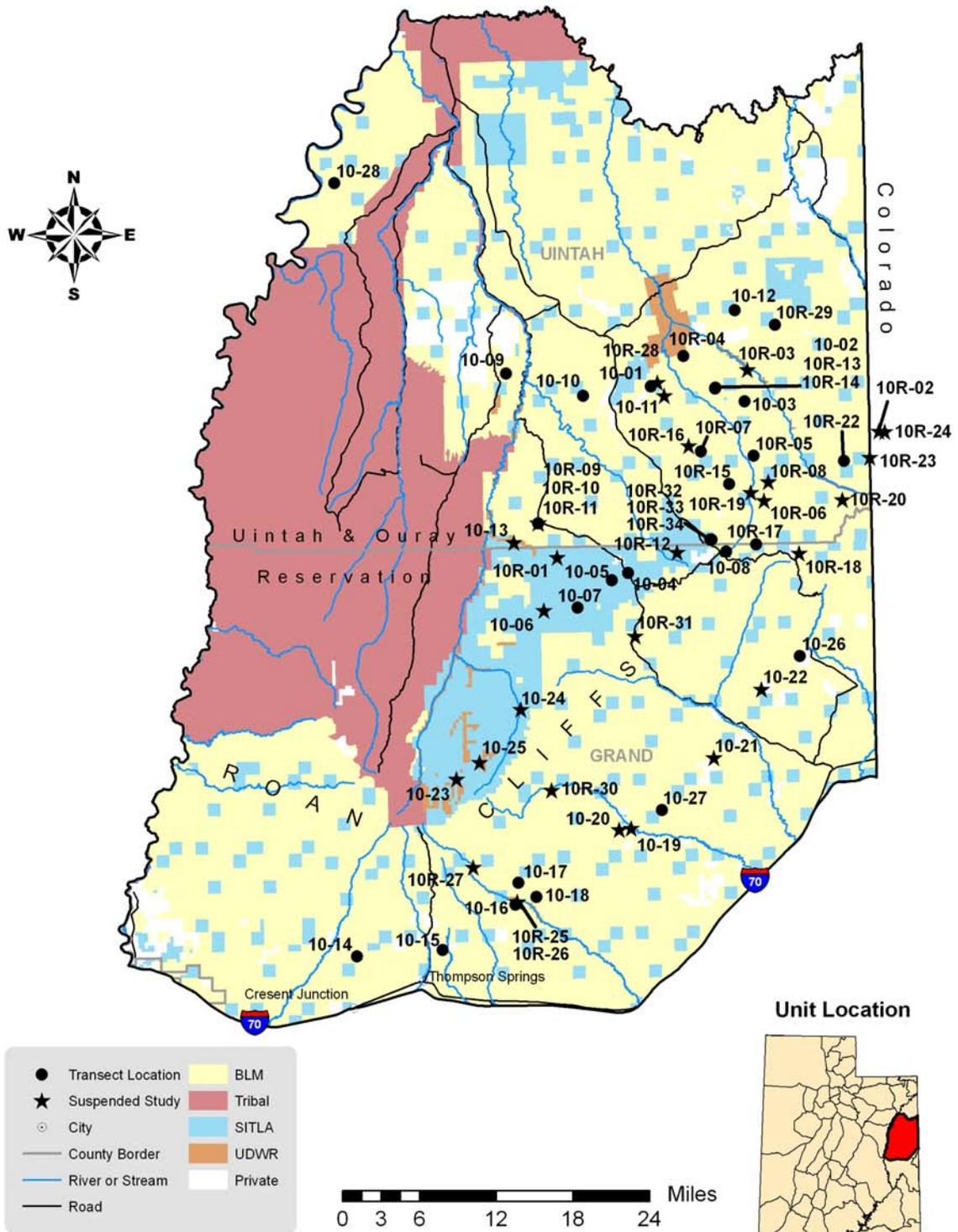


# Management Unit 10



## WILDLIFE MANAGEMENT UNIT - 10 BOOK CLIFFS

### Boundary Description

**Utah and Grand Counties** - Boundary begins at Interstate 70 and the Green River in Green River; northeast along the Green River to the White River; east along the White River to the Utah-Colorado state line; south along the Utah-Colorado state line to I-70; southwest along I-70 to the Green River and beginning point.

### Management Unit Description

The Book Cliffs Management Unit includes both the North Book Cliffs and the South Book Cliffs. Of the entire land area of the Book Cliffs, about 1.7 million acres are classified as deer range. Of this 1.7 million acres 68% is classified as deer winter range, 10% as deer summer range and 22% as deer year-long range. Approximately 1.7 million acres in the Book Cliffs are also classified as elk range with 63% of this being elk winter range, 19% elk summer range and 18% elk year-long range. The Bureau of Land Management (BLM) manages 63% of all the area classified as mule deer ranges and 53% of all the area classified as elk ranges. State of Utah Trust Lands and Native American Trust Lands make up most of the remainder of deer and elk ranges on the Book Cliffs.

On the North Book Cliffs, areas such as Lower McCook Ridge, Big Park, the Crows Roost, Sunday School Canyon, Indian Ridge and Atchee Ridge, all support concentrations of wintering deer. Elk utilize many of the same areas, especially McCook Ridge. The winter range is composed of several main vegetation types including pinyon-juniper, salt desert shrub and Wyoming big sagebrush. The consensus is that the quantity and quality of the summer range are the most limiting factors on this unit. Vegetation composition on the summer range is principally sagebrush/grass and mountain brush, with isolated patches of conifer and aspen. During the late 1990's, the BLM completed several thousand acres of prescribed burning in the mountain big sagebrush and mountain brush zones to help improve herbaceous vegetation on summer ranges.

The South Book Cliffs is valuable mainly as deer winter range. With a maximum elevation of just over 9,000 feet, the unit contains only small amounts of fawning areas and summer range, with few deer residing in the unit year-round. However, many deer that spend the summer on higher ranges in the northern portion of the unit migrate annually to winter ranges in the southern portion of the unit. Terrain between the higher summer ranges and lower winter ranges in the south is steep and rugged, and is used primarily as a travel corridor with limited migration occurring over a short period of time. The upper limits of the normal winter range are found normally between 8,000 and 8,500 feet, depending on the slope and exposure. During severe winters the upper limits are usually lowered to about the 7,000 feet. The lower limits of the winter range are bordered by the salt desert type at approximately 5,000 feet. There are concentrations of wintering deer at Horse Pasture, Nash Wash, Cottonwood Ranch, and the Pear Park area. Due to the steep, rough terrain at the upper elevations of the winter range, these lower critical areas have been historically over-utilized by livestock and game for a long period of time.

Pictographs and petroglyphs found in the unit historically indicate the presence of bighorn sheep, deer, bison and elk in the area before settlement by Europeans. Large herds of cattle and sheep were brought into the area around Moab in the mid-1870's and the 1890's. During this time, livestock use on the South Book Cliffs was limited to the stock of local settlers. This changed in the 1920's when Colorado sheepmen began wintering large herds on the South Book Cliffs. During this period, as many as 200,000 sheep were using the range each winter (Carter 1983). Wild horses are also found in the Winter Ridge and Hill Creek areas. In cooperation with local ranchers, the BLM has been working on fences, water developments, and other improvements to encourage more uniform use of the range by livestock (Carter 1983).

Following the liberal hunting regulations of the late 1950's and 1960's, deer numbers were low and recovery has been slow. The buck only (1974-77) and 4-point-or-better (1978-84) restrictions have played a role in

increases in deer numbers and hunter success. Between 1986 and 1993, however, the harvest of bucks slowly declined. Drought conditions and the harsh winter of 1992-93 had detrimental effects on the deer population in the Book Cliffs and throughout the state. Deer hunting was closed in the unit in the mid-1990's due to low population numbers, and re-opened again in 1999 as a limited entry hunting area. Currently, both deer and elk hunting are on a limited entry basis. Pronghorn are also hunted on the Book Cliffs unit. Bison were also reintroduced in the North Book Cliffs in the winter of 2009.

Management concerns on Unit 10 principally revolve around low fawn production, summer range condition and/or quality (especially fawn rearing habitat), drought impacts on winter range browse species, and the increasing demands for oil and gas development with its associated habitat fragmentation. There is also the possibility at some later date that oil shale and tar sands will be developed.

### **Range Trend Studies**

Thirtyone interagency range trend studies were sampled in Unit 10 during the summer of 2010. In the North Book Cliffs, five studies were established in 1982. Two of these studies [Indian Ridge (10-1) and McCook Ridge Exclosure (10-2)] sample desert shrub communities, one study [McCook Ridge Chaining (10-3)] samples a chained and seeded pinyon/juniper community, one study [Wirefence Point (10-4)] samples a mountain brush community and one study [Willow Flat (10-5)] samples a mountain big sagebrush community. Another five studies were established in the South Book Cliffs in 1986. Four of these studies [East Floy Bench (10-14), West Horse Pasture (10-15), East Calf Canyon (10-17) and East Horse Pasture (10-18)] sample Wyoming big sagebrush communities and one study [East Thompson Bench (10-15)] samples a juniper community. A further five studies were established in the North Book Cliffs in 1988. Of these studies, two studies [Agency Draw (10-9) and Sunday School (10-10)] sample desert shrub communities, one study [Cherry Mesa (10-7)] samples a chained and seeded pinyon/juniper community, one study [Black Horse (10-8)] samples a mountain brush community and one study [Wolf Den (10-12)] samples a Wyoming big sagebrush community. One study [Bitter Creek (10-26)] was established in 2000 and another study [Long Canyon (10-27)] was established in 2005 in the South Book Cliffs. Both of these studies sample Wyoming big sagebrush communities. Another study [Wild Horse Bench (10-28)] was established in 2010 in the North Book Cliffs and samples a black sagebrush community in bison range. An additional 31 special studies were established in the North Book Cliffs during the summers of 1997, 1998 and 1999 to address conflicts over elk and livestock use in the Book Cliffs. Many of these sites have been suspended, but ten of the studies were monitored in 2010. Of these ten studies, two of the studies [McCook Ridge Livestock Exclosure (10R-13) and McCook ridge Total Exclosure (10R-14)] sample an exclosure complex in conjunction with study 10-2, three studies [Winter Ridge Exclosure Out (10R-9), Railroad Canyon (10R-17) and Rathole Ridge (10R-22)] sample mountain big sagebrush communities, two studies [Lower Tom Patterson Point (10R-5) and Monument Ridge (10R-7)] sample two chained and burned communities, one study [Massey Junction (10R-29)] samples a desert shrub community and one study [Two Water WMA (10R-4)] samples a black sagebrush community. Three further studies [PR Spring Total Exclosure (10R-32), PR Spring Livestock Exclosure (10R-33) and PR Spring Exclosure Outside (10R-34)] were established in 2002 to monitor an exclosure complex in a mountain brush community. As mentioned above, many studies on Unit 10 have been suspended for various reasons and were not monitored in 2010. For further info on suspended studies, refer to past reports at <http://wildlife.utah.gov/range/>.

## SUMMARY

### WILDLIFE MANAGEMENT UNIT 10 - BOOK CLIFFS

Unit 10 is divided into two subunits, the North Book Cliffs and South Book Cliffs. The North Book Cliffs are managed as part of the Utah Division of Wildlife Resources (UDWR) Northeastern Region, while the South Book Cliffs are managed as part of the UDWR Southeastern Region. These two subunits are summarized separately in this report.

#### **Community Types**

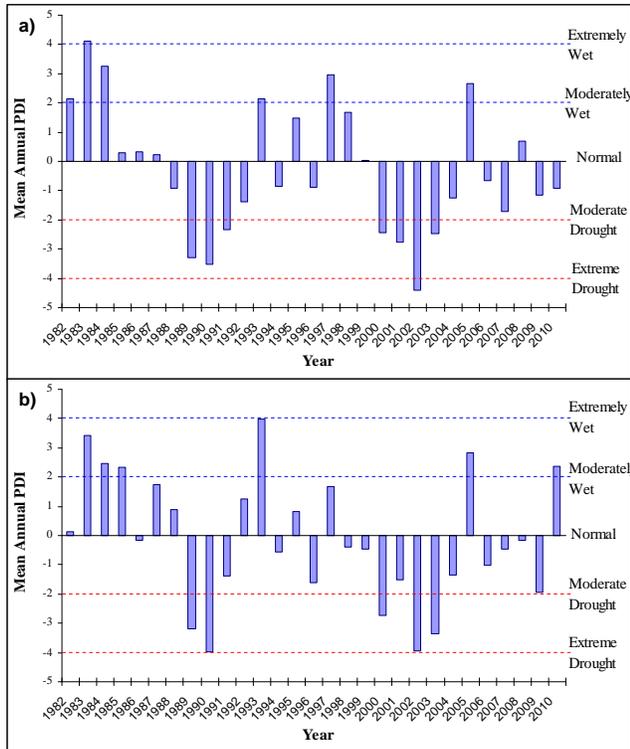
Deer winter range within a unit is summarized into three categories based on ecological potentials which include low potential, mid-level potential and high potential. Low potential sites include desert shrub, Wyoming big sagebrush (*Artemisia tridentata* ssp. *wyomingensis*) and cliffrose (*Cowania mexicana* ssp. *stansburiana*) communities. Mid-level potential sites include mountain big sagebrush (*A. tridentata* ssp. *vaseyana*) communities. High potential sites include mountain brush communities. Black sagebrush (*A. nova*) and basin big sagebrush (*A. tridentata* ssp. *tridentata*) communities are placed within the low potential or mid-level potential scales based on precipitation and elevation. Deer summer range is summarized separately from winter range as a fourth category and typically includes aspen (*Populus tremuloides*) and high elevation mountain brush communities.

#### North Book Cliffs

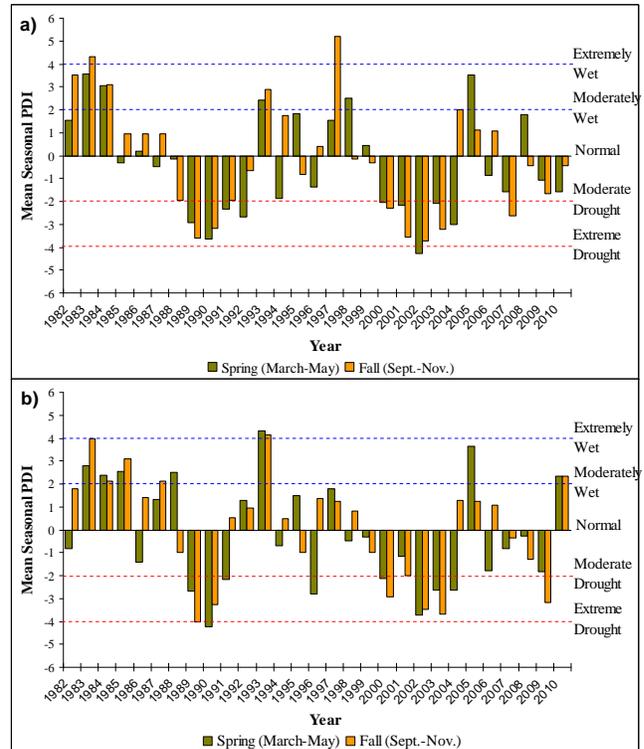
Twenty four interagency range trend studies were sampled in the North Book Cliffs subunit of Unit 10 during the summer of 2010. Five of the range trend studies in the area [Black Horse (10-8), Saddle Horse (10R-15), PR Spring Total Exclosure (10R-32), PR Spring Livestock Exclosure (10R-33) and PR Spring Exclosure Outside (10R-34)] are categorized as high potential sites for deer winter range and sample mountain brush communities. All of these high potential sites are also classified as crucial summer range for deer and elk, and are generally only used by deer in mild winters. Eight of the studies [McCook Ridge Chaining (10-3), Wirefence Point (10-4), Willow Flat (10-5), Cherry Mesa (10-7), Lower Tom Patterson Point (10R-5), Monument Ridge (10R-7), Winter Ridge Exclosure Out (10R-9) and Railroad Canyon (10R-17)] are categorized as mid-level potential sites for deer winter range and sample mountain big sagebrush communities. Though categorized as deer winter range in this summary, many of the studies are also considered to be crucial deer summer range and fawning habitat. Also, all of these studies are considered to be elk winter or summer range, with use by elk occurring during both seasons on many of the sites. Nine of the studies [Indian Ridge (10-1), McCook Ridge Exclosure (10-2), Agency Draw (10-9), Sunday School (10-10), Wolf Den (10-12), Two Water WMA (10R-4), McCook Ridge Livestock Exclosure (10R-13), McCook Ridge Total Exclosure (10R-14) and Massey Junction (10R-29)] are classified as low potential deer winter range sites and sample Wyoming big sagebrush communities. All of these studies are also considered to be elk winter range. There was only one study [Rathole Ridge (10R-22)] in this area that is considered to be strictly summer range. One study [Wild Horse Bench (10-28)] was established in 2010 to monitor year-long bison range. These two studies were not included in this summary. For further information on these sites, refer to the discussion section.

#### South Book Cliffs

Seven interagency range trend studies were sampled in the South Book Cliffs subunit of Unit 10 during the summer of 2010. All seven of the studies [East Floy Bench (10-14), East Thompson Bench (10-15), West Horse Pasture (10-16), East Calf Canyon (10-17), East Horse Pasture (10-18), Bitter Creek (10-26) and Long Canyon (10-27)] are classified as low potential deer winter range sites and sample Wyoming big sagebrush communities. Only two of the studies, Bitter Creek and Long Canyon, are also considered to be elk winter range.



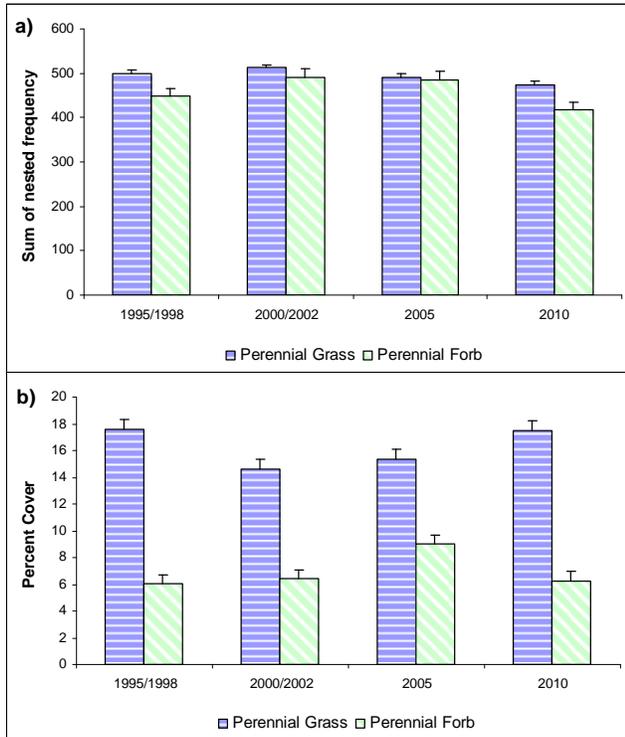
**Figure 1. a)** The 29 year mean annual Palmer Drought Severity Index (PDSI) for the Uinta Basin (Division 6). **b)** The 29 year mean annual PDSI for the Southeast Division (Division 7). The PDSI is based on climate data gathered from 1895 to 2010. The PDSI uses a scale where 0 indicates normal, positive deviations indicate wet and negative deviations indicate drought. Classification of the scale is  $\geq 4.0$  = Extremely Wet, 3.0 to 3.9 = Very Wet, 2.0 to 2.9 = Moderately Wet, 1.0 to 1.9 = Slightly Wet, 0.5 to 0.9 = Incipient Wet Spell, 0.4 to -0.4 = Normal, -0.5 to -0.9 = Incipient Dry Spell, -1.0 to -1.9 = Mild Drought, -2.0 to -2.9 = Moderate Drought, -3.0 to -3.9 = Severe Drought and  $\leq -4.0$  = Extreme Drought (Time Series Data 2011).



**Figure 2. a)** The 29 year mean spring (March-May) and fall (Sept.-Nov.) Palmer Drought Severity Index (PDSI) for the Uinta Basin (Division 6). **b)** The 29 year mean spring (March-May) and fall (Sept.-Nov.) PDSI for the Southeast Division (Division 7). The PDSI is based on climate data gathered from 1895 to 2010. The PDSI uses a scale where 0 indicates normal, positive deviations indicate wet and negative deviations indicate drought. Classification of the scale is  $\geq 4.0$  = Extremely Wet, 3.0 to 3.9 = Very Wet, 2.0 to 2.9 = Moderately Wet, 1.0 to 1.9 = Slightly Wet, 0.5 to 0.9 = Incipient Wet Spell, 0.4 to -0.4 = Normal, -0.5 to -0.9 = Incipient Dry Spell, -1.0 to -1.9 = Mild Drought, -2.0 to -2.9 = Moderate Drought, -3.0 to -3.9 = Severe Drought and  $\leq -4.0$  = Extreme Drought (Time Series Data 2011).

## Precipitation

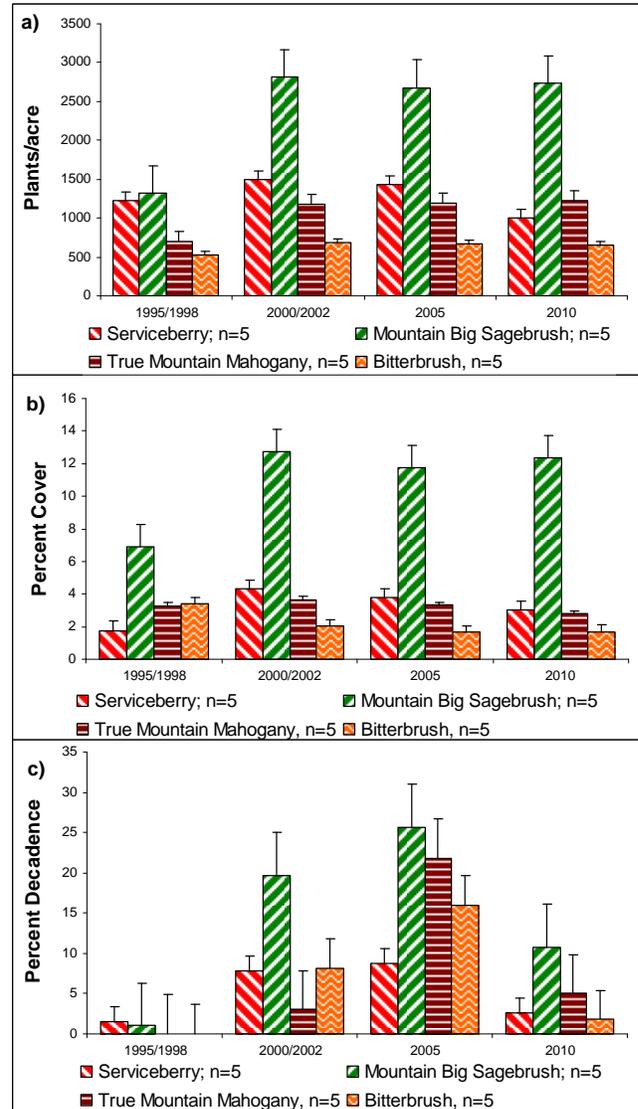
Vegetation trends are dependent upon annual and seasonal precipitation patterns. Precipitation and Palmer Drought Severity Index (PDSI) data for the unit were compiled from the National Oceanic and Atmospheric Administration (NOAA) Physical Sciences Division (PSD) as part of the Uintah Basin (Division 6) and the Southeast (Division 7) Divisions. All of the studies in the South Book Cliffs subunit of Unit 10 fall within the Southeast Division, while the studies in the North Book Cliffs subunit are within both the Uintah Basin and Southeast Divisions. The Uintah Basin and Southeast Divisions had historic annual mean precipitation of 7.99 inches and 9.07 inches, respectively, from 1895 to 2010. Over the course of the study years in Unit 10, the mean annual PDSI of both of the Divisions display several periods of prolonged drought. Moderate to extreme wet years in the Uintah Basin included 1982-1984, 1993, 1997 and 2005, and moderate to extreme drought years included 1989-1991 and 2000-2003 (Figure 1a and Figure 2a). Moderate to extreme wet years in the Southeast Division included 1983-1985, 1993, 2005 and 2010, and moderate to extreme drought years included 1989-1990, 2000, 2002-2003 and 2009 (Figure 1b and Figure 2b) (Time Series Data 2011).



**Figure 3.** a) High potential sites mean perennial grass and perennial forb sum of nested frequency (n=5) by year for WMU 10, Book Cliffs. b) High potential sites mean perennial grass and perennial forb cover (n=5) by year for WMU 10.

### Mountain Brush Communities (High Potential Winter Range)

**Browse:** High potential studies were located only in the North Book Cliffs subunit for Unit 10. The high potential cumulative median browse trend has remained relatively stable throughout the study years (Figure 12a). The browse composition in the mountain brush studies tends to be a mixture of four predominant species; serviceberry (*Amelanchier utahensis*), mountain big sagebrush, true mountain mahogany (*Cercocarpus montanus*) and bitterbrush (*Purshia tridentata*). Mountain big sagebrush is typically dominant in cover across the studies for these four species. Snowberry (*Symphoricarpos oreophilus*) is also prevalent on most of the studies. Bitterbrush is prevalent on the Saddle Horse and PR Spring Exclosure Out studies, but is less common on the other three studies. Serviceberry is less prevalent on the Saddle Horse and PR Spring Exclosure Out studies, and true mountain mahogany is less prevalent on the PR Spring Exclosure Out study. The three studies at the PR Spring Exclosure were not sampled until 2002, which influenced some of the changes in means between the 1995/1998 sample years and the 2000/2002 samples. The density of serviceberry was significantly lower in 2010 than the other sample years. There was a significant increase in the density of mountain big sagebrush and true mountain mahogany in 2000/2002, but this is an artifact of adding the three PR Spring Exclosure studies which have high densities of mountain big sagebrush. The mean density of mountain big sagebrush remained similar through the remaining sample years. The density of bitterbrush remained similar throughout the study years (Figure 4a). The mean cover of serviceberry, mountain big sagebrush and true mountain mahogany displayed similar trends as the mean density of the three species. Mean cover of bitterbrush decreased significantly in 2000/2002, and then remained similar throughout the remaining sample years (Figure 4b). The decrease in mean cover of bitterbrush was due to the addition of the PR Spring Exclosure Total and PR Spring Exclosure Livestock studies which have lower cover



**Figure 4.** a) High potential sites mean density of mountain brush by year for WMU 10, Book Cliffs. b) High potential sites mean cover of mountain brush by year for WMU 10. c) High potential sites mean population decadence of mountain brush by year for WMU 10.

of bitterbrush than the other high potential studies within the unit. The mean decadence increased significantly for serviceberry, mountain big sagebrush and bitterbrush in 2000/2002. Mean decadence increased significantly again in bitterbrush and true mountain mahogany in 2005 with a substantial, but not significant, increase in the decadence of mountain big sagebrush. This increase in decadence followed several drought years (Figure 1 and Figure 2). The mean decadence of all four species was significantly lower in 2010 (Figure 4c).

**Herbaceous Understory:** The high potential median cumulative grass trend increased slightly from 1995/1998 to 2000/2002, then remained stable in subsequent sample years (Figure 12a). Grasses within these communities are diverse and abundant. The annual species cheatgrass (*Bromus tectorum*) has been sampled on the Black Horse and Saddle Horse studies, but is rare on the sites. The mean sum of nested frequency of perennial grasses has remained high throughout the sample years with slight, but significant, decreases in 2005 and 2010 (Figure 3a). Mean cover of perennial grasses was significantly lower in 2000/2002 and 2005 than in 1995/1998 and 2010 (Figure 3b).

The high potential median cumulative forb trend decreased slightly in 2000/2002, then decreased slightly again in 2010 (Figure 12a). Perennial forbs are also diverse within the sampled communities with similar sums of nested frequency as perennial grasses, but perennial forbs are typically not nearly as abundant in cover as perennial grasses. The mean sum of nested frequency of perennial forbs was significantly higher in 2000/2002 and 2005 than in 1995/1998 and 2010 (Figure 3a). Cover of perennial forbs was significantly higher in 2005 than any other sample year (Figure 3b).

**Utilization:** Pellet group transect data indicates that deer predominantly use the area, though use by elk is also prevalent. The PR Spring Total Enclosure study was not included in this summary because wildlife and livestock are excluded from the study. The mean deer days use/acre on the studies has been moderately heavy to heavy over the course of the study years, but decreased somewhat in 2010. The mean elk days use/acre on the studies was moderate in 2000/2002 and 2005, but was lighter in 2010 (Figure 13a). Cattle use is minimal on these studies and was not included in this summary. Cattle use is excluded from the PR Spring Livestock Enclosure.

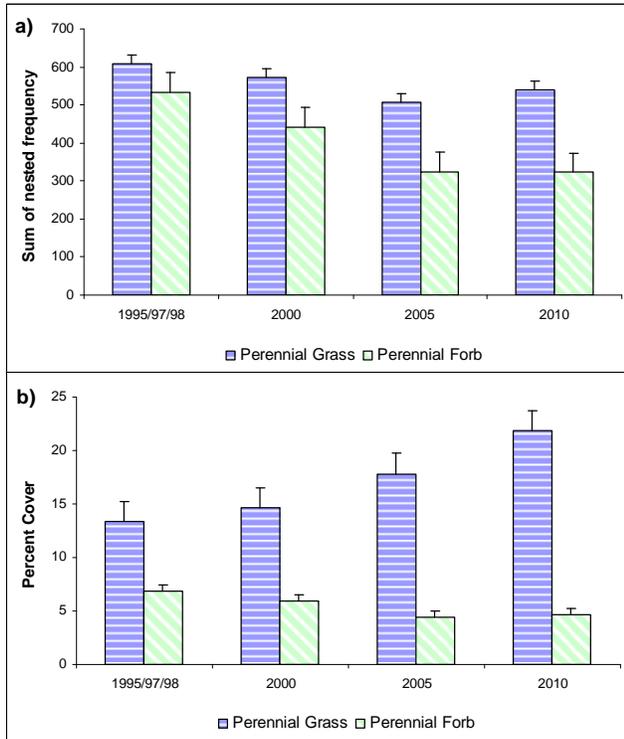
**Deer Desirable Components Index (DCI):** The high potential deer DCI has remained relatively similar, though with a slight general trend downward from 1995/1998 to 2005. The ranking of the DCI has been good to good-excellent throughout the sample years (Table 1 and Figure 11a).

Year	Preferred Browse Cover	Preferred Browse Decadence	Preferred Browse Young	Perennial Grass Cover	Annual Grass Cover	Perennial Forb Cover	Noxious Weeds	Total Score	Ranking
95/98	23.0	14.8	14.6	30.0	-0.1	6.7	0.0	<b>89.1</b>	Good-Excellent
00/02	27.1	10.4	11.4	28.2	0.0	8.3	0.0	<b>85.4</b>	Good
05	26.0	7.8	10.0	27.7	-0.1	8.4	0.0	<b>79.8</b>	Good
10	23.9	12.5	7.6	28.8	-0.1	8.5	0.0	<b>81.2</b>	Good

**Table 1.** High potential scale mean deer DCI scores (n=5) by year for WMU 10, Book Cliffs. The deer DCI scores are divided into three categories based on ecological potentials which include low, mid-level and high.

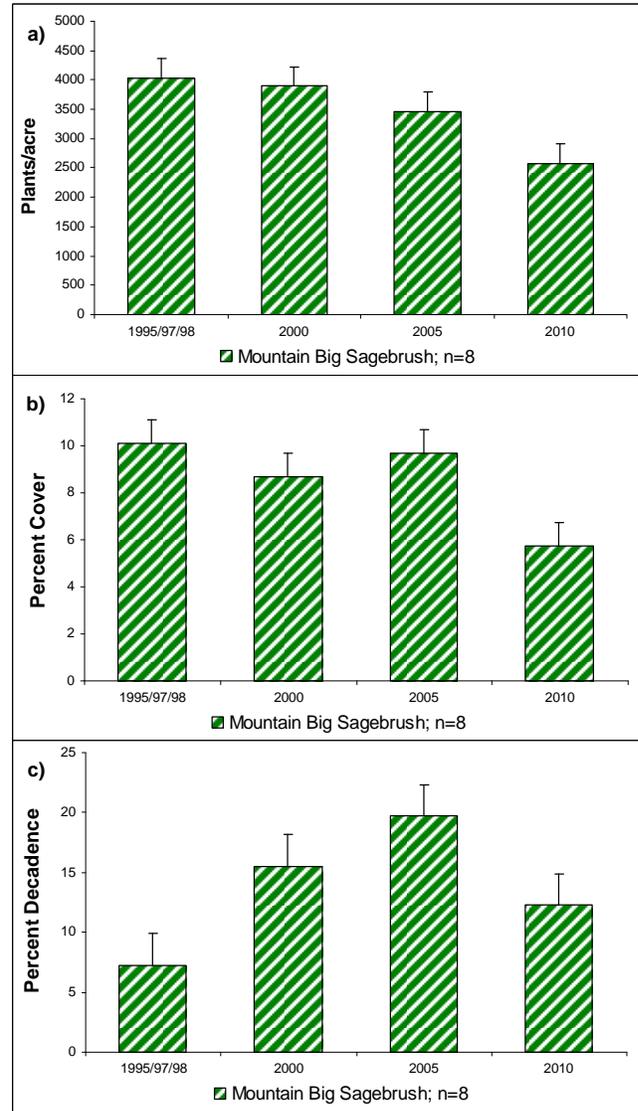
### **Mountain Big Sagebrush Communities (Mid-Level Potential Winter Range)**

**Browse:** Mid-level potential studies were located only in the North Book Cliffs subunit for Unit 10. The mid-level potential studies cumulative median browse trend was up from 1982 to 1988, and then remained relatively stable through the subsequent sample years (Figure 12b). The dominant browse species on all of the mid-level potential studies is mountain big sagebrush. The Lower Tom Patterson Point and Monument Ridge study sites were burned by wild fire in the 1980's, removing most of the browse species before sampling



**Figure 5.** a) Mid-level potential sites mean perennial grass, perennial forb and cheatgrass sum of nested frequency (n=8) by year for WMU 10, Book Cliffs. b) Mid-level potential sites mean perennial grass, perennial forb and cheatgrass cover (n=8) by year for WMU 10.

began. The Railroad Canyon study site was burned by a prescribed fire in 1998 and the Willow Flat study site was treated by a tebuthiuron (Spike) herbicide treatment in 2005, reducing the browse species on both sites. The Railroad Canyon study was not sampled in the 2005 sample year. Mean density and mean cover of mountain big sagebrush was significantly lower in 2010 than the other sample years (Figure 6a and Figure 6b). The decrease in density and cover is largely due to the herbicide treatment on the Willow Flat study site that removed much of the mountain big sagebrush from that site. The mean decadence of mountain big sagebrush has been moderate on the studies, but was high in 2005 (Figure 6c).



**Figure 6.** a) Mid-level potential sites mean density of mountain big sagebrush (*Artemisia tridentata* ssp. *vaseyana*) by year for WMU 10, Book Cliffs. b) Mid-level potential sites mean cover of mountain big sagebrush by year for WMU 10. c) Mid-level potential sites mean population decadence of mountain big sagebrush by year for WMU 10.

**Herbaceous Understory:** The mid-level potential median cumulative grass trend decreased in 1995/1997/1998, then remained stable throughout the subsequent sample years (Figure 12b). Grasses within these communities are diverse and very abundant, though several study sites are dominated by seeded species such as crested wheatgrass (*Agropyron cristatum*) and intermediate wheatgrass (*A. intermedium*). The annual species cheatgrass (*Bromus tectorum*) was sampled on several of the studies, but tends not to be a prevalent component on the sites and was not included in this summary. The mean sum of nested frequency of perennial grasses steadily decreased from 1995/1997/1998 to 2005, with a significant decrease in the mean sum of nested frequency in 2005. The mean sum of nested frequency increased again in 2010, though the increase was not significant (Figure 5a). Despite the decrease in frequency the cover of perennial grasses has steadily increased over the sample years and was significantly higher in 2010 than in any other sample year (Figure 5b). This increase in cover while frequency decreased is explained by general changes in composition across the studies. In general, low cover producing species such as Sandberg bluegrass (*Poa secunda*) and blue

grama (*Bouteloua gracilis*) have decreased in nested frequency while high cover producing species such as crested wheatgrass and needle-and-thread (*Stipa comata*) have increased in cover and nested frequency.

The mid-level potential median cumulative forb trend has fluctuated over the sample years with an increase in 1995/1997/1998 and then a steady decrease through 2005. Overall, the trend is down since 1988 (Figure 12b). Perennial forbs are also diverse and fairly abundant within most of the sampled communities. The mean sum of nested frequency of perennial forbs had a steady decrease from 1995/1997/1998 to 2005, but remained similar in 2010. The decrease in the sum of nested frequency was significant in 2005 (Figure 5a). The trend of the mean cover of perennial forbs was less drastic, but nearly identical to the trend of the sum of nested frequency (Figure 5b).

Utilization: Pellet group transect data indicates that elk predominantly used these study areas, but use by elk decreased slightly in 2010. The mean elk days use/acre on the unit moderate in 2000, but decreased markedly to moderately light use in 2010. The mean days use/acre of deer has increased from light use in 2000 to moderately light use in 2010. Cattle use was mostly light over the course of the study with the heaviest use noted in 2010 (Figure 13b).

Deer Desirable Components Index (DCI): The mid-level potential deer DCI remained stable over the sample years with a ranking of fair throughout the course of the study (Table 2 and Figure 11a).

Year	Preferred Browse Cover	Preferred Browse Decadence	Preferred Browse Young	Perennial Grass Cover	Annual Grass Cover	Perennial Forb Cover	Noxious Weeds	Total Score	Ranking
95/97/98	14.8	9.2	8.1	21.6	0.0	8.3	0.0	<b>62.1</b>	Fair
00	12.6	5.0	5.3	24.2	0.0	7.5	0.0	<b>54.7</b>	Fair
05	14.0	5.6	2.6	25.4	0.0	6.2	0.0	<b>54.0</b>	Fair
10	9.7	6.4	6.2	26.0	-0.4	6.6	0.0	<b>54.6</b>	Fair

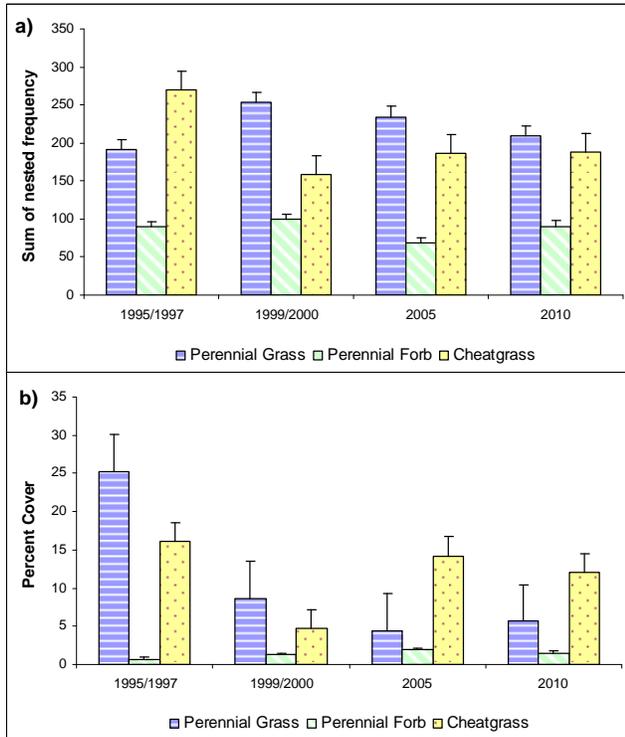
**Table 2.** Mid-level potential scale mean deer DCI scores (n=8) by year for WMU 10, Book Cliffs. The deer DCI scores are divided into three categories based on ecological potentials which include low, mid-level and high.

## Wyoming Big Sagebrush Communities (Low Potential Winter Range)

### North Book Cliffs

Browse: The low potential site cumulative median browse trend for the North Book Cliffs increased in 1988, remained stable through 1999/2000, and then steadily decreased through 2010. Overall, the browse trend has been relatively stable for the studies (Figure 12c). The dominant browse on these low potential studies is typically comprised of five species, black sagebrush (*Artemisia nova*), Wyoming and basin big sagebrush, fourwing saltbush (*Atriplex canescens*) and winterfat (*Ceratoides lanata*). Basin big sagebrush is the dominant browse species on the three studies at the McCook Ridge Exclosure complex and was sampled on the Indian Ridge and Sunday School studies. For the purpose of this summary basin big sagebrush and Wyoming big sagebrush data will be combined and referred to simply as big sagebrush. Composition of these browse species varies over the studies with different species dominating different study sites. Black sagebrush is the dominant species only on the Two Water WMA study and the trend for black sagebrush is almost entirely dictated by this study. Therefore, black sagebrush is not included in this summary. For further information on the trends for black sagebrush refer to the discussion section.

Big sagebrush mean density decreased steadily from 1995/1997 to 2005 and was significantly lower in 2005 than in 1995/1997. Mean density of big sagebrush increased significantly in 2010 (Figure 8a) primarily due to a large increase in recruitment of young plants on just one study, Sunday School. The mean cover of big sagebrush has decreased steadily since 1999/2000. Despite the large increase in density in 2010, the young

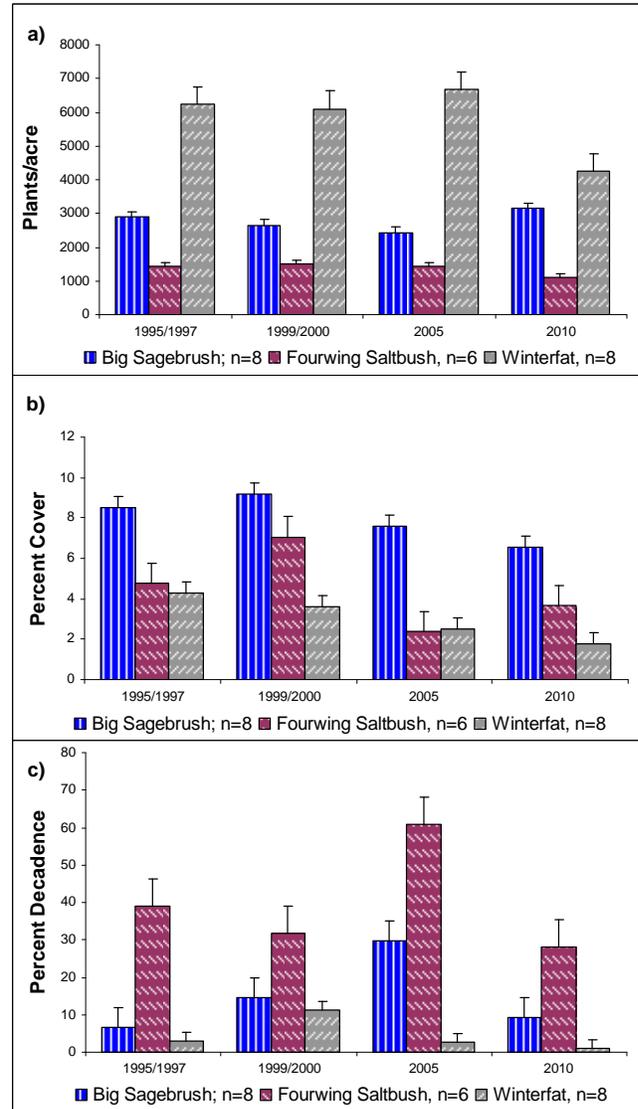


**Figure 7.** a) Low potential sites mean perennial grass, perennial forb and cheatgrass sum of nested frequency (n=9) by year for WMU 10, Book Cliffs, North Book Cliffs. b) Low potential sites mean perennial grass, perennial forb and cheatgrass cover (n=9) by year for WMU 10, North Book Cliffs.

plants provided little cover and mean cover continued to decrease and was significantly lower than in 1999/2000 (Figure 8b). The mean density of fourwing saltbush has been less variable than the other dominant browse species, but was significantly lower in 2010 (Figure 8a). The mean cover of fourwing saltbush has been variable and was significantly higher in 1999/2000 than all the other sample years (Figure 8b). Because of its growth form, the mean density of winterfat is typically much higher than the other browse species, but mean cover of winterfat is typically lower compared with the other dominant browse species on the studies.

Density of winterfat was significantly lower in 2010 than the other sample years and cover has steadily decreased over the course of the study (Figure 8a and Figure 8b). The mean decadence of big sagebrush has been low to moderate in most sample years, though decadence increased significantly from moderate levels to high levels in 2005. The mean decadence of fourwing saltbush has been high throughout the course of the study, but was also significantly higher in 2005. Winterfat mean decadence has been mostly low, but was significantly higher in 1999/2000 (Figure 8c).

**Herbaceous Understory:** The low potential median cumulative grass trend for the North Book Cliffs increased substantially in 1999/2000 and remained up throughout the remaining sample years (Figure 12c). Grasses within these communities are typically dominated by just a few species that provide varying amounts of cover. The annual species cheatgrass (*Bromus tectorum*) is common on the studies and has been the dominant grass species in many sample years on most of the studies. The cheatgrass mean nested frequency was significantly higher in 1995/1997 than the other sample years (Figure 7a). The mean cover of cheatgrass was significantly



**Figure 8.** a) Low potential sites mean density of big sagebrush (*Artemisia tridentata* spp.), fourwing saltbush (*Atriplex canescens*) and winterfat (*Ceratoides lanata*) by year for WMU 10, Book Cliffs, North Book Cliffs. b) Low potential sites mean cover of big sagebrush, fourwing saltbush and winterfat by year for WMU 10, North Book Cliffs. c) Low potential sites mean population decadence of big sagebrush, fourwing saltbush and winterfat by year for WMU 10, North Book Cliffs.

lower in 1999/2000 than the other sample years (Figure 7b). Mean sum of nested frequency of perennial grasses increased significantly in 1999/2000, but then steadily decreased and was significantly lower in 2010 than in 1999/2000 (Figure 7a). The mean cover of perennial grasses decreased significantly in 1999/2000 and remained lower throughout the remaining sample years (Figure 7b).

The low potential median cumulative forb trend for the North Book Cliffs decreased slightly in 2005, but has remained relatively stable throughout the study years (Figure 12c). Perennial forbs are neither diverse nor abundant within the sampled communities. Most of the studies forb component is dominated more by annual species than perennial species. The mean sum of nested frequency of perennial forbs was significantly lower in 2005 than the other sample years (Figure 7a). However, the mean cover of perennial forbs was higher in 2005 than the other sample years (Figure 7b).

Utilization: Pellet group transect data indicates that deer predominantly use these study areas, though elk use was moderate in 1999/2000. The mean deer days use/acre on the unit has been mostly heavy over the course of the study years, and was substantially higher in 2005. The mean elk days use/acre has had a general decrease throughout the study years. Cattle use has been mostly light on the study sites (Figure 13c). Cattle are excluded from the two studies within the McCook Ridge Exclosure complex and wildlife is excluded from the McCook Ridge Total Exclosure Study. Light use by wild horses has also been sampled on the Agency Draw and Sunday School study sites in several sample years.

Deer Desirable Components Index (DCI): The low potential deer DCI has fluctuated over the sample years, but was substantially lower in 2005 than the other years. The decrease is due to a multiple of variables including decreases in the cover of preferred browse, an increase in decadence of browse, decreased recruitment of young browse, decreased perennial grass and perennial forb cover and increases in annual grass cover. The ranking ranged from fair to good (Table 3 and Figure 11a).

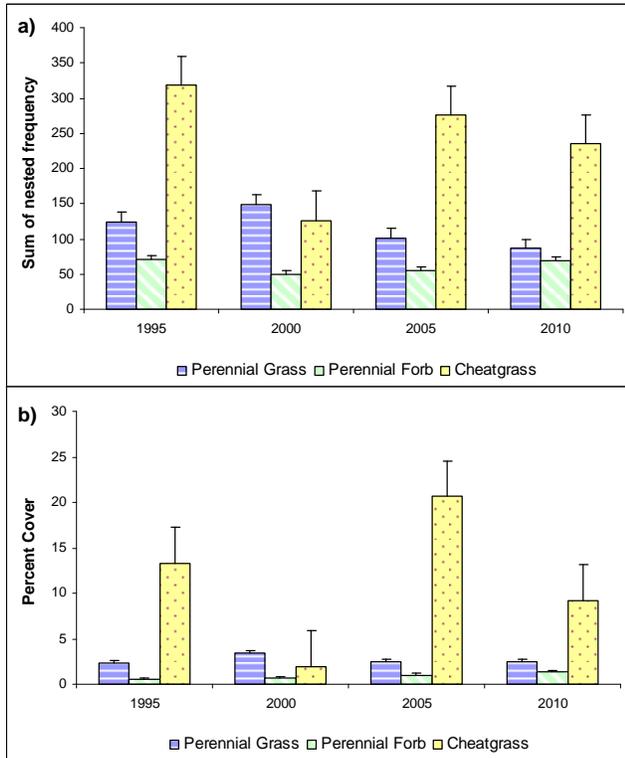
Year	Preferred Browse Cover	Preferred Browse Decadence	Preferred Browse Young	Perennial Grass Cover	Annual Grass Cover	Perennial Forb Cover	Noxious Weeds	Total Score	Ranking
95/97	23.5	11.2	10.3	5.7	-9.5	1.3	0.0	<b>42.4</b>	Fair
99/00	24.1	8.4	6.2	14.7	-3.5	2.5	0.0	<b>52.4</b>	Good
05	18.4	5.9	3.5	8.9	-8.6	1.8	0.0	<b>29.9</b>	Fair
10	19.3	11.5	12.0	11.2	-7.6	2.9	0.0	<b>49.4</b>	Good

**Table 3.** Low potential scale mean deer DCI scores (n=9) by year for WMU 10, Book Cliffs, North Book Cliffs. The deer DCI scores are divided into three categories based on ecological potentials which include low, mid-level and high.

### South Book Cliffs

Browse: The low potential site cumulative median browse trend for the South Book Cliffs decreased slightly in 2000 and decreased even more drastically in 2005. Overall, the browse trend has is down for the studies over the sample years (Figure 12d). The dominant browse on these low potential studies is typically comprised of moderate to very dense stands of Wyoming big sagebrush. A small fire burned the West Horse Pasture study between the 2005 and 2010 sample years and construction of a oil well during the same period required that the transect be moved slightly in 2010 as well. Wyoming big sagebrush mean density was significantly lower in 2005 than the other sample years (Figure 10a). The mean cover of Wyoming big sagebrush was significantly higher in 2000 than the other sample years (Figure 10b). The mean decadence of Wyoming big sagebrush has been moderate to high in most sample years with a significant increase in decadence in 2005 (Figure 10c).

Herbaceous Understory: The low potential median cumulative grass trend for the South Book Cliffs increased substantially from 1986 to 2000, then decreased throughout the remaining sample years (Figure 12d). Grasses within these communities are lacking and typically dominated by just a few species that provide varying

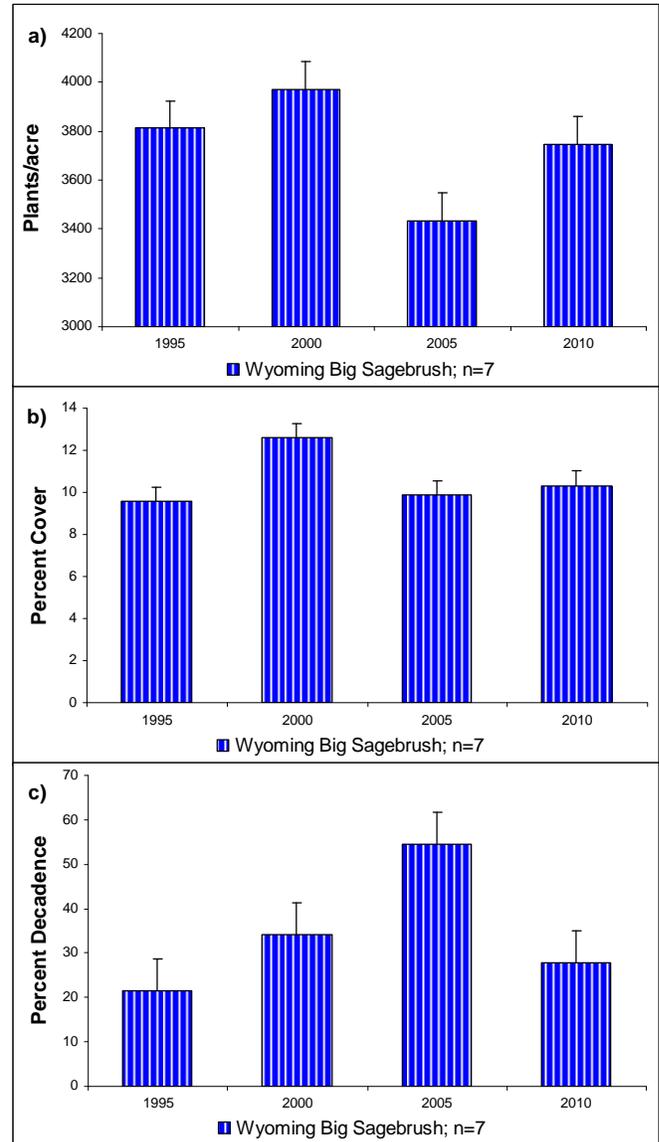


**Figure 9.** a) Low potential sites mean perennial grass, perennial forb and cheatgrass sum of nested frequency (n=7) by year for WMU 10, Book Cliffs, South Book Cliffs. b) Low potential sites mean perennial grass, perennial forb and cheatgrass cover (n=7) by year for WMU 10, South Book Cliffs.

amounts of cover. The annual species cheatgrass (*Bromus tectorum*) is common on the studies and has been the dominant grass species in many sample years on most of the studies. The cheatgrass mean nested frequency was significantly lower in 2000 than the other sample years (Figure 9a). The mean cover of cheatgrass was lowest in 2000 and highest in 2005 (Figure 9b). Mean sum of nested frequency of perennial grasses increased in 2000, but then decreased significantly in 2005 and remained lower in 2010 (Figure 9a). The mean cover of perennial grasses displayed a similar trend as frequency (Figure 9b).

The low potential median cumulative forb trend for the South Book Cliffs increased slightly in 1995, but has remained relatively stable throughout the remaining study years (Figure 12d). Perennial forbs are neither diverse nor abundant within the sampled communities. The mean sum of nested frequency of perennial forbs was significantly lower in 2000 and 2005 than the other sample years (Figure 9a). However, the mean cover of perennial forbs has steadily increased over the course of the study and was significantly higher in 2005 and 2010 than in 1995 and 2000 (Figure 9b). Mean cover of perennial forbs remained low.

**Utilization:** Pellet group transect data indicates that deer predominantly use these study areas. The mean deer days use/acre on the unit has been mostly moderate over the course of the study years, but increased to heavier levels in 2010. The mean elk days use/acre has been generally light throughout the study years. Cattle use has been mostly light on the study sites with a slight increase in 2010 (Figure 13d). Light sheep use has also been sampled on several of the study sites.

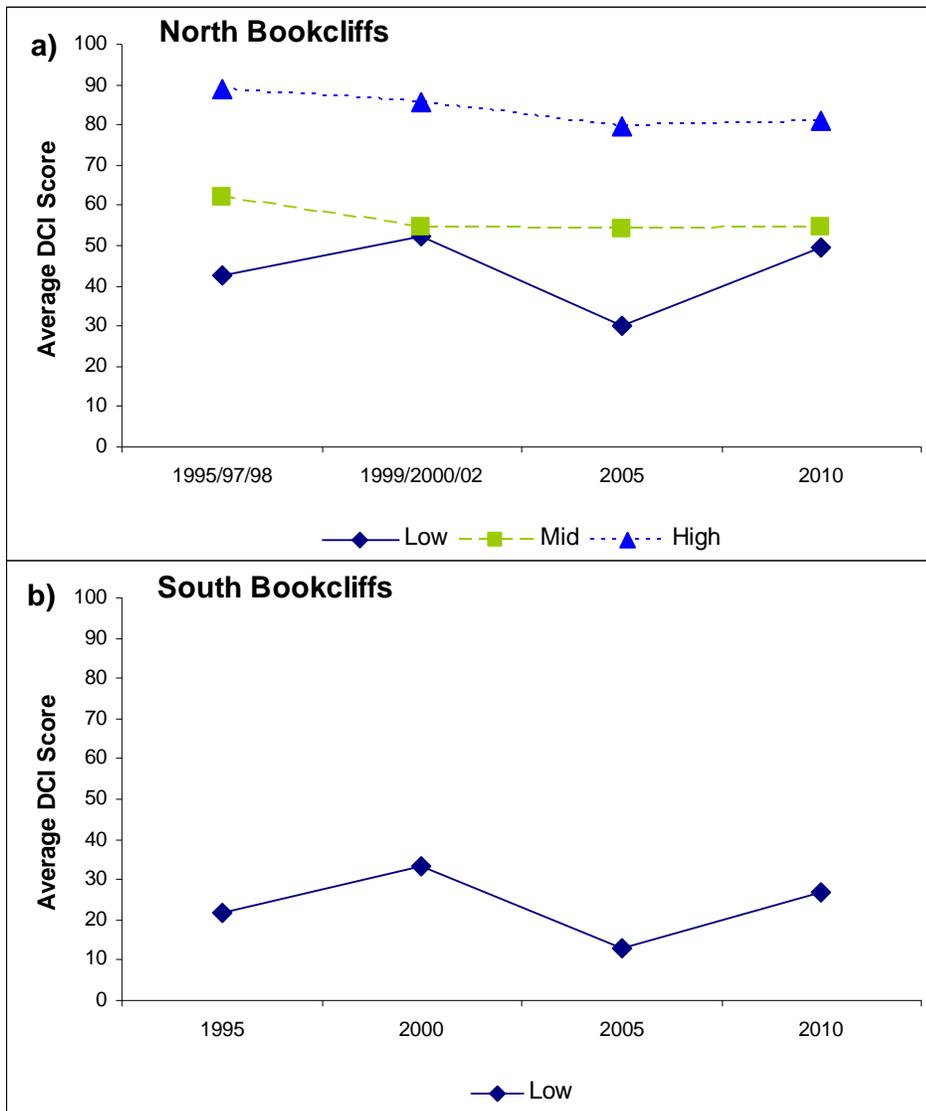


**Figure 10.** a) Low potential sites mean density of Wyoming big sagebrush (*Artemisia tridentata* ssp. *wyomingensis*) by year for WMU 10, Book Cliffs, South Book Cliffs. b) Low potential sites mean cover of Wyoming big sagebrush by year for WMU 10, South Book Cliffs. c) Low potential sites mean population decadence of Wyoming big sagebrush by year for WMU 10, South Book Cliffs.

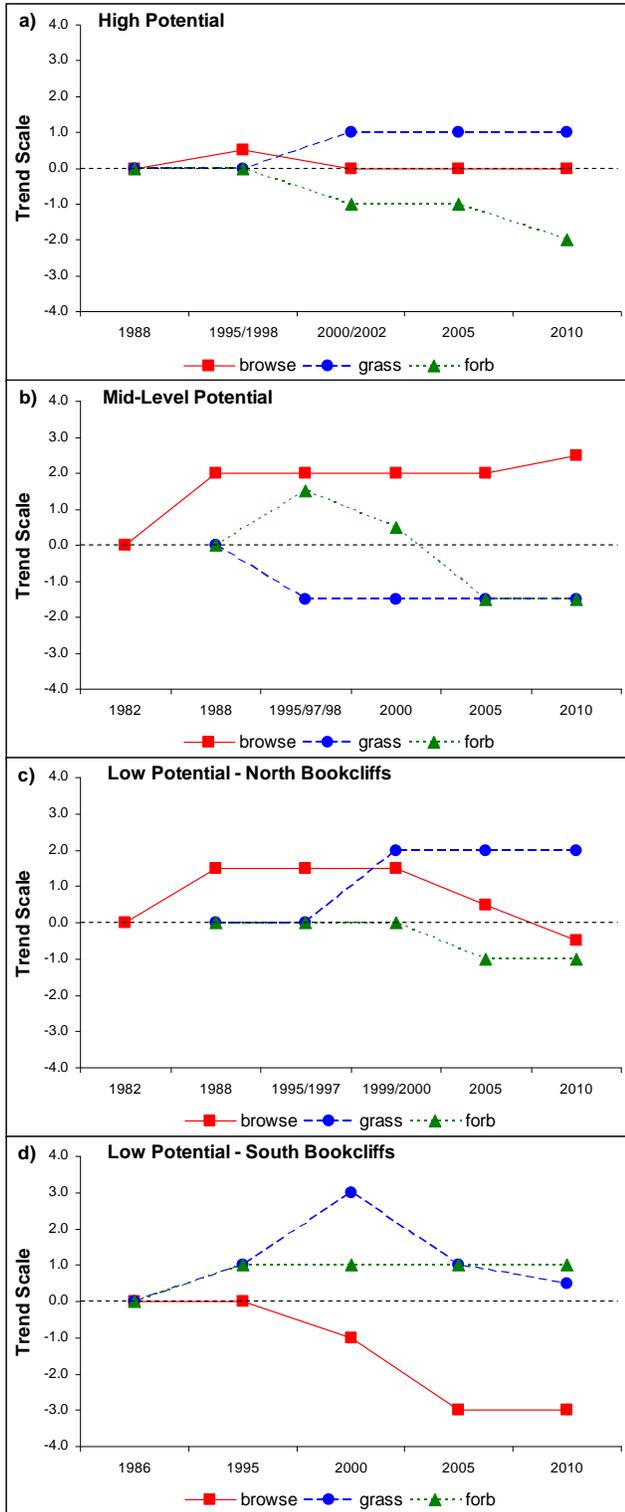
**Deer Desirable Components Index (DCI):** The South Book Cliffs low potential deer DCI has fluctuated over the sample years, but was substantially lower in 2005 than the other years. The decrease was primarily due to an increase in decadence of browse and increases in annual grass cover. The ranking ranged from poor to fair (Table 4 and Figure 11b). The DCI for these studies generally ranked lower than similar communities in the North Book Cliffs, but the trends were similar.

Year	Preferred Browse Cover	Preferred Browse Decadence	Preferred Browse Young	Perennial Grass Cover	Annual Grass Cover	Perennial Forb Cover	Noxious Weeds	Total Score	Ranking
95	12.2	8.6	5.0	4.6	-9.7	1.0	0.0	<b>21.8</b>	Poor
00	16.4	4.6	5.8	6.9	-1.5	1.3	0.0	<b>33.5</b>	Fair
05	12.9	1.4	4.3	4.9	-12.7	2.0	0.0	<b>12.9</b>	Poor
10	14.1	6.6	5.4	4.9	-6.9	2.6	0.0	<b>26.7</b>	Poor-Fair

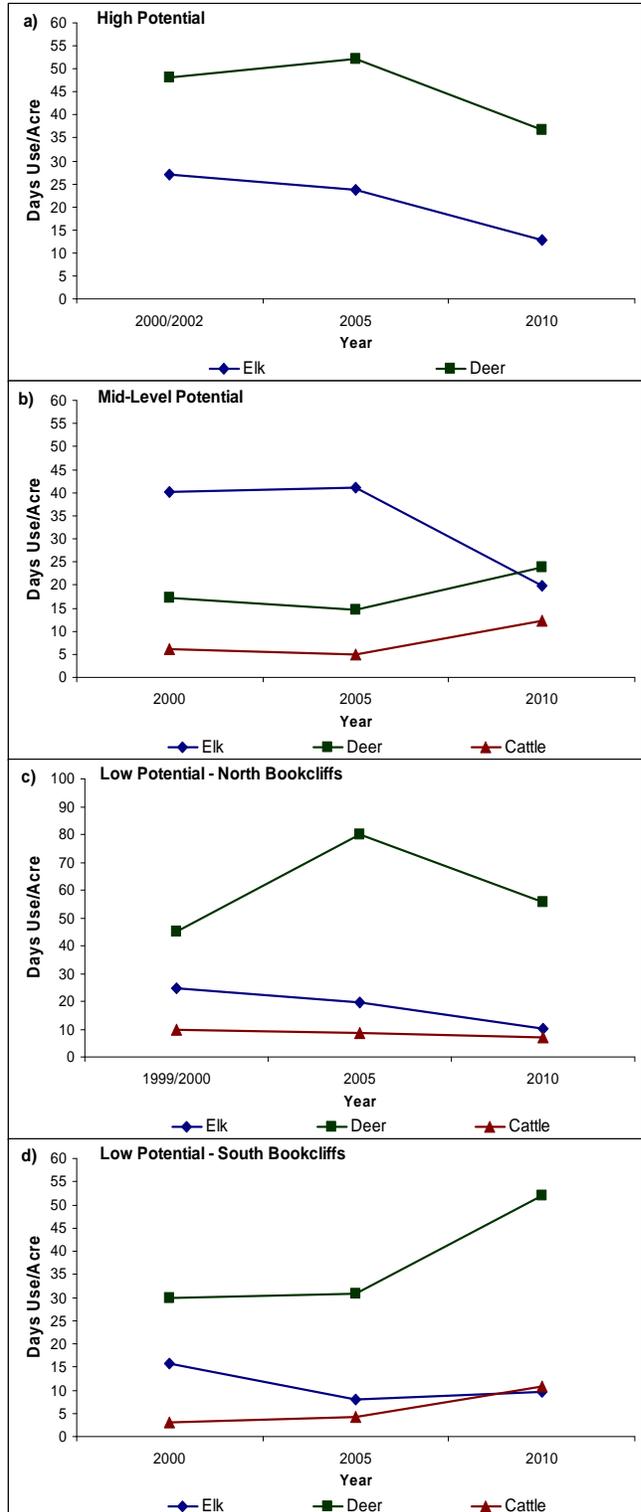
**Table 4.** Low potential scale mean deer DCI scores (n=7) by year for WMU 10, Book Cliffs, South Book Cliffs. The deer DCI scores are divided into three categories based on ecological potentials which include low, mid-level and high.



**Figure 11.** a) Mean low (n=9), mid-level (n=8) and high (n=5) potential scale deer DCI scores by year for WMU 10, Book Cliffs, North Book Cliffs. b) Mean low (n=7) potential scale deer DCI scores by year for WMU 10, Book Cliffs, South Book Cliffs. The deer DCI scores are divided into three categories based on ecological potentials which include low, mid-level and high.



**Figure 12.** a) High potential sites (n=5) cumulative median browse, grass and forb trends by year for WMU 10, Book Cliffs, North Book Cliffs. b) Mid-level potential sites (n=8) cumulative median browse, grass and forb trends by year for WMU 10, North Book Cliffs. c) Low potential sites (n=9) cumulative median browse, grass and forb trends by year for WMU 10, North Book Cliffs. d) Low potential sites (n=7) cumulative median browse, grass and forb trends by year for WMU 10, Book Cliffs, South Book Cliffs



**Figure 13.** a) High potential sites (n=4) mean animals days use/acre by year for WMU 10, Book Cliffs, North Book Cliffs. b) Mid-level potential sites (n=8) mean animal days use/acre by year for WMU 10, North Book Cliffs. c) Low potential sites (n=8) mean animal days use/acre by year for WMU 10, North Book Cliffs. d) Low potential sites (n=7) mean animal days use/acre by year for WMU 10, Book Cliffs, South Book Cliffs.