APPENDIX A

Casper Region Shrub Production and Browse Data

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INTRODUCTION

Habitat changes throughout the West are creating challenges for wildlife managers that have never before been so critical. The long-term impacts of these changes are yet to be understood. It is apparent, given habitat quality and quantity are declining, carrying capacity for many wildlife species is decreasing. This is due to a variety of causes including: urbanization, drought, fire suppression, invasive plant species, changes in fire frequency, climate change, past and current over-use by ungulates, vegetation type conversions, and etc. While some impacts can be minimized or even eliminated, others are not so easy to either understand or to manage. For example, managers can plan and implement prescribed burning projects with some measure of success. But how to properly manage for changing climatic conditions or even relatively short-termed drought is yet to be understood.

Global climatic change is a natural process that has occurred for centuries and has caused dramatic changes in the earth's ecosystems. Generally these changes have progressed slowly over the last 10,000 – 20,000 years, however the present rate of global warming has increased 30-fold in the last 100 years (deVos and McKinney, 2007). DeVos and McKinney (2007) continue to explain this warming trend corresponds with widespread changes in distribution and trends in biotic communities as specie distribution is shifting towards the poles and upward on mountain slopes and earlier onset of spring activities by many species of plants and animals is occurring.

Are changes occurring in Wyoming? Based on observations over the past 15 years it has been noted many cool season grasses are 'seeding or booting out' much earlier in the spring (April and May). In addition, shrub transect data is collected in Wyoming big sagebrush (*Artemisia tridentate wyomingensis*), true mountain mahogany (*Cercocarpus ledifolius*), and curl-leaf mountain mahogany (*Cercocarpus montanus*) stands throughout the Casper Region. These data clearly show a dramatic decline in shrub vigor and productivity (Tables 1 and 2) in most stands. There has also been a dramatic increase (though un-quantified) in the frequency and distribution of invasive and harmful plant species such as cheatgrass (*Bromus tectorum).*

Observed declines in pronghorn and mule deer population productivity in some herd units could be due, in part, to shifts in vegetative condition on spring/summer and winter ranges. Grasses and forbs important to pregnant and fawning does are curing out earlier prior to fawning. This puts lactating does on a nutritional plane much lower than needed to provide nutritionally optimal milk to fawns. Declining winter range shrub productivity decreases winter food availability and quality resulting in poorer survival over all sex and age classes and reduces fetal fawn condition resulting in poorly conditioned neonates at birth. In addition, declining health of winter range habitats may also increase the susceptibility of pronghorn and mule deer herds to experience dramatic large-scale winter losses during severe winters.

Shrubland habitat availability and quality has also declined throughout much of pronghorn and mule deer range in the West. These declines can be attributed to a myriad of anthropogenic causes including: habitat fragmentation such as oil/gas, urban, and wind power development, certain agricultural practices such as sagebrush eradication to increase grass production and yearlong grazing, and lack of natural disturbances (i.e. fire suppression) leading to climax vegetative communities. However, in some areas, catastrophic wildfires with shortened event

intervals due to the introduction of invasive plant species has had a dramatic impact on hundreds of thousands of acres of sagebrush throughout the West. In many cases this cycle of flashy fine fuels (invasive plants) and shortened fire intervals has eliminated entire winter ranges important to pronghorn, mule deer, sage-grouse, and other wildlife species. Also, as shrub communities are reduced or eliminated, the amount of stress on the remaining communities increases (i.e., increased browse pressure). This, of course, is a spiraling circle of increased browse use resulting in decreased shrub vigor and production.

How can wildlife managers respond to these challenges? And can we reverse these trends? These questions are daunting and pose new and important challenges to resource managers. Certainly, it is unknown whether, through management actions or continued changes in climate, these trends in vegetative condition will improve. It is certain doing nothing and simply hoping for the best is both irresponsible and short-minded and will most likely lead to further reduced carrying capacities for future generations.

So, as managers responsible for wild ungulate population management, what can we do? In the Casper Region, our contention is we, as an agency, need to focus on the concept of sustainable wildlife populations in times of ever increasing change. It is important, as habitats continue to change, managers measure those changes and implement management to improve habitat conditions both directly (i.e., habitat improvements projects) and indirectly (i.e., controlling the amount of use). Adjusting wild ungulate use on key plant species to balance animal use (browse) and the plant's ability to produce adequate nutrition and maintain its health/sustainability is essential. At minimum, as managers we need to control wild ungulate populations at a level that does not cause further degradation to plant vigor and viability. Concurrently, it is imperative land managers implement progressive management activities to improve the condition of shrub communities.

METHODS

Measures of browse intensity, productivity, and hedging class have been collected on permanent step transects in shrub communities throughout the Casper Region in some areas since 1993. Techniques are described in detail in the Wyoming Game & Fish Department's Manual of Biological Techniques (WGFD 2007). Transects were located in homogenous shrub stands in areas of known ungulate winter concentration that best represent the winter range as a whole. Transects are permanently marked with posts. The UTM coordinate of origin and orientation for each transect are recorded and mapped.

Big sagebrush browse intensity (or utilization) is obtained using at least 2 observers to ocularly estimate the percentage of the current year's leaders that have been nipped. This data is collected in April through early May prior to shrub growth. 25 plants that occur nearest the toe in a 180^0 arc in front of the observer at 3-pace intervals along the transect line are sampled. Only those plants deemed available to a big-game species during the winter are sampled. Each shrub is assessed for browse or utilization (% leaders browsed) and characterized according to the hedging class criteria (Wyoming Game & Fish Dept. 2007, Appendix XII-page 29). Shrub utilization is recorded as the average of the ocular estimates made to the nearest 5%. This provides an estimate of the proportion of terminal buds removed from the plant.

A hedging class score is assigned to each individual shrub along each transect in the fall (usually September). A score of 1 represents a shrub in optimal condition (high number of current year's growth extending from last year's terminal buds), a score of 2 represents a moderately hedged plant (30 – 60% of current year's growth extending from last year's terminal bud), and a score of 3 represents a plant that has been severely hedged with relatively few sprouts extending from last year's terminal bud. A period of extended over-utilization generally leads to severe hedging of sagebrush plants. Severely hedged plants may experience short term boosts in production with little to no utilization in good years, yet may still be considered severely hedged as the plant's ability to produce leaders from terminal buds has been limited.

True and curlleaf mountain mahogany browse intensity (or utilization) is obtained by counting the number of the current year's leaders that have been nipped out of a total of 10 leaders. This data is collected in April through early May prior to shrub growth. 10 leaders that occur nearest the toe in a 180^0 arc in front of the observer at 3-pace intervals along the transect line are sampled. Only those plants deemed available to a big-game species during the winter are sampled. Each shrub is assessed for browse or utilization (% leaders browsed).

RESULTS

All shrub productivity, browse, and hedging data by herd unit and year are presented in Tables 1 and 2.

Cheyenne River Pronghorn

The Wyoming big sagebrush communities represented by our sampling transects are generally in poor to fair condition. Since 2001, annual production is trending upward, even though we have documented several years below average production. The sagebrush plants in the 6-mile Basin, Frog Creek, Red Hills, and M Creek areas are more decadent and heavily hedged as compared to the other transect locations. The older and more hedged the sagebrush plants are, the less likely they are to produce seed and perpetuate the community into the future. So, it is our responsibility to maintain utilization rates at levels that will not only facilitate sustainable wildlife populations, but will also sustain viable and vigorous shrub communities.

Medicine Bow Pronghorn

The big sagebrush communities represented by our sampling transects are generally in poor condition. Poor production years exacerbated by heavy utilization has contributed to the decline of these communities. Furthermore, the sagebrush plants are decadent and heavily hedged, which also contributes to the decline in community health. In the Casper Region, the big sagebrush communities in this herd unit are by far in the worst condition of those communities represented by our sampling transects. But, we have implemented pronghorn population management strategies over the last several years that appear to be improving the situation.

Bates Hole-Hat Six Mule Deer

The majority of true mountain mahogany communities in this herd unit are in poor condition due to poor production, past heavy utilization, and poor seedling recruitment, but there are some communities that are more productive. Our sampling efforts indicate we are maintaining utilization levels well below the 35 percent threshold, which should start improving the condition of the plants over time.

South Converse Mule Deer
The true mountain mahogany communities in this herd unit are in poor condition due to poor production, past heavy utilization, and poor seedling recruitment. Data indicate we are maintaining utilization levels below the 35 percent threshold, which should help improve the condition of the individual plants. Furthermore, we have implemented a treatment that is intended to improve true mountain mahogany stands.

North Natrona Mule Deer
These curl-leaf mountain mahogany communities are in poor to fair condition due to poor production, lack of seedling establishment, past heavy utilization and current utilization levels. Albeit the utilization levels are within the 35 percent threshold, utilization rates documented are still impacting the individual plants by limiting annual production and reducing seed production. Curl-leaf mountain mahogany is a long-lived species and is very difficult to get seedling establishment. We implemented a prescribed burn in this community almost 16 years ago, and still have not documented seedling establishment.

Black Hills Mule Deer
The true mountain mahogany communities in this herd unit are in poor condition due to poor production and past heavy utilization. Our sampling efforts indicate we are maintaining utilization levels below the 35 percent threshold, which will help improve the condition of individual plants. Mule deer population management measures are being taken to minimize additional impacts to the individual plants.

Habitat Improvement Project Progress Report

North Laramie Range Watershed Restoration Project Phase 2010
During September 2011, Wyoming Helicopters was used to chemically treat 6,405 acres of cheatgrass-infested big sagebrush communities. In addition, funds were used to purchase materials to install a 2-mile fence, which will allow Garrett Ranch Company to rotate livestock grazing through a 4 pasture system. This rotation system will further improve the chemical treatment area by allowing livestock grazing deferment opportunities. According to our records, we have chemically treated a total of 16,432 acres of cheatgrass-infested big sagebrush communities since the start of this project. All of these acres lie within the North Laramie Range Watershed Restoration project.

Bolton Creek Riparian Restoration Project
As of October 2011, we have aerially deposited 296 bundles of aspen that ranged in weight from 250 to 900 pounds. Using an average weight of 575 pounds per bundle, we moved approximately 170,200 pounds of aspen trees into existing beaver dam complexes, which is more than double the 82,000 pounds we airlifted in 2010. This was accomplished using 29 hours of helicopter flight time over a two week period. Field observations on November 9, 2011 showed beaver continue to use the aspen for dam building activities, which accounts for 12 documented new dams, but other dam building activity is occurring along Bolton Creek.

Table 1. Shrub Leader Growth in inches. All pronghorn transects are in Wyoming big sagebrush communities and all mule deer transects are in true mountain mahogany, except North Natrona mule deer is in curl-leaf mountain mahogany.

Herd Unit	**1998**	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**
Cheyenne River Pronghorn				**0.70**	**0.93**	**0.83**	**0.35**	**1.54**	**0.83**	**1.91**	**1.75**	**1.41**		
Medicine Bow Pronghorn	**0.17**	**1.37**	**0.46**	**0.65**	**0.27**	**0.53**	**0.51**	**0.74**	**0.59**	**1.42**	**1.90**	**1.60**	**1.84**	
Bates Hole-Hat Six Mule Deer				**0.53**	**0.30**	**0.33**	**0.05**	**0.79**	**0.95**	**2.52**	**2.78**	**n/a**	**2.88**	**3.54**
South Converse Mule Deer			**3.60**	**1.36**	**0.64**	**1.30**	**0.77**	**2.17**	**2.01**	**2.80**	**3.66**	**n/a**		
North Natrona Mule Deer				**0.70**	**0.54**	**0.35**	**n/a**	**0.95**	**0.71**	**1.27**	**n/a**	**1.56**	**2.60**	**1.46**
Black Hills Mule Deer						**1.59**	**0.94**	**3.25**	**3.51**	**2.50**	**2.91**	**2.38**		

Table 2. Shrub Use expressed as the percent of leaders browsed. Numbers in red indicate those years/areas when leaders browsed exceeded 35%.

Herd Unit	**1998**	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**
Cheyenne River Pronghorn					**5.60**	**19.52**	**31.94**	**22.76**	**20.24**	**37.18**	**14.38**	**23.69**	**14.83**	**7.50**
Medicine Bow Pronghorn	**9.72**	**18.35**	**15.92**	**32.26**	**11.83**	**38.03**	**29.25**	**23.92**	**30.43**	**72.70**	**66.82**	**76.03**	**40.32**	
Bates Hole-Hat Six Mule Deer				**24.30**	**34.78**	**n/a**	**n/a**	**24.40**	**12.00**	**26.87**	**15.87**		**28.20**	**13.60**
South Converse Mule Deer			**28.90**	**30.65**	**25.31**	**n/a**	**20.00**	**21.20**	**20.13**	**25.87**	**12.00**	**15.33**	**15.20**	**17.87**
North Natrona Mule Deer								**24.00**	**24.13**	**21.07**	**10.27**		**29.92**	
Black Hills Mule Deer								**18.00**	**20.40**	**6.20**	**14.40**	**7.20**	**15.9**	**6.0**