June 2015

JACKSON MOOSE HERD UNIT
POPULATION OBJECTIVE REVIEW

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The Jackson Moose Herd covers 2,023 square miles north of the Town of Jackson, encompassing primarily Bridger-Teton National Forest (BTNF) and Grand Teton National Park (GTNP) lands (Figure 1). This herd unit includes Hunt Areas 7, 14, 15, 17-19, 28, and 32 and is comprised of 96% public land, with 236 square miles in the Gros Ventre Wilderness and 546 square miles in the Teton Wilderness. Most of the herd is migratory, spending summers at high elevations (2800 meters) in the Gros Ventre Mountain Range and Teton Wilderness and spreading out to several lower elevation winter ranges in riparian habitats in Buffalo Valley, Spread Creek, Snake River bottom, and Gros Ventre drainage. The management designation for the Jackson moose herd is Special Management.

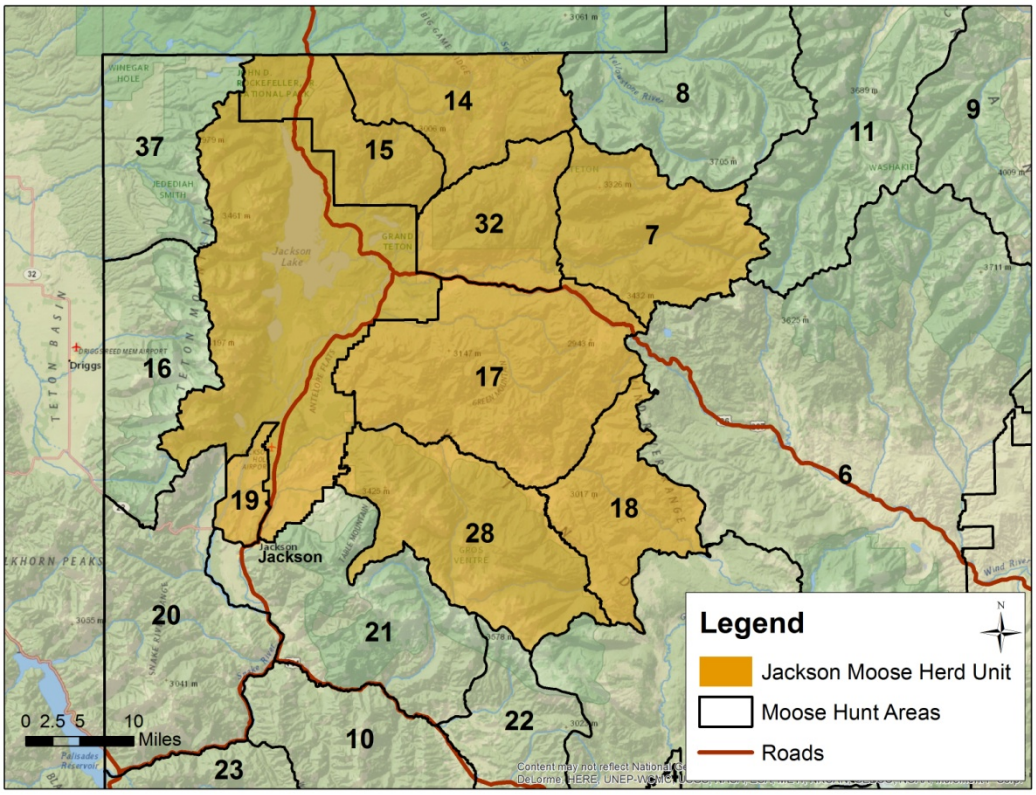

Figure. 1. Map of the Jackson Moose Herd Unit (orange shading), which includes Grand Teton National Park, National Elk Refuge, and Hunt Areas 7, 14-15, 17-19, 28, and 32.

Population Objective Review

Native moose populations naturally expanded and colonized the Jackson area in the late 19th century. In July 1872, members of the Hayden expedition killed a cow and a calf moose while camped in Jackson Hole (Reeves and McCabe 1997). On the west side of the Teton Mountains,

Richard Leigh mentioned the abundant moose sign he observed and the encounters he had with moose during June 1875 (Blair 1987). In 1912, a Forest Service survey found 47 moose in the Jackson area (Straley, 1962) and by 1950, 600 moose were estimated in the area (Wyoming Game and Fish Commission, 1951). The species' arrival was followed by a classic exponential population increase, peaking at approximately 3,000-5,000 animals (depending on modeling techniques) (Figure 2). For many years, the Jackson Herd served as a source for moose transplants in multiple states and supported nearly 500 hunting licenses. However, the population underwent a dramatic population crash beginning in the early 1990s (Figure 3). Despite drastic reductions in hunting licenses, the population has failed to recover and continues to decline.

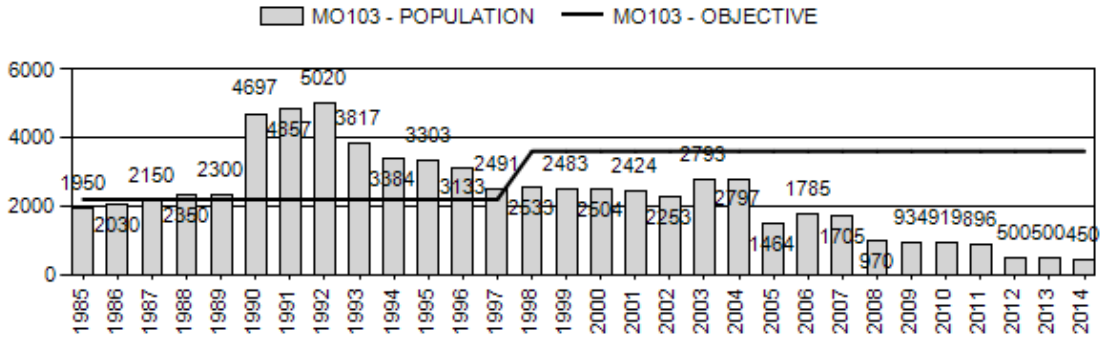

Figure 2. Estimated population size of the Jackson Moose Herd based on POP-II models from 1985-2011 and hand calculations from 2012-2014. The black line shows the population objective over time.

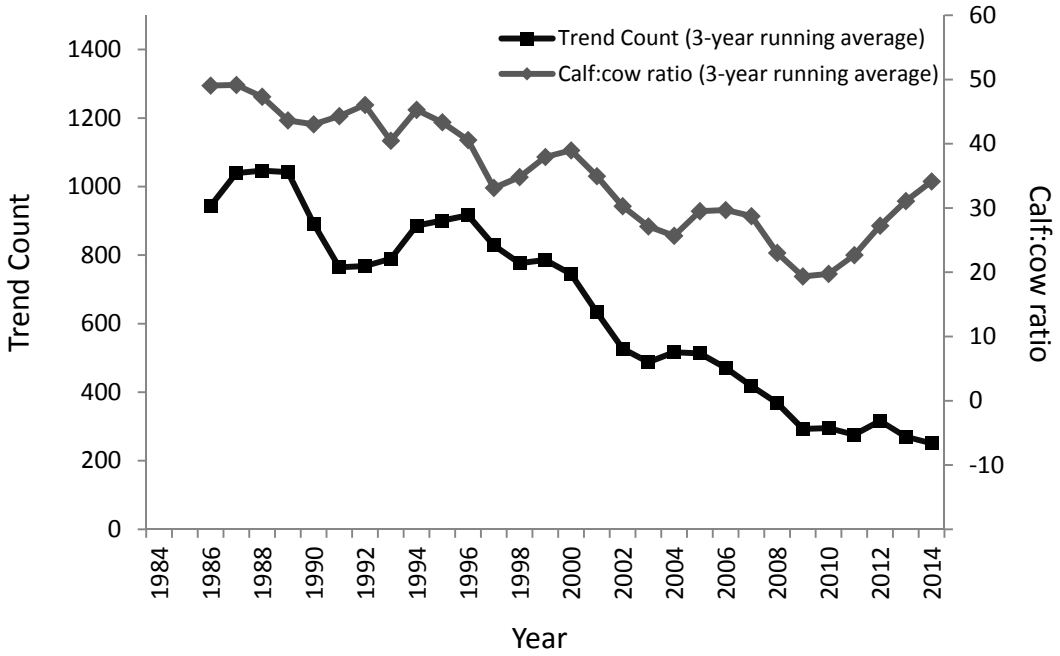

Figure 3. Three-year running averages of trend counts (black line) and calf:cow ratios (gray line) of the Jackson Moose Herd, 1987-2014.

Habitat

Moose summer ranges are primarily at mid and high elevations in the Gros Ventre Range, Teton Wilderness, and GTNP. Summer ranges are characterized by riparian corridors, montane meadows, aspen stands, and forested areas. Winter ranges are primarily at low elevations in riparian willow, cottonwood, mountain shrub, and aspen habitats. Previous research has demonstrated that moose exhibit strong fidelity to their winter and summer home ranges and migration routes (Vartanian 2011). Houston (1968) reported winter moose densities as high as 50 moose/square mile in the Buffalo Valley in the 1960s. In recent years, the highest densities observed are 12-17 moose/square mile.

Moose winter ranges first appeared to be over-browsed in the 1960s (Houston 1968). Houston (1968) recorded an average of 67-88% of willow leaders browsed annually on winter ranges in the Buffalo Valley and GTNP from 1964-1966. In addition, he reported that 41-62% of willows were severely hedged and 50% of willow tops were dead. These measurements indicate over-utilization of willow habitat by ungulates (some areas were heavily browsed by cattle and elk during the summer and fall). During the same period, pregnancy rates were 90% for the Jackson Moose Herd and average winter calf:cow ratios were 57:100, which are both relatively normal. However, twinning rates were only 4.5%, suggesting that cow moose were experiencing some degree of nutritional stress (Houston 1968). By the mid-1980s, winter calf:cow ratios had dropped to less than 50 calves:100 cows (Figure 3), signaling that a population decline was imminent.

Several recent habitat improvement projects have been completed for this herd, mostly focusing on aspen regeneration. These projects include the Lower Gros Ventre prescribed burn (2008-2012), Red Rock Wildfire (2011, managed for resource benefit), Dry Quad prescribed burn (2013), and Northeast Quad prescribed burn (2014). While prescribed burns and mixed-intensity wildfires are beneficial to moose habitat and forage quality, severe large scale wildfires are detrimental (Tyers 2006). Tyers (2006) found that the Northern Yellowstone Moose Herd declined by at least 75% after the 1988 Yellowstone wildfires. Jackson moose summer range in the Teton Wilderness was also affected by the 1988 fires and several large-scale wildfires since. Severe, large scale wildfires are a concern for moose because of loss of mature forests and thermal cover. Moose become heat stressed when temperatures exceed 60 degrees Fahrenheit in the summer, which interrupts feeding and causes them to seek shade to cool down. Approximately 45% of the Teton Wilderness has burned since 1988, totaling 394 square miles. Most of these wildfires were severe, and converted many previously forested areas to grassland types, which provide little thermal cover for moose.

Research

Research projects in the Jackson Moose Herd during the past 20 years have evaluated topics including population dynamics, predation, migration patterns, winter and summer habitat quality, pregnancy and calf production, and body condition. It should be noted that nearly all research has taken place in the portion of the herd that winters north of Spread Creek. Berger (2001) initiated research in the early 1990s at the beginning of the population decline and conducted a 10-year study, concluding in 2004. He found that pregnancy rates averaged 58%, which is

among the lowest ever reported for a North American ungulates species. In addition, moose twinning rates declined throughout his study, suggesting nutritional limitation.

Becker (2008) found that Jackson moose experienced low reproductive potential in the form of low twinning rates, reproductive pauses, and relatively low parturition rates, suggesting some form of nutritional limitation. Vartanian (2011) built on the study and found that cow moose that summered in former wildfire areas in the Teton Wilderness exhibited significantly lower pregnancy rates, birth rates, neonate survival, and calf survival than cows that summered in unburned areas. This suggests a nutritional consequence of summering in former wildfire areas. Indeed, moose summer diets in wildfire areas were less digestible than diets in unburned areas, due to approximately 10% higher indigestible fiber content (Vartanian 2011). As climate change increases the probability of more large, severe wildfires, habitat conditions will likely deteriorate on more moose summer ranges.

In contrast, recent research indicates that moose winter ranges have largely recovered from over-browsing several decades ago. Preliminary results suggest that willow habitats in the Jackson Herd are some of the healthiest in Wyoming (Jesmer 2014). This suggests that although habitat deterioration may have been the leading cause of the initial population decline in the early 1990s, winter habitat condition is currently not preventing the population from rebounding. An average of 25% of willow leaders were browsed in winter 2012/2013 (Wyoming Game and Fish 2013) and positive Keigley live-dead indices suggest that willow habitats are not currently limited by ungulate browsing (Vartanian 2011, Jesmer 2014).

Predation

Wolves expanded from Yellowstone National Park and began re-colonizing the Jackson Hole area beginning in about 1998. Grizzly bear populations also rebounded and expanded into much of the Jackson Moose Herd by 2000 (Pyare et al. 2004). Unfortunately, empirical information regarding the relative impacts of wolf and bear predation on Jackson moose are sparse and inconsistent. Berger (2004) identified 51 radio-collared cow moose mortalities from 1995 - 2004 and found that 60% died from malnourishment, 14% from bear predation, 10% from hunting, 8% from vehicles, 2% from wolves, and 6% from unknown causes. From 2011-2012, GTNP conducted a winter kill study of three wolf packs utilizing the northern portion of the park (Stephenson et al. 2011, 2012). They found that on average, moose comprised 33% of wolf kills during the winter, with elk making up the difference. Over two winters, 43 moose kills, 80 elk kills, and 4 deer kills were located by research teams. Sixty-two percent of moose killed were cows, while 20% were bulls, and 17% were calves or yearlings. In the summer, moose comprised only 4% of wolf kills. This relatively high predation rate on moose during winter is in large part due to a scarcity of elk, the main prey of wolves, on the northern winter ranges. In recent years, more elk are wintering on the National Elk Refuge instead of native winter ranges around Buffalo Valley and Spread Creek.

Although initial the moose population decline beginning in the early 1990s was due to deteriorated habitat conditions, re-colonization by wolves and grizzly bears likely further exacerbated the decline starting around 2000 and continues to impact the population today. Carrying out a comprehensive cause-specific mortality study on Jackson moose would improve

our understanding of the relative role that predation plays in calf and adult survival and population dynamics. However, the feasibility of such a study would be limited by the lack of efficient and timely access to mortalities in Wilderness areas. We are hopeful that future improvements to GPS-collar technology will create ways to investigate cause-specific mortality remotely.

Disease

Similar to other declining moose herds in the United States and Canada, the Jackson moose herd is affected by a variety of parasites and diseases. Moose, especially calves, commonly experience hair loss and stress in late winter due to winter ticks (*Dermacentor albipictus*). Winter ticks seem to be especially prevalent in the southern portion of the herd. Winter tick loads are higher after warm springs, summers, and falls, which favor tick abundance. With climate change, it is reasonable to expect that winter ticks will become more common in northern portions of the herd in the future.

Elaeophora schneideri is a filarioid nematode that lives in the carotid arteries of mule and black-tailed deer (normal definitive hosts) and is transmitted by horse flies. One of the aberrant hosts of *E. schneideri* is moose. Aberrant hosts are susceptible to a variety of negative effects caused by reduced blood flow to the head and brain, including antler malformations, frostbite on ears, blindness, difficulty eating, and nervous system damage. Both the prevalence of infection and the parasite's geographic extent appear to have undergone a drastic increase. In 1973-74 Worley (1975) examined 69 apparently healthy, hunter-harvested moose from Teton and Fremont Counties in Wyoming. None of the moose were infected with *E. schneideri*. In 2009, the Wyoming Game and Fish Department and Wyoming State Vet Lab made a major effort to survey hunter-harvested moose throughout the state to establish baseline data on prevalence and distribution of the parasite. Sixty percent of harvested moose in the Jackson Herd were found to have *E. schneideri* present in their carotid arteries (Henningsen et al. 2012). Anecdotally, targeted moose (roadkill or euthanized due to emaciation or disease symptoms) usually have even higher prevalence rates of *E. schneideri.*

In addition, several moose in the Jackson Herd have been observed in recent years with keratoconjunctivitis, which is a bacterial infection of the eye. Many cases have been so severe that individuals have become blind, leading to emaciation, injury, and death.

Current Herd Unit Objective and Management Strategies

The post-season population objective is developed based on both biological and social factors, including, but not limited to: habitat carrying capacity, population dynamics, and hunter and public desires. The current population objective is 3,600 and was set in 1999. At the time, field managers voiced concerns about setting the objective this high based on POP-II modeling. Soon after the 3,600 objective was adopted, it was evident that the population dynamics would not allow the population to achieve this level. There is a multitude of factors affecting this population, which have kept it below objective for the past 17 years. In 2014, it was 88% below objective. Prior to 1999, the objective for the herd was 2,200 moose, which was set in 1989. Current spreadsheet models developed for this herd do not adequately simulate observed trends.

The number of hunting licenses issued was as high as 500 in the early 1990s, and included both antlered and antlerless opportunity (Figure 4). Antlerless licenses were eliminated in the Teton Wilderness in 2001 and herd-wide in 2004. Antlered moose hunting seasons were closed in the Teton Wilderness in 2011 (Areas 7, 14, 15 and 32), and Areas 17 and 28 in the Gros Ventre were combined into one unit beginning in the 2012 season. Total licenses issued for the herd dropped to 10 in 2012-2014 (Figure 4). Despite hunting season closures and a reduction in the number of licenses, this population has not responded to management changes. Hunter success averaged 91% from 2010-2014, and days per animal harvested averaged 7.0 over the same time period.

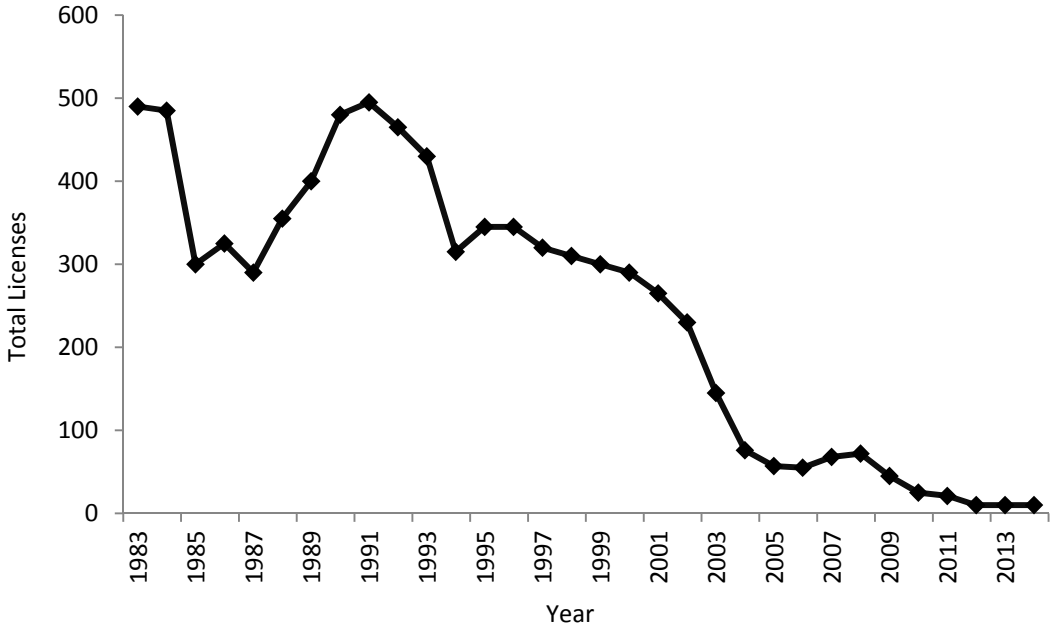

Figure 4. Total hunting licenses issued for the Jackson Moose Herd, 1983-2014.

Recommended Herd Unit Objective

Jackson Region wildlife personnel recommend changing the objective for the Jackson Moose Herd from a Post-Season Population Objective to a Mid-Winter Trend Count Objective. New spreadsheet models initiated in 2012 do not adequately simulate population trends for the Jackson Herd. The approach of using a mid-winter trend count will allow regional personnel to monitor population trends, while recognizing that no working spreadsheet model exists for the population. In addition we propose using a male quality benchmark as outlined in the special management criteria for moose herds.

We propose the following objectives for the Jackson Moose Herd:

Primary Objective:

Manage for a mid-winter trend count of 800 moose on key winter ranges, which will be estimated using aerial surveys. Mid-winter trend counts will be analyzed using a 3-year

running average. The population will be managed for ± 20% of the objective (range of 640 – 960).

Secondary Objectives:

1. Maintain a 5-year running average of 40% of male harvest ≥ 5 years of age (benchmark recommended by the 2008 Moose Working Group Report)

2. Maintain a 3-year median age ≥ 4.5 years old for harvested moose.

Ages of harvested moose will be determined using cementum annuli from teeth submitted by hunters.

Justification

Past trend counts have been as high as 1,050 in the late 1980s when the population was at its peak (Figure 5). However, the multitude of factors that now affect this herd will likely prevent it from reaching those numbers again in the future. Instead, it is more realistic to expect that the herd could recover to population numbers seen around 1998-2000. At that time, managers were counting approximately 800 animals during winter flights (Figure. 5). For those reasons and because the public has expressed interest in having more moose, 800 was selected as the proposed mid-winter trend count objective. However, the public should expect any future population recovery to be slow. Although calf:cow ratios have improved in recent years, overall numbers of moose, and especially cows, remain low.

We propose using annual mid-winter trends counts to classify moose on key winter ranges, including the Snake River bottom, Gros Ventre drainage, Spread Creek, Buffalo Valley, and Willow Flats (Figure. 6). The Snake River corridor south of Moose and north of the confluence with the Gros Ventre River will not be surveyed due to the high density of private residences. The mid-winter trend count will be analyzed using a 3-year running average to smooth out some variation due to sampling bias and weather/counting conditions. All winter ranges will be surveyed with a helicopter. All of these key winter ranges must be surveyed to obtain a quality trend count.

Secondary objectives for the Jackson Moose Herd are proposed following guidance from the October 18, 2014 Memorandum from Scott Smith, Deputy Chief, Wildlife Division "Alterative objectives, Recreational, Special and Private Land Management Guidelines…". Maintaining a median age ≥ 5 years of age is a management parameter for moose herds designated as Special Management. No habitat indices are proposed, instead managers may consider fecal indices as a means to assess nutrition/habitat condition in the future.

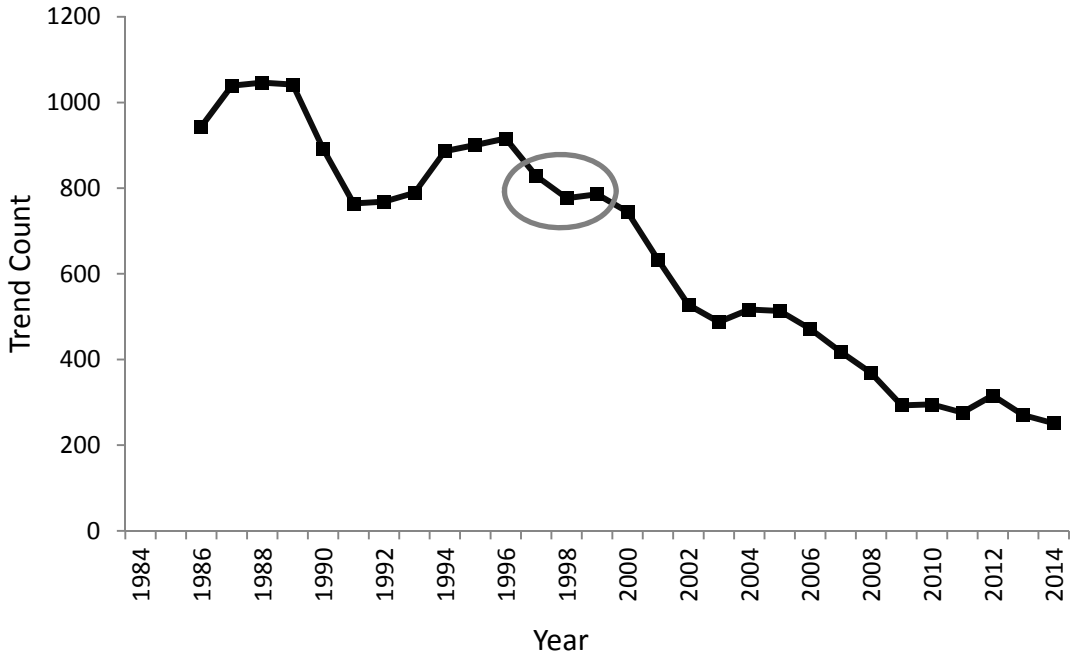

Figure. 5. Three-year running average of trend counts in the Jackson Moose Herd, 1984-2014. Gray circle indicates the proposed mid-winter trend count objective of 800.

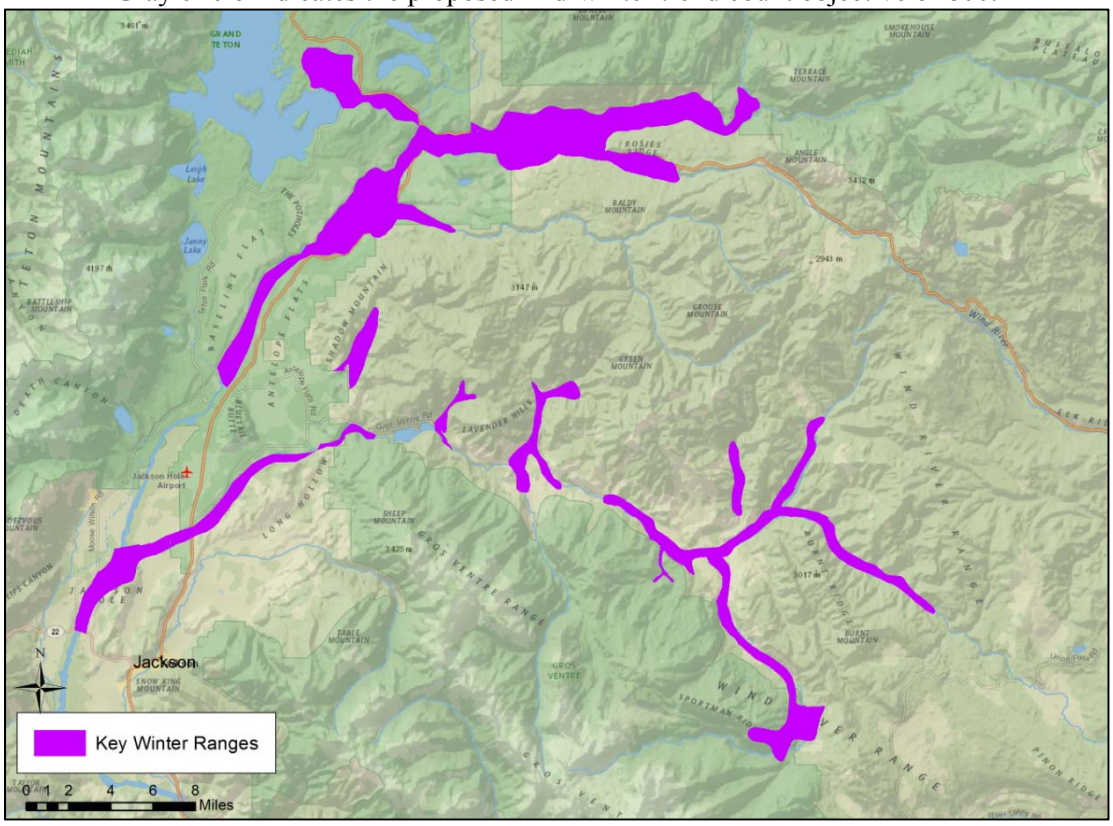

Figure. 6. Key winter ranges (purple) that will be included in the mid-winter trend count for the Jackson Moose Herd.

Public Involvement

The Jackson moose herd objective was discussed during public meetings in the Jackson and Pinedale regions during the 2015 season setting process. The proposed objective review schedule was discussed at Open Houses and Formal Public Meetings during March 23-26, 2015. These meetings were held in Afton (24 people in attendance), Marbleton (7 people in attendance), Pinedale (8 people in attendance), and Jackson (29 people in attendance).

In addition, the review was discussed at a Jackson Hole Outfitters and Guides Association meeting, a local sportsmen group meeting, and with staff members from the Jackson Hole Conservation Alliance and Greater Yellowstone Coalition. A total of 34 members and publics were in attendance at these meetings.

Regional personnel discussed the proposed objective review process with the Bridger-Teton National Forest Supervisor and District Rangers during the annual BTNF/WGFD Coordination meeting on March 19, 2015 in Jackson. A follow-up meeting was held Monday, June 1, to discuss the specific objective changes.

On June 3 a public meeting was hosted in Jackson and the local paper ran an article on the proposed objective changes (JH News and Guide article attached). Seven members of the public attended the meeting and Department personnel fielded questions regarding recent University of Wyoming research, the number of twins detected in the herd and whether habitat was limiting. We also discussed the proposed objective in comparison to the existing objective and if the population could reach 800 moose in five years. One meeting attendee acknowledged that he had a hand in over harvesting cow moose in the late 1990s when he worked for the Department and another person voiced concerns that there are too many wolves in the Gros Ventre. One NGO provided comments regarding a trend count objective, and another NGO and Grand Teton National Park support adopting an objective that is more in line with current population levels (Meeting signup sheet, public and agency comments attached).

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