Fall Creek Elk Herd Unit (E103)
Brucellosis Management Action Plan Update
April 2011

A. Introduction and herd unit overview

This update to the Fall Creek Elk Herd (FCEH) Brucellosis Management Action Plan (BMAP) was prepared to evaluate brucellosis management recommendations developed and implemented during this plan's original development in 2006. Meetings among Wyoming Game and Fish Department (WGFD) personnel, interested livestock producers, federal land managers, and state and federal livestock health and regulatory officials were held to discuss progress on the plan's recommendations, review the various brucellosis management action options, and develop new brucellosis management recommendations based upon updated information. The WGFD has made progress in the FCEH to better understand characteristics of elk to elk brucellosis transmission, refine elk parturition delineations, and to reduce the risk of both intra- and inter-specific brucellosis transmission. This update should be considered complementary to the original FCEH BMAP.

The FCEH includes Elk Hunt Areas 84 and 85 and encompasses 686 square miles (mi^2) in Teton, Sublette, and Lincoln Counties. Land ownership is distributed between U.S. Forest Service (USFS; 91%), private (6%), Bureau of Land Management (BLM; 3%), and WGFD (1%; Figure 1).

Approximately 582 mi^2, or 85% of total occupied elk habitat is designated spring, summer, and fall range. Included in this is approximately 68 mi^2 considered parturition range. There are 61 mi^2 (9%) designated crucial winter range, and 41 mi^2 (6%) are considered winter yearlong range (Figure 2).

The primary land uses in the FCEH include livestock grazing, timber harvest, and recreation (camping, horseback riding, hunting, fishing, firewood gathering). Access to hunting areas is primarily limited to hiking and horseback. The number of roads is limited and much of the area is designated as roadless, wilderness, or wilderness study area. Apart from the highways in the Snake River and Hoback canyons, Cliff Creek, Granite Creek, and the Munger Mountain-Mosquito Creek area are the only areas accessible by roads. The USFS Bridger-Teton National Forest (BTNF) land east of the Snake River from Snow King Mountain south to Poison Creek is closed to all human presence from December 1 - April 30. Also, the southern end of Munger Mountain (west of Hoback Junction to the Dog Creek feedground) and the WGFD Wildlife Habitat Management Areas (WHMA) are closed to all human presence from December 1 - April 30. Four elk feedgrounds are located within the FCEH: South Park, Dog Creek, Camp Creek, and Horse Creek. These feedgrounds were established primarily to reduce depredation to privately-owned stored hay, minimize risk of interspecific co-mingling of elk and livestock, and reduce winter mortality.

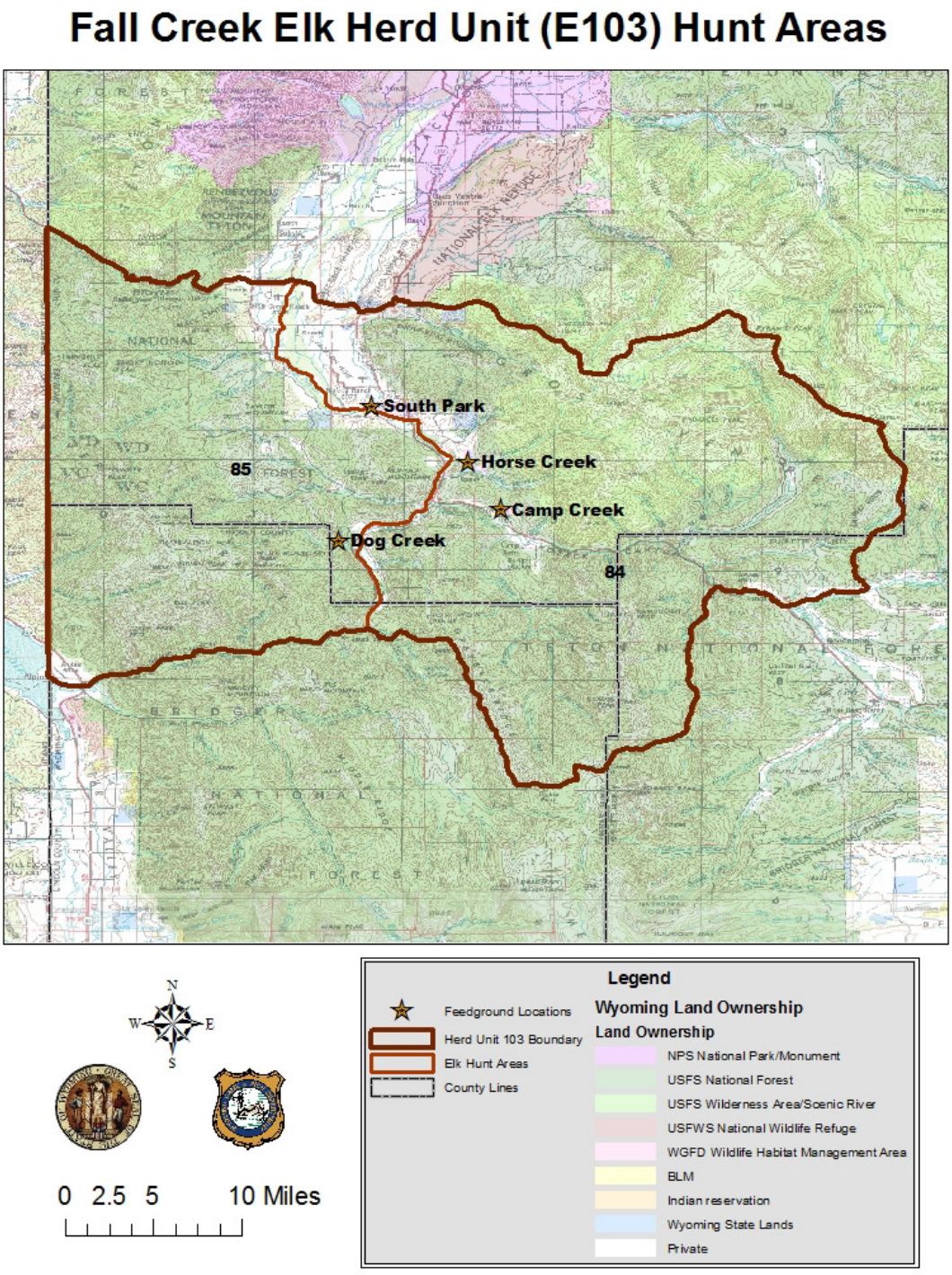

Figure 1. Land ownership, feedground locations, and Hunt Areas within the FCEH.

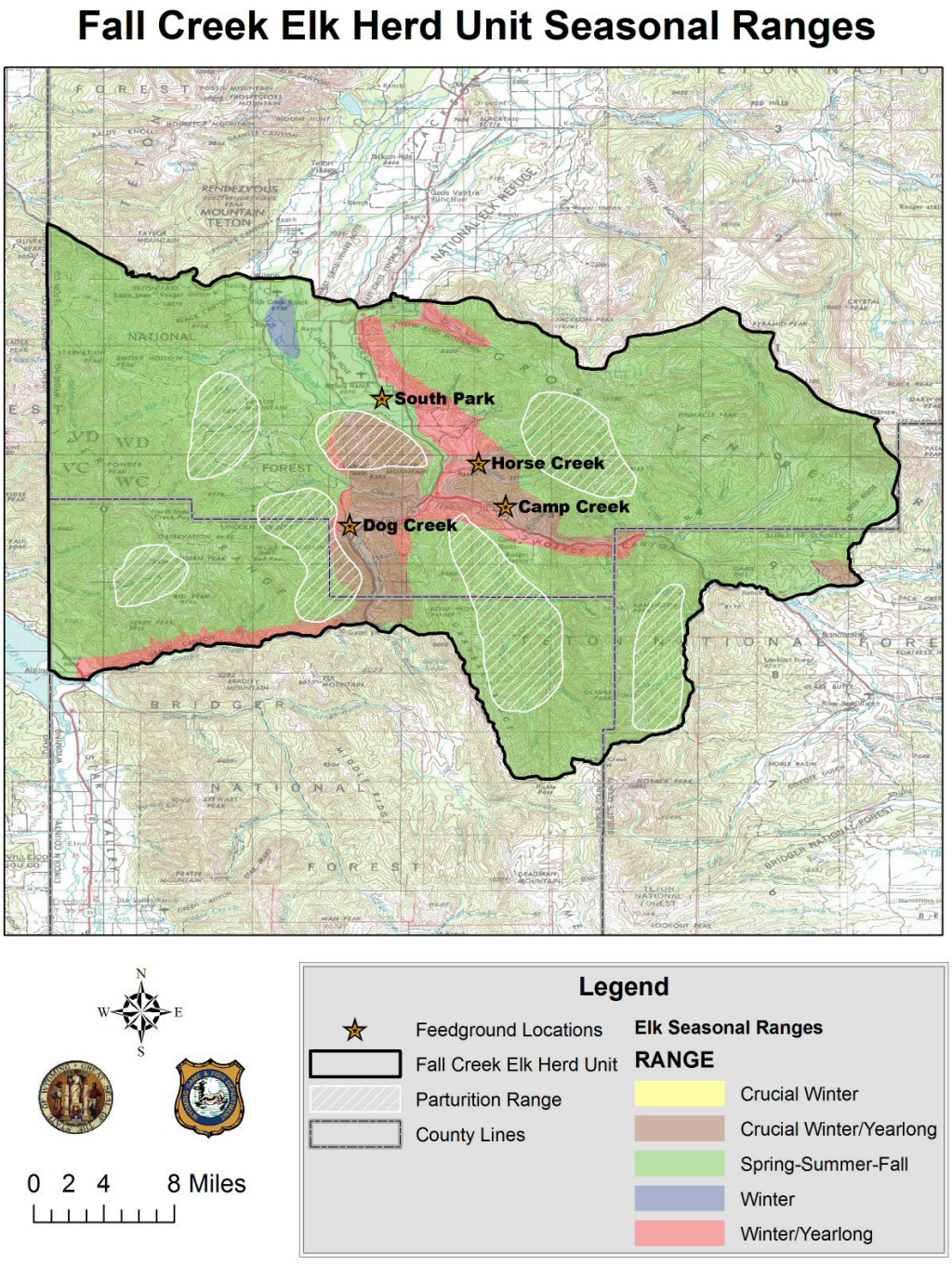

Figure 2. Currently delineated seasonal elk ranges and feedgrounds within the FCEH.

B. Brucellosis Management Options

Listed below are potential options for managing brucellosis on the four feedgrounds in the FCEH. Short-term objectives of these options are to reduce co-mingling of elk and cattle and the prevalence of brucellosis in elk. Long term objectives include eliminating the reservoir of brucellosis in wildlife in the GYA if determined to be technically feasible, maintain livestock producer viability, reduce/eliminate dependence of elk on supplemental feed, maintain established elk herd unit objectives, improve range health, and maximize benefits to all wildlife. The WGFC will require support from various constituencies (agriculture, land management agencies, sportspersons, etc.) prior to pursuing these options, and several options will require decisions from entities other than the WGFC.

1. Re-locating feedgrounds to lower elevation sites with increased geographic area for elk to disperse and increased distance from winter cattle operations.
2. Reduction/elimination of supplemental feeding.
3. Reducing numbers of elk on the feedgrounds through increased harvest.
4. Reducing numbers of susceptible cattle and stored crops in areas around feedgrounds during winter, or implementing changes in cattle operations by providing incentives to producers.
5. Elk-proof fencing of feedgrounds or private lands to prevent elk from drifting onto private land and reduce commingling.
6. Elimination of seropositive elk on feedgrounds through test and removal program.
7. Extensive habitat enhancement projects in suitable winter range areas near feedgrounds where the potential of commingling with livestock is minimal.
8. Acquisition of native winter range through fee-title purchase, conservation easements, or other methods.
9. Continuation of *Brucella* strain 19 elk vaccination.

C. Discussion of Options

1. Feedground Relocation

Feedground relocation options are limited in the FCEH. The feedgrounds in this herd unit are located on or near existing native winter ranges. Migration opportunities out of the area are minimal to non-existent. There is not an available site where interspecific disease transmission possibilities could be improved by moving a feedground.

Feeding operations at Dog Creek should, if possible, remain on the Ralph Gill property as opposed to the Pritchard Pond area. The Gill property offers a much larger feeding site, which reduces the density of elk while on feed lines.

Elk at the Horse Creek site have occasionally been fed on the bench north of the feedground. This alternative site is part of the WGFC-owned WHMA; thus this would only be a slight relocation. Feeding here would reduce the density of elk while on feedlines, but would also move the elk to a location where damage might be more likely to occur, depending on the presence of neighboring livestock.

There is vacant space (private property) across the highway from the Camp Creek feedground on Bryan Flats. If elk were fed here, it would reduce the number of elk at the

Horse Creek and Camp Creek feedgrounds, but the WGFD does not support creation of additional feedgrounds.

Pros:

- may contribute to lower brucellosis prevalence
- elk would have increased area to disperse
- elk could be fed on larger areas and in more sanitary conditions
- elk numbers could be maintained at or near current levels
- fewer elk on or near the highway (Bryan Flats)
- move the elk away from the USFS residences, Pritchard Pond, and the Fall Creek road (Gill property)

Cons

- brucellosis prevalence may persist
- damage problems may increase (Horse Creek bench)
- might require funds for erection of new structures, fences, roads, etc.
- difficulty would be experienced during initial habituation of elk to the new site
- localized damage to vegetation

2. Feedground Elimination

This option, given current conditions and herd objectives, is probably unfeasible for feedgrounds in the FCEH. However, if current conditions and herd objectives change, through implementation of one or more of options 3, 4, 6, 7, and 8, this option may become more realistic. The WGFC has the authority to make this decision.

Pros:

- would reduce the risk of intraspecific transmission of brucellosis and other density-dependent diseases
- would facilitate efforts to eliminate brucellosis in elk in the FCEH
- would reduce feedground and vaccination expenses to the WGFD

Cons

- would increase the risk of property damage and interspecific transmission of brucellosis to livestock if implemented abruptly with current numbers of elk and /or prior to elimination of brucellosis in elk
- would increase elk winter mortality
- would lower the number of elk that could be maintained in the FCEH
- would reduce income to the WGFD due to reduced license sales
- would reduce hunter opportunity
- may increase potential for vehicle-elk collisions

3. Elk Reduction

Current management strategy in the FCEH is to reduce the elk population to the WGFC-approved population objective. Record-high numbers of elk counted on feedgrounds over the past five years have required a more diverse response from the Department in elk reduction efforts. That response has been the issuance of more limited

quota reduced-price antlerless elk licenses, and hunting seasons that have extended to November 30 and even January 31.

Since 2006 managers have had success with emphasizing antlerless elk harvest. From 2006-2009, antlerless harvest comprised 56%, 50%, 58%, and 62% of the total harvest in the FCEH. In comparison, antlerless harvest in 2005 was just 40% of the total elk herd harvest.

Hunter numbers have increased substantially over the last five years. The increase in hunter numbers is in response to liberalizing antlerless elk hunts into November and beyond, and issuance of more limited-quota licenses. In 2010, a combined 1,200 type 6 antlerless elk licenses were available in hunt area 84 and 85. In addition to being reduced-price licenses, hunters are able to hold two of these licenses. A small number of Type 1 licenses (any elk) were also available for the 2010 season. These were valid for any elk from November 1- January 31 on private lands along the Snake River in hunt area 84 to encourage hunting opportunities that eliminate private land refuges. Unused type 6 licenses could also be used in December and January for the same purpose.

Any reductions in population objectives beyond current objectives would be subject to a public review process and WGFC approval.

Pros:

- may contribute to lower brucellosis prevalence
- would increase hunting opportunities in the short term
- would increase license revenues in the short term
- would decrease elk densities on feedgrounds
- potentially reduce conflicts on private lands
- would reduce costs of supplemental feeding and vaccination

Cons:

- the response of seroprevalence of brucellosis in elk when populations are reduced is unknown, yet it is unlikely to reduce incidence to an acceptable level assuming the remaining elk are still fed.
- damage to private crops may still continue as hunter harvest is random and does not select for "problem" elk
- the general public may be unwilling to accept large reductions in elk numbers
- success might be limited to hunter efficiency
- would result in loss of hunting opportunities in the long term
- would reduce license revenue in the long term (might be offset by reduced management costs)

The pros and cons of reducing the number of elk that reside yearlong in the Snake River bottom and on the private property near the South Park feedground differ greatly from those presented above for feedgrounds in the FCEH. These elk offer virtually no hunting opportunities; yet contribute to disease and damage problems, plus increased management costs. The elimination/reduction of this segment of the FCEH would be desirable in most aspects.

4. Cattle Producer Change of Operation

This is an option that high-risk and other producers in the FCEH could implement to minimize/eliminate brucellosis risks to their herd. Brucellosis transmission potential within cattle and testing requirements associated with cow/calf operations would be eliminated if all cattle operations were yearlings, spayed heifers, and/or steers. Conversion to yearlings would also eliminate the need of storing most hay crops and winter feeding, reducing winter elk conflicts. Operations that feed through the winter can take small measures to avoid attracting elk such as feeding in the morning and feeding every day to keep feeding areas clean of hay. The opportunity for disease transmission is also greatly reduced if cattle and elk do not co-mingle between February and 15 June. Implementing facets of this option would require changes by the producer and possibly a favorable decision by the USFS to alter grazing permits.

Evaluation and implementation of alternatives in this option are totally under the jurisdiction of individual livestock operators, Wyoming Livestock Board, State Veterinarian, and APHIS. Discussion and recommendations pertaining to this option should be contained in Individual Ranch Herd Plans for each livestock operation.

5. Fencing

Fencing of winter cattle feedlines could prevent elk from co-mingling with cattle. Elk-proof fencing around private stackyards can help in reducing an operation's attractiveness to elk. New fencing would require favorable decisions by the landowner. Where fencing stackyards is considered beneficial, the WGFD provides fencing materials to landowners.

Elk-proof fencing of feedgrounds may contain most elk within a given area, but can reduce the ability of non-target species (e.g., deer, moose) to make daily and seasonal movements. Additional fencing around feedgrounds would require favorable decisions by the landowner (private and/or state/federal).

Pros:

- may reduce damage problems and complaints
- may reduce risk of elk-cattle brucellosis transmission
- may be successful in fencing off stored hay and small-scale issues
- reducing the attractiveness of particular operations to elk may lead to overall reductions in damage in the general area

Cons:

- costs may be prohibitive- must consider construction, maintenance, and monitoring
- congregating all or most of the elk within the fence may be unfeasible
- long lengths of fencing could impede movements of other wildlife
- does not address seroprevalence of brucellosis in elk
- some producers may be unwilling to erect fences
- may require federal agency cooperation and potential National Environmental Policy Act (NEPA) compliance
- could impede public land access
- takes away opportunities to view wildlife

Opportunities for fencing around feedgrounds in the FCEH are limited. About one mile of fence separates the South Park feedground and the private property north of the feedground. Two situations allow co-mingling: 1) elk can leave the feedground and walk around the ends of the fence, 2) migrating elk can approach from the north side of the fence and then cannot readily access the feedground.

There is already elk-proof fencing along the west boundary of the Horse Creek WHMA. A similar situation exists here as at South Park, in that elk sometimes will go all the way around the fence and create damage issues with the adjacent landowner's horse feeding operations.

6. Elk Test and Removal

This option has been shown to reduce brucellosis antibody prevalence among elk captured from feedgrounds (see WGFD Test and Slaughter pilot project report- Scurlock et al. 2010: http://gf.state.wy.us/wildlife/Brucellosis/index.asp). The number of aborted fetuses and associated fetal fluids contaminated with *Brucella* bacteria would likely be decreased among elk attending feedgrounds in the FCEH if this option were mplemented, likely reducing risk of both intra- and interspecific brucellosis transmission. The WGFC has the authority to make this decision.

Pros:

- would reduce brucellosis antibody prevalence in elk
- may reduce elk numbers to more efficiently pursue options 1,2,6,7, and 8.
- may increase tolerance of elk on private lands if brucellosis prevalence is decreased
- may increase other State's acceptance of cattle from within the GYA

Cons:

- very expensive and requires substantial fiscal and personnel resources
- requires large traps on feedgrounds capable of working many animals with large holding pens
- must be implemented for several years to have appreciably decrease in brucellosis antibody prevalence
- general public may not support such an operation due to decreased elk numbers/hunting opportunity
- does not address other potential diseases on feedgrounds
- Data suggest only 54% of antibody-positive elk are actually infected
- *Brucella* antibody prevalence will likely rebound post implementation
- would require federal agency cooperation and potential NEPA evaluation for federal lands

7. Habitat Enhancement

Habitat enhancement projects may reduce the time elk spend on feedgrounds. If habitat improvements are completed near feedgrounds or between summer range and feedgrounds, the enhanced forage produced will decrease the dependence of elk on artificial feed, snow conditions permitting. Reduced feeding durations and lower elk concentrations on feedgrounds, especially during the high transmission risk period, may

decrease the probability of intraspecific brucellosis transmission events. Habitat enhancement projects also create vegetative diversity, enhance aspen communities, and improve range conditions for other species.

Decision authority is with the USFS for most areas. Affected permittee consultation and cooperation is also necessary. USFS personnel have indicated there might be opportunities, particularly for aspen treatments within the FCEH. WGFD personnel are involved with USFS in the planning stages of habitat enhancements along the east side of the Snake River Range. Mechanical thinning and prescribed fires are being used in the Wildland-Urban Interface (WUI) in the Beaver Mountain, Palmer Creek, and Willow Creek areas in order to mitigate the effects of future wildfires. These projects should also have some habitat enhancement benefits, and WGFD is actively involved in the planning and post-treatment monitoring of those projects. Habitat enhancement options may continue to arise, and WGFD will continue close involvement with USFS to pursue habitat enhancement options. In addition to habitat on USFS lands, WGFD will explore options to increase palatability of forage on feedgrounds owned by WGFC in the FCEH. Increased forage quality in the fall may entice elk onto the feedgrounds and away from damage situations, without an earlier initiation of feeding. This option may be best used in conjunction with options 2, 3, and 8 to achieve maximum success.

Pros:

- could reduce feeding duration and brucellosis prevalence
- would benefit many species of wildlife and, in some instances, cattle
- funding is available through government and non-government agencies

Cons:

- may have limited effectiveness in reducing dependency on supplemental feed in years of average or greater snow accumulations that make forage unavailable.
- elk may not be tolerated on treatment areas when in close proximity to livestock
- requires changes in post-treatment wildlife and livestock management within the treatment area to ensure treatment effectiveness
- might increase likelihood of invasive species establishment
- would require approval of federal agencies for federal land, private landowners for private land, and the State Land Board for state land projects

8. Acquisition/Conservation Easements

Disease transmission risk on feedgrounds in the FCEH might be decreased by managing lands adjacent to, or connected with, areas used by wintering elk. With adequate intact, healthy, and accessible elk winter habitat available, elk feeding may be reduced in the FCEH. The buying or long-term leasing of land to be managed commensurate with wildlife benefits is an option that can be used to maintain stability and health of all wildlife populations. Decision authority is with the private landowner.

Pros:

- secures habitat for all wildlife
- long-term solution
- helps secure future revenues for the WGFD
- may facilitate options 2 and 7

- could reduce brucellosis prevalence in elk
- agreeable among landowners and agencies

Cons:

- expensive
- limited availability of lands with high potential for wintering elk or connecting to existing or potential elk winter ranges
- requires landowner willingness

9. Continuation of Strain 19 Elk Vaccination Program

The WGFD initiated this program in 1985 on Greys River feedground and has vaccinated about 80,000 elk to date on 21 state operated feedgrounds and the National Elk Refuge. Elk cows and calves were vaccinated the first two years on each feedground, then calves only thereafter assuming adequate coverage is maintained. Dell Creek feedground within the Hoback EHU serves as a control population (i.e., no vaccination) to assess effectiveness of the vaccination program in reducing brucellosis seroprevalence in elk. Brucellosis seroprevalence data from Dell Creek and Greys River feedground elk indicate no significant difference, no downward trend, and that seroprevalence may fluctuate cyclically over time throughout both populations (WGFD 2010b, Figure 3).

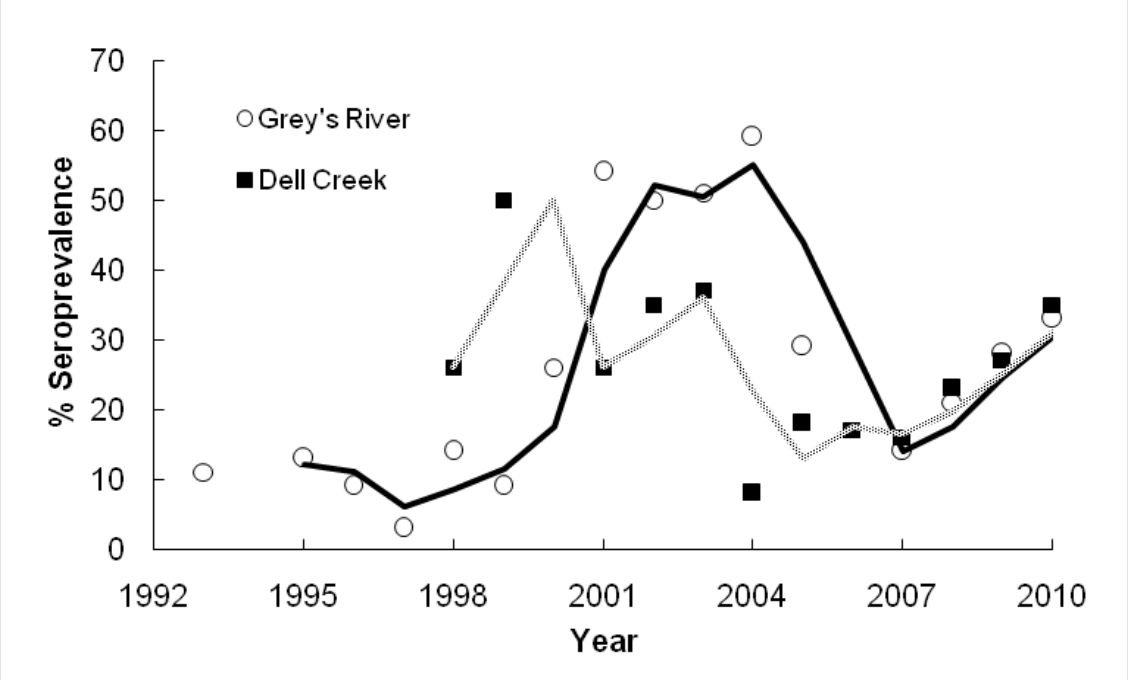

Figure 3. Seroprevalence levels in elk from Grey's River and Dell Creek feedgrounds, 1993-2010. Trendlines depict moving averages within individual feedground.

In captive studies, Strain 19 prevents abortion in 29% (Roffe et al. 2004) to 62% (Herriges Jr. et al. 1989) of elk challenged with *Brucella* strain 2308. Protection from *B. abortus* induced abortions afforded by strain 19 vaccination may not be sufficient to effectively reduce seroprevalence in elk on feedgrounds. This may be due to the potential for numerous elk to come into contact with a single infected fetus aborted on a

feedground (Maichak et al. 2009), and the potential that the infectious dose may overwhelm antibody protection (Cook 1999). The decision authority lies with the WGFC.

This option is currently employed on each of the four feedgrounds in the FCEH. Disease transmission risk will likely not decrease significantly if this option is continued, based on previous controlled studies and the program's evaluation to date between Grey's River and Dell Creek feedgrounds.

Pros:

- may be reducing total number of *Brucella* induced and infected elk fetuses aborted on feedgrounds
- perceived by many as an effective disease management tool

Cons:

- cost and logistics
- not shown to reduce seroprevalence in elk on feedgrounds
- elk must be concentrated on feedgrounds to ensure delivery is feasible

D. Coordination Meetings

1. Producer Meeting

A meeting was held 15 December 2010 in Jackson to discuss the nine options among livestock producers and associated land and resource management agencies within the Jackson and Fall Creek Elk Herds. A presentation was given by WGFD that summarized brucellosis management and research strategies and their relation to the nine options. Seven producers, nine WGFD personnel, and USFS personnel attended the presentation. Several questions and comments were proposed by attending producers regarding habitat treatments, strain 19 vaccination, Test & Slaughter strategies, and brucellosis in elk and cattle outside of the feedground area. There was a comment of support from producers for landowner elk licenses in dealing with elk on private lands; discussion followed on the variety of methods WGFD has taken to increase harvest in Hunt Areas 84 and 85. No substantial changes or actions were made to the BMAP or management of the FCEH feedgrounds following this meeting.

2. Interagency Meetings

A meeting was held 18 January 2011 between WGFD and USFS personnel to discuss the nine options. As with the producer meeting, WGFD began with a presentation covering brucellosis management strategies and research projects. Several questions arose regarding the future of Test & Slaughter, efficacy of strain 19 vaccination and associated costs, and findings from ongoing brucellosis/feedground research projects. USFS gave their general support for WGFD in research endeavors, habitat enhancement projects, and elk management strategies.

3. Public Meeting

A meeting was held 23 March 2011 between WGFD and concerned members of the public to discuss the nine options as they pertained to the Jackson, Fall Creek, and Afton Elk Herd Units. Seven public individuals, and four WGFD personnel attended the presentation which summarized WGFD brucellosis management and research strategies

and their relation to the nine options. Several topics were discussed following the presentation including *B. abortus* in wolves, environmental persistence of *B. abortus*, impacts of wolves on feedground elk populations and management, strain 19 vaccination efficacy, and financial impacts of brucellosis. No major changes were proposed at that time for any Herd Unit, and members of the public found the presentation informative and useful.

Additional written comments were accepted from the public through 12 April 2011. Comments were received from one member of the public, and from representatives of the Greater Yellowstone Coalition (GYC) and Jackson Hole Conservation Alliance (JHCA). Principal comments pertinent to the FCEH are collated below:

- Encouraged the WGFD to pursue erection of elk-proof fencing around winter livestock feeding areas in order to maintain separation between elk and livestock.
- Stressed the importance of diseases other than brucellosis in feedground management (e.g., CWD).
- Questioned effectiveness of *Brucella* strain 19 vaccination for reducing seroprevalence of elk.
- Commended the WGFD for brucellosis research being conducted, and for the Target Feedground Project.

E. Proposed Management Actions

1. Feedground Relocation

Feeding on the private property adjacent to Dog Creek feedground is beneficial, and WGFD will continue working with the landowner to allow this.

2. Feedground Elimination

The WGFD will not pursue this option in the near future in the FCEH given existing elk brucellosis seroprevalence rates and the utility of elk feedgrounds in manipulating winter distributions of elk.

3. Elk Reduction

The WGFD will continue to manage for current WGFC-established elk herd unit population objectives. Reductions beyond the current population objective would require a public input process to discuss the issue and determine the level of support. Authority over this option ultimately lies with the WGFC. The WGFD will continue to design and implement harvest strategies that bring the population closer to objective, while maintaining hunting pressure on private lands to affect elk distribution and reduce the risk of elk-cattle commingling.

4. Cattle Producer Change of Operation

WGFD will work with cattle producers and other agencies (e.g., NRCS, Teton Conservation District, USFS, WLSB) in the FCEH to implement any changes to their operations that decrease the risk of interspecific disease transmission.

5. Fencing

WGFD will encourage cattle producers in the FCEH to fence areas where hay is stored (stackyards) for winter-feeding operations and continue delivery of materials for stackyard construction. As opportunities arise for additional fencing projects (e.g., winter cattle feeding exclosures), WGFD will assess those opportunities on a case-by-case basis.

6. Elk Test and Removal

WGFD implemented the pilot Test & Removal project in the Pinedale EHU from 2006 through 2010. The WGFD does not plan to implement this Option in the FCEH in the foreseeable future.

7. Habitat Enhancement

WGFD will continue to coordinate with private landowners, federal land managers, and livestock permittees to develop and implement habitat improvements that may reduce elk dependency on supplemental feed in the FCEH (WGFD 2010b). WGFD will emphasize coordination among the BTNF and WGFD through JIHI. These projects will focus on areas designated as winter and transitional ranges, while working within the constraints of sensitive-species management and funding.

8. Acquisition/Conservation Easements

WGFD will attempt to identify and pursue opportunities to implement this option. As projects are identified, proposals will be drafted and submitted, either through the Department's process of obtaining less than fee-title lands, or to various funding agencies to facilitate implementation of this option.

9. Vaccination of Elk Calves

WGFD will continue the ballistic strain 19 elk vaccination program until adequate data are collected to determine efficacy of the program in reducing brucellosis seroprevalence in elk on feedgrounds.

F. Best Management Practices

In addition to the above options and commensurate with their short and long term goals, the following best management practices should be considered for elk feedgrounds. Some may be currently employed, and should be maintained. Others may or may not be viable options for individual feedgrounds and livestock producers.

Feedground Management

1. Feed on clean snow whenever possible
2. Report abortions to WGFD
3. Minimize feeding season to the extent possible
4. Low Density feeding methods
5. No harassment/harvest of scavengers on feedgrounds

G. Additional Actions

Brucellosis Surveillance

WGFD currently captures (trap or dart) and tests elk for exposure to brucellosis on 7 to 15 feedgrounds annually. This practice should continue on as many feedgrounds as possible annually to assess efficacy of the Strain 19 vaccination program and monitor prevalence of the disease. To assess efficacy of Target Feedground Project activities such as Low Density feeding and early end date (WGFD 2008), sufficient number of elk should be captured and tested for brucellosis prior to or during inception of those activities for comparison to elk tested eight to 10 years (Cross et al. 2007) following inception of those activities. Additionally, hunter-harvested elk brucellosis surveillance will occur annually in an effort to survey the entire state over a 4-year period.

Information and Education

BFH and other WGFD personnel regularly inform and educate various public factions about wildlife diseases, including brucellosis. Educational outreach has included group presentations, news releases, interpretive signs at feedgrounds and crucial winter ranges, and various brochures and publications. The importance of quality wildlife habitat and substantial role that disturbance (e.g., fire) plays in natural ecosystems are also stressed during public forums. BFH and other WGFD field staff make numerous private landowner contacts regarding habitat improvement projects, wildlife-friendly management techniques, or ways to prevent commingling of elk and livestock. Additional efforts are focused on area school groups and events such as the WGFD's annual Hunting and Fishing EXPO to inform children and their parents on brucellosis. These efforts should be continued to inform the public of the WGFD's role in brucellosis research and management and relay consequences of the disease to the State's economy. Additionally, should any of the aforementioned Options be officially adopted, I&E efforts should focus on why the Option(s) was (were) pursued and what benefits may be realized. The public should be made aware of any proactive management embarked upon by the WGFD, and their interests in the actions should be heard.

Research

Sound management of brucellosis in elk on feedgrounds and the risk of transmission from elk to cattle necessitate accurate and reliable data to facilitate decisions. Most research concerning brucellosis, feedground elk, and feedground management has focused on elk vaccination and its impacts to seroprevalence of the disease at the population level. More recently, the Brucellosis-Feedground-Habitat (BFH) Program of WGFD in cooperation with Iowa State University, Montana State University, and the University of Wyoming has conducted and published several epidemiological studies regarding transmission at the elk-to-fetus level on and off feedgrounds. Summaries of unique research projects and their findings are listed below.

1. **Effects of management and climate on brucellosis seroprevalence of feedground elk**

Cross et al (2007) compiled 16 years of seroprevalence data from feedground elk and 54 years of feeding and climate data from feedgrounds and local weather stations throughout the Greater Yellowstone Ecosystem. They found that brucellosis seroprevalence was positively correlated to length of feeding season and end date of feeding, with feeding seasons lasting longer during years of increased snow. However, host (feedground) population size or density (animals per unit area of feedground) had little to no influence on seroprevalence. Therefore, they suggested management strategies to reduce length of feeding season (e.g., early end date) to reduce potential elk-to-fetus contacts (transmission events), and ultimately, seroprevalence of the disease on feedgrounds.

2. **Effects of management, behavior, and scavenging on risk of brucellosis transmission**

Maichak et al (2009) collected 48 culture-negative fetuses, fluids, and placentas (fetal units) from elk associated with the Test & Removal project and placed these on and adjacent to feedlines, as well as off feedgrounds and on native winter range (NWR) locations from 2005 through 2007. They found that elk density and elk-to-fetal unit contacts declined dramatically off feedlines (no contacts off feedgrounds), females were slightly predisposed to fetal unit investigations (greater time of investigation than males and juveniles), and that most elk did not investigate fetal units when ≥ 2m from their line of travel, particularly off feedlines. Additionally, they found that scavengers remove fetal units faster from feedground than NWR locations and reduce numbers of elk contacting fetal units. Therefore, they suggested that reduction of elk densities on feedgrounds, time spent on feedlines (e.g., altered feeding patterns), and protection of scavengers on and adjacent to feedgrounds could reduce intraspecific transmission of brucellosis.

3. **Target Feedground Project and effects of low-density feeding**

Based on the findings from the projects mentioned above, WGFD developed and implemented management actions pertaining to the Target Feedground Project (TFP) in 2008 (WGFD 2008). The two (2) primary objectives of the TFP are to increase dispersion of hay throughout the feedground (termed Low-Density feeding) and actively end feeding three (3) weeks prior to the current 10-year average. Creech et al. (In Review) compared Low-Density (LD) to traditional feedlines via data-logging radio collars and digital video cameras and found that LD feeding reduces elk-to-fetus contacts by 66%-75% and, based on an appropriate SIR disease model, may substantially reduce seroprevalence in elk if implemented over a decade or more. Active early termination of feeding is possible on some feedgrounds in light snow years, but the impacts of LD feeding and early termination of feeding on actual seroprevalence at the population level will require implementation of eight to 10 years (Cross et al. 2007).

4. **Parturition/abortion ecology of feedground elk**

From 2006 through 2010, the BFH program of WGFD in conjunction with Iowa St, University, University of WY, Montana St University, and USGS deployed and

recovered 301 vaginal implant transmitters (VITs) in 19 feedground and 3 NWR elk populations as part of a multi-faceted project to identify and characterize elk parturition (269/301) and abortion (17/301) sites, potential overlap with current elk parturition ranges, and potential overlap with public grazing allotments. Barbknecht et al. (2009) found that VITs were an effective tool for locating elk parturition sites. Furthermore, Barbknecht et al. (In Press) found that most elk tend to select parturition sites with substantial horizontal and overhead cover, often on gentle southern aspects in aspen or aspen/conifer stands, but that parturition sites range from low elevation willow/riparian to high-elevation alpine habitats. To date about 90% of parturition sites have occurred out of currently delineated parturition ranges, and several parturition events have occurred on active grazing allotments. WGFD in conjunction with USGS is currently compiling and drafting various GIS models based on VITs to help refine elk parturition ranges. Of the abortions, 20% (13/65) were from seropositive females, 2% (4/227) were from seronegative females, and these occurred from 17 Feb to 6 July. About half of the abortions occurred on feedgrounds. Based on current funding, the BFH program will continue to deploy VITs through 2014 to further refine parturition ranges of specific feedground populations and increase sample size of abortions.

Furthermore, many aspects of feedground elk ecology, brucellosis transmission and pathology, and feedground management have not been investigated. Potential research topics that could assist in management decisions include:

1. Influence of Target Feedground Project actions (active early end feeding date, Low- Density feeding, lower palatability feed) on seroprevalence in elk.
2. Relationship of seropositive vs. culture positive, and strain of *Brucella*, in feedground elk.
3. Feedground elk parturition habitat site characteristics and proximity to cattle.
4. Effects of habitat improvement projects near feedgrounds on minimizing feedground dependence of elk (i.e. distribution, dispersal, length of feeding season, brucellosis seroprevalence).
5. Disease presence (other than brucellosis) and parasite loads in elk on feedgrounds.
6. Relationship of local scavenger densities vs. scavenging rates on feedgrounds.
7. Abortion and viable birth rates, and temporal and spatial distribution of abortions and births, in seropositive feedground elk.
8. Influence of snow-water equivalent (SWE) and habitat enhancement on elk use and distribution.
9. Genetic comparison of seropositive elk that do or do not abort.
10. Potential aerosol transmission of brucellosis and impacts to sero- and culture prevalence in elk and livestock.
11. Potential for salt/mineral licks as sites of inter- and intraspecific brucellosis transmission

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