Pinedale Elk Herd Unit (E108)  
Brucellosis Management Action Plan Update  
Wyoming Game and Fish Department  
April 2011

A. Introduction and herd unit overview

This update to the Pinedale elk herd unit (PEH) 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 much progress in the PEH 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 PEH BMAP.

The Pinedale Elk Herd (PEH) is located on the west slope of the Wind River Mountain Range in eastern Sublette and northern Sweetwater Counties, Wyoming and includes elk hunt areas 97 and 98 (Fig. 1). The area is bounded on the northwest by Pine Creek and Fremont Lake, the northeast by the Continental Divide, the southwest by the Green River, and the southeast by the Big Sandy River. It encompasses approximately 2,430 square miles (mi²), of which only 505 mi² are considered occupied elk habitat. Approximately 465 mi² is delineated as spring/summer/fall range, 18 mi² as Crucial Winter Yearlong, 16 mi² as Crucial Winter, and 6 mi² as Winter Year Long (Fig. 2). The remaining 1,925 mi² are mostly lower elevation areas in lower precipitation zones, once portions of native elk winter range. Three feedgrounds are located within the PEH: Fall Creek, Scab Creek, and Muddy 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.

The U.S. Forest Service (USFS) manages the majority of lands within the occupied elk habitat in the PEH, with over half designated as Wilderness (Bridger Wilderness). Most private lands in this herd unit are concentrated at lower elevations associated with riparian and floodplain habitat of the Big Sandy, East Fork, Boulder Creek, and Pole Creek drainages. The Bureau of Land Management (BLM) manages the majority of unoccupied elk range within the PEH (Fig. 1)
Fig. 1. Land ownership, feedground locations, and Hunt Areas within the Pinedale Elk Herd Unit.
Fig. 2. Land ownership, feedground locations, and current seasonal elk ranges within the Pinedale Elk Herd Unit.
B. Brucellosis Management Options

Listed below are potential options for managing brucellosis on the three feedgrounds in the PEH. 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 Wyoming Game and Fish Commission (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

This option would initially require a suitable area lower in elevation, in a lower precipitation zone, with no winter cattle operations in the vicinity. Current habitat conditions should be evaluated to determine production, health of vegetation, and approximate potential of the area. All lands within the BLM Pinedale Field Office are leased for grazing, so it is likely one or more permittees will need to be involved in the selection of a particular area. If purchase of AUMs is acceptable to a permittee, this could reserve forage for elk and other wildlife. Decision authority would lie with the permittee, BLM, and the WGFC.

Prior to feeding elk at the present site of the Muddy Creek feedground, the WGFD fed at three other sites. One of these sites was between Pocket Creek and the East Fork River, one at the Leckie place (SE of current site), and another near Buckskin crossing. The Fall Creek feedground was originally started several miles west of the present location and was moved twice before the present site was selected. Scab Creek
feedground was also located at two different sites before the present location was selected. Documentation of why these sites were moved is lacking.

Pros:
• may contribute to lower brucellosis prevalence
• elk would have increased area to disperse
• feeders could feed in larger area and on clean snow
• elk numbers could be maintained at or near current levels
• may decrease damage and co-mingling situations
• reduced browsing on local native woody vegetation

Cons:
• brucellosis prevalence may persist
• requires funds for erection of new structures, fences, roads, etc.
• potential difficulty relocating and/or habituating elk to the new site
• may increase localized grazing of native herbaceous and woody vegetation
• may increase dietary competition of elk with other wildlife

2. Reduction or Elimination of Supplemental Feeding
Correlation data indicate that truncating the feeding season by 3 weeks could lead to a 66% reduction in brucellosis seroprevalence. This option is most feasible for the Fall Creek feedground, followed by Muddy Creek, then Scab Creek feedgrounds. 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 practical. The WGFC has the authority to make this decision.

Pros:
• would reduce the risk of intraspecific transmission of brucellosis and other diseases
• would facilitate efforts to eliminate brucellosis in elk within the PEH
• 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 damage control costs for WGFD
• would increase elk winter mortality
• would lower the number of elk that could be maintained in the PEH
• would reduce income to the WGFD due to reduced license sales
• would reduce hunter opportunity
• may increase potential for vehicle-elk collisions on Highway 191

As a result of the 2006 BMAP, numerous research studies were developed to improve our limited understanding of brucellosis transmission among elk on feedgrounds. Based on results of those studies, the Target Feedground (TFG) Project was developed, which targets some feedgrounds for alternative management in effort to reduce elk-elk disease transmission. A major objective of the TFG project is the reduction of the supplemental
feeding season by forcing elk on to native range 3-4 weeks earlier in late winter/early spring. The Fall Creek feedground has been successfully targeted for that objective since 2008.

3. Elk Reduction
Reduction elk numbers on feedgrounds in the PEH through liberalized hunting seasons could allow more flexibility to pursue options 1, 2, and 6, and could lead to more favorable conditions for options 7 and 8. The WGFC has the authority to make this decision.

Pros:
• might 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 might still continue
• 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 some hunting opportunity in the long term
• will reduce license revenue in the long term (might be offset by reduced management costs)

While a loss of hunting opportunities was realized due to the Test and Slaughter Pilot Project (type 6 cow/calf elk tags not issued), the PEH is currently maintained at the WGFC-established population objective. All feedgrounds within the PEH would probably be affected equally by implementation of this option. The Scab Creek feedground may benefit the most if numbers were reduced due to the smaller area of the feedground.

4. Cattle Producer Change of Operation
This is an option high-risk and other producers within the PEH could implement to minimize/eliminate brucellosis risks to their herds. Changing cattle operation from cow/calf to yearling, spayed heifer, or steer would eliminate brucellosis transmission potential within cattle and testing requirements associated with cow/calf operations. Conversion to yearlings would also eliminate the need of storing most hay crops and winter-feeding, reducing winter elk conflicts. Smaller changes in operations, such as developing a water source enabling the producer to calve in a lower risk area, are other options that could be more appealing if incentives were provided. Implementing facets of this option would require a decision from the producer and possibly a favorable decision by the BLM or USFS to alter grazing permit(s).
Evaluation and implementation of the 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 Herd Reports for each livestock operation.

5. Fencing
Elk proof fencing of feedgrounds may contain most elk within a given area, and fencing of winter cattle feedlines could prevent elk from co-mingling with cattle. This would require favorable decisions by the landowner (private and/or state/federal).

Pros:
- may reduce damage complaints
- may reduce risk of elk-cattle brucellosis transmission

Cons:
- costs
- congregating all or most of the elk within the fence may be unfeasible
- large areas of fencing could impede migrations of other wildlife
- does not address seroprevalence of brucellosis in elk
- some producers may be unwilling to erect fencing
- would require federal agency cooperation and potential NEPA evaluation for federal lands

An elk fence was erected on the private/state land border near the Muddy Creek feedground during the 1980’s. As a result of the 2006 BMAP, a new ~1.5 mi elk fence was added on the western edge of the USFS boundary adjacent to the Muddy Creek feedground. Interspecific disease transmission may decrease equally among all feedgrounds within the PEH with further implementation of this option.

6. Elk Test and Removal
This Option could eliminate a percentage of the seropositive animals on a feedground (Scurlock et al. 2010). The number of aborted fetuses and associated fetal fluids contaminated with \( B.\ abortus \) may be decreased. The WGFC has the authority to make this decision.

Pros:
- would reduce brucellosis prevalence in elk
- could 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

The rates of both intra- and interspecific brucellosis transmission may decrease on all feedgrounds within the PEH given implementation of this option. The WGFC has the authority to make this decision.

7. Habitat Enhancement
Habitat projects have been utilized in areas adjacent to feedgrounds with some success in reducing feeding duration. The decision authority is with the BLM and USFS for most areas. Affected permittee consultation and cooperation is also necessary.

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
• may increase likelihood of invasive species establishment

This option may be best used in conjunction with options 1, 2, 3, and 8 to achieve maximum success. The risk of intra- and interspecific disease transmission may decrease on all feedgrounds within the PEH with implementation of this option.

8. Acquisition/Conservation Easements
Disease transmission risk on feedgrounds in the PEH 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. This option also secures habitat for other wildlife species. 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

Disease transmission risk on all feedgrounds within the PEH may decrease by managing lands adjacent to, or connected with, native elk winter ranges.

9. Continuation of Strain 19 Elk Vaccination Program

The WGFD initiated this program in 1985 on Grey's River feedground and has vaccinated around 80,000 elk to date on 22 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 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 Grey's River feedground elk indicate no significant difference, no downward trend, and that seroprevalence may fluctuate cyclically over time throughout both populations (WGFD 2010b, Fig. 3).

![Figure 3. Seroprevalence levels in elk from Grey’s River and Dell Creek feedgrounds, 1993-2010. Trendlines depict moving averages within individual feedground.](image)

In captive studies, Strain 19 prevents abortion in 29% (Roffe et al. 2004) to 62% (Herriges Jr et al. 1989) of elk challenged with *B. abortus* strain 2308. Protection from
*Brucella* 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.

**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

Strain 19 vaccination was discontinued on the feedgrounds in the PEH in effort to adequately evaluate effects of the Test and Slaughter Pilot Project. Vaccination will not be continued as evaluation of test and slaughter is still in progress.

**D. Coordination Meetings**

1. Producer Meeting
   A meeting was held 28 December 2010 in Pinedale to discuss the nine options among livestock producers and associated land and resource management agencies within the PEH. A presentation was given by WGFD that summarized brucellosis management and research strategies and their relation to the nine options. Seven producers and seven WGFD personnel were present. Representatives from the WLSB, BLM, USFS, NRCS, and WY land board were invited, but did not attend. Several questions and comments were proposed by attending producers regarding the completion of the Test and Slaughter Project. One commenter suggested that it should never be referred to as the Test and Slaughter Project because that gives a negative connotation among the public. It was noted that the Test and Slaughter was the term used in the method aimed to eradicate brucellosis from cattle. Producers generally spoke in favor of the Test and Slaughter Pilot Project conducted 2006-2010 in the PEH, noting that the benefits outweighed the costs and therefore should be continued at least on Muddy Creek feedground due to the commingling risks at that site. Another producer urged the WGFD to pursue re-implementing Test and Slaughter if seroprevalence were to rise above a certain threshold (maybe 10-15%), and a final producer commented that Test and Slaughter should continue every year because very few elk would be removed annually if seroprevalence is low, making it more palatable to the public.

   Regarding habitat treatments to reduce elk dependency on supplemental feed, a producer suggested that treatments be conducted in the Muddy Ridge/Muddy Canyon area. This would not only boost grass production, but reduce the amount of deadfall and thick vegetation in the area which makes it difficult to trail livestock.
Additionally, there were producer comments in support of extended hunting seasons and extending the existing Hunter Management Area to around the Scab Creek feedground. A producer noted that if over-harvest were a concern, the WGFD could always emergency close the season. Another commented that the WGFD should re-evaluate if they are initiating feeding early enough in the fall. Producers also voiced general support for the continuation of ongoing brucellosis research using VITs conducted by the WGFD to further evaluate elk parturition ranges.

2. Public Meeting

A meeting was held 24 March 2011 between WGFD and concerned members of the public to discuss the nine options as they pertained to the Pinedale, Upper Green River, Hoback, and Big Piney Elk Herd Units. Three individuals and five WGFD personnel attended the presentation which summarized WGFD brucellosis management and research strategies and their relation to the nine options. A couple topics were discussed following the presentation including strain 19 vaccination efficacy in elk and cattle, and VIT research. 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 representatives of the Greater Yellowstone Coalition (GYC) and Jackson Hole Conservation Alliance (JHCA). Principal comments pertinent to the PEH 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.
- Because fencing could be used to contain winter cattle feeding areas to eliminate commingling and prevent hay damage, Test and Slaughter has lowered elk seroprevalence and thereby lowered risk of exposure to cattle, and because there’s plenty of big game winter range within the Pinedale elk herd unit, the WGFD should initiate a phase-out of these three feedgrounds.
- Livestock Producers should implement the most effective vaccination practices for cattle, including booster vaccinations.

E. Proposed Management Actions

1. Feedground Relocation

There is currently low potential for moving the Scab and Fall Creek feedgrounds due to current elk numbers, land ownership patterns, and the large number of cattle operations in the vicinity of these feedgrounds. It may be more possible for Muddy Creek feedground now that lower brucellosis seroprevalence has been achieved through Test and Slaughter. Any potential impacts to the producer and public land allotment permittee(s) nearest the new proposed location would need to be evaluated. No detailed discussion of this option was held.

2. Feedground Elimination

Of the three feedgrounds in the PEH, Muddy Creek feedground has the highest potential for phase-out due to the site’s close proximity to native winter range, the known
interchange of feedground and native winter range-utilizing elk, and the current low seroprevalence and correspondingly low risk of exposure to cattle due to the Test and Slaughter Project. However, low tolerance for elk-cattle commingling, combined with the potential for elk damage to stored crops on private lands around the Muddy Creek feedground and downrange from the feedground in elk HA99 remain the dominant drivers in the decision to continue supplemental feeding.

Additionally, concerns have been raised about impacts to elk currently utilizing the winter ranges adjacent to Muddy Creek in HA99 if 300-400 feedground elk were to be moved south. Native winter-range elk in HA99 were observed foraging in the HW191 right of way extensively during winter 2010-11, as they have in previous winters with average snowpack. This foraging behavior likely indicates that the quality of the winter range is poor, or that there is low abundance/availability of feed in HA99. Some wildlife managers have also voiced concerns over increased competition with mule deer and pronghorn, which share some of the winter ranges in HA99, should more elk be expected to winter on these ranges.

Thus, in order to phase-out the Muddy Creek feedground and move those elk to native ranges to the south during winter, elk numbers would likely need to be reduced. Habitat enhancement projects and modifications to current land use practices would need to be conducted to increase forage production on the HA99 winter ranges. Additionally, private landowners and cattle producers in the Muddy Creek area and downrange would need to modify their operations to reduce the potential for elk damage and elk-cattle commingling. Without these actions, the potential for elimination or phase of the Muddy Creek feedground is low.

3. Elk Reduction
The PEH is currently at its population objective, and 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.

4. Cattle Producer Change of Operation
Most producers believed that large changes in operations (conversion from cow/calf to yearling) are too drastic, but other smaller alterations (moving hay, developing water sources to allow calving in lower risk areas) have potential if a funding source were available to compensate producers.

5. Fencing
An elk-proof fence was erected in 2005 along the FS boundary and on private land adjacent to the Muddy Creek feedground to prevent elk from funneling into cattle calving areas near the feedground in March/April. The WGFD encourages cattle producers in the PEH to fence areas where hay is stored (stackyards) for winter-feeding operations and will continue to deliver fencing materials for stackyard construction where appropriate. As opportunities arise for additional fencing projects (e.g., winter cattle feeding exclosures), WGFD will assess those situations on a case-by-case basis.
6. Elk Test and Removal
   The WGFD implemented the pilot Test & Slaughter project in the PEH from 2006 through 2010. The WGFD will retain Test and Removal as a tool for brucellosis management.

7. Habitat Enhancement
   The 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 PEH. 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
   The 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
   The 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.
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
H. Literature Cited


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