Elk Winter Feeding = Disease Facilitation

THE THREAT AS CWD APPROACHES WESTERN FEEDGROUNDS

By Bruce L. Smith

Credit: Diana Smith

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"*The recreational value of a game animal is inverse to the artificiality of its origin and the intensiveness of the management system that produced it.*" — Aldo Leopold, 1933

As winter settles across the West, nearly 32,000 elk are gathering at 46 feedgrounds scattered across five western states. More than 70 percent of these animals are fed in western Wyoming each winter at 22 state-run feedgrounds and at the federal National Elk Refuge (NER). Winter feeding arguably enhances recreational and economic benefits by sustaining wild elk in numbers beyond available habitat and social constraints. But this unusual management system is fraught with complex political and biological problems.

Based on my 22 years as the biologist at the NER, the most challenging problem is the task of managing diseases fostered in dense aggregations of wildlife, a concern that has grown over the years (Smith 2011). In a previous article, I reviewed the origins, scope, justifications, and liabilities of feeding wild elk (Smith 2001). In 2013, I surveyed wildlife managers and learned that similar numbers are still being fed by state and federal agencies, though some changes have occurred (see chart on page 43). Following a synopsis in *The Wildlife Professional* (Miller 2012) of how game farming has facilitated the spread among private herds of chronic wasting disease (CWD)—an emerging disease of North American cervids—I felt a review was needed of artificial feeding and its potential influence on CWD in our wild, public herds.

I'm among those who argue that winter feeding (as well as baiting) serves neither the long-term health nor conservation of wildlife, and therefore is not in the public's best interests. As CWD has recently infected cervids within 50 miles of several elk feedgrounds (see map on page 43), two fundamental questions arise: "What happens when CWD reaches those feedgrounds, and should something be done now to address this threat?" The following briefly explores those issues.

Credit: Bruce Smith

Conditioned for handouts, thousands of elk line up along winter feed lines at the National Elk Refuge in Jackson Hole, Wyoming. Alfalfa pellets provided by the U.S. Fish and Wildlife Service help sustain some 6,000 to 8,000 elk at the refuge, a popular wildlife spectacle for tourists but a potential source of disease transmission.

Roots of Winter Feeding

In 1909 at the NER's future site near Jackson, Wyoming, wildlife managers initiated the first government program of feeding elk (Smith 2011). As continental populations of elk collapsed and migrations from northwest Wyoming to winter ranges much farther south were eliminated, elk that remained in the Jackson Hole valley were fed to limit winter mortality and damage by elk to ranchers' hay. By the late 1990s, state and federal wildlife agencies were feeding about 3 percent (some 31,400) of the continent's one million elk. Today elk feeding continues in the same five states (it's not done in Canada), but there have been shifts in the numbers of elk fed in Idaho and Washington.

From 2,000 animals at 26 sites in the late 1990s, Idaho slashed winter feeding to just 150 elk during winter 2011-12. As Idaho wildlife manager Jon Rachael puts it, "Idaho determined that feedgrounds are not compatible with restored wolf populations."

Wolves travelled the packed snowmobile trails used by elk feeders to access snowbound feedgrounds, rendering sedentary elk easy targets. But the Idaho Department of Agriculture's concerns over bovine brucellosis provided the primary impetus, given that feedgrounds serve as a nexus for the disease's transmission among elk and then to cattle (Etter and Drew 2006). Idaho may someday eliminate winter feeding in all but emergency situations—a management prerogative reserved by wildlife agencies to avert unacceptable mortality during unusually severe winters. Like Idaho, Utah could conceivably end the feeding of 400 elk at the Hardware Ranch, leaving Oregon, Washington, and Wyoming with the only government-sponsored elk feeding operations on the continent.

Contrary to Idaho, Washington State now feeds twice as many elk as 15 years ago, according to state wildlife officials. The Yakima herd, at 10,000–11,000 elk, is the only herd food-supplemented by the state each winter. Although the herd size is similar to the past, and wildlife managers have streamlined the feeding program by reducing the number of feeding sites, a growing proportion of the herd has become habituated to winter feeding.

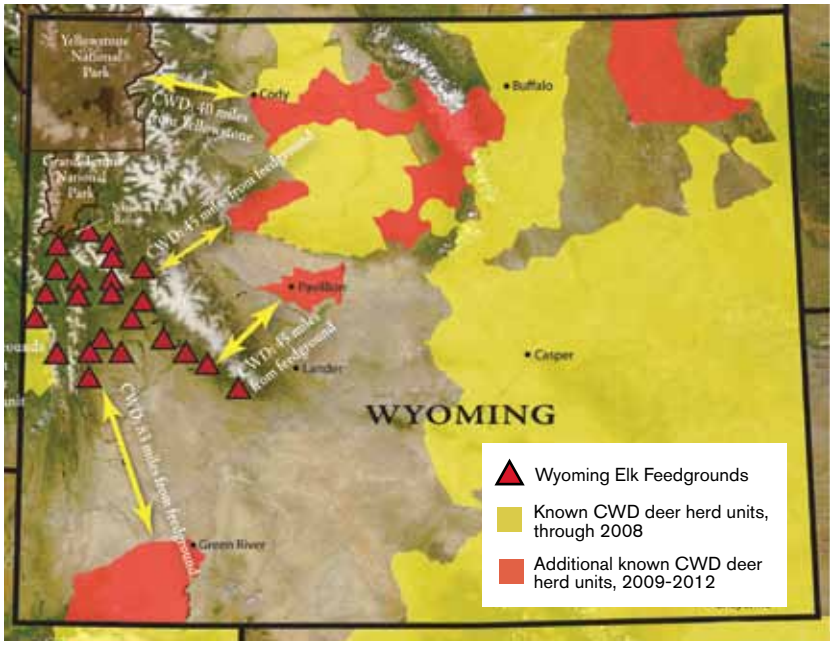
This pattern of habituation is not unexpected when animals migrating down the precipitation gradient to better foraging areas are short-stopped by hay handouts along the way. In Jackson Hole I found that the lowest attendance at NER feedgrounds was by calves, followed by yearlings, and then older animals. As they grow older, an increasing percentage of each cohort is likely to use a feedground, if only by chance or the occurrence of a tough winter (Smith 1994).

Short of restoring migrations to historic winter ranges, or reducing a fed population to the carrying capacity of available habitat, dismantling a feeding program can be problematic. Indeed, many winter feedgrounds were established at higher elevations along fall migration routes—a strategy to keep elk off private lands and away from livestock and crops. In some cases this has truncated historical migrations to winter habitat on public lands (Smith 2001, 2011). Most of Wyoming's 23 feedgrounds and some former feed sites in Idaho are classic examples.

True Costs of Feeding Elk

Feedgrounds boost elk numbers but at extraordinarily high costs. The state of Wyoming, for example, spends more than $2 million annually to feed elk and to study and manage feedground disease. This typically produces an annual deficit above revenues derived from the sale of licenses to hunt elk west of the Continental Divide, where the state's feedgrounds are located (Smith 2001). The total runs far higher because U.S. taxpayers foot the bill for most management costs at the NER.

As a wildlife professional, I find the ecological costs of this agricultural model of managing public resources most disturbing. Truncated migrations, habitat degradation, loss of biodiversity, the dewilding of wildlife, and the perception that hay can be substituted for habitat—all these issues plague feeding programs (Smith 2001, 2011). These and other ecological effects (at the individual, population, and community levels) and human societal



Credit: Greater Yellowstone Coalition

Data compiled by the Greater Yellowstone Coalition show how chronic wasting disease (CWD) is marching westward in Wyoming. By 2012, this fatal neurodegenerative disease had infected deer herds as close as 45 miles from some elk winter feedgrounds.

Where Elk Are Fed

State	1995–1999		2011–2012		Statewide Elk Population in 2012
	No. of Feed Sites	No. of Elk Fed	No. of Feed Sites	No. of Elk Fed	
Idaho	26	2,005	2	150	100,000
Oregon	13	2,548	13	2,500	127,000
Utah	1	490	1	400	75,000
Washington	13	3,000	7	6,700	55,000–60,000
Wyoming	23	23,391	23	22,000	115,000
Totals	**76**	**31,434**	**46**	**31,750**	**472,000–477,000**

This chart shows the numbers of wild elk fed annually at feedgrounds in five western states. Averages for the years 1995–1999 (Smith 2001) are compared to numbers reported by wildlife managers (through interviews or on websites) in each state for winter 2011-2012.

Credit: Bruce Smith

An elk on the National Elk Refuge suffers end-stage hemorrhagic septicemia, one of several diseases that afflict feedground elk. Large congregations of animals aid the spread of disease. As chronic wasting disease moves closer to western feedgrounds, concerns arise about how it might spread among elk and other cervids.

issues surrounding feeding and ungulate overabundance should concern resource professionals and all who cherish our wildlife heritage (for examples, see McShea et al. 1997, Williamson 2000, Dunkley and Cattet 2003, Smith et al. 2004). Yet, diseases fostered by feedground conditions most directly affect our elk.

Abundant hosts packed close together on soiled grounds make magnificent laboratories for most pathogens to persist and spread, and to develop even more successful forms (McNeil 1989). What's more, a recent study comparing physiology of elk on 19 Wyoming feedgrounds to 11 unfed, free-ranging populations in Montana and Wyoming found that glucocorticoid concentrations (inflammation and stress can escalate production of these steroidal hormones) excreted in feces of feedground elk were 31–43 percent higher than among unfed elk. Likewise, rates of aggression increased significantly when elk were fed (Forristal et al. 2011). Given the harmful effects that chronically elevated glucocorticoids have on immune function of mammals (Sapolsky 2002), feeding may exacerbate diseases like scabies, hemorrhagic septicemia, foot rot, and bovine brucellosis of elk (Peterson 2003, Smith and Roffe 1994).

As the record of bovine brucellosis demonstrates, managing animal health under feedground conditions has proven challenging (see sidebar below). Yet the worst may lie ahead.

CWD: A Rising Concern

An infectious, neurodegenerative disease, CWD is caused by abnormal proteinaceous particles or prions (PrP^{CWD}). Following an incubation period lasting 12–34 months, clinical CWD is considered 100 percent fatal, and epidemics are self-sustaining in both captive and free-ranging populations (Williams et al. 2001, Williams et al. 2002).

Lessons from Brucellosis

A Cautionary Tale Relevant to CWD

By Bruce L. Smith

The complexities of trying to manage, let alone eradicate, diseases in elk drawn to feedgrounds may best be understood from the history of bovine brucellosis in elk. Brucellosis was first discovered in elk in 1930 at the National Elk Refuge in Wyoming, and later at 22 Wyoming and three Idaho state elk feedgrounds. An infectious bacterial disease caused by *Brucella abortus*, bovine brucellosis primarily affects cattle. The disease's hallmark sign is spontaneous abortions of some first pregnancies. It is transmissible among cattle, bison, and elk through oral contact with bacteria that contaminate aborted fetuses or birth by-products.

Recognizing the threat to livestock production and commerce, in 1934 state and federal authorities launched a Cooperative Brucellosis Eradication Program, which sought to eliminate the disease from cattle and swine through testing, removal of infected animals, quarantines, and vaccination of healthy herds. Those efforts reduced the number of infected cattle herds from over 100,000 in the 1950s to just a handful today, leading authorities in the Rocky Mountain region to increasingly focus on brucellosis in wildlife to curb reinfection of livestock (USDA-APHIS).

Credit: Bruce Smith

Hay for cattle on private land in Wyoming lures elk to feed along with cattle. Fear of brucellosis spreading from elk to cattle is one reason why the state maintains separate elk feedgrounds.

Within the U.S., infected herds of wild elk and bison are clustered in the Greater Yellowstone Ecosystem of northwest Wyoming and adjacent areas of Idaho and Montana. Most epidemiologists agree that brucellosis has been perpetuated in elk by disease transmission on winter feedgrounds. During the 1990s in Wyoming, about 37 percent of elk at the state's 23 feedgrounds tested positive for brucellosis, as did 77 percent of bison fed at the National Elk Refuge (Cheville et al. 1998).

Growing concerns about infectious wildlife comingling with cattle led to the formation of the Greater Yel-

Scope. From its initial discovery at Colorado and Wyoming state wildlife research facilities in the 1960s, and in nearby wild cervids in 1981, CWD had infected mule deer and white-tailed deer in 13 states plus Saskatchewan and Alberta by 2005 (see chart at right). Free-ranging public herds as well as game-farmed animals were afflicted. "Like an epidemic in slow motion," is how Colorado wildlife veterinarian Mike Miller describes its relentless spread. Perhaps it's not so slow, however, considering that deer in nine more states tested CWD positive from 2006 to 2012. Free-ranging elk in Colorado, South Dakota, and Wyoming have also tested positive for CWD. And the first wild moose were diagnosed with CWD in 2005 in Colorado, 2008 in Wyoming, and 2012 in Alberta. The only native North American cervids yet unaffected are woodland and barren ground caribou, perhaps only because they have yet to be exposed (Mitchell et al. 2012).

In Colorado and Wyoming, where the disease has been established longest, local annual prevalence growth rates exceed 1.15 in some mule deer populations (Almberg et al. 2011). More than 25 percent of animals in some wild deer herds in those states are now infected, though prevalences elsewhere measure ≤10 percent. In a mule deer herd in Converse County, Wyoming, CWD prevalence

The March of Chronic Wasting Disease

State or Province	Wild Cervids	Confined/Farmed Cervids
Colorado	1981	1999
Wyoming	1985	
Saskatchewan	2000	1996
South Dakota	2001	1997
Montana		1999
Nebraska	1999	2002
Oklahoma		2002
New Mexico	2002	
Wisconsin	2002	2002
Minnesota	2011	2002
Illinois	2002	
Alberta	2005	2002
Utah	2003	
New York	2005	2005
West Virginia	2005	
Kansas	2006	
Michigan		2008
Virginia	2010	
Missouri	2012	2010
North Dakota	2010	
Maryland	2011	
Texas	2012	
Iowa		2012
Pennsylvania	2012	2012

Credit: CWD Alliance

This chart shows the first known occurrence of chronic wasting disease (CWD) in wild and game-farmed white-tailed deer, mule deer, or elk in Canadian provinces and the United States. Most CWD-infected game farms have been depopulated, with property owners indemnified for the destroyed animals.

lowstone Interagency Brucellosis Committee (GYIBC) in 1994. That year the group issued a position statement affirming, "The evidence is overwhelming that winter feeding of elk has proven to perpetuate and enhance the spread of diseases, especially brucellosis. Once certain contagious diseases become endemic within a population of elk, bison, or other wildlife, they become very difficult, if not impossible, to eradicate" (GYIBC 1994). Subsequently, Idaho has reduced winter feeding of elk more than 90 percent (Etter and Drew 2006).

Because of concerns about brucellosis, Wyoming opposes the creation of new feedgrounds, but has not eliminated any of its existing sites or reduced the numbers of elk the state authorizes fed. State officials addressed their dilemma in an article in *Wyoming Wildlife News,* writing: "Biologically, it would be preferable to close existing feedgrounds. Unfortunately, much of the historic winter habitat has been lost. Closing feedgrounds would require a great reduction in the number of elk in the Greater Yellowstone Area. There is tremendous public, political, and economic pressure not to substantially reduce these elk populations. Because of this, it is unlikely that feeding can be discontinued any time soon" (Cook et al. 2000).

Eradication Meets Limited Success

Wyoming has tried other measures to contain and eradicate brucellosis. For nearly 30 years, the state has vaccinated elk with Strain 19, a vaccine originally developed to protect cattle. Clinical trials have demonstrated that Strain19 protects against abortion in 25 percent of elk, but offers no detectable protection against contracting the disease (Roffe et al. 2004). The Wyoming Game and Fish Department (WGFD) reports that at 12 feedgrounds where elk have been vaccinated, seroprevalence for antibodies to brucellosis ranges from 13-30 percent, while seroprevalence in elk that do not frequent feedgrounds has averaged only 2.3 percent. "These data support the contention that feedgrounds increase the probability of disease transmission," the department concludes (WGFD 2004).

In 2006, the WGFD expanded its use of livestock management techniques to remedy brucellosis, initiating a test-and-slaughter program at the Muddy Creek feedground near Pinedale. The state ended that program in 2011, largely because of high costs and little likelihood of eliminating brucellosis in the elk (Scurlock et al. 2010). Despite such well-intentioned efforts to control brucellosis in Wyoming, cattle herds in the vicinity of infected elk herds experienced outbreaks of the disease in 2004, 2008, and 2010 (*Casper Star Tribune* 2010). Meanwhile, millions in sportsmen's fees and taxpayer dollars have been spent on wildlife brucellosis research and management, and repeated litigation against state and federal resource agencies (and sometimes between those agencies) has plagued efforts to find science-based solutions to brucellosis in wildlife (Smith 2011).

The struggle with brucellosis offers a cautionary tale should chronic wasting disease reach Wyoming's winter-fed elk.

among hunter-harvested animals increased from 15 percent in 2001 to 57 percent in 2011 (Wyoming Game and Fish Department 2012). From its original nexus, CWD has spread north, south, east, and west.

Ticket to Ride. Among the reservations that scientists and conservationists have voiced about captive wildlife facilities is the potential for disease eruptions and subsequent transmission to wild herds (Samuel and Demairais 1993, TWS Technical Review 2002, Miller 2012). Over the past two decades, farming of deer and elk has likely facilitated the spread of CWD. In short, as infected animals were exchanged among cervid farms, their pathogens went with them. This also spawned recurrent outbreaks of bovine tuberculosis (another deadly disease affecting many mammal species) in cervid farms (Clifton-Hadley et al. 2001).

Credit: James Griffin

Masses of elk that congregate to feed at the base of the Tetons lure tourists (and their dollars) to the National Elk Refuge in winter. But the ecological price of such a show is steep, including altered migration routes, habituation, and the rising threat of disease.

Transmission to wild cervids may occur across fences (by animal-to-animal contact through single-fenced facilities or by contamination of soil) or when captive animals escape. Given the proximity of a number of wild CWD-infected cervid herds to game farms, this has likely happened repeatedly in North America (Herring 2002). Dispersing animals presumably then spread the disease among free-ranging herds.

Deadly in a Crowd. Regardless how epizootics become established, animal density apparently elevates the risk of CWD amplification, increasing transmission and infection rates in wild populations (Williams et al. 2002). One recent study in Rocky Mountain National Park—where prevalence measured 13 percent in 2008—led researchers to infer that "high density elk populations (10–100 elk/km^2) can support relatively high rates of CWD (>10 percent prevalence) that may substantially affect the dynamics of such populations" (Monello et al. 2013). But on feedgrounds, elk densities reach 343–2,055 elk/ha (34,300–205,500 elk/km^2) during the 65 to 164 days that feeding occurs (Creech et al. 2012, Smith 2001).

As the nearest surrogate for elk feedgrounds, the record of game farming is instructive. Reported prevalence rates among captive elk have ranged as high as 59 percent in a CWD-infected elk farm in South Dakota (Peters et al. 2000). Infected cervid farms are routinely depopulated—herds destroyed by state and federal officials to eliminate the disease—rendering uncertain what magnitude prevalences might reach in protracted epidemics.

Transmission and Persistence. Researchers modeling CWD's spread have concluded that where environmental contamination is significant, that route of transmission is far more likely to explain the observed spread of disease than transmission by direct contact between infected and susceptible deer (Miller et al. 2006, Almberg et al. 2011). It's now accepted that PrP^{CWD} can be shed, transmitted, and contaminate the environment via saliva, urine, feces, and carcass tissues. Shed prions bind to clay soil particles, which increases both PrP^{CWD} bio-availability and infectivity. Studies of a closely related prion disease, sheep scrapie, have shown that these prions can remain infectious and bio-available in the environment for at least 16 years (as summarized in Almberg et al. 2011). This environmental accumulation of PrP^{CWD} suggests that recurrent die-offs will follow return of cervids to CWD-infected sites (Georgsson et al. 2006, Mathiason et al. 2009), making the prospect of CWD on feedgrounds all the more disconcerting.

Can CWD Be Controlled?

Given that there are no efficacious vaccines or therapeutic treatments for CWD, prevention and population control may offer the only hope for wildlife. Over the past decade, state, federal, and provincial officials have worked to limit the spread of CWD, including restricting transport of animals and carcasses from infected areas and depopulating infected captive herds. Colorado tried to reduce

CWD in wild mule deer through experimental herd reductions. Wisconsin went a step further: After finding CWD in deer in 2002, the state's Department of Natural Resources sought complete eradication by killing thousands of white-tailed deer with special hunts and culling programs designed to reduce deer densities. Unfortunately, those states' efforts have met with limited success.

In Illinois, on the other hand, 10 years of government culling of white-tailed deer in areas of new CWD infections has limited disease prevalence to 1 percent. By comparison, prevalence climbed to 5 percent after localized culling in Wisconsin ceased in 2007 (Manjerovic et al. 2013). A prescription to similarly limit CWD infections of elk crowded on feedgrounds would compel the culling of very large numbers of animals.

It may be true that little can be done to slow the spread of CWD in the wild, but the risk of its amplification can be lessened by preventing anthropogenic animal aggregations. Compared to closing wildlife feed sites, merely modifying feeding protocols does not mitigate the enhanced disease transmission of CWD, as demonstrated in Wisconsin white-tailed deer (Thompson et al. 2008).

In an effort to limit the opportunity for transmission of both CWD and bovine tuberculosis, a number of states have sought to regulate or ban winter feeding and baiting of deer by citizens (Dunkley and Cattet 2003). For example, after the first CWD-infected white-tailed deer was discovered in Michigan in August 2008, the state imposed a ban on baiting and feeding of deer and elk throughout the Lower Peninsula. Citizens had long practiced these activities to attract deer during hunting season and to enhance recreational viewing of animals in winter. The ban was litigated but upheld in court.

Shift to an Ecological Paradigm

In Wyoming, 22,000 elk are fed in the midst of 200,000 deer, moose, and elk that inhabit the 20-million-acre Greater Yellowstone Ecosystem, acclaimed as an international model for ecosystem management. East of the Continental Divide, Wyoming doesn't feed elk. Instead they're managed like 97 percent of North American elk, by working with private landowners and federal land managers to conserve and improve habitats, and by limiting elk numbers to the ecological and social carrying capacities of available range.

Habituating elk to feedgrounds can be viewed as a means of conflict resolution spawned by public pressure rather than decision making seated in scientific principle and sustainable resource management policy. Administrators may see winter feeding as the least painful remedy producing immediate results to appease agricultural interests that desire rapid resolution to crop damage, and pro-wildlife constituencies that oppose reductions in elk densities despite dwindling habitat and human-wildlife conflict. As such, winter feeding fits into the context in which wildlife management initially developed as an "agricultural paradigm"—one that employed simplified concepts of ecosystems in an effort to produce abundant numbers of certain species for harvest. However, the potential for the spread of epizootic disease in artificially crowded elk populations argues for a shift from a production-consumption model of elk management toward an "ecological paradigm" long advocated for the wildlife profession (Lancia et al. 1996).

It has been eight decades since Aldo Leopold advised against artificial management of wildlife. Following Leopold's lead, our profession has weighed in on this issue. In a 2007 position statement, The Wildlife Society encouraged phasing out feeding of wild ungulates by both government agencies and the general public, and reducing populations to levels that are sustainable by habitat conditions (TWS 2007). Given that winter feeding is unsupported by scientific evidence as advantageous to the long-term well-being of the resource, these are sensible policy positions. Wildlife, and surely elk, are adapted to survive winter without supplemental feeding.

While other drawbacks of maintaining overstocked numbers of elk may be rationalized and deemed acceptable, the spread of CWD calls for rethinking the rationale for winter feeding. We may never have all of our questions answered about CWD's consequences to winter-fed elk and to other ecosystem components and functions—surely not before it reaches the West's elk feedgrounds. Rather than waiting for the drama to play out, our current knowledge suggests that dismantling feedgrounds will limit prevalences, mortality, and the costs of managing CWD—and the next emerging disease. ■

This article has been reviewed by subject-matter experts.

For a complete bibliography and additional resources on disease risks of feeding wild elk, go to news.wildlife.org/twp.