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Growing Wild: Crested Wheatgrass and the Landscape of Belonging

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GROWING WILD: CRESTED WHEATGRASS AND THE LANDSCAPE OF
BELONGING

by

Lafe Conner

A thesis submitted in partial fulfillment
of the requirements for the degree

of

MASTER OF ARTS

in

History

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ABSTRACT

Growing Wild: Crested Wheatgrass and the Landscapes of Belonging

by

Lafe Conner, Master of Arts

Utah State University, 2008

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Crested wheatgrass arrived in North America at the turn of the twentieth century through the foreign plant exploration missions sponsored by the United States Department of Agriculture. During the first two decades of the new century, scientists tested the grass at agricultural experiment stations. They determined it was useful for grazing and particularly valuable because it could grow in drought conditions with little or no care and would continue to produce high quality feed even after several years of heavy use. Beginning in the 1930s federally sponsored land utilization and agricultural adjustment programs sponsored the use of crested wheatgrass for soil conservation and weed control. The grass protected the soil on the land that had been entered into the acreage reserves and the conservation reserves programs of the federal soil bank. Also in the late 1930s and through the 1960s, rangeland managers used crested wheatgrass to improve forage productivity on public lands that were used for grazing. By the 1970s somewhere between 12 and 20 million acres of crested wheatgrass grew in North

America in eleven western states, and in Saskatchewan and Alberta. By 1980 attitudes about agriculture and wilderness had changed in the United States and land management was focused on multiple uses and on protecting ecosystems and native species. Attitudes about grazing and agricultural landscapes had changed and many preferred non-agricultural landscapes and land uses. As a result, crested wheatgrass went from being considered one of the most valuable plants in North America to being considered an invasive weed, in some quarters. Debates in the last 25 years have tried to determine if, where, and how crested wheatgrass belongs in North America. This thesis explains the discourses, or interest groups, that are participating in the current conversation. One impulse is to use empirical evidence to determine whether or not introduced plants like crested wheatgrass belong, but the main contention of this thesis is that empirical studies alone will always be insufficient measures because belonging is also a subjective and experientially or emotionally derived measure.

(154 pages)

To Diane and the Boys

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I would like to thank the folks in the archives at Utah State University, especially Bob Parson for helping me navigate the files of the Crops Research Lab and several other files we've discussed together, and Brad Cole for helping with the Lincoln Ellison papers. Thanks also to Liane Ellison Norman for sharing her father's papers, which have been an inspiration to me far beyond what is found in this thesis. I also acknowledge Richa Wilson for her help with the Forest Service Archives in Ogden, Utah.

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Figure 1. Paul Bieler, **Forest Supervisor Blaine Betenson Noting Growth of First Year Crested Wheatgrass at Pine Valley Ranger Station, Dixie National Forest, 1 June 1941**, Courtesy of FS region 4 Ogden, Utah.

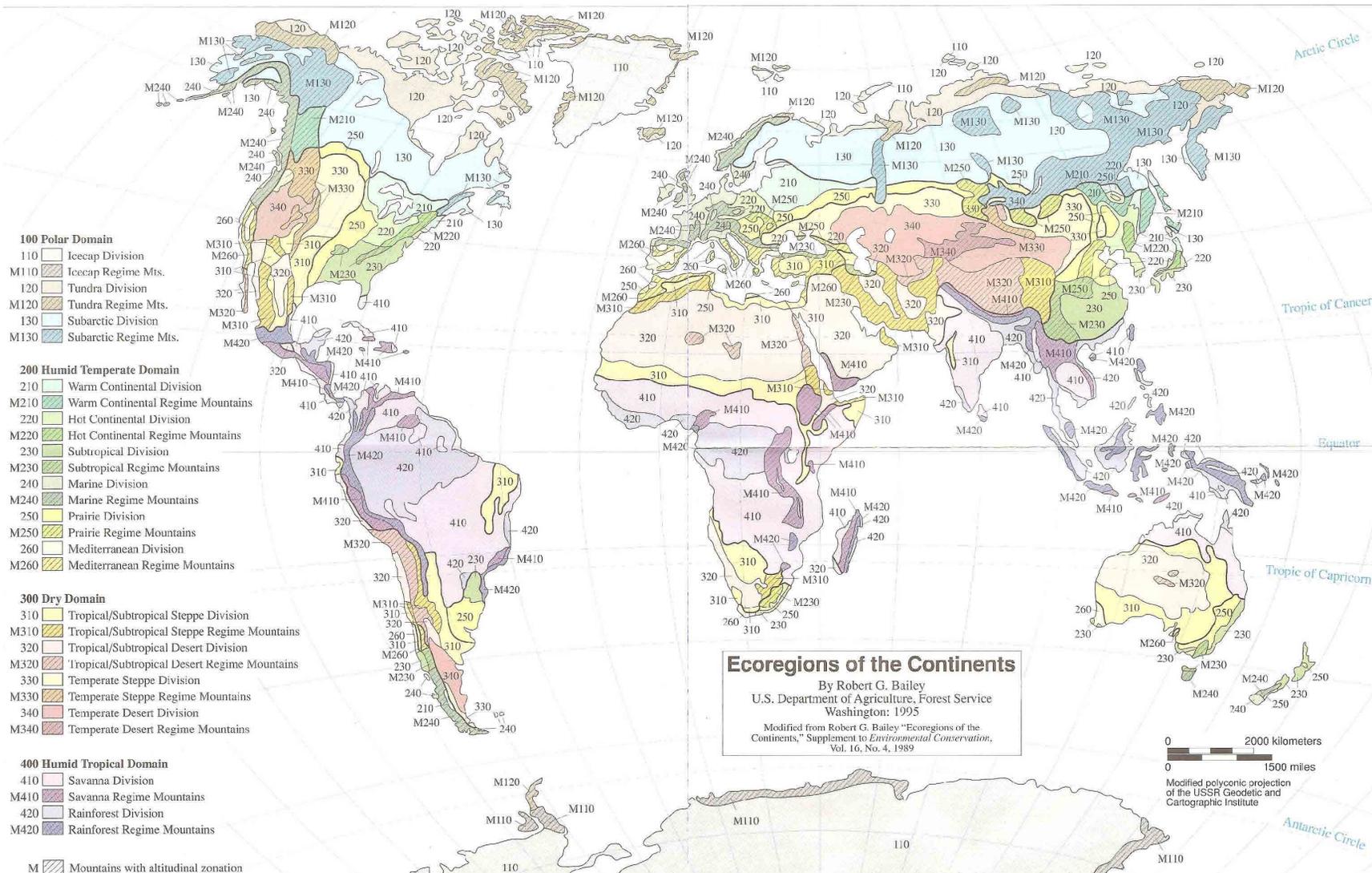


Figure 2. Ecoregions of the Continents. Source: Robert Bailey, *Ecoregions: The Ecosystem Geography of the Oceans and Continents* (New York: Springer, 1998)

CHAPTER I
INTRODUCTION



Figure 5. Seeding to crested wheatgrass on private land west of Cedar City, Kolob Plateau in background, Virgin Grazing District, June 25, 1945, courtesy of Merrill-Cazier Library Special Collections, Logan, Utah.

Figure 5 shows a stretch of rangeland in southern Utah, which in 1945 grew in straight rows of crested wheatgrass. A native of the semiarid steppes of Asia, crested wheatgrass found a place on the grasslands of western North America as a result of multiple acts of human agency. Unlike invasive plants that spread and colonize environments through their own adaptive traits, crested wheatgrass owes its distribution to agricultural researchers, farmers, ranchers, soil conservation officers and public land managers. Over the past century many individuals within each of these categories

determined that crested wheatgrass belonged within the framework of what they believed the western landscape should be. Over the course of the twentieth century crested wheatgrass became, according to one range scientist, “the single most important range plant in North America.”¹

Taxonomically crested wheatgrass belongs to the *Triticeae* tribe of grasses, the same tribe as wheat, barley and rye. Its genus, *Agropyron*, Greek for “wild wheat,” once included several different species that taxonomists, in the last 30 years, have transferred to different genera. Today, several different species of crested wheatgrass fit into the genus *Agropyron* and the genus is limited to only the crested wheatgrasses. The principle species include *A. cristatum*, *A. desertorum* (also known as desert wheatgrass), and *A. fragile* (Siberian wheatgrass, also known as *A. sibericum*). Taxonomists still disagree over species delineation, especially because the breakdown of traditional genetic and geographic barriers has led to natural and artificial crosses that complicate both biological and geographical indicators. The crested wheatgrasses exhibit a large amount of genetic and phenotypic diversity as illustrated in the following lineup of various types of seed heads commonly found in crested wheatgrass.

In October 1983 a symposium of scientists and land managers gathered at Utah State University for the purpose of discussing the values, problems and myths associated with crested wheatgrass. By that time a controversy had arisen over the use of the grass, and other non-native species, in restoration and range improvement projects on public lands. Proponents of traditional range improvement, which meant removing sagebrush

¹ Don Dwyer, “Setting the Stage for the Crested Wheatgrass Symposium,” In *Crested Wheatgrass: Its Values, Problems and Myths, Symposium Proceedings*, ed. By Kendall Johnson, (Logan: Utah State University, 1986), 1.

and planting forage grasses, continued to praise the grass for its endurance under grazing pressure and its survival in drier areas of the West, while an outspoken few called the grass a weed and said it did not belong. The roots of the controversy over crested wheatgrass lay in conflicting views of how rangeland environments should be used and what the landscapes should be like.

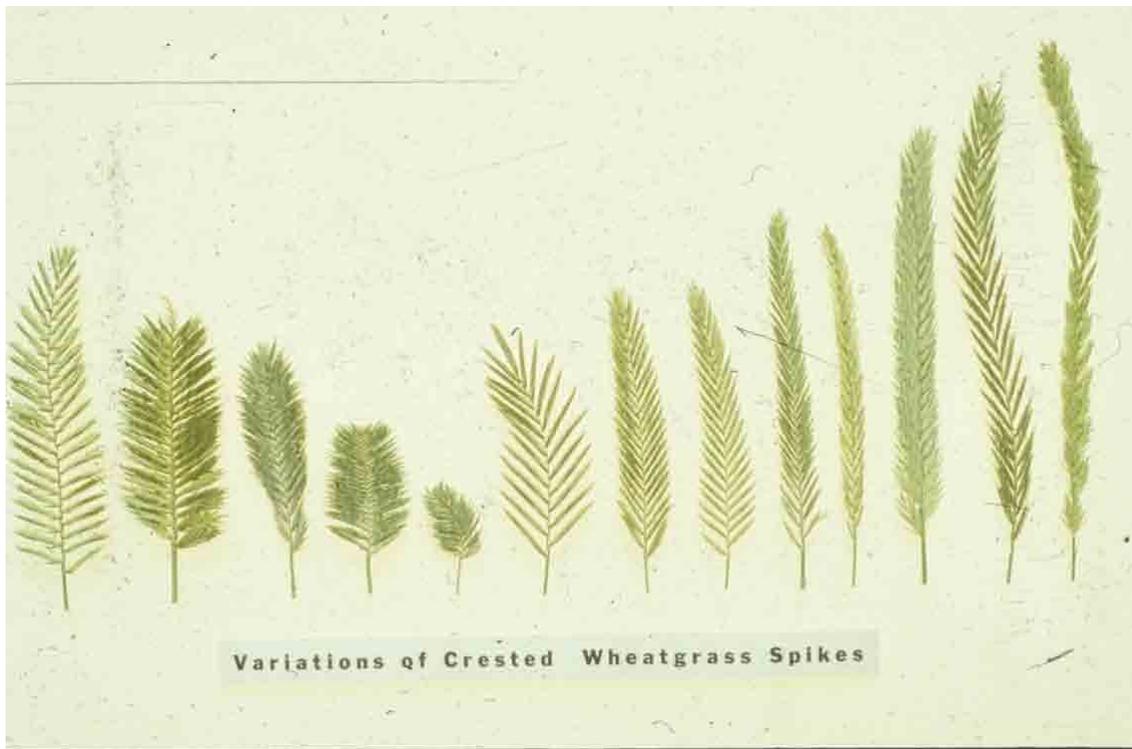


Figure 6. **Variations of Crested Wheatgrass Spikes**, courtesy of USDA Forage and Range Research Lab, Logan, Utah.

This thesis's discussion of the cultural and ecological aspects of crested wheatgrass unfolds in three chapters, which describe three distinct yet interconnected landscapes. In each landscape *belonging* is a function of several different conditions. First, ecology offers one measure of belonging and reflects the organism's relationship to

the environment and to other organisms. Economics offers a second measure reflecting both the cost of establishing crested wheatgrass and the economic value of the grass compared to other plants. Social and cultural values, such as aesthetics, biodiversity and naturalness, represent a third measure. Each of these measures represented conditions *within* and *between* the landscapes examined in this thesis.

Background

At the turn of the twentieth century, cultivation and grazing removed native plant communities from several million acres of western prairie. When combined with the regular cycles of drought and rain and the fine textured (i.e. high-clay content) soils, farming and grazing created a real environmental crisis. By the 1930s the need for drought-tolerant plants that could grow in parched soils set the stage for crested wheatgrass's role in recovering stability and productivity.

In the first decades of the new century scientists tested crested wheatgrass by planting it in experimental landscapes. They discovered the grass's potential as a valuable forage plant and as part of a program aimed at creating more rational and scientific agricultural landscapes. During the 1930s crested wheatgrass gained popularity on lands that had been cleared for growing dryland crops. Farmers and soil conservation officers used the grass to heal the damages of soil erosion. Meanwhile, on land used for grazing, ranchers and rangeland managers faced the dual problems of increased erosion and decreased forage production. By mid-century, range improvement projects that involved the Forest Service, the Civilian Conservation Corps and the Bureau of Land Management, in addition to private owners of land and livestock, annually converted tens

of thousands of acres of sagebrush ecosystems into grasslands dominated by crested (and a handful of other Asian-steppe) grasses. Also, beginning in the 1930s and 1940s, a multiple-use philosophy developed among some land managers and public land users. Multiple use placed higher value on landscapes used for nonagricultural purposes, such as wildlife habitat and recreation, thus challenging the place that agricultural interests had given to crested wheatgrass creating, in the process, what might be categorized as the post-agricultural landscape.²

When Don Dwyer, head of the Range Science Department at Utah State University, opened the 1983 symposium he spoke endearingly of the contribution that crested wheatgrass had made to the rangelands of the West. Dwyer called crested wheatgrass a “range plant,” meaning it belonged on the range. Facing dissent from professionals and from growing public opinion, he appealed to the plant’s history for justification. For fifty years crested wheatgrass held its ground in the West, supporting grazing and surviving droughts. For Dwyer that proved the plant’s “ecological credentials.” Speaking for his colleagues at Utah State University he said, “We have decided... that crested wheatgrass deserves to receive its papers – at least a permanent work visa if we cannot grant it a citizenship based on naturalization.”³

Dwyer's appraisal of crested wheatgrass represents his belief that some western landscapes should support grazing. Those who participated at the symposium

² George Rogler and Russell Lorenz, “Crested Wheatgrass: Early History in the United States,” *Journal of Range Management* 36 (January 1983): 91-3;. George Rogler, “Growing Crested Wheatgrass in the Western States,” *USDA Leaflet 469*. Washington D.C.: Government Printing Office, 1960; Thomas Alexander, *The Rise of Multiple-Use Management in the Intermountain West* (Washington, D.C.: U.S. Forest Service, 1988).

³ Dwyer, “Setting the Stage,” 1.

acknowledged that a different vision was taking hold on western rangelands; a new discourse had emerged, one that placed greater value on naturalness and diversity. At the close of the crested wheatgrass symposium the dean of the College of Natural Resources at Utah State University, Thad Box, spoke of the growing concern over the use of crested wheatgrass on public lands. “As resource managers,” Box said, “I believe we have grossly underestimated the public concern for diversity. We have been lulled into thinking that the quest for diversity is simply an attack on monocultures or a battle to save a few endangered species. It is not.” Box recognized that the opposition to crested wheatgrass was “part of a much deeper desire for diversity of thought, of communities, and of gene pools.”⁴

The symposium brought together range scientists and land managers to discuss the values underlying western landscapes. Though many of the presenters acknowledged arguments that opposed the use of crested wheatgrass, they presented arguments that suggested, often explicitly, that crested wheatgrass still belonged. Conference presenters argued for an end to the use of the labels “foreign” and “alien” in descriptions of crested wheatgrass. They argued that the grass should be included in the same classification schemes of range health and condition as other range plants. Their arguments, beyond determining whether crested wheatgrass belonged or not, were really arguments over the definition of health in rangeland environments. The question of how to recognize a healthy landscape had troubled land managers and resource scientists since the early 1900s. The earliest definitions of healthy landscapes derived entirely from measurements

⁴ Thadis Box, “Capstone Address: Crested Wheatgrass: Its Values Problems and Myths; Where Now?,” In *Crested Wheatgrass Symposium*, ed. by Kendall Johnson, 344.

of forage production. Healthy rangelands produced a lot of food for livestock. During the 1940s researchers like Lincoln Ellison at the Great Basin Experiment Station in central Utah offered new measurements of health. The science that supported agricultural landscapes provided one definition while the science of post-agricultural landscapes answered with another.

Geographic Scope

This thesis encompasses a broad geographic region that is defined by the extent of the area in North America to which crested wheatgrass is adapted. This area includes the northern Great Plains: the western half of the states of North and South Dakota, Montana and western portions of Colorado and Wyoming, as well as the southern areas of Saskatchewan and Alberta. Crested wheatgrass is also adapted to the Intermountain Region. The political boundary of the Intermountain region, defined by the Forest Service as Region 4, includes the states of Utah and Nevada and the southern half of Idaho (see map page xi). The range of crested wheatgrass's adaptation extends beyond this political boundary and includes environments in northern Arizona and New Mexico and the eastern portions of Washington, Oregon and California. The area is defined as arid and semiarid, meaning that average annual precipitation is less than twenty inches per year. In many areas crested wheatgrass grows well with only 8 to 10 inches of annual precipitation (see map page x). This thesis also refers to the Great Basin, a sub-region of the Intermountain region, consisting of a physical geography known as basin and range, in which broad valleys are divided by low-lying mountain ranges that run generally north-south. The Great Basin lies between the western edge of the Rocky Mountains and

the eastern edge of the Sierra Nevada range. It covers land in Utah, Nevada and southern Idaho.

This thesis also refers to crested wheatgrass's land of origin. The environmental conditions of the Central Asian Steppes resemble those of the northern Great Plains and the Intermountain region. Both areas are cold and dry. The steppes cover portions of the countries of Mongolia, Russia, China, Kazakhstan and Iran. In its native home, crested wheatgrass represents several different species and subspecies, identifiable in part by geographic distribution. As it has been introduced into North America, the particular identities of the individual species and subspecies have been lost (see map page ix).

Review of the Literature: Aliens and Landscapes

Scientists and environmental historians have offered many definitions for the term *alien* species. Range scientists James Young and William Longland, in the paper "Impacts of Alien Species on Great Basin Rangelands," defined alien species as any species transported beyond the reach of its historic enemies. By crossing an ecological barrier that used to prohibit the movement of the species, a plant or animal enters into a new community of organisms where it may possess a competitive advantage due to the absence of its native pathogens and predators. Alien species migrate with and without the help of humans. Species migration plays an essential role in creating biological diversity and species have always migrated and changed their ranges as climates and conditions change both at local and global scales. Trade between human societies has transformed the migration for plants, animals and pathogens. As trade increased so did the rate of migration. In fact, migrations increased so much that some scientists have argued that

today biological exchanges of plants and animals across oceans and continents represents a change in *kind* not just in *degree*.⁵

Some alien species expand their range in new environments to the detriment of other species. These are known as *invasive* or *colonizing* species. Other species, mostly referring to plants, persist only in areas where humans put them. Crested wheatgrass, in most areas of western North America, falls in the non-invasive category. However, scientists in Saskatchewan recently labeled it invasive. The application of this label reflects differences in the plant's behavior in more favorable environments but also reflects the changing understanding of global ecology and changing values in the science of measuring range health. Their research was conducted in Grasslands National Park in southwestern Saskatchewan, which has a history of agricultural use, while the dominant values and uses today are decidedly non-agricultural.⁶

Scientists and historians in the past two decades have written extensively about the ecological and cultural effects of globalizing nature. Most of this scholarship draws upon examples of harmful invasive species of plants, animals and pathogens. In *Nature Out of Place: Biological Invasions in the Global Age*, Jason and Roy Van Driesche present several case studies of invasive species and provide an ecological context for

⁵ James Young and William Longland, "Impact of Alien Plants on Great Basin Rangelands," *Weed Technology* 10 (June 1996): 384-391; Alfred W. Crosby, *Ecological Imperialism: The Biological Expansion of Europe, 900-1900* (Cambridge: Cambridge University Press, 1986); Alfred W. Crosby, *The Columbian Exchange: Biological and Cultural Consequences of 1492* (Westport: Greenwood, 1972); Alfred W. Crosby, *Germ, Seeds & Animals: Studies in Ecological History* (Armonk, NY: M.E. Sharpe, 1994); Van Driesche and Van Driesche citing P.M. Vitousek et al., "Biological Invasions as Global Environmental Change," *American Scientist* 84 (1996): 468-78.

⁶ Malin Hansen and Scott Wilson, "Is Management of an Invasive Grass *Agropyron cristatum* Contingent on Environmental Variation?," *Journal of Applied Ecology* 43 (2006): 260-80; Malin Hansen, "Evaluating Management Strategies and Recovery of an Invasive Grass (*Agropyron cristatum*) Using Matrix Population Models," *Biological Conservation* 140 (November 2007): 91-9.

understanding the causes and consequences of biological invasions. “Invasive species,” they write, “are among the most ecologically devastating forces humans have ever unleashed upon the natural world.” The case studies in their book represent harmful invasive species, which account for one tenth of one percent of all species introduced into new ecological contexts.⁷

Invasive species compete with and threaten local species and they also transform landscapes in ways that threaten the local character of individual places. The Van Driesches characterized this process as a transformation from the endemic to the generic. Thad Box described this concern when he said, “there is a fear that the Iowa farm has moved to the West.” The argument for maintaining local character is itself a reflection of values attached to specific landscapes. Throughout the colonial age, settlers, placing value on the familiar, transformed landscapes to look more like the cities and gardens they left behind. The value placed on maintaining local character is a modern development and may itself be a product of globalization.⁸

Much of the discussion in scholarly works and in the media focuses on the devastating consequences of a few successful invaders, like the zebra mussel in the Great Lakes and cheatgrass in the Great Basin. While the case studies in *Nature Out of Place* depict biological invasion as a modern environmental catastrophe, the authors distinguish between non-harmful immigrant species (the vast majority of all introductions) and harmful invasives (about one tenth of one percent of introduced species). It is helpful to begin thinking of crested wheatgrass within these distinctions. A plant or animal becomes

⁷ Jason Van Driesche and Roy Van Driesche, *Nature Out of Place: Biological Invasions in the Global Age* (Washington, D.C.: Island Press, 2000), 1.

⁸ Van Driesche and Van Driesche, *Nature Out of Place*, 7; Box, “Capstone Address,” 344.

harmful and invasive more as a function of present ecological relationships than historical origins.⁹

The term *weed* refers to a cultural perception rather than an ecological relationship. Though weeds are generally *invasive* they may be either alien or native. A weed is simply a plant that does not fit with the design of a cultural landscape. In *The War on Weeds in the Prairie West*, Clinton Evans argues that “because weeds are inextricably both products of psychology and ecology, weed problems are best addressed by considering not only the agroecosystems that produced them but also the culture that informs how we farm and think.” If we have come to consider crested wheatgrass as a weed in North America it is not so much because the behavior of the plant has changed but because the way we think about the environment has changed. In many cases the ideal landscape we envision has become more native.¹⁰

Authors and journalists attach many popular metaphors to plant migrations that have parallels in discussions of human migration. In *American Perceptions of Immigrant and Invasive Species: Strangers on the Land*, Peter Coates discusses the naming of alien species and the concept that has been referred to as *ecological* or *biological nativism*. It is tempting to construct parallels between non-human immigrants and their counterpart, yet Coates’ finds that “for all the colorful and arresting accusations of botanical xenophobia and econativism, ties between conservation and prejudice, between the desire

⁹ Van Driesche and Van Driesche, *Nature Out of Place*, 106. Young and Longland, “Impact of Alien Plants,” 385. Other sources about the causes and consequences of biological invasion include Chris Bright, *Life Out of Bounds: Bioinvasion in a Borderless World*, The Worldwatch Environmental Alert Series, Linda Starke, ed. (New York: W.W. Norton and Company, 1998); Mark Williamson, *Biological Invasions* (London: Chapman and Hall, 1996).

¹⁰ Clinton L. Evans, *War on Weeds in the Prairie West: An Environmental History* (Calgary: University of Calgary Press, 2002), 14.

to preserve an ‘American’ nature and to defend old-stock America, once substantial, have largely dissolved.” In place of metaphors and prejudice over origins, the behavior of a species in relation to its current habitat offers the best measure of its belonging.¹¹

Criticism over the use of the term “alien species” has come because it represents shifting and often difficult to determine boundaries. In place of the term “alien,” geographer Charles Warren recently suggested that “the merits of a species should perhaps be judged not by notions of historic authenticity but against pragmatic criteria such as its value (of whatever kind) to human and/or biological communities.” While Warren’s conclusion may seem the most reasonable in light of the subjectivity of the labels “native” and “alien,” determining the merits of a species can prove an exhaustive and ultimately inconclusive process because values in both human and biological communities are often site specific and competitive with one another.¹² During the second half of the twentieth century the use and management of federal public lands shifted from focusing on commodities like forage, minerals and timber to providing recreational experiences and ecological functions. Landscapes where the highest value had been the ability to feed livestock gained new value as watersheds, wilderness and wildlife habitat. The founding of the Wilderness Society in the mid 1930s marked the beginning of a long search for naturalness. The emergence of wilderness as a land use led

¹¹ Peter Coates, *American Perceptions of Immigrant and Invasive Species: Strangers on the Land* (Berkeley: University of California Press, 2006), 10.

¹² Charles Warren, “Perspectives on the ‘Alien’ Versus ‘Native’ Species Debate,” *Progress in Human Geography* 31 (2007): 437.

to the formation of a new type of cultural landscape, one in which crested wheatgrass held little or no belonging.¹³

Whether crested wheatgrass belongs in the West is a question of ecological relationships but more decisively it is a question of cultural values. Therefore, the question can best be answered through examination of the grass in specific cultural and ecological settings. Beginning with Carl Sauer in 1925, geographers developed a discipline of landscape analysis that defines landscape “as both a material presence and a conceptual framing,” and that considers the formative influences of cultures, individuals, and discourses. Geographers viewed landscapes as material products of human societies that can be read like an autobiography to provide insight into the values of a particular culture. Accepting the model of Sauer, Peirce Lewis sought to “read” cultural landscapes as a “reflection of our tastes, our values, our aspirations and even our fears.”¹⁴

New cultural geographers accepted Sauer’s and Lewis’s fundamental assumption that landscape is an impress of human culture and expanded the definition of culture to emphasize humans as individual agents. Donald Meinig argued that within a society each individual carries his or her own perception of landscapes and there may be as many perceptions as there are individuals. Expanding Meinig’s analysis, James Duncan demonstrated that within a society there exist shared meanings. These shared meanings (which he referred to as discourses) inform human manipulations of environments in a

¹³ Alexander, *Rise of Multiple-Use Management*.

¹⁴ Carl O. Sauer, *The Morphology of Landscape* (1925), reprinted in *Land and Life: A Selection from the Writings of Carl Ortwin Sauer*, ed. John Leighly (Berkeley: University of California Press, 1963), 315–50. cited in Richard Schein, “The Place of Landscape: A Conceptual Framing of Interpreting an American Scene,” *Annals of the Association of American Geographers* 87 (December 1997): 662; Peirce Lewis, “Axioms for Reading the Landscape,” *The Interpretation of Ordinary Landscapes*, ed. D.W. Meinig (New York: Oxford University Press, 1979), 33-50.

“social framework...within which all practices are communicated, negotiated, or challenged.” This history of crested wheatgrass is an examination of such discourses and the associated landscapes.¹⁵

Environmental historians of the West also interpret cultural landscapes as both a material presence and a conceptual framework. Landscape defines both the physical reality of what an environment *is* and the different ideas of what that environment *should be*, as Nancy Langston put it: “All attempts to manage are attempts to tell a story about how the land ought to be.” In their study of cultural landscapes, historians grapple with several of these competing stories, contained in the symbols and myths of the conceptual landscape and manifested in the different ways that human agency makes use of these mythologies through actions that shape landscapes as both historical and physical presence.¹⁶

Crested wheatgrass was placed into specific landscapes at specific times because individuals believed that it belonged there. Human agency ultimately carries the responsibility for shaping the landscapes that contain crested wheatgrass, however, as a living organism the grass has been its own agent in continuing to shape landscapes.

Through very deliberate actions, plant geneticists encouraged the characteristics that

¹⁵ Schein, “The Place of Landscape,” 661; D.W. Meinig, “The Beholding Eye,” in Meinig, *Interpretation of Ordinary Landscapes*, 33-50, quoted in Schein, 663; James Duncan, *The City as Text: The Politics of Landscape Interpretation in the Kandyen Kingdom* (New York: Cambridge University Press), 12, quoted in Schein, 663.

¹⁶ Nancy Langston, *Forest Dreams, Forest Nightmares: The Paradox of Old Growth in the Inland West* (Seattle: University of Washington Press, 1995), 297; Henry Nash Smith, *Virgin Land: The American West as Symbol and Myth*, (Cambridge, 1950; reprinted Cambridge: Harvard University Press, 1970); Annette Kolodny, *The Lay of the Land: Metaphor as Experience and History in American Life and Letters* (Chapel Hill: University of North Carolina Press, 1975); Frieda Knobloch, *The Culture of Wilderness: Agriculture as Colonization in the American West* (Chapel Hill and London: University of North Carolina Press, 1996); Donald Worster, *Under Western Skies: Nature and History in the American West* (New York; Oxford: Oxford University Press, 1992); Marcus Hall, *Earth Repair: A Transatlantic History of Environmental Restoration* (Charlottesville: University of Virginia Press, 2005).

made crested wheatgrass a successful competitor on western rangelands. The grass will dominate most of the areas where it is planted. Over time sagebrush and other native plants will invade stands of crested wheatgrass, but the plant will continue to suppress many native species, especially other grasses. The plant's persistence in competition with native species provides the basis for one of the major arguments against use of the plant.

The uncertainty over crested wheatgrass's belonging makes it an interesting and illustrative example through which one can trace developments in the philosophies, values and practices that shaped the cultural landscapes of western rangelands. A large body of scientific literature also allows for an in-depth discussion of the effects crested wheatgrass had on the biophysical landscape. The more crested wheatgrass was placed on the range the more researchers became interested in its interactions with other plants, animals and insects. Wildlife biologists measured the grass's value as food and as habitat for well-known species like sage grouse, ferruginous hawks, song birds, lizards, snakes and mammals, both small and large.¹⁷

Entomologists examined the grass's relationship to outbreaks of black grass bug, which became increasingly common where with the expansion of range improvement and reseeding programs. As early as 1928 researchers noted the grass's ability to compete against unwanted annual plant species and crested wheatgrass has long been valued as a

¹⁷ Richard Howard and Michael Wolfe, "Range Improvement Practices and Ferruginous Hawks," *Journal of Range Management* 29 (January 1976): 33-7; Louis Best, "First Year Effects of Sagebrush Control on Two Sparrows," *The Journal of Wildlife Management* 36 (April 1972): 534-44; John S. Castrale, "Effects of Two Sagebrush Control Methods on Nongame Birds," *The Journal of Wildlife Management* 46 (October 1982): 945-52; Timothy O'Meara, Jonathan Haufler, Lavern Stelter, and Julius Nagy, "Nongame Wildlife Responses to Chaining of Pinyon-Juniper Woodlands," *The Journal of Wildlife Management* 45 (April 1981): 381-9; Timothy Reynolds and Charles Trost, "The Response of Native Vertebrate Populations to Crested Wheatgrass Planting and Grazing by Sheep," *Journal of Range Management* 33 (March 1980): 122-5.

biological control for cheatgrass and many other annual invasive plants.¹⁸ In recent years restoration researchers have revived this earlier interest in crested wheatgrass and are investigating ways to give native plants additional advantage over crested wheatgrass once it is established on the range. Researchers call this use of crested wheatgrass “assisted succession.”¹⁹ In assisted succession crested wheatgrass helps to capture sites dominated by cheatgrass, thereby interrupting the destructive fire cycles and hopefully providing the means for later reintroduction of native species.²⁰

Outline of Chapters

Chapter II places crested wheatgrass in an experimental landscape, consisting of greenhouses, nurseries and fields. Scientists working for the United States Department of Agriculture tested hundreds of different plant and animal species for specific criteria to determine which were most valuable for agriculture. Researchers evaluated crested wheatgrass’s growth and survival to determine where and how it could be used to support agriculture. After determining the plant’s value plant geneticists experimented with different breeding populations to create cultivated varieties that provided more forage over a wider range of environmental conditions. Crested wheatgrass belonged in the agricultural landscape where researchers worked with dryland forage grasses.

Environmental adaptation provided the first measure of whether the grass belonged. In irrigated regions and in regions with greater than twenty inches of annual

¹⁸ T.K. Pavlychenko, “The Place of Crested Wheatgrass, *Agropyron cristatum* L., in Controlling Perennial Weeds,” *Scientific Agriculture* 22 (1942): 459-60.

¹⁹ Robert Cox and Val Jo Anderson, “Increasing Native Diversity of Cheatgrass-Dominated Rangeland Through Assisted Succession,” *Journal of Range Management* 27 (March 2004): 203-10.

²⁰ Mike Pellant and Cindy Lysne, “Strategies to Enhance Plant Structure and Diversity on Crested Wheatgrass Seedlings,” *USDA Forest Service Proceedings RMRS-P-38* (2005): 81-92.

rainfall, researchers valued other plants more than crested wheatgrass because they provided greater economic returns. However, arid and semiarid environments of western North America required that researchers find hardier and more drought tolerant plants. The Great Plains and the rangelands of the Intermountain West were used for livestock production and the intent of the experimental landscape was to improve existing agricultural systems. Beyond environmental adaptation, researchers measured the nutritional value, annual productivity, longevity and competitive characteristics of crested wheatgrass. The grass belonged in the experimental landscape in as much as it was valuable to the agricultural landscape.

The third chapter explores a changing agricultural landscape as seen in the changing economics and ecology of western farms and ranches. Crested wheatgrass fit into the mixed agricultural landscapes of dryfarms and rangelands in the northern Great Plains and the Intermountain region. This landscape consisted of the mixed economy of the livestock and dryland forage production. Livestock production in these regions, but more especially in the Intermountain states, required various strategies for feeding livestock during different seasons of the year. Crested wheatgrass became important for early spring grazing and, when stored as hay, for emergency winter feed. Crested wheatgrass became important in federally sponsored agricultural adjustment programs that tried to restore economic and ecological stability on small, failing dryfarm homesteads.

During the 1930s the Land Utilization Program, part of the New Deal for agriculture, provided funds for the Resettlement Administration, the Farm Security

Administration, the Soil Conservation Service, the Bureau of Indian Affairs and the Bureau of Biological Survey to purchase and reseed dryfarm homesteads with grasses like crested wheatgrass in the northern Great Plains and the Intermountain region and with Sudan grass in the southern Plains. All together more than 11 million acres were converted from failing farms into federally managed grasslands, wildlife refuges and recreation areas or added to Indian reservations. Crested wheatgrass helped make this land utilization program successful. In 1953 the Secretary of Agriculture declared more than 3 million acres of land utilization projects as national grasslands to be administrated by the Forest Service and managed for multiple use, with special emphasis on grazing.

Crested wheatgrass also expanded its territory as federal agencies worked to make public grazing lands produce more forage. Range improvement projects converted millions of additional acres of public lands dominated by sagebrush ecosystems in various levels of health, into grasslands. All of these efforts combined compose the agricultural landscape where crested wheatgrass belonged and where it still has its most ardent supporters. Managers of the agricultural landscape treated crested wheatgrass seedings as a crop and when they experienced outbreaks of black grass bugs that damaged several hundred thousand acres of rangelands in the west, managers responded with a variety of strategies that included increasing structural diversity to provide habitat for black grass bug predators, breeding insect resistant grasses, using pesticides and getting rid of excess grass through the use of fire and more intense grazing.

Chapter IV explores how range managers started to emphasize the non-agricultural uses and values of public lands after World War II. This system of values

created the post-agricultural landscape where the place of crested wheatgrass has been most hotly debated. The post-agricultural landscape represents a different connection and way of knowing western environments. If agriculturalists knew the environment through their labor and attempts to make it more rational and efficient, then post-agriculturalists knew their environment through recreation. Recreation describes a spiritual and intuitive connection to the environment as well as an escape from the industrialized landscapes of cities. The wilderness experience encompasses such concepts as solitude and the feeling of being in a place untrammelled by man. Both concepts have been difficult for scientists to define and ascribe value to, but both concepts are real and important forces in informing the decisions that shape post-agricultural landscapes. The values determining that crested wheatgrass does not belong are not solely measures of science. They are also measures of a more intuitive, spiritual encounter with the universe. In post-agricultural landscapes non-native species, like crested wheatgrass, do not belong because they compete with and reduce the diversity of life forms which people expect to encounter when having a wilderness experience.

A Note about Sources

As one of their primary purposes, agricultural experiment stations conveyed information to farmers and to other agricultural researchers. Two different types of documents come out of the experiment stations: scientific reports published as technical bulletins or research bulletins, and farmers bulletins that summarized the findings of experiments in ways that farmers could use when selecting crops and methods. These documents form the basis for the discussion of the experimental landscape.

Several types of documents inform the discussion of the agricultural landscape including: letters written by A.C. Hull, Jr. who was an employee of the Intermountain Forest and Range Experiment Station in the 1940s; the papers of Herschel Bullen, Jr., who served for fifty years as the secretary of the Promontory Curlew Land Company; and the records of the Oneida County Recorder that report the homestead claims and sales of homesteads in the Curlew Valley area of southern Idaho. An interview with Patty Timbimboo Madsen and John Warner, who serve as director of culture and history and as housing director for the Northwest Band of the Shoshone Nation, respectively, also informs the chapter about the agricultural landscape.

The diaries and professional writings of Lincoln Ellison provide a major source for the discussion of the post-agricultural landscape. Ellison was a range ecologist and wilderness advocate who worked as a researcher for the Forest Service at the Great Basin Branch Experiment Station from 1938 to 1945 and who later served as the director of range research for the Intermountain Region until his death in 1958. Editorials and additional publications in the *Journal of Forestry*, the *Journal of Range Management* and *Rangelands* also provide information about the rise of the post-agricultural landscape. A personal interview with Mike Pellant, coordinator of the Great Basin Restoration Initiative, and personal communication via e-mail with Katie Fite, biodiversity director for the Western Watersheds Project, also inform this discussion. Legal documents from recent litigation sponsored by the Western Watersheds Project against the Bureau of Land Management also describe the values and objectives of those who argue that crested wheatgrass does not belong in the post-agricultural landscape.

Kendall Johnson, a range extension specialist at Utah State University during the 1980s, edited the proceedings of the crested wheatgrass symposium that took place at Utah State University in Logan, Utah, October 3-7, 1983. These proceedings contain all but three of the papers presented at the symposium. This thesis utilizes these papers in discussing various aspects of the history of crested wheatgrass and in placing the discussion of crested wheatgrass into the context of changing values and landscapes after 1980.

In several places published research of studies relating to crested wheatgrass have been used as primary sources, in other words the conditions described in the study have been used as empirical evidence of conditions that existed in particular places at specific times. This is the case especially in the studies of crested wheatgrass and wildlife in Chapter IV and the discussion of crested wheatgrass and black grass bugs near the end of Chapter III.

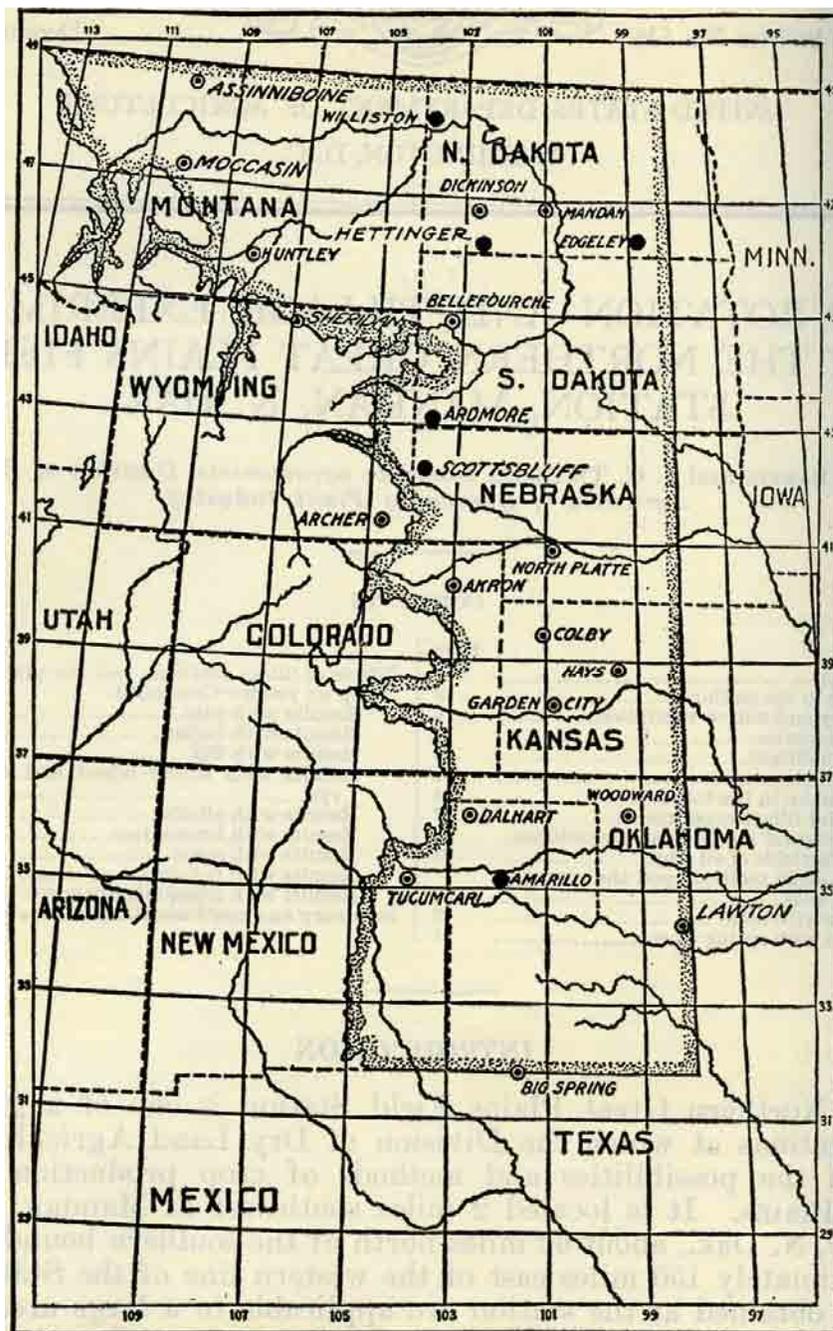


Figure 7. Sketch Map of Experiment Stations in the Great Plains Region. Source: Sarvis, Johnson T. and J.C. Thysell. "Crop Rotation and Tillage Experiments at the Northern Great Plains Field Station, Mandan, N. Dak." *USDA Technical Bulletin 536*. Washington D.C.: Government Printing Office, 1936.

CHAPTER II

THE EXPERIMENTAL LANDSCAPE

“This period has been one of remarkable progress in the development of agriculture as a more rational, enlightened, and progressive industry, and also in the attitude of the farming people toward experimentation and education in agriculture.”¹

The movement of crested wheatgrass from the grasslands of Asia to the grasslands of North America began as a connection between experimental landscapes in Russia and South Dakota. The American scientist Neils E. Hansen, a regular employee of the South Dakota Agricultural College on special assignment for the United States Department of Agriculture, connected these two landscapes in 1898 when he traveled to the Kostichev Agricultural Experiment Station in Valuika, near the Volga River in the Samara government region of Russia. Geographically, the Samara region resembles the Great Plains of interior North America. Samaran farmers planted their fields with wheat, barley, corn and potatoes and they raised cattle, swine and poultry. At the Kostichev Station, Hansen observed test plantings of crested wheatgrass. The station's director, Vasili Bogdan, encouraged Hansen to take samples back to the United States. Bogdan regarded the species as promising for cultivation. Hansen brought back five samples of the grass and distributed seeds to Alabama, Indiana, Michigan, Colorado and Washington while retaining some seeds for the Highmore Farm, a substation of the South Dakota Agricultural Experiment Station.²

¹ *Annual Reports of the Department of Agriculture for the year ended June 30, 1908* (Washington, D.C.: Government Printing Office, 1909), 130.

² Arthur Dillman, “The Beginnings of Crested Wheatgrass in North America,” *Journal of the American Society of Agronomy* 38 (1946): 238; George Rogler and Russell Lorenz, “Crested Wheatgrass – Early History in the United States,” *Journal of Range Management* 36 (January 1983): 91-3; Harvey Westover,

The first experiment stations in the United States followed the pattern of stations that already existed in Europe. German and British scientists created the first agricultural experiment stations in the 1840s and by 1884 there were 148 experiment stations in Europe. In 1875 in Middletown, Connecticut the first agricultural experiment station in the US was organized through the joint action of Orange Judd, the board of trustees at the university at Middletown, and the state legislature. By 1881 four experiment stations operated in the states of Connecticut, North Carolina, New Jersey and New York and during that year several state legislatures created experiment stations by reorganizing the departments of agriculture at the land-grant universities. Prior to reorganization, many of these land-grant colleges already carried on work similar to that of the experiment stations. Congress passed an act to establish experiment stations at the land-grant colleges and to offer financial support to those stations already in existence in 1887. Known as the Hatch Act, this act provided funds to experiment stations while also providing a means for the Department of Agriculture to become involved in directing agricultural experiments nationwide. The Secretary of Agriculture created an office of experiment stations that coordinated the transfer of reports between stations and the translation of reports from European stations. In this way experiment stations participated in a transatlantic exchange of information regarding the latest developments in scientific agriculture.³

J.T. Sarvis, Leroy Moomaw, George Morgan and John Thysell, "Crested Wheatgrass as Compared with Bromegrass, Slender Wheatgrass, and Other Hay and Pasture Crops for the Northern Great Plains," *USDA Technical Bulletin 307* (Washington, D.C.: Government Printing Office, 1932), 2-3.

³ A.C. True, "A Brief Account of the Experiment Station Movement in the United States," in *Organization of the Agricultural Experiment Stations in the United States, USDA Experiment Station Bulletin 1* (Washington, D.C.: Government Printing Office, February 1889), 73-8.

The motivation behind agricultural experiment stations came from the needs of local farmers and from Americans' desire to keep pace with worldwide trends in agriculture. When the Committee on Agriculture presented their recommendations to the House of Representatives on March 3, 1886 they cited several reasons for the stations, including, "The decay of agriculture in the older States, the deterioration of soils in the first-settled group of new States, the rapid absorption of public lands, and the increasing competition of Russia and India in the food markets of the world."⁴

To the researchers who shaped the experimental landscape, crested wheatgrass belonged only in as much as it provided for the needs of local farmers in bringing them a more rational and scientific agriculture. In the 1880s, the Committee on Experiment Stations predicted that "the stations will be sustained in proportion as they help the cause they are intended to serve. It is essential that they recognize the immediate demand for things immediately useful; that they find what questions are of direct, practical importance, and give such questions an amount of early attention which under other circumstances might be disproportionate." The needs of the farmer provided the values and questions that guided station research, and in turn the experiment stations provided information and technical assistance to farmers. To this end the USDA published regular farmers' bulletins in order to convey the results of agricultural experiments in "a form so plain that the intelligent farmer will understand it, so brief that he will read it through, and so practical that he will take it to heart."⁵

⁴ "Report of the Committee on Agriculture of the House of Representatives, March 3, 1886," House Report No. 848, Forty-ninth Congress, First Session, reprinted in *USDA Experiment Station Bulletin 1*, 61.

⁵ *USDA Experiment Station Bulletin 1*, in the introduction by the Secretary of Agriculture quoting a report by the Association of American Agricultural Colleges and Experiment Stations' Committee on Experiment

Foreign Plant Introductions

The introduction of plants from other parts of the world into North American landscapes has a long history. As long as humans have been migrating to the continent they have intentionally and unintentionally brought seeds with them. Immigrants and merchants from Europe and from other parts of the world have carried plants, animals and pathogens with them both to and from the Americas. Historians have written extensively about the consequences to societies and to ecosystems that have resulted from this transfer, which they refer to as the Columbian Exchange.⁶ In the colonies governors and plantation owners sought after and introduced valuable crop plants. They also inadvertently introduced less desirable species. At the time when the United States declared independence from Britain enterprising land owners and politicians like Benjamin Franklin and Thomas Jefferson encouraged and participated in plant introductions. While Jefferson served as minister to France, he sent seeds of rice and other grasses as well as peppers, olives and several kinds of trees.

Plant introductions continued throughout the 1800s and by 1862, when the Department of Agriculture became a separate unit of the government, the international exchange of seeds had developed a roughly organized system. In the 1880s the funding of experiment stations fueled a revival of interest in finding new and valuable agricultural

Stations, 9. The second quote comes from the body of the Bulletin, 13; Alan Marcus, *Agricultural Science and the Quest for Legitimacy: Farmers, Agricultural Colleges, and Experiment Stations, 1870-1890* (Ames: Iowa State University Press, 1985).

⁶ Alfred Crosby introduced the topic of the biological and environmental consequences of European colonialism with his book *The Columbian Exchange* (1972), followed by *Ecological Imperialism* (1986), and *Germ, Seeds and Animals* (1994).

plants, and in 1897 Secretary of Agriculture James Wilson sponsored the office of Seed and Plant Introductions which became part of the Bureau of Plant Industry.⁷

Through the expanded efforts of the foreign plant investigations and the Bureau of Plant Industry, seeds of a hundred thousand different varieties poured into the experimental landscapes. However, many of these seeds were never planted. Of those planted, many showed poor results given particular environmental conditions. Of those plants that showed favorable results only a handful fit the needs of the surrounding agricultural systems. For any plant to find a place in the experimental landscape researchers had to show an interest in the plant and then had to gain funding and control of the space needed to grow it. The first attempt to bring crested wheatgrass to the United States produced few results. Hansen distributed seeds to a handful of stations. In Michigan, Indiana and Alabama crested wheatgrass, if it was planted, probably did not grow well given the climate to which it was adapted. Perhaps researchers in Colorado and Washington planted the grass but nothing immediately came of it.

Johnson T. Sarvis, who became the first booster of crested wheatgrass and who was known as the “cowboy botanist,” recalled seeing crested wheatgrass for the first time when he visited Highmore Farm in 1906. At Highmore Professor William Wheeler had a small nursery that he used for experimental breeding of dryland forage plants. In 1908 the new manager at Highmore decided to plow up the grass nursery. No record indicates that any of the seeds from Hansen's 1898 introduction survived. However, Johnson Sarvis, Professor Wheeler, and Arthur Dillman, one of Wheeler's students at the time, had seen

⁷ Knowles A. Ryerson, “History and Significance of the Foreign Plant Introduction Work of the United States Department of Agriculture,” *Agricultural History* 7 (July 1933): 110-128.

crested wheatgrass and they were aware of its potential. In the years that followed, Dillman and Sarvis would give crested wheatgrass the space it needed to become established in the experimental landscape.⁸

The second introduction of crested wheatgrass succeeded because the seeds reached researchers who were interested in finding drought tolerant forage plants for use in cold and arid agricultural landscapes. In 1906 Vasili Bogdan sent 25 to 30 pounds of seed labeled as two separate species to Neils Hansen in South Dakota. Hansen distributed these seeds to fifteen different experiment stations between 1907 and 1913. Crested wheatgrass seeds from this introduction thrived in a handful of experiment stations in North and South Dakota, Montana, Wyoming, Colorado and Saskatchewan. Plant scientists speak of safe seed sites as places where seeds find the right combination of conditions to allow for germination. The experimental landscape, as an intersection of conditions and values, provided a safe site for crested wheatgrass to germinate in North America. The following examples of experimental landscapes in the northern Great Plains and in the Intermountain West demonstrate how *belonging* is a function of conditions within particular landscapes and of relationships between different kinds of landscapes. These examples also demonstrate that belonging changes over time as a result of changes in environmental, economic and social conditions.

⁷ Dillman, "Beginnings," 238.

Crested Wheatgrass at Belle Fourche Station, SD

In 1908 the Office of Forage-Crop Investigations transferred the breeding experiments that Professor Wheeler began at Highmore farm to the Belle Fourche Field Station near the town of Newell, South Dakota. The newly hired assistant plant physiologist, Arthur Dillman, took charge of the plant breeding experiments. Most of Dillman's work focused on alfalfa, smooth brome (*Bromus inermis* Leyss.) and on two grasses gathered from local seeds, western wheatgrass (*Pascopyrum smithii* (Rydb.) A. Löve) and slender wheatgrass (*Elymus trachycaulus* (Link) Gould and Shinnars). In 1910 crested wheatgrass occupied a small space in Dillman's breeding nursery among the category entitled "various other forage grasses." As crested wheatgrass showed potential in the nursery and breeding experiments, Dillman passed seeds to other experiment stations. Dillman was slowly beginning to determine where crested wheatgrass belonged in North America in terms of environmental adaptation and specific agricultural uses.

Dillman believed crested wheatgrass belonged at Belle Fourche because it could provide forage for livestock and could tolerate drought. However, it was not at Belle Fourche that researchers gained a full appreciation for what crested wheatgrass could do. When Dillman began his research in 1908, the farms surrounding Belle Fourche still operated on the annual precipitation that nature provided. Between 1908 and 1932 the average annual precipitation at Belle Fourche was just over sixteen inches, while precipitation ranged from eight inches in dry years like 1931 to over twenty-four inches in wet years like 1928.

The record of precipitation that Dillman had for the Belle Fourche area extended back from 1910 only seventeen years. Had he been able to measure over a longer period of time he would have discovered that within the past 400 years, 160 represented what he considered drought conditions. Furthermore he would have known that drought years came to the area in a clumped pattern that lasted an average of thirteen years. However, neither Dillman nor the farmers surrounding Belle Fourche understood the long-term patterns of climate. As a result they developed the practice of plowing up more native sod during wet years only to abandon these fields when rainfall declined.⁹

In the decade following the opening of the Belle Fourche station the surrounding agricultural area became part of a federal reclamation project. Breeding dryland forage crops did not make much sense at Belle Fourche when local farmers were more interested in growing irrigated crops that were more productive and provided higher economic returns. In 1921, Dillman transferred to the Division of Cereal Crops and took charge of flax investigations and the dryland forage nursery moved to the Northern Great Plains Experiment Station in Mandan, North Dakota, where crested wheatgrass was already making a significant impression on the agronomist Johnson Sarvis.¹⁰

Though crested wheatgrass did not remain popular at Belle Fourche the information that Dillman gained about the plant's characteristics and life history helped

⁹ Johnson T. Sarvis and J.C. Thysell, "Crop Rotation and Tillage Experiments at the Northern Great Plains Field Station, Mandan, N. Dak.," *USDA Technical Bulletin 536* (Washington D.C.: Government Printing Office, 1936), 3; H.E. Weakly, "A Tree Ring Record of Precipitation in Western Nebraska," *Journal of Forestry* 41 (1943): 816-9, and L.R. Borchert, "The Climate of Central North American Grassland," *Annals of the Association of American Geographers* 40 (1950): 1-39, both cited in J.M Suttie, S.G. Reynolds and C. Batello, *Grasslands of the World* (Rome: Food and Agriculture Organization of the United Nations, 2005), 245.

¹⁰ Dillman, "Beginnings," 238; Arthur Dillman, "Breeding Drought-Resistant Forage Plants for the Great Plains Area," *USDA Bureau of Plant Industry Bulletin 196* (Washington D.C.: Government Printing Office, 1910), 9-10, 32.

to move the grass to places where it would grow well and where it would support the needs of local farmers and ranchers. Dillman's observations at Belle Fourche also suggest that the conditions that made crested wheatgrass so valuable resulted from the actions of farmers.

While aridity provided a precondition that made crested wheatgrass valuable, changes in the soil that resulted from plowing and breaking the sod provided the other condition. Dillman introduced crested wheatgrass into a patchwork of new projects at Belle Fourche in 1908, the summer after plows broke up and removed the native mixed-grass prairie plant communities from the station. Beneath the needle grass, western wheatgrass and prairie sage at Belle Fourche, researchers found a heavy clay soil known locally as "gumbo." As part of the Pierre shale formation, this gumbo clay covered more than one-fifth of the state of South Dakota and stretched outward in a semicircle across parts of Montana and Nebraska. As the smallest of the three types of soil particles clay typically moves downward through the top layer of soil, known as the A horizon, and collects in the lower B horizon. In the Great Plains however, ants and other soil organisms actively transport clay from the B up to the A horizon. The heavy clay content in the upper layer means that the soils absorb water slowly but will also store water well as long as they remain covered by vegetation or litter. When exposed to wind the clay dries, causing the particles to shrink together and to form deep cracks, sometimes as deep as four or five feet. During his first few years at the station, Dillman observed this drying of the soils which intensified during the winter months when parched and freezing

air passed through the cracks and reached deep beneath the surface. Dillman figured that this condition, even more than the cold alone, caused the winterkilling of forage crops.¹¹

This drying of soils that Dillman observed at the station also occurred on the newly created farms in the West, and in the 1930s, after so many farms had been abandoned, these dried out soils would blow away creating the dust storms of the Great Depression and providing the conditions in which crested wheatgrass would be particularly valuable. In the 1920s researchers at other experiment stations would discover that crested wheatgrass could grow even in these extremely dry soils, and that it would grow so much better than the other valuable forage plants, even the native grasses.

After 1915, the importance of crested wheatgrass increased at the Mandan and Dickinson stations in North Dakota, the Sheridan station in Wyoming, the Havre and Judith Basin branch stations in Montana, the Saskatoon station in Saskatchewan, the Manyberries Station in Alberta, and the station at Ardmore, South Dakota. Researchers in these landscapes cooperated with each other and with local farmers as they tested and measured crested wheatgrass's belonging.¹²

Crested wheatgrass at Mandan, ND

Crested wheatgrass owes much of its early distribution in the United States to the work carried out in the experiment station at Mandan, North Dakota. The experimental landscape at Mandan covered 1,280 acres and included a 250 acre experimental farm in

¹¹ Rex Pieper, "Grasslands of North America," In *Grasslands of the World*, J.M. Suttie, S.G. Reynolds and C. Batello, eds., Plant Production and Protection Series 34 (Rome: Food and Agriculture Organization of the United Nations, 2005), 221-63; S.W. Buol, F.D. Hole and R.J McCracken, *Soil Genesis and Classification*, 2nd ed. (Ames: Iowa State University Press, 1980), cited in Pieper, "Grasslands," 226; Dillman, "Breeding Drought-Resistant Forage Plants," 11.

¹² Aune, Hurst, and Osenburg, "Agricultural Investigation," 1-5; Westover et al. "Crested Wheatgrass as Compared," 2-3.

addition to 640 acres of native prairie used for grazing experiments. Researchers located the station on the west side of the Missouri River across from the city of Bismarck. Hundreds of miles of rolling hills and mixed-grass prairie surrounded the fields at Mandan. During the summer of 1913 plows cut through the thick prairie sod and prepared plots for experimental plantings. Plows sliced through a dense growth of needle-and-thread grass (*Stipa comata* Trin. And Rupr.), so called because of the long slender awn attached to each dark brown seed, blue grama (*Bouteloua gracilis* (H.B.K.) Lag.), and western wheatgrass, as well as grass-like sedges that grew in clusters standing up to four feet high. The roots of bull sod sedge (*Carex filifolia* Nutt.) formed the tightly-woven sod that earned the plant the nickname “nigger” wool. Other species included prairie sagewort (*Artemisia frigida* Willd.), false tarragon (*A. dracunculoides* Pursh.), June grass (*Koeleria cristata* Pers.), gray goldenrod (*Solidago pulcherrima* A. Nels.), blacksamson Echinacea (*Echinacea angustifolia* DC.), and the less common grass fendler threeawn (*Aristida logiseta* Steud.). Beneath the prairie of green and silver researchers uncovered soil they described as strong dark-brown, almost black. In reporting the work at Mandan, Johnson Sarvis and J.C. Thysell remarked upon the slowness with which the piles of wooly sedge roots rotted beside the newly exposed soil.¹³

¹³ Sarvis and Thysell, “Crop Rotation and Tillage Experiments,” 4.



Figure 8. Northern Great Plains Field Station, July 28, 1915. Source: Johnson T. Sarvis and J.C. Thysell, "Crop Rotation and Tillage Experiments at the Northern Great Plains Field Station, Mandan, N. Dak," *USDA Technical Bulletin 536* (Washington D.C.: Government Printing Office, 1936), 5.

The following summer, 1914, researchers began testing crop rotation cycles and tillage methods. They also searched for grasses and other plants that would augment the forage produced in pastures. Changing conditions in the agriculture and organization of settler communities increased the need for hay crops and pastures of high-quality forage. Prior to 1908 the native-plant communities growing on the prairie around Mandan had fed cattle on the open range. Then farmers moved into the area, many of them settling

homesteads under the Expanded Homestead Act of 1909, plowed up the prairie around Mandan and planted flax. Flax and wheat, grown without irrigation, became the most important crops in the area. Forage crops like alfalfa and perhaps, as some researchers hoped, crested wheatgrass provided farm income and also fed the livestock that provided the real income from dryland agriculture. The increasing number of farms diminished the amount of open range and created the demand for hay crops and forage that made crested wheatgrass valuable to researchers at Mandan.

Within the experimental landscape at Mandan researchers measured the value of crested wheatgrass based on the physiological characteristics of the plant itself and the plant's responses when grown in combination or in competition with other plants. Researchers also measured crested wheatgrass's nutritional value and palatability and its ability to compensate for herbivory. When crested wheatgrass first arrived at Mandan researchers gave it a spot on one-tenth of an acre beside the most promising forage plants and amid experiments with more than one hundred different species from many different parts of the world. At Mandan researchers grew an experimental forest that contained more than 8000 trees of 79 different species. They also tended ornamental plants, grape vines, berry patches and orchards.

Crested wheatgrass grew in straight rows where researchers carefully collected and measured its forage and seed yields. The neighboring rows of slender wheatgrass produced more hay initially but were killed by the frost and drought during the winter of 1919-20. Shortly afterward the rows of smooth brome became "sod bound" and lost their

productivity. Only crested wheatgrass continued to produce high yields, even after fifteen years.¹⁴

Crested wheatgrass out competed the other grasses not through direct competition for resources but through meeting the researchers' criteria. Crested wheatgrass began growth early in the spring and entered dormancy in the hottest and driest times of the summer, a growth pattern that made crested wheatgrass especially successful in the northern Great Plains where most precipitation occurred between April and July. Summer dormancy helped crested wheatgrass survive the dry spells and in the fall, if rains came again, crested wheatgrass broke dormancy and produced up to eight inches of fall growth, ideal for winter grazing. These traits gave crested wheatgrass an advantage in the eyes of researchers who hoped to find the most valuable drought-tolerant forage plants.¹⁵

In addition to adaptability studies, researchers planted crested wheatgrass in larger experimental pastures where cattle could graze it. They measured the grass's value in terms of its grazing preference, livestock weight gain, and grazing tolerance compared to other grasses. Researchers also examined the chemical composition of crested wheatgrass as a measure of nutritional value. At one station in Redfield, South Dakota, researchers placed a forkful of crested wheatgrass hay and a forkful of slender wheatgrass in front of several horses in a barn. They watched to see which hay the horses ate first and reported that "invariably the crested wheat grass straw was completely consumed first."¹⁶

¹⁴ J.M. Stephens et al., "Report of the Northern Great Plains Field Station for the 10-Year Period, 1913-1922, Inclusive," *USDA Department Bulletin 1301* (Washington, D.C.: Government Printing Office, 1925), 60-1.

¹⁵ Westover et al., "Crested Wheatgrass Compared," 16-17.

¹⁶ L.E. Kirk, "New Grass Under Test Adaptable to Southwest – Crested Wheat Grass has Great Possibility for Hay and Pasture – Combines Good Seeding Habit with Drought Resistance, Palatability, High Yield

Researchers devised means of measuring the value of crested wheatgrass in dollars and cents. At Ardmore, South Dakota, researchers quantified the monetary value of pasture grasses as measured by milk production. Using dairy cows, researchers estimated the value of an acre of crested wheatgrass at \$7.70, nearly a dollar an acre above smooth brome grass (\$6.75) and sweet clover (\$6.63), and more than three dollars an acre above native pasture (\$4.43). As a seed producer crested wheatgrass also out ranked both smooth brome grass and slender wheatgrass. Because crested wheatgrass produced so much seed it remained inexpensive compared to other grasses. It also had a higher germination rate.¹⁷

Crested wheatgrass's performance led researchers to believe that the plant belonged both environmentally and economically. As crested wheatgrass demonstrated its adaptability and forage value, researchers distributed seeds of the grass to farmers. Between 1918 and 1930 the Mandan Experiment Station in North Dakota distributed nearly 2,700 pounds of crested wheatgrass seed. Each pound contained between 250 and 300 thousand seeds; twice the amount of seeds found in a pound of slender wheatgrass. Twelve hundred pounds went directly to local farmers and 500 pounds reached farmers through county extension agents. Five hundred pounds went to experiment stations in the United States and Canada, and 500 pounds went to the Division of Forage Crops and Diseases for further distribution. Researchers distributed crested wheatgrass seeds from

and High Protein Content," *Saskatchewan Farmer* 19 (1928): 7, quoted in Westover et al., "Crested Wheatgrass Compared," 16.

¹⁷ Westover et al., "Crested Wheatgrass Compared," 27-8, 30.

the Judith Basin branch near Moccasin, Montana, as early as 1920 and in 1929 commercial seed catalogs began listing crested wheatgrass.¹⁸

The experimental landscape gave crested wheatgrass its roots in North America and it continued to shape the genetic and physical character of the grass throughout the century. Plant breeding work that Wheeler and Dillman started at the Highmore Farm continued at Belle Fourche until 1921 when Dillman transferred to the Division of Cereal Crops and took charge of the flax investigations. Through several plant selections at Belle Fourche, Dillman tried to create a variety of crested wheatgrass with relatively slender spikes and awnless seeds. Dillman's attempts to make awnless crested wheatgrass failed because, as he later learned, the grass was largely self-sterile and therefore naturally cross pollinated. In 1922 the work of breeding crested wheatgrass transferred to the Mandan station under the direction of Johnson Sarvis. In the nursery at Mandan, Sarvis planted four of the selections made by Dillman at Belle Fourche. Two of these selections, known as 98-9 and 98-11, produced an average of more than 200 pounds of seed per acre over the twenty year period between 1923 and 1943. Several thousand pounds of seeds from these two selections went out to farmers during that time. When directorship of the dryland plant breeding program fell to Sarvis in 1922 he already had seven years of experience with crested wheatgrass and believed the plant would make a valuable contribution to agriculture on the northern Great Plains.¹⁹

Researchers in the northern Great Plains tested, selected and distributed crested wheatgrass, and by 1930 the grass reached the Intermountain states of Utah, Idaho and

¹⁸ Westover et al., "Crested Wheatgrass Compared," 5, 31; Dillman, "Beginnings," 247.

¹⁹ Dillman, "Beginnings," 244-5.

Nevada. The popularity and use of crested wheatgrass spread quickly across the arid basin and range topography of the Intermountain region. The grass grew in private pastures across Idaho as early as 1933. In the Great Plains researchers had encouraged farmers to experiment with the crested wheatgrass, but in the Intermountain region it was often the reverse, with researchers responding to farmers' and land managers' use of the grass.

Crested Wheatgrass and the Intermountain Forest and Range Experiment Station

The Forest Service created the Intermountain Forest and Range Experiment Station with headquarters in Ogden, Utah, on July 1, 1930. The McSweeney-McNary Act of 1928 had separated Forest Service research from the regular administration of the national forests. The Intermountain Forest and Range Experiment Station became the management office for all forest and range research in the Intermountain region. The preexisting Great Basin Experiment Station which had operated in Ephraim, Utah since 1912, and the Cooperative U.S. Sheep Station in Dubois, Idaho fell under the direction of the Ogden office. A new Boise Branch Station opened in 1931 to develop methods of controlling soil erosion and to study stream flow. In the following years several additional branch stations were organized including the Desert Branch Station and the associated Desert Experimental Range, the Davis County Experimental Watershed and the Wasatch Branch Station.

The Forest Service ecologists who staffed the Intermountain Forest and Range Experiment Station studied the causes and effects of soil erosion, range reseeding, forest

production, grazing management and conducted experiments to reduce competition for forage by exterminating rodents. Two forest ecologists, George Stewart and Alvin Hull, Jr., more often called A.C., became particularly interested in using crested wheatgrass to improve range conditions. Previous decades of unrestricted grazing had led to serious damage from soil erosion. Unrestricted grazing also damaged the ecological integrity of native plant communities which contributed to the spread of invasive annual weeds. In the 1940s, Hull and Stewart started to experiment with the use of crested wheatgrass as a means of controlling the spread of the annual and invasive cheatgrass, that had taken over large portions of the characteristic sagebrush covered rangelands of the Intermountain region.²⁰

In the early 1940s Hull traveled to farms in southwestern Idaho to view fields where farmers had already planted crested wheatgrass. Hull reported his observations to the main office in Ogden, Utah. Copies of his letters also went to George Stewart, who at the time was the head of range reseeding research for the Forest Service in the region. Hull's fieldwork revealed that crested wheatgrass invaded stands of cheatgrass. The low-growing annual cheatgrass came to North America in much the same way as crested wheatgrass, aided by foreign plant introductions and the experiment stations. However, unlike crested wheatgrass, cheatgrass had proven especially prolific and researchers considered it an ecological invader. Cheatgrass spread along railroads where grass seeds fell from cars transporting livestock. Through its own mechanisms cheatgrass invaded the rangelands and prairies that had been overgrazed or exposed through farming. By the late

²⁰ A.C. Hull, Jr. and George Stewart, "Cheatgrass (*Bromus tectorum* L.) an Ecological Intruder in Southern Idaho," *Ecology* 30 (January 1949): 58-74.

1940s Hull and Stewart were lauding crested wheatgrass for its potential to replace cheatgrass on the range.

Hull and Stewart gave crested wheatgrass a new place in the experimental landscape. Hull conducted his first experiments comparing the growth of crested wheatgrass and cheatgrass between 1945 and 1947 at three sites near Boise, Idaho. “The only advantage of cheatgrass,” Hull concluded, “[was] that it is present in considerable amounts in some years without the labor of reseeding. This alone,” he continued, “is not enough on which to base a livestock operation... To use this basis with cheatgrass would mean a very limited operation if no supplemental feeding was done.” Through this description of cheatgrass Hull demonstrated that the measure of a plant’s belonging was largely a function of the economics of producing livestock. By this measure cheatgrass did not belong on the range because it produced less feed than other grasses not because it was harmful to ecological functions. During the following years Hull and Stewart argued that it was important to replace cheatgrass by reseeding perennial grasses because cheatgrass senescens early in the summer and creates a pronounced fire hazard.²¹

Hull compared crested wheatgrass to cheatgrass and found that it grew earlier in the spring, remained green longer in the summer, produced more overall herbage and displayed more stable production from year to year. The lowest yield measurement he had for crested wheatgrass between 1940 and 1947 was three times the amount of the lowest yield of cheatgrass for the same period. Hull’s measurements and observations

²¹ A.C. Hull, Jr., “Growth Periods and Herbage Production of Cheatgrass and Reseeded Grasses in Southwestern Idaho,” *Journal of Range Management* 2 (October 1949): 183-6; A.C. Hull, Jr. and George Stewart, “Replacing Cheatgrass by Reseeding with Perennial Grasses on Southern Idaho Ranges,” *Journal of the American Society of Agronomy* 40 (1948): 694-703; Hull and Stewart, “Cheatgrass an Ecological Intruder,” 58-74.

supported the conclusions he had reached after talking to farmers in the area. Through his experiments and several articles, Hull expressed his belief that crested wheatgrass belonged. He concluded that seeding crested wheatgrass or a combination of other grasses would considerably extend the grazing period, especially when seeded on ranges dominated by cheatgrass. Hull and Stewart increasingly focused on crested wheatgrass as a biological control. Perhaps the most renowned manifestation of this belief occurred on July 14, 1952 when Congress passed the Halogeton Control Act, which funded projects to seed crested wheatgrass as a way of fighting the spread of the invasive and poisonous plant, halogeton.²²

Crested Wheatgrass and the Crops Research Laboratory

The Crops Research Laboratory (which became the Forage and Range Research Laboratory in 1987) located in Logan, Utah, became one of the most important landscapes for the genetic development of crested wheatgrass. In the 1960s, Doug Dewey, a USDA Agricultural Research Service research geneticist, became particularly interested in creating hybrids of crested wheatgrass and he led several excursions to Asia and Eastern Europe to collect plant materials for breeding research. The experimental landscape continued to serve as a conduit for species and information to travel around the world. Dewey helped to facilitate this global sharing through the organization of the International Triticeae Consortium for scientists working with grasses that belonged to the *Triticeae* tribe. Back at home, on the eastern edge of the Great Basin in northern Utah, Dewey and his associates created a grass nursery at Evans Farm between the towns

²² A.C. Hull, Jr., "Growth Periods and Herbage Production," 183-6; William Mathews, "Early Use of Crested Wheatgrass Seedings in Halogeton Control," In *Crested Wheatgrass*, ed. Kendall Johnson, 27-28.

of Providence and Millville. Dewey's "living collection of perennial Triticeae grasses," as he called the nursery, contained as many varieties of crested wheatgrass and other perennial Triticeae grasses as grew in any one place anywhere else in the world.²³

By 1962, when Dewey began his own plant exploration trips for seed collecting, crested wheatgrass had already covered millions of acres of land in western North America. Researchers in the Great Plains had tested and proven the grass's value and the extensive plantings made by farmers and public land managers verified researchers' findings. Crested wheatgrass had a special place in Dewey's experiments because he valued agriculture and range improvement and because the grass had already proven valuable in both fields.²⁴

Through his observation of crested wheatgrass in the nursery, in the field and under the microscope, Dewey gained a unique and valuable perspective of the relationship between various species of crested wheatgrass. Dewey used cytogenetics to understand the relationship between different species of the grass based on chromosome counts and pairing. He had experience observing and collecting crested wheatgrass in its native habitats and had participated in hybridization and selection of the species. In the 1980s Dewey tried to work out the confusion that existed in the plant's taxonomy. He hoped that his work would serve other plant breeders in making predictions of the possibilities and outcomes of crossing different varieties of the grass. Dewey recognized

²³ Kay Asay and Doug Johnson, personal communication, 22 February 2008, Logan, Utah.

²⁴ Jerry Holechek, "Crested Wheatgrass," *Rangelands* 3 (August 1981): 152, 151-3. Holechek offered the estimate that crested wheatgrass covered 20 million acres in the United States and 6 million acres in Canada. It is very difficult to accurately estimate how much land has been planted to crested wheatgrass because seedings multiple seeding have been recorded for the same location and because many seedings on private land have never been recorded.

that in native, Old-World populations crested wheatgrass contained much greater diversity than was present in North American populations of the grass. Out of the ten species and nine subspecies recognized by the Soviet taxonomist N.N. Tzvelev, Dewey regarded only three as important for taxonomists to recognize in North America.

To define a plant species taxonomists often rely on subjective judgments. As a result taxonomists present different ways of interpreting genetic and biological diversity. Among taxonomists there are those known as lumpers and those known as splitters. Lumpers tend to recognize fewer species, with each species representing a wider variety of types. Splitters, on the other hand, tend to recognize more species with sharper distinctions being made between local and endemic varieties. To a certain extent, lumping and splitting results from individual interpretations of diversity. However, lumping and splitting also reflect real geographic and botanical differences. Plants that display genetic and morphological differences in their native habitats may easily hybridize and produce fertile offspring. By a purely biological definition these plants, however different they may appear in features, belong to the same species. In its native habitats across Central Asia crested wheatgrass exists as several endemic populations might be identifiable as distinct species in the field based on geographic and historical inferences rather than biology alone. Asian taxonomists have recognized anywhere from 2 to 15 different species and as many as 26 taxa (species and their related subspecies) of crested wheatgrass. In 1976 the Soviet researcher N.N. Tzvelev, Curator of Vascular Plants at the Komarov Botanical Institute in Leningrad, defined ten different species and

nine subspecies of crested wheatgrass. Chinese taxonomists recently recognized fifteen crested wheatgrass species, including five found only in China.²⁵

Taken out of their native habitat the crested wheatgrass species became much harder to distinguish. Species identified based on their geographic distribution could not be identified when grown in a common environment on the basis of biological relationships or morphological traits. Furthermore in the experimental landscapes, plants derived from diverse populations crossed and hybridized of their own accord. Species and subspecies of crested wheatgrass lost their taxonomic identity and genetic integrity because of extensive intercrossing in the nursery and in the field. Taxonomist Mary Barkworth recently used the term *de-speciation* to describe the process that created crested wheatgrass as it exists in North America.²⁶

Dewey recognized that great diversity existed in native populations of crested wheatgrass. The problem he faced was how to collect and make the best use of that diversity. Most of the crested wheatgrass growing in the United States and Canada in the 1930s and 1940s could be traced back to the handful of seeds that came from the Samara government region of Russia. In 1946 Arthur Dillman traced the distribution of crested wheatgrass back to the nurseries at Belle Fourche and Mandan. Though other introductions had been made and recorded between 1906 and 1946, Dillman seemed to think that these were not important in the distribution of the grass in the northern Great

²⁵ Doug Johnson, personal communication, 20 February 2008; N.N. Tzvelev, "Tribe 3, Triticeae Dum.," in *Poaceae USSR* (Leningrad: Nauka Publishing House, 1976), 105-206; S.-L. Chen and G.-H. Zhu, "Agropyron," in Z.-Y. Wu, P.H. Raven and D.-Y. Hong, eds., *Flora in China*, vol. 22 (Poaceae), (Beijing: Science Press, 2006), 439-441, cited in Mary Barkworth, "Agropyron Gaertn.," 277-9, In Mary Barkworth et al., eds., *Flora of North America: North of Mexico*, vol. 24 *Magnoliophyta: Commelinidae (in part): Poaceae, part 1* (New York: Oxford University Press, 2007).

²⁶ Douglas R. Dewey, "Taxonomy of the Crested Wheatgrasses (Agropyron)," in Johnson, ed. *Crested Wheatgrass*, 31; Mary Barkworth, "Agropyron," 278.

Plains. If Dillman was correct then crested wheatgrass in North America owed its genetic heritage to no more than 9 million seeds representing six accessions defined by Vasili Bogdan and Neils Hansen as two different species. These six accessions displayed morphologically differences in the shape and size of the seed heads and in the amount of leafy growth individual plants produced. Dillman based his breeding work on variations manifested in seed characteristics. In Canada, at the Saskatoon Experiment Station connected to the University of Saskatchewan, the plant breeder L.E. Kirk made a mass selection of leafy plants between 1925 and 1927 that led to the release in 1935 of “Fairway,” the first recognized cultivar (or certified variety that will carry on key characteristics of the parent generations) of crested wheatgrass.²⁷

Throughout the 1930s and 1940s crested wheatgrass was distributed under the names “Fairway” and “Standard.” Kirk developed Fairway from seeds that had been labeled *A. cristatum*. Standard crested wheatgrass referred to varieties that had been listed as *A. desertorum*. In 1953 federal governments created international standards for cultivated varieties and researchers quickly worked to register the plants they released as cultivars. In Canada researchers registered the cultivar “Summit,” while researchers in North Dakota registered “Nordan” and researchers in Idaho registered “P-27.” Researchers derived Nordan crested wheatgrass from Standard varieties while Summit came from a mass selection of seeds that had been introduced into Canada from the Omsk Experiment Station in western Siberia in 1925 and 1929. The variety P-27 came from introductions that Harvey Westover and C. Enlow collected in 1934 and labeled *A. sibericum*. Later taxonomists changed the name of this sample to *A. fragile*, though the

²⁷ Dillman, “Beginnings,” 241.

variety is still called Siberian wheatgrass. In 1969 the Canadian researchers released “Parkway,” which was an improved variety of Fairway and 1975 researchers in Nebraska released a second improved variety of Fairway that they called “Ruff.” Researchers in Utah released “Ephraim” crested wheatgrass in 1982, believing it to be a rhizomatous form of the grass. Unfortunately, Ephraim proved only weakly rhizomatous and only when grown where precipitation annual averaged fourteen inches or more. In 1984 researchers at the Crops Research Laboratory, including Kay Asay, Doug Dewey and Doug Johnson, released the first hybrid of crested wheatgrass, “Hycrest.” In 1995 many of the same researchers who had worked to release Hycrest released the cultivar “Douglas,” named in honor of Doug Dewey.²⁸

As researchers recognized the value of crested wheatgrass they expanded and refined their efforts to collect and to diversify their stores of the plant’s genetic material. Several recorded introductions of crested wheatgrass followed after 1906. The earliest came from the plant explorer Frank Meyer who spent ten years between 1906 and 1918 traveling in Asia collecting seeds and cuttings of valuable agricultural plants. His 2,500 plant introductions included five samples of crested wheatgrass. Three samples came from China [Liaoning (1906), Xinjiang (1913), and Hebei (1910)], one from northern Korea (1906) and one from seeds Meyer collected on sandy hillsides near the town of Sarenta in the Saratov District of Russia (1911). In November 1934 two scientists, C.

²⁸ J.R. Carlson and J.L. Schwendiman, “Plant Materials for Crested Wheatgrass Seedlings in the Intermountain West,” In Johnson, ed., *Crested Wheatgrass*, 45-46; USDA-NRCS Aberdeen Plant Materials Center, “Fact Sheet: ‘Ephraim’ Crested Wheatgrass,” Online resource. August 2004. 3 April 2008, <http://plant-materials.nrcs.usda.gov/pubs/idpmcfs5633.pdf>; K. H. Asay et al., “Registration of ‘Hycrest’ Crested Wheatgrass,” *Crop Science* 25 (1985): 368-9; K. H. Asay et al., “Registration of ‘Douglas’ Crested Wheatgrass,” *Crop Science* 35 (1995): 1510-1.

Enlow and Harvey Westover, donated crested wheatgrass seeds from Kazakhstan labeled as the species, *A. sibiricum* these were the seeds later reclassified as reclassified this species as *A. fragile* that were used to create 'P-27'. The following year Westover collected a sample of *A. cristatum* from Ankara, Turkey.

Collection of crested wheatgrass continued to expand throughout the twentieth century. In 1949 J. Harlan introduced samples of *A. cristatum* from six different sites in Turkey. In 1952 two additional samples came from Turkey followed by another in 1953. Samples of *A. cristatum* reached the United States through experiment stations in Spain and Portugal in 1956 and from the Russian Federation in 1961. These Russian samples came from the Vavilov Research Institute of Plant Industry and had already been bred into improved cultivars by Russian scientists. In 1962 samples came from experiment stations in Canada, Berlin, Australia, and Denmark. More samples followed: two in 1964 and twenty-two in 1966. By 1970 more than sixty accessions of crested wheatgrass had been donated from all over the world and had been catalogued and collected in the National Plant Germplasm System repositories. Many of these seeds are still held in refrigeration at regional repositories where researchers can request samples for experiments and where the seeds are kept safe to provide for the possible needs of future generations.²⁹

Plant explorers like Frank Meyer collected plants wherever they could find them. They gathered seeds in markets and in fields, from farmers and from experiment station researchers. They sent back anything they found. Over time seed collection targeted

²⁹ USDA, ARS, National Genetic Research Program, Germplasm Resource Information Network (GRIN – Online Database), National Germplasm Resources Laboratory, Beltsville, Maryland, http://www.ars-grin.gov/cgi-bin/npgs/html/tax_stat.pl (28 January 2008).

specific species and individuals within those species that displayed specific attributes. When Dewey traveled to the Soviet Union on a forty-five day plant collecting mission during the summer of 1977 he specifically wanted to collect a broad range of crested wheatgrass types because of his interest in breeding the plant and because of what he called “a recent increased awareness of the genetic hazards of seeding large areas to a single species with a narrow genetic base.”³⁰ Dewey believed that problems such as outbreaks of black grass bugs, which posed a major threat to range grasses in the 1960s, could be limited by breeding plants with genetic resistance to the insect.³¹

Like other researchers, Dewey’s interest in crested wheatgrass stemmed from conditions on farms and rangelands and from his own desires to have a successful career by providing valuable services to farmers. Dewey’s experience with crested wheatgrass reflected problems that farmers and land managers encountered when they planted it in large monocultures in the field. In spite of these problems, Dewey still defended the place of crested wheatgrass on the range. “In recent years,” he wrote, “more emphasis has been given to the use of native plants in range revegetation, and a considerable sentiment prevails that native plants should be used to the exclusion of exotics. Plant breeders and range scientists must be committed to the best plant materials regardless of their geographic origin. To do otherwise would unnecessarily hinder range improvement.”³²

Early studies with crested wheatgrass in the experimental landscape had shown the plant’s value as a dryland forage crop. The livestock industry and the agricultural

³⁰ Dewey was probably referring to epidemic outbreaks of diseases in corn and coffee. Researchers believed that genetic diversity might have effectively stopped the spread of these diseases.

³¹ D.R. Dewey and A.P. Plummer, “New Collections of Range Plants from the Soviet Union,” *Journal of Range Management* 33 (March 1980): 89, 89-94.

³² *Ibid.*

adjustment and conservation movements that began in the mid 1930s provided conditions in the agricultural landscape that made crested wheatgrass valuable to researchers. Within the experimental landscape crested wheatgrass became valuable because plant breeders could take advantage of its broad genetic diversity. Crested wheatgrass possessed valuable attributes and it could be hybridized and bred selectively to maximize these characteristics. In the Intermountain region researchers hoped that crested wheatgrass would help to restore productivity to the range by replacing less valuable plants. Because crested wheatgrass produced so many seeds and was desirable for livestock, it became an inexpensive ally in the costly and often unsuccessful fight against invasive annual plants. In each of these regards crested wheatgrass out competed native and invasive grasses.

Compared to introduced agricultural plants, native plants occupied a relatively small space in the experimental landscape. Though some of the earliest experiments involved native species and many of these species continue to be useful to agriculture, it was not until the public became interested in native plants for reasons of aesthetics and biodiversity that programs for native plants expanded and gained importance in the experimental landscape. The growing interest in native plants during the 1980s caused Dewey to become defensive. These changing interests also created the conditions for the Crested Wheatgrass Symposium in 1983 where Dewey met with others who shared his concern about recent challenges to the grass's belonging. At the symposium these researchers recounted the grass's history and its great contributions to the rangelands and farmlands of North America. Indirectly, Dewey and his colleagues outlined a means of evaluating belonging that involved history and ecology, a means that measured belonging

in terms of economic and social conditions as well as physiological fitness in specific environments. Using these measures, Dewey and his fellow researchers argued that crested wheatgrass belonged. Any argument to the contrary, according to them, was neither scientific nor logical. Through their defense of crested wheatgrass these researchers summarized the conclusion that had been reached over seventy-five years of research: scientifically and logically crested wheatgrass belonged. However, through their defense of crested wheatgrass these researchers also demonstrated that scientific logic alone was insufficient.³³

³³ Kendall Johnson, "The Social Values of Crested Wheatgrass: Pros, Cons and Tradeoffs," in Johnson ed., *Crested Wheatgrass*, 334.

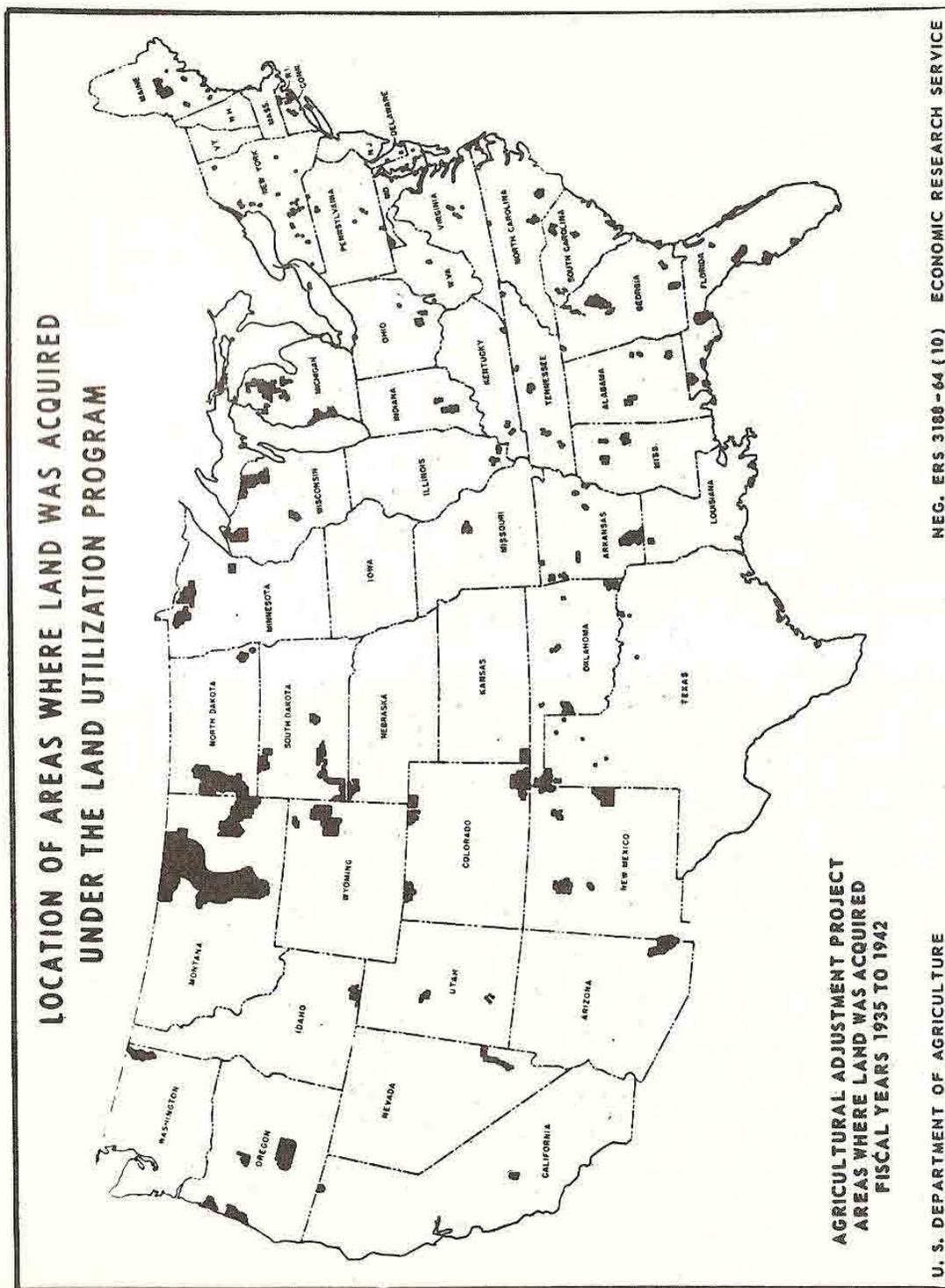


Figure 9. Location of Areas Where Land Was Acquired Under the Land Utilization Program. Source: H.H. Wooten, *The Land Utilization Program 1934 to 1964: Origins, Development, and Present Status* (Washington, D.C.: Government Printing Office, 1965).

CHAPTER III

THE AGRICULTURAL LANDSCAPE

In the keynote address at the 1983 crested wheatgrass symposium, Professor Lee Sharp from the University of Idaho in Moscow described the conditions of drought and depression during the 1930s that led to the widespread use of crested wheatgrass to stabilize farm economies by replacing wheat fields with pastures, and to secure farm soils that were eroding from unplanted fields. After describing these conditions Sharp asked, “Was it fate or manifest destiny that put crested wheatgrass in the right place at the right time?” Sharp’s description of the causes of farm failure in the 1920s and 1930s answered his own question. As causes of the conditions that made crested wheatgrass useful he listed: advancing technology, an increase in the area devoted to crops, increased production and consequently depressed farm prices, and a severe drought that caused a massive abandonment of farm land in the plains and western states. Sharp described the 1930s as a decade of dust storms, “the fruits of unwise land policy,” and “a period of transition from a land policy stressing settlement to one conserving the land for the general welfare of society.”³⁴

The agricultural experiment stations had succeeded in providing a more rational and scientific agriculture. They succeeded in increasing production and providing higher efficiency methods, plants and machines. During the 1920s the cost of this transformation became apparent in the ruin of farmers and the land. Agriculture pushed too hard, extended too far, and demanded too much, without respect for or anticipation of the

³⁴ Lee Sharp, “Keynote Address. Crested Wheatgrass: Its Values, Problems and Myths,” in Johnson ed. *Crested Wheatgrass*, 4.

consequences. The new business of industrial agriculture in the American West created a landscape that historian Donald Worster called our *cultural boneyard*.³⁵

The boneyard resulted, according to Worster, from the application of capitalist ideals to the use and management of natural systems. The capitalist culture espoused three maxims: nature must be seen as capital; man has a right, even an obligation, to use this capital for constant self-advancement; and the social order should permit and encourage this continual increase of personal wealth. This ethos conceptually, and consequently physically, reduced diverse and interdependent living systems into raw materials for producing profits.³⁶

The Homestead Act of 1862 and the expanded Homestead Act of 1909 succeeded in putting much of the land in western states into private hands. However, the legislation's goal of creating a yeoman class living on small farms collapsed in the face of capitalist competition and consolidation. Owners and tenants of small farms struggled just to make a living while those who had capital collected the land from failing farms. In the 1920s, when wheat prices fell and agricultural depression began, bare soils and abandoned farmlands lay in place of native ecosystems.

During the 1930s the federal government mobilized to help farmers and the land recover from the economic and the related ecological disasters. Crested wheatgrass assisted in recovery programs in two ways. By replacing crops that already had a large

³⁵ Two books that have largely influenced the construction of this contextual narrative are Sidney Baldwin, *Poverty and Politics: The Rise and Decline of the Farm Security Administration* (Chapel Hill: University of North Carolina Press, 1986); Donald Worster, *Dust Bowl: The Southern Plains in the 1930s* (New York: Oxford University Press, 1979), quote on page 3; David Hamilton, *From New Day to New Deal: American Farm Policy from Hoover to Roosevelt, 1928-1933* (Chapel Hill: University of North Carolina Press, 1991); John Opie, *The Law of the Land: Two Hundred Years of American Farm Policy* (Lincoln: University of Nebraska Press, 1987).

³⁶ Worster, *Dust Bowl*, 6.

surplus, crested wheatgrass helped decrease production and stabilize prices and, at the same time, it protected farm soils against erosion and weeds. Grazing became the major use of much of the land that farmers and federal assistance programs planted with crested wheatgrass. One of the largest programs to support the planting of crested wheatgrass in agricultural landscapes was the program of agricultural adjustment through federally funded land utilization projects.

Background of Federal Land Utilization

Up until World War I homesteaders continued to claim and create small farms on the dry plains of western North America. Wheat prices peaked while the war raged in Europe and farmers converted even poorly suited prairies into wheat fields. Post-war price collapses led to farm failures, bank foreclosures, and tax delinquencies. For the period from 1921 to 1925 farm bankruptcies averaged more than seven for every one thousand farms in the state of Montana while in the neighboring states of North and South Dakota, Idaho and Wyoming farm bankruptcy closed three out of every one thousand farms. Bankruptcies in Montana in both 1924 and 1926 reached over 2000 percent of the average of bankruptcies for the pre-war period from 1910-1914. The state recorded 3006 bankruptcies in the 1920s.³⁷

Those farms that survived bankruptcy and tax delinquency had to grow. The farm landscape entered a period of consolidation in which business farmers and bankers bought the old homesteads. Large land holdings allowed farmers to make a profit from their crops that would have been impossible with small farms. As large farm businesses

³⁷ R.R. Renne, "Montana Farm Bankruptcies," *Montana Agricultural Experiment Station Bulletin 360* (Bozeman: Montana State College Agricultural Experiment Station, 1938), 17.

started to do very well small farmers had an even harder time competing in the market. Small farms that were not taken up in the consolidation were often abandoned and reclaimed by the county when owners did not pay their taxes. This landscape of changing ownership was matched by changing social expectations. Rural sociologists became concerned about the impoverished conditions in which owners of small farms lived. Farmers in rural areas lived in dispersed communities, making it difficult to build infrastructure. The situation only worsened when farmers failed to pay taxes.

Western states saw more farm foreclosures and tax delinquencies in the 1920s than in any other decade. By 1930, politicians and federal agencies had the combination of rhetoric and conditions (both economic and environmental) they needed to gain public approval for programs to help owners and tenants of small farms find a different way to live. In November 1931, Secretary of Agriculture Arthur M. Hyde convoked a National Conference on Land Utilization. He invited representatives from the Department of Agriculture and the Department of the Interior, state agricultural colleges, farm organizations and other interested parties. Out of the conference in Chicago came the National Land Use Planning Committee whose focus was to find a solution to the problems caused by attempting to farm submarginal lands. The term “submarginal” refers to land where the cost of farming is greater than the market value of the crops grown on it. The committee’s broadly stated goal was to promote the reorganization of agriculture in order to divert lands from unprofitable use and to avoid cultivation of land that contributed to the poverty of those who lived on it. The committee, led by Secretary Hyde, envisioned a program of agricultural adjustment in which the federal government

would lease submarginal lands from farmers and convert these lands to other uses such as parks for recreation and grasslands for grazing. The program would release farmers, ensnared in mortgage debt and tax delinquency, and would put to good use land being wasted by misuse.³⁸

In 1933 President Hoover asked Congress to act upon the committee's recommendations. The National Planning Board, established in July 1933, became the National Resources Planning Board in 1934 through President Franklin D. Roosevelt's executive order. The Board prepared a comprehensive report of the nation's land and water use. The board recommended that State and Federal forests, public parks, recreation areas, Indian reservations and wildlife refuges should replace farming on submarginal lands. They recommended the purchase of 75 million acres and they enlisted the work of soil conservation officers in order to reclaim farmlands for these other uses. In 1934 Congress approved funding for the program and made appropriations from the Federal Emergency Relief Administration.³⁹

Congress intended the initial budget of \$ 25 million for use in demonstration projects. The Bureau of Indian Affairs, the National Park Service, the Bureau of Biological Survey, and the Department of Agriculture each played a part in the planning and purchase of Land Utilization projects. Planning and purchase began in 1934. By 1937 over 5.4 million acres had been purchased and an additional 4 million acres had been approved. Agricultural adjustment, which would convert the purchased land into grasslands or forests, represented 6.8 million acres covering 98 different land utilization

³⁸ Hugh Wooten, *The Land Utilization Program 1934 to 1964: Origins, Development, and Present Status* (Washington, D.C.: Government Printing Office, 1965), 4.

³⁹ *Ibid.*, 4-5.

projects. Indian reservations would gain 1.2 million acres and 723,000 acres would become wildlife refuges. The remaining 402,000 acres went to recreation areas.

In 1937 Congress passed the Bankhead-Jones Farm Tenant Act through which they intended to extend the work of agricultural adjustment. The Bankhead-Jones Act moved agricultural adjustment from the Agricultural Adjustment Administration to the Farm Security Administration (FSA). Initially congress approved \$10 million for the first year and \$20 million each year thereafter. However, after the first year the appropriation fell to \$5 million. Eighty percent of the first \$10 million went to purchase lands in the Great Plains. In 1938 agricultural adjustment transferred to the Soil Conservation Service. Land acquisition continued until 1943 and reached a total of 11,342,000 acres. Over the next decade the federal government distributed the land utilization lands between various agencies. Some went to the Bureau of Indian Affairs and some to the Bureau of Biological Survey, now known as the Fish and Wildlife Service. A small portion went to the National Park Service. On January 2, 1954 the secretary of agriculture established nineteen national grasslands comprised of 3,804,000 acres of the remaining land utilization lands. The management of these national grasslands fell to the Forest Service which continues to hold responsibility for these lands today.⁴⁰

Crested wheatgrass became important in this program that combined the removal of impoverished rural farmers with the realignment of land uses to match land characteristics. Through agricultural adjustment and rural resettlement crested wheatgrass eventually covered several million acres in the northern Great Plains and in other parts of the West.

⁴⁰ Wooten, *Land Utilization*, 29.

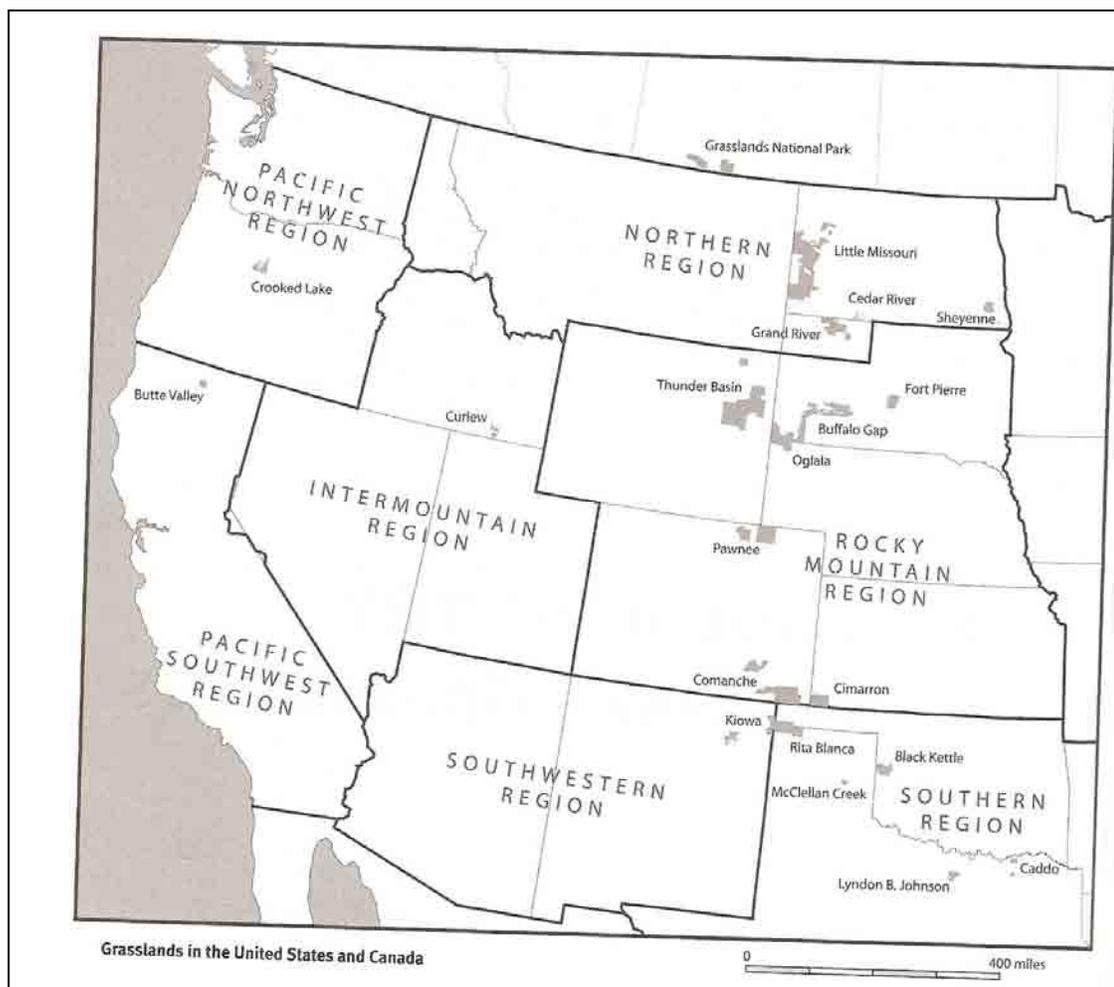


Figure 10. **Grasslands of the United States and Canada.** Source: Francis Moul, *The National Grasslands: A Guide to America's Undiscovered Treasure* (Lincoln: University of Nebraska Press, 2006).

An Example of Land Utilization in Southern Idaho

One land utilization project where crested wheatgrass has had an especially important and interesting history came out of the purchase of failing farms in the Curlew Valley of southern Idaho. Crested wheatgrass helped convert this cultural boneyard into a National Grassland that is used intensively by livestock owners who belong to two grazing districts, while also being managed as habitat for wildlife and recreation. The history of how this valley was converted from sagebrush steppe to dry-farms to

grasslands involves several different conditions including the environment and topography and the patterns of ownership and use. Crested wheatgrass was planted on 30,000 acres of Bankhead-Jones land utilization properties as a way of covering up and repairing the damage caused by failure in one type of agricultural landscape, specifically that of the small dry-farm. With the help of crested wheatgrass, the Curlew Valley still supports cattle grazing.

The Curlew Valley basin runs north and south between the sagebrush covered benches and narrow ranges that represent the typical topography of the Great Basin. Between 32,000 and 14,000 thousand years ago, the Curlew Valley lay under the far northern edge of Lake Bonneville. The soils of the valley floor and the surrounding benches formed from alluvial deposits. The heaviest sediments that entered the lake from runoff and river inlets settled nearest to the shoreline. Smaller and lighter particles stayed in suspension longer and drifted further out into the lake and finally settled on the broad basin floor. As a result the benches contain coarser material and loamy soils while the lowlands consist of fine-grained clay soils. Before dry-farmers plowed the Curlew Valley and removed the native plant communities, patches of sagebrush, shadscale saltbush (*Atriplex confertifolia* (Torr. & Frém.) S. Watson), rabbitbrush (*Chrysothamnus* Nutt.), and blue bunch wheatgrass covered the landscape in a mosaic that reflected microclimates created by both subtle and dramatic variations in soils and topography.⁴¹

⁴¹ Rosemary Sucec, *Still Ancestral Homeland: An Ethnographic Overview and Assessment of American Indian Histories and Resource Uses Associated with Hill Air Force Base, Utah* (Hill Air Force Base, Utah: Department of Defense, 2007), 16-7. F.S. Harris, "Report of F.S. Harris on Land in the Northwest Part of Box Elder County, Utah, and in Southern Idaho," 10 November 1927, contained in Herschel Bullen to Luther Foss, 29 January 1934, Herschel Bullen Jr. Papers, Merrill-Cazier Library Special Collections, Logan, box 6, fd 4.

By the time farm settlers staked their claims the Curlew Valley already had a long history of human habitation. People, whose descendants are known today as the Northwest Band of the Shoshone Nation, used the Curlew Valley as a place to hunt rabbits and other game. These people spoke a Numic dialect and lived in several dispersed groups that interacted with one another at different times of the year. They moved frequently to make the best use of their environment and they used more than sixty of the 117 principal plant species found in the area for food, medicine, shelter, tools and warmth. Their main food sources included wild grass seeds, pine nuts, camas roots, trout, chubs, suckers, ducks, rabbits and pronghorns.⁴²

In January 1863 federal troops massacred more than half of the Northwest Band of the Shoshone when they were gathered for their winter camp on the banks of the Bear River in the Cache Valley area of southern Idaho. The survivors dispersed onto reservations that were created through subsequent treaties. Some went to Fort Hall to the Shoshone-Bannock reservation while others went to the Wind River Reservation or moved to Deep Creek in Nevada. One of the principal survivors was Chief Sagwitch. He and those who followed him refused to go to the reservations and they settled for a time near the town of Corinne, in Box Elder County in northern Utah. After a confrontation between the settlers of Corinne and their Mormon and Indian neighbors, an episode known to history as the Corinne Scare, the Shoshone fled in the middle of the night leaving almost all of their belongings behind. A few years later in 1880 the LDS Church created a cooperative farm community for the Northwest Band. The community, given

⁴² Ibid., 19, 55-65.

the name Washakie, was home to the Northwest Band until 1966 when the homes were burned and the people forced to move.⁴³

The Northwest Band used the Curlew Valley mostly as a place of passing as they moved between the pine nut areas in Nevada and the marshes of the Bear River. In the 1860s the transcontinental railroad passed through the southern end of the valley. The wedding of the rails occurred less than 20 miles away on Promontory Mountain near the northern shore of the Great Salt Lake. The Railroad Act signed by President Lincoln in 1862, six months after the signing of the Homestead Act, granted railroads ownership of all the even-numbered sections, as outlined by the public land surveys that lay within a twenty-mile buffer of the railroad. In 1870 Charles Crocker, one of the directors of the Central Pacific Railroad Company, bought 400 thousand acres of land in the Promontory and Curlew Valleys. Crocker formed a ranch on this checkerboard of land. The ranch operated until 1909 when several prominent Utah businessmen purchased all 400,000 acres and started the Promontory-Curlew Land Company in order to sell the land off in smaller parcels.⁴⁴

The Promontory Curlew Land Company owned the even-numbered sections in the southern portion of the Curlew Valley. Further north the Curlew Valley remained for the most part within the public domain. Ranchers had free use of the public domain for grazing their cattle and the dry sagebrush benches and lowlands of the Curlew provided

⁴³ Patty Timbimboo Madsen and John Warner, personal communication, 27 February 2008; Sucec, *Ancestral Homeland*; Scott Christensen, *Sagwitch: Shoshone Chief, Mormon Elder, 1822-1887* (Logan: Utah State University Press, 1999); Forrest Cuch, ed., *A History of Utah's American Indians* (Salt Lake City: Utah State Division of Indian Affairs and Utah State Division of History, 2000); John Heaton, *The Shoshone-Bannocks: Culture and Commerce at Fort Hall, 1870-1940* (Lawrence: University of Kansas Press, 2005).

⁴⁴ Herschel Bullen, Jr., "History of the Promontory Curlew Land Company (Draft)," Herschel Bullen, Jr. Papers, box 4, fd 8.

forage for many livestock. Homesteading increased in the Curlew Valley between 1906 and 1914 in part due to the expanded Homestead Act that doubled the size of the homestead claims from 160 to 320 acres, but probably much more as part of a general fervor of land speculation and the desire to make money from the development and sale of cheap lands.

During the First World War land sales dropped and the Promontory-Curlew Land Company created sales brochures in 1917 to try and sell their remaining holdings. The brochures claimed that the Curlew Valley contained some of the best land for dry-farming in the West. However, the company had already sold most of the best farm land before 1913. Few sales followed from the advertisements even with the company's promise of wealth to level-headed farmers; claims which were more likely deceptive than optimistic.⁴⁵

Some interesting patterns of ownership emerge out of the claims and deed records of the Oneida County records office for land owned in the Curlew Valley between 1906 and 1940. Homesteading increased during the first decade and a half until almost all of the land in the valley belonged to private owners. In order to prove a claim the homesteader would have to show evidence of a permanent dwelling on the property even though most owners lived in nearby towns for the greater part of the year. Homesteaders who did use their claims as farms spent the first season removing sagebrush. The main crops in the dryfarm areas were wheat and rye while sugar beets were popular in irrigated fields. Between 1910 and 1920 farmers gathered in several big harvests from these new

⁴⁵ "European War Will Make Wheat Raisers Millionaires," ca. 1917, Bullen Papers, box 4, fd 10. Bullen, "History of the Promontory Curlew Land Company"; Craig Torbenson, "The Promontory-Curlew Land Company: Promoting Dry Farming in Utah," *Utah Historical Quarterly* 66 (Winter 1998): 14-5.

farms. High wheat prices also encouraged new farm homesteads. After 1920 farms began to fail. Beginning in 1923 tax delinquencies started to fill the books of the Oneida County Recorder; over six hundred would be recorded in the county before 1940.

The names of a few entrepreneurs dot the books of land purchases and sales in Oneida County. David L. Evans and his wife Margaret began purchasing homesteads in 1908 and by 1920 they owned dozens of properties comprising several thousand acres. Evans also started a bank and began acquiring property through mortgage foreclosures. Thus, the short flurry of homesteading was followed by a period of consolidation. Bankers were joined by livestock companies like the Bar B Company owned by the Browning brothers who were heirs of the Browning Firearm fortune. The Promontory Curlew Company sold its last 40 thousand acres to the Browning brothers for a nominal price. The secretary, Herschel Bullen, explained that “the 1930s were years of mortgage foreclosures, bank failures and depression at its worst.” With no new sales but taxes every year, Bullen said they were looking and hoping for a chance to sell out.⁴⁶

In this era of consolidation and post-war price depressions many farmers abandoned their homesteads because they could not afford to live and farm there. When the federal purchases for the Curlew Valley Land Utilization Project began in January 1936 the first to sell were the land development companies and land owners who lived far away. On January 6th The Utah-Idaho Development Company based in Ogden, Utah sold seventeen parcels of land ranging from 155 to 798 acres for a total of \$16,053. Each property was individually appraised and purchased. In March, Hettie and Henry Ellis sold

⁴⁶ *Index to Deeds Volume 3, Reverse*, Oneida County Recorder’s Office, Malad, Idaho; Bullen, “History,” 20, 18.

their 160 acres for \$816 (\$5.10/acre). At the time of the sale the Hettie and Henry resided in Tekon, Washington. Local residents began selling their farms as well. David and Margaret Evans sold at least thirteen properties to the land utilization project between January and April 1938. They sold 4,391 acres for \$21,317, approximately \$4.85 per acre. Those who were most eager to get out of farming sold first while others held out, in some cases up to four years before selling. A few owners never sold out and the land utilization project engulfed these dispersed private properties.⁴⁷

During the fall of 1936 the Resettlement Administration began planting crested wheatgrass on the land utilization project lands in the Curlew Valley. After 1938 the Soil Conservation Service continued the work of planting crested wheatgrass and also built stock ponds and laid fences to make the landscape more suitable for use by livestock. In 1954 management of the Curlew Valley Project transferred from the Soil Conservation Service to the Forest Service. The Forest Service worked with organized grazing districts which controlled the distribution of grazing allotments on the National Grasslands. The Curlew National Grassland included 47,600 acres of which 30,000 had been planted with crested wheatgrass.

For thirty years, between 1936 and the mid-1960s the primary purpose of the land utilization project in the Curlew Valley was to provide forage for livestock. With this objective the land managers -- first the Soil Conservation Service and then the Forest Service -- maintained the Curlew National Grassland as an agricultural landscape. Land managers worked with livestock owners to build stock ponds and fence pastures. Land managers also protected crested wheatgrass from insects and from sagebrush invasion.

⁴⁷ Deed Record Book 18 and 21, Oneida County Recorder's Office, Malad, Idaho.

Then in the mid-1960s Wendell Johnson, the manager of the Curlew National Grassland, started to contemplate a redesign of the grassland's landscape. Johnson surveyed the grassland and found that crested wheatgrass grew in near monocultures on approximately 25,000 acres and crested wheatgrass with sagebrush dominated an additional 5,000 acres. Johnson believed that some structural adjustments like planting shrubs along the fences and tearing down the tallest and densest stands of sagebrush would make these acres of crested wheatgrass into better habitat for wildlife. He envisioned a landscape with the objective of nonagricultural use. He had to work with the crested wheatgrass already growing on the grassland, but he believed that he could make better wildlife habitat and keep most of the crested wheatgrass at the same time. Johnson's thinking represents the transition in thinking about rangelands that created the post-agricultural landscape, as will be seen in chapter IV.⁴⁸

Crested Wheatgrass Gains Popularity with Ranchers: Hull's Observations

At the sixth annual meeting for the American Society of Range Management in 1953 Montana rancher Burton Brewster recounted that "one conservation practice that has been very successful on our ranch and in most of Montana is the seeding of abandoned dry land fields and barren flats to crested wheatgrass. Our fields of crested wheatgrass produced many tons of hay that we carried over for use in emergencies." The sentiments expressed by Burton Brewster about the contribution of crested wheatgrass for making abandoned croplands productive and for providing emergency feed echoed from

⁴⁸ Wendell Johnson, *Curlew National Grassland Development Plan* (Caribou National Forest: United States Forest Service, 1970).

other parts of the West. Jerry Holechek, who worked as a professor of range ecology at New Mexico State University, had his first experience with crested wheatgrass as a youth living on a cattle ranch near the Crooked River in central Oregon. His parents planted crested wheatgrass on some of their deteriorated rangelands and increased the rancher's forage resources by four or five fold.⁴⁹

The mixed agricultural economy of the arid West included farmers who raised livestock for supplemental income and ranchers who raised hay to supplement the diets of their livestock. This economy developed through trial and error during the last half of the nineteenth and the first half of the twentieth century. Ranching in western North America depended largely on seasonal grazing of native rangelands that belonged to the public domain. For several decades prior to 1900, grazing on public lands had no set regulations or restrictions. As a result, overgrazing severely damaged the native plant communities upon which the industry depended.

Ranching in the Intermountain West required the seasonal movement of livestock from lowland winter range in the cold deserts of the Great Basin to spring and summer pastures at higher elevations. Severe weather conditions made it hard for animals to find forage on the winter range, especially after the accumulated effects of several years of grazing diminished populations of the most palatable plants. Ranchers across the West began feeling these effects during the 1880s when winter losses of livestock increased drastically. Texas ranchers lost as much as 30 to 40 percent of their herds during the winter of 1885-86, and in the Great Basin ranchers called the winter of 1889-90 the

⁴⁹ Burton Brewster, "My Personal Experience in Ranching for Profit and Conservation," *Journal of Range Management* 6 (July 1953): 222, 221-4; Jerry Holechek, "Crested Wheatgrass," *Rangelands* 3 (August 1981): 151.

“white winter” because of all the bleached skeletons that covered the range after the snows melted.⁵⁰

Overgrazing alone did not cause the death of so many livestock during these harsh winters in the 1880s. Cyclical drought patterns affected forage growth in ways that compounded the damage caused by overgrazing. The loss of winter forage because of grazing was also compounded by the loss of access to rangelands formerly used for winter grazing. As homesteaders settled new towns and farms, ranchers lost access to rangelands that formerly belonged to the public domain.⁵¹

After the losses of the 1880s, ranchers throughout the West became more dependent upon hay for winter feed. The earliest plants used for hay by ranchers in the Great Basin included alkali bulrush (*Bolboschoenus maritimus* L. Palla), cattail tule (*Typha* L.), and spike rush (*Eleocharis*). Ranchers found these plants near wet marshes and seasonal ponds. They used a thick scythe to cut the hay and often ended up cutting willow stems and rabbit brush (*Chrysothamnus*) and anything else that livestock could chew on during the cold season. Ranchers in the northern Great Plains placed special value on western wheatgrass which grew sparsely on most of the range but grew in nearly uniform stands in lower and wetter areas near stream banks. In the Great Basin ranchers depended heavily on a grass known both as blue joint and creeping wild rye (*Calamagrostis canadensis* (Michx.) P. Beauv.). After the 1900s, ranchers began growing hay crops, especially alfalfa, to feed their livestock through the winter. Ranchers harvested native plants for hay only once a year but when they started growing alfalfa

⁵⁰ These losses are described in detail in James Young and B. Abbott Sparks, *Cattle in the Cold Desert*, (Logan: Utah State University Press, 1985), 121-40.

⁵¹ *Ibid.*, 122,127.

they harvested as many as three crops a season increasing their hay yields by nearly four times.⁵²

In the Intermountain region the basin and range topography influenced the distribution of precipitation such that the lowlands and the benches used for winter and spring grazing received much less rain than the surrounding mountains. Crested wheatgrass belonged in the drier places. Streams and canals brought water to lowland farms, but on the dry benches most of the land received very little precipitation annually. The dry benches favored the use of crested wheatgrass while the high elevation rangelands that receive more precipitation favored smooth brome, timothy (*Phleum L.*), and orchard grass (*Dactylis glomerata L.*).

Crested wheatgrass provided feed for livestock throughout the spring before ranchers moved livestock up into high mountain meadows during the summer months. From a conservation perspective the ideal season for grazing the mountain meadows is from June to September. However, before ranchers had a reliable source of spring and fall forage they often kept their animals on the range longer than the ideal length of time. By providing more forage on the spring range, crested wheatgrass protected plants at higher elevations during the early stages of growth.⁵³

Farmers in North Dakota and Montana started planting crested wheatgrass in the 1920s when researchers at Mandan and at the Judith Basin branch experiment station

⁵² Ibid., 165-6.

⁵³ W.C. Clos suggested that the ideal dates for grazing in the high range in Central Utah, from a forage standpoint, were June 5 to September 25. At the time the Forest Service allowed grazing until October 15. W.C. Clos, "Extracts from Report on Grazing Conditions and Experiments, Manti National Forest," Files of the Agricultural Research Service Crops Research Laboratory (hereafter ARS CRL), Merrill-Cazier Library Special Collections, Logan, box 2 fd 2.

began large-scale seed distributions. Farmers in the Intermountain states of Utah, Idaho and Nevada started planting crested wheatgrass in the early 1930s. Herman Winter, a farmer in Pleasant Valley, Idaho, planted several acres of crested wheatgrass for seed and for pasture in 1932. During his appointment as an ecologist for the Intermountain Forest and Range Experiment Station, A.C. Hull visited Winter's farm in 1944 to inspect this planting of crested wheatgrass. In the twelve years that lapsed between Winter's first seeding and Hull's inspection visit the price of wheat had stabilized and was on the rise. In 1944 America was again at war and the terrible economic depression that ruined so many farmers during the two previous decades had ended. Herman Winter had plowed all of his crested wheatgrass in order to take advantage of high wheat prices. Even though he plowed up his own fields of crested wheatgrass Winter believed that "a man with livestock (sheep or cattle) cannot afford to be without a field of crested wheatgrass for early spring feed."⁵⁴

As A.C. Hull visited other farms and ranches in southern Idaho he heard similar sentiments about crested wheatgrass. The Nielsen Brothers - George, William and Irwin - planted their first fifty acres of crested wheatgrass in 1938 on a portion of rangeland midway between Idaho Falls and Greys Lake, land that they used for spring and fall grazing. Pleased with the results of the first planting, the Nielsen Brothers hired a local farmer to use his seed drill to plant crested wheatgrass on an additional 100 acres of land directly east of the town of Ammon. A.C. Hull visited with William Nielsen in 1944 to talk about crested wheatgrass. Hull learned that in 1942 the brothers had planted 400 more acres because the grass had proved so valuable to their sheep operation. William

⁵⁴ A.C. Hull, Jr. to Files, May 26, 1944, Subject: Plantings by Herman Winter, ARS CRL, box 1 fd 4.

said, regretfully, that in the spring of 1944 the brothers had decided to plow all of these 400 acres because they believed the seeding had failed.⁵⁵

Farmers and ranchers valued crested wheatgrass because it provided early spring grazing on rangelands that had been heavily stocked and depleted of much of the native forage. Crested wheatgrass belonged in the agricultural landscape of the farm and ranch because it cut the cost of operation by shortening the amount of time that livestock needed supplemental winter feeding. Soon after farmers and ranchers started planting the grass for its economic and nutritional benefits, they found that the grass could help solve other problems in the agricultural landscape. Crested wheatgrass could grow in harsh environments, even in soils that had severely dried out or had been badly eroded by wind and runoff. Crested wheatgrass also competed with weeds which were common on abandoned fields.

Depending on the price of wheat, farmers decided to plant more or less of their land with crested wheatgrass. In attempts to stabilize the fluctuating prices the federal government created the Soil Bank. Through the acreage reserves program, farmers received a subsidy for not planting key crops like wheat and through the conservation reserves program farmers received a soil rental for planting grasses and trees on crop lands taken out of production. Both of these programs constituted the Soil Bank and both aided farmers economically while attempting to improve the environmental and ecological conditions of private farmland.

⁵⁵ A.C. Hull, Jr. to Files, December 10, 1939 and June 2, 1944, Subject: plantings of crested wheatgrass made by Nielsen Brothers, ARS CRL, box 1 fd 4.

Farmers like Herman Winter also valued crested wheatgrass for its ability to compete with weeds in the field. When A.C. Hull visited Herman Winter's farm he found that "the original plantings [had] spread up to 200 feet through sagebrush, cheatgrass, and lava outcrops surrounding his fields." In several places crested wheatgrass had crossed over roads and was spreading into adjacent abandoned fields. If farmers did not already consider crested wheatgrass to be a valuable agricultural plant, this type of behavior might have caused some alarm. Instead it actually encouraged farmers and agricultural researchers who were looking for ways to combat less useful weeds.

The fact that crested wheatgrass spread on Winter's farm represents both the plant's potential and several contingencies in local environmental conditions and conditions of the surrounding plant communities. The communities that surrounded Winter's planting were disturbed and open to colonization. Normally a community comprised of native plants from a variety of functional groups (including a mixture of grasses, shrubs and broadleaf forbs) will resist invasion. Thus ecologists refer to these as closed communities, a term that they often represent as a measure of resource availability. Disturbances such as grazing and plowing created openings in plant communities and allowed for the spread of colonizing species. Natural disturbances like fire and mudslides have the same effect.⁵⁶

The potential of crested wheatgrass to spread through the understory of degraded sagebrush and cheatgrass dominated rangelands provided many ranchers with the hope that they could easily improve the grazing on these lands. From the cockpit of a small

⁵⁶ Hull, *Plantings by Herman Winter*, 1; Mark A. Davis, Philip Grime, and Ken Thompson, "Fluctuating Resources in Plant Communities: A General Theory of Invasibility," *Journal of Ecology* 88 (2000): 528-34.

airplane, Carl Rudeen seeded his 320 acres of sagebrush and cheatgrass near the town of Pocatello, Idaho during the fall of 1938. When A.C. Hull visited with Rudeen nearly six years later, Rudeen displayed a great enthusiasm for crested wheatgrass. Rudeen said that the grazing capacity of the area increased by four times because of the reseeding. As Hull described the reseeding he attributed much of the success of crested wheatgrass to a fire that had burned over the area in 1942. Two years after the fire Hull observed that young sagebrush seedlings were coming in very thick on the burn and the individual crested wheatgrass plants had increased about four times in size over those on the surrounding unburned areas.⁵⁷

As Carl Rudeen watched crested wheatgrass spread to fill in the openings created by the fire he began to believe that crested wheatgrass was the answer to making the range more productive for livestock. A.C. Hull wrote that Rudeen “firmly believes that 100 pounds of seed on 1,000 acres is better than on 10 acres because it will produce more forage (not so much crowding of plants) and will serve as a seed source and let the range reseed itself naturally.”⁵⁸

Crested Wheatgrass and Range Improvement

Contrary to Rudeen’s optimism that crested wheatgrass would spread naturally across the western range, rangeland managers found that they often had to work very hard to get the grass to grow. Beginning in the 1930s range improvement projects used federal funds and the expertise of federal land managers to replace sagebrush plant communities with stands of crested wheatgrass. In 1957 the Intermountain Region office

⁵⁷ A.C. Hull, Jr. to Files, May 26, 1944, Subject: Plantings by Carl Rudeen, ARS CRL, box 1 fd 4.

⁵⁸ *Ibid.*, 1.

of the Forest Service compiled an atlas of range reseeding and improvement projects that had taken place in all of the national forests in Idaho, Utah and Nevada between 1936 and 1957. According to the records in this atlas the Forest Service participated in reseeding more than 349,725 acres. Crested wheatgrass was planted in monocultures on 40,947 acres and in mixture with other grasses and clovers on 227,256 acres. The remainder of reseedings, more than 80,000 acres used grasses and plants other than crested wheatgrass.⁵⁹



Figure 11. Charles Demoisy, **Tractor-Drawn Wheatland Type Disc Harrow Clearing Sage and Preparing Seedbed for Grasses, The Rocks, Soldier Fork, Fish Lake National Forest, 4 September 1942**, Courtesy of FS Region 4 Ogden, Utah.

⁵⁹ Figures were compiled by the author from *Record of Reseeding Projects R4_1680_90_0005_7*, United States Forest Service Archives Ogden, Utah.

Early Research

Forest Service range managers had been trying, with limited success, to improve the forage production and quality on grazing lands since the Forest Service took over management of the federal forest reserves in 1905. In the first decade of the Forest Service, Arthur Sampson became the leader in the science of range management. He worked with botanist Frederic Coleville between 1907 and 1911 to test the best grasses to use for reseeding the range and the best methods to get the grass planted and to help it to grow. As Sampson saw it, “the grazing problem is the problem of getting the largest possible use out of the range,” and that meant “making the range grow the best possible crop of forage.” Sampson experimented with smooth brome, timothy, red top, Kentucky bluegrass and a few different varieties of clover. He also corresponded with forest rangers in eighty-six national forests in eleven western states who were simultaneously conducting reseeding experiments.⁶⁰

In 1912 Arthur Sampson transferred from his position in the Wallowa National Forest in Oregon to the Great Basin Branch Experiment Station near the town of Ephraim in central Utah. At the Great Basin Station Sampson undertook a most serious and intense application of scientific methods to improving the grazing problem. As part of these experiments Sampson gathered seeds of promising range grasses from neighboring forests and grew these in nurseries. He also undertook a scientific study of different methods of eradicating native plants like giant larkspur that were poisonous to cattle. He experimented with various methods of rodent poisoning in order to cut down on the

⁶⁰ Arthur Sampson, “The Reseeding of Depleted Grazing Lands to Cultivated Forage Plants,” USDA *Bulletin 4* (Washington D.C.: Government Printing Office, 1913), p 2.

competition for forage plants. Soon after Arthur Sampson transferred to the University of California in 1922 many of the experiments he had started in range reseeding gave way to new experiments that attempted to map the natural distribution of plant communities in relation to various soil and climate factors.⁶¹

Seeding Resurgence

The 1930s saw a revived interest in rangeland reseeding, created largely by the New Deal Conservation Programs. In 1933 President Roosevelt created the Civilian Conservation Corps and put thousands of men to work in the project of range improvement. The funding and the manpower were finally available to land managers to enforce the types of changes that Sampson had envisioned and experimented with. What the CCC lacked in technology they made up for in numbers. Two rangeland historians later characterized the reseeding efforts of the CCC as “a picture of futility.” The work was labor intensive and the dense stands of sagebrush, which had grown thicker as a result of grazing, made it difficult to lay the seeds. Improving the range therefore devolved into a battle against sagebrush. Crews of CCC developed the method of dragging heavy segments of railroad rail behind tractors, knocking over the mature sagebrush and opening up space for grass seedlings. They also employed fire, bulldozers,

⁶¹ Marguerite A. Israelson, comp. *Publications of the Intermountain Forest and Range Experiment Station, 1912 through 1952* (Ogden: Intermountain Forest and Range Experiment Station, 1952); David A. Prevedel, Durant McArthur and Curtis M. Johnson, *Beginnings of Range Management: An Anthology of the Sampson-Ellison Photo Plots (1913 to 2003) and a Short History of the Great Basin Experiment Station* (Fort Collins: USDA Forest Service, Rocky Mountain Research Station, 2005).

and the specially modified brushland plow, which had free-mounted discs that could individually maneuver over obstacles like stumps and large rocks.⁶²

As the Forest Service and the CCC became better grass planters other agencies also engaged in the work. The Soil Conservation Service, the Resettlement Administration, and the Farm Security all joined the work planting grasses during the 1930s. When the federal government combined the General Land Office with the Grazing Service to create the BLM in 1946, this agency became one of the leaders in range improvement using crested wheatgrass.

Crested Wheatgrass and the Fight against Weeds

In southwestern Canada farmers and agricultural researchers also took notice of crested wheatgrass's performance in relation to other plants in the field. Canadian and American scientists engaged in an ongoing dialogue that originated in the observations of crested wheatgrass growing on abandoned agricultural fields. Researchers published their findings in professional journals and in experiment station reports and in their publications they cited and commented on each others findings.

In 1942, the Canadian researcher T.K. Pavlychenko observed crested wheatgrass in competition with quack grass (*Elymus repens* (L.) Gould), sow thistle (*Sonchus* L.), Canada thistle (*Cirsium arvense* (L.) Scop.), poverty weed (*Monolepis* Schrad), leafy spurge (*Euphorbia esula* L.), and field bindweed (*Convolvulus arvensis* L.). In his paper,

⁶² James Young and Raymond Evans, "History of Crested Wheatgrass in the Intermountain Area," In *Crested Wheatgrass*, Johnson, ed., 21-5.

22; Joseph H. Robertson and C. Kenneth Pearse, "Artificial Reseeding and the Closed Community," *Northwest Science* 19 (August 1945): 58-66; James Young and Dan McKenzie, "Rangeland Drill," *Rangelands* 4 (June 1982): 108-113.

“The Place of Crested Wheatgrass, *Agropyron cristatum* L., in Controlling Perennial Weeds,” Pavlychenko argued that the soundest and most economical method for controlling weeds was through the use of more aggressive crop plants. In Saskatchewan farmers used alfalfa for this purpose on irrigated lands, and Pavlychenko demonstrated through a five year experiment that crested wheatgrass could do the same in dryland fields. “Experiments and practical usage have shown,” Pavlychenko wrote, “that no other grass has the competitive power of crested wheat grass in this area.”⁶³

Pavlychenko’s experiments began in 1933 when he planted the experimental weeds and continued when he introduced crested wheatgrass into the weed plots a few years later. At the same time, in Manyberries, Alberta, near the border of Montana, researchers experimented with reseeding methods to establish crested wheatgrass in abandoned dryland fields. On one seventy-acre field that had been abandoned prior to 1928 and then colonized by Russian thistle (*Salsola pestifer* A. Nels.), pasture sage (*Artemisia frigida* Willd.), tumbling mustard (*Sisymburuum altissimum* L.), dwarf plantain (*Plantago purshii* R.&S.), blue bur (*Lappula echinata* Gilib.), and gum weed (*Grindilia perennis* A. Nels.). Researchers then planted slender wheatgrass, crested wheatgrass, blue joint, and smooth brome. Of all the grasses only crested wheatgrass survived. In 1949 W.A. Hubbard reported twenty years of observations of crested wheatgrass at Manyberries. He found crested wheatgrass effectively controlled annual weeds even when seeded in rows three feet apart.⁶⁴

⁶³ T.K. Pavlychenko, “The Place of Crested Wheatgrass, *Agropyron cristatum* L., in Controlling Perennial Weeds,” *Scientific Agriculture* 22 (1942): 459-60.

⁶⁴ W.A. Hubbard, “Results of Studies of Crested Wheatgrass,” *Scientific Agriculture* 29 (1949): 385-95.

Researchers throughout the western United States reached similar conclusions. In 1936, three researchers in Montana recommended the use of crested wheatgrass on abandoned farm lands occupied by Russian thistle and tumbling mustard. In the 1940s A.C. Hull and George Stewart published a number of articles which expressed hope that crested wheatgrass might replace cheatgrass on rangelands in the Intermountain region.⁶⁵

Farmers and researchers had interest in the ecological relationship between crested wheatgrass and native plants for at least two reasons. Scientists had some concern about crested wheatgrass's potential to become an invasive species. If crested wheatgrass invaded and replaced native grasses it might prove devastating to grazing. Crested wheatgrass offered good spring and fall grazing but it dried out during the summer and became practically inedible. Summer grazing continued to depend largely on native grasses and open range. In 1940 B.W. Allred published an article in the journal *Soil Conservation* in which he described his observations of crested wheatgrass in the northern Great Plains. "Although such cases have been reported," Allred wrote, "I have never seen a situation where crested wheatgrass has migrated into a climax stand of grasses or even produced competitive stands when drilled into them." Hubbard reported that crested wheatgrass did not invade adjacent stands of native sod but instead the dominant native grasses, blue grama and common spargrass, invaded stands of crested wheatgrass. Furthermore, it appeared to Hubbard that early spring grazing considerably increased the migration of native grasses into seeded areas. Researchers believed that

⁶⁵ L.P. Reitz, M.A. Bell, and H.E. Tower, "Crested Wheatgrass in Montana," *Montana State College Agricultural Experiment Station Bulletin* 323 (1936); A.C. Hull and George Stewart, "Replacing Cheatgrass by Reseeding with Perennial Grass in Southern Idaho Range," *Journal of the American Society of Agronomy* 40 (1948): 694-703; D.H. Heinrichs and J.L. Bolton, "Studies on the Competition of Crested Wheatgrass with Perennial Native Species," *Scientific Agriculture* 30 (October 1950): 428-43.

crested wheatgrass could only establish successfully in places where the native grasses had been diminished through drought or cultivation.⁶⁶

Through this scientific discussion researchers confirmed and institutionalized the observations that many farmers had already made in valuing crested wheatgrass as a biological control for weeds. On the agricultural landscape of the farm and the ranch, crested wheatgrass helped restore productivity to fields that were expensive and not well suited to more profitable crop plants. Crested wheatgrass saved many farms and ranches that might otherwise have failed financially and ecologically. Without crested wheatgrass farmers had few other alternatives to weeds and ranchers faced the expensive prospect of prolonged supplemental feeding.

Problems with Grass Bugs (*Labops hesperius* Uhler)

Crested wheatgrass did well in the more arid western environments. The plant could grow in places that often other plants could not. Abandoned farms were especially harsh sites after years of baking, freezing and eroding. Crested wheatgrass helped to transform these farms back into productive agricultural landscapes at the same time the grass was being used to convert dense and heavily grazed stands of sagebrush into prime grazing lands. Ranchers and land managers who shaped and created the western agricultural landscape worked extremely hard to establish forage grasses like crested wheatgrass. Within a few decades of the extensive reseedings that took place after the late 1930s crested wheatgrass stands started to show signs of damage from insects.

Several different insect species lived on and in crested wheatgrass and a few species fed

⁶⁶ B.W. Allred, Crested Wheatgrass in Competition with the Native Grassland Dominants of the Northern Great Plains," *Soil Conservation* 6 (1940): 59-63; Hubbard, "Results," 385-95.

on the grass itself. The insect known as the black grass bug or sometimes the wheatgrass bug (actually three or four different species), has a tiny rounded body and round bulging eyes. Grass bugs do not have well developed wings and depend upon other forms of transportation to spread into different areas. Grass bugs feed on the sap of plants and survive cold temperatures by hiding in the grass's crowns. Researchers have recorded densities of grass bugs as high as 1000 bugs per square foot of land covered by crested wheatgrass.⁶⁷

When crested wheatgrass and other introduced range grasses started moving all over western North America the black grass bug spread with them. Black grass bugs are native to North American prairies and they feed on almost all kinds of grasses. The bugs formed particularly large and dense populations on places that had been reseeded with crested wheatgrass because they had sufficient food and fewer predators. Plant communities that included a mixture of shrubs and grasses provided habitat for lizards, birds, spiders, snakes and a host of other grass bug eaters. But in pure grass stands grass bugs reigned.

Grass bugs hit rangelands in eleven western states and in Canada. Reports of infestations of the insect in Colorado and New Mexico claimed that damage spread from a quarter acre to more than 400 acres in a single year and in four years spread up to 10,000 acres. In 1966 the Forest Service and Bureau of Land Management estimated that grass bugs damaged plants on more than 200,000 acres of lands in the state of Utah. Two

⁶⁷ Austin Haws, "Black Grass Bugs *Labops hesperius* Uhler (Hemiptera: Miridae) and Other Insects in Relation to Crested Wheatgrass," in Johnson ed., *Crested Wheatgrass*, 126, 123-45.

counties in central Utah reported combined damage of more than 60,000 acres of reseeded rangelands.⁶⁸

The Utah Experiment Station assembled a team of researchers to examine the black grass bug problem in 1971. The following year the USDA Agricultural Research Service joined the team and contributed \$20,000 dollars to the cause. The project included *taxonomic* studies to identify and assemble a collection of specimens of different grass bug species, *biological* studies that examined the life cycles of the bugs and followed their seasonal movements at the same time identifying the bugs' enemies and its responses to climate and other environmental factors, *grass* studies to determine which grasses the bugs preferred to eat and grasses that demonstrated resistance, and finally management studies to develop different types of control.

After studying grass bugs in relation to reseeded rangelands, the Utah research team determined that the reason there were so many grass bugs was because there was too much grass. The research team recommended several remedies which they divided into six categories. First, researchers recommended that reseedings include a more diverse mix of plant types. Instead of pure stands of grass they recommended that some shrubs and forbs be left standing or added back into the seed mixture. Second, they recommended burning as a means of removing excess grass, especially the lower growth where grass bugs lay their eggs. The third strategy, more intensive grazing, could

⁶⁸ George Knowlton, "Grass Bugs: A Serious Range Problem in 1966," *Proceedings of the Utah Academy of Sciences, Arts and Letters* 43.2 (1966): 20-21; J. W. Bohning and W.F. Currier, "Does Your Range Have Wheatgrass Bugs?," *Journal of Range Management* 20 (July 1967): 265-7; B. Austin Haws, Don Dwyer, and Max Anderson, "Problems with Range Grasses? Look for Black Grass Bugs!," *Utah Science* 34 (March 1973): 3-9; J.G. Todd and J.A. Kamm, "Biology and Impact of a Grass Bug *Labops hesperius* Uhler in Oregon Rangeland," *Journal of Range Management* 27 (November 1974): 453-8.

accomplish the same goal of removing excess grass. Breeding more resistant grasses was the fourth approach. Researchers observed in studies that grass bugs did less damage to native grasses than to crested wheatgrass. The fifth strategy that the Utah research team investigated was the use of parasitic insects as biological control agents that would attack and kill grass bugs. The team also researched the use of chemical pesticides and recommended the use of ultra-low volume malathion that would kill grass bugs before they had a chance to lay their eggs. Generally the team did not recommend the use of insecticides.⁶⁹

How researchers chose to approach the problem of grass bugs demonstrates a dual perception of crested wheatgrass. From an agricultural point of view crested wheatgrass was comparable to other crops grown as monocultures under intensive conditions. But in the 1970s agricultural researchers began to see the practical value of diversity. In the terms of scientists studying the problem of grass bugs in crested wheatgrass, they were learning the practical value of “the steady state of ecological balances existing in some native rangelands.” When ranchers and land managers confronted the infestations of black grass bug by treating crested wheatgrass the same as other crop monocultures they were maintaining the agricultural landscape. However, more and more researchers were looking at other uses of rangelands. They were interested in rangelands not merely as agricultural landscapes but as habitat for wildlife, both the kind that attracted recreation and the grass-bug-eating kind. They were also interested in using rangelands, especially those in the National Forests, for recreation.

⁶⁹ Haws, “Black Grass Bugs,” 133-7.

The values associated with these changing land uses created the post-agricultural landscape. Crested wheatgrass belonged in the agricultural landscape for several reasons; it increased the amount of forage by several times, it provided a practical and productive means of adjusting agriculture to fit with the changing economics and arid environments, it competed with weeds, and it stopped the erosion of parched and abandoned fields. The use of crested wheatgrass created new understanding about the importance and the functions of ecological relationships like the relationship between grass and grass bugs, and the relationship between diversity in plant communities and diversity in the associated insect and wildlife communities.

CHAPTER IV

THE POST-AGRICULTURAL LANDSCAPE

“[Western Watershed Project] members use and actively recreate on the public lands of the Elko District and the specific allotments affected by this fire on neighboring BLM lands including the Allotments affected by this action for scientific, educational, spiritual, aesthetic and recreational (including camping hiking, wildlife viewing, botanizing, bird-watching, sightseeing, photography) purposes.”¹

As a concluding note to the crested wheatgrass symposium proceedings the editor Kendall Johnson, an extension range specialist, wrote that guidelines and regulations enacted to restrict the use of crested wheatgrass “[were] not helpful and often reflected ignorance of ecological understanding. Such regulations,” he continued, “should be replaced by an ecological approach allowing maximum appropriate use of *all* [emphasis added] available biological resources.” Johnson echoed the statement of his colleague Edward DePuit who had written that the curtailment of crested wheatgrass use in reclamation of disturbed lands -- partially the result of public reaction to prior over-use of the species – was, in some cases, “neither objective nor logical.” Johnson, DePuit and others recognized that the appropriate use of a plant was not a question that could be answered solely through an appeal to the same rationale of science, technology and efficiency that got it there. Land managers by 1983 had to account for land users who

¹ Katie Fite, Biodiversity Director, Western Water Sheds Project Letter to the Department of Interior Board of Land Appeals, 21 December 2006. “Notice of Appeal, Statement of Reasons, Appeal and Request for Partial Stay of Elko Field Manager Helen Hankin’s Finding of No Significant Impact for the Environmental Assessment of the Amazon Emergency Stabilization and Rehabilitation Plan.”

wanted a different type of landscape and who had different measures of the plant's value.²

On the experimental and agricultural landscapes, biology, chemistry, ecology and physiology had each been used to measure crested wheatgrass's belonging. After establishing that the grass belonged, researchers used these same sciences to improve breeding and cultivation and to extend the area of crested wheatgrass's use. Put to use with a different set of values and objectives, these same sciences would help researchers determine the importance of native plants and animals in maintaining and restoring healthy ecosystems. As an ideological framework, the post-agricultural landscape emerged from the philosophies of authors, naturalists and ecologists who knew their environment through recreation rather than labor. In contrast to the agricultural landscape which was both the product and the source of knowing the earth through one's work, the post-agricultural landscape was the product and the source of escaping every-day toils. The agricultural landscape's highest value lay in humanity's ability to manipulate the elements and provide ever more productive returns, while the highest value of the post-agricultural landscape lay in its ability to aid the imagination in envisioning a world untouched by human hands.³

In the agricultural landscape crested wheatgrass represented the ability of human ingenuity to adapt to, and extend the limits of nature. Scientists selected its genes and in

² Kendall Johnson, "The Social Values of Crested Wheatgrass: Pros, Cons, and Tradeoffs," in Johnson ed., *Crested Wheatgrass*, 334; Edward DePuit, "The Role of Crested Wheatgrass in Reclamation of Disturbed Lands," in Johnson ed., *Crested Wheatgrass*, 327.

³ Rodrick Nash, *Wilderness and the American Mind* (New Haven: Yale University Press, 1967); William Cronon, "The Trouble With Wilderness; or, Getting Back to the Wrong Nature," In *Uncommon Ground: Rethinking the Human Place in Nature*, William Cronon, ed. (New York: W.W. Norton and Company, 1996), 69-90.

time they developed effective tools for cultivating the grass. Scientists learned the best methods of planting the seeds and resisting competition from native plants and insects. The Golden Age of crested wheatgrass, however, was short lived.

The shifting favor of crested wheatgrass did not happen overnight. It began when authors and scientists first suggested that western rangelands might have other more important uses than the production of livestock. As recreation became an increasingly popular use of rangelands, researchers and land managers responded by incorporating social values that demanded greater diversity of wildlife and more natural appearances, as management objectives. The *Journal of Forestry* serves as one record of the acknowledgement that the demands made by forest users were changing. An editorial in the September 1943 issue discussed the problems researchers and land managers faced in managing forests for timber, range and wildlife as well as recreation. Traditionally timber, range and even wildlife could be measured in terms of revenue but recreation had its own framework of value. Bob Marshall, founder of the Wilderness Society, said “It is no more valid to rate [the value of forest recreation] in terms of dollars and cents than it would be to rate the worth of a telephone pole in terms of the inspiration it gives.” He added, “A forest wilderness may be practically worthless commercially but invaluable spiritually.”⁴

Researchers, who supplied guidelines for range management, recognized the importance of the public voice though they had trouble comparing recreation demands

⁴ “Editorial: Multiple Use, Biology, and Economics,” *Journal of Forestry* 41 (September 1943): 625-6; “Editorial: Multiple Use Again,” *Journal of Forestry* 41 (October 1943): 703-21; J.V.K. Wagar, “Recreation in Relation to Multiple Land Use in the West,” *Journal of Forestry* 41 (November 1943): 798-802; Thomas Alexander, *The Rise of Multiple-Use Management in the Intermountain West* (Washington, D.C.: U.S. Forest Service, 1988).

with the measures that represented grazing and forage. Range scientists had devised ways to measure livestock forage and weight gain, but range science had not included measures of whether or not people thought the grass looked nice or how much they despised the grass because they associated it with the destruction of native species. Aldo Leopold expressed this view when he wrote “what remains of our native fauna and flora, remains only because agriculture has not yet got around to destroying it.” In the decades that followed, the perception of agriculture as destroyer continued to gain support and force in national politics and in local land-management decisions.⁵

The ecologists and recreation enthusiasts, who shared Leopold’s view that agriculture destroyed rather than improved nature, longed to experience places where the earth and its community of life were untrammelled by man. At the beginning of the crested wheatgrass symposium, Don Dwyer argued that crested wheatgrass belonged because of the contributions it had made in transforming western rangelands into agricultural landscapes. Dwyer and his associates feared that crested wheatgrass was being rejected by association and not on firm scientific or logical grounds. In their view, it was the land managers and ranchers who had sinned in planting too much of the grass. It was they who needed to change their ways and not crested wheatgrass itself. Crested wheatgrass could still be useful, its apologists believed, even in post-agricultural landscapes. The grass already demonstrated that it could grow in places and support uses that native grasses could not. Dwyer appealed to its significance and success in the past

⁵ Aldo Leopold, *A Sand County Almanac and other Essays from Round River* (New York: Sierra Club/Ballantine Books, 1974), 199, quoted in Debra Donahue, *The Western Range Revisited: Removing Livestock from Public Lands to Conserve Native Biodiversity* (Norman: University of Oklahoma Press, 1999), 115; Donald Worster “Transformations of the Earth: Toward an Agroecological Perspective in History,” *The Journal of American History* 76 (March 1990): 1087-1106.

and appealed to an expansive body of scientific literature. He and the colleagues he spoke for were convinced that the grass belonged.

Science and history may have convinced several people that crested wheatgrass deserved its place among the valuable range plants in North America, but the years following the symposium saw an increase in advocacy for a post-agricultural landscape that did not include introduced grass species. The most vocal opponents of crested wheatgrass believed management of public rangelands should preserve diversity in native plant communities and not nurture the livestock tradition through subsidies. In the final printed version of Kendall Johnson's symposium paper he quoted from Edward Abbey's essay "Even the Bad Guys Wear White Hats: Cowboys, Ranchers and the Ruin of the West." Abbey lashes out against the whole "stinking" cattle industry, subsidized by cheap grazing and the reconfiguration of the environments of public lands. "Overgrazing is much too weak a term," Abbey said. "Most of the public lands in the West... are what you might call 'cow burnt.' Almost anywhere and everywhere you go in the American West you find hordes of the ugly, clumsy, stupid, bawling, stinking, fly-covered, shit-smearing, disease-ridden brutes... They pollute our springs and streams and rivers. They infest our canyons, valleys, meadows, and forests. They graze off the native bluestem and grama and bunch grasses. They trample down the native forbs and shrubs and cactus. They spread exotic cheat grass, Russian thistle, and the crested wheat grass. *Weeds.*" He emphasized.⁶

⁶ Edward Abbey, "Even the Bad Guys Wear White Hats: Cowboys, Ranchers, and the Ruin of the West," *Harper's Magazine* (January 1986): 51-55, quoted in Kendall Johnson, "The Social Values of Crested Wheatgrass: Pros, Cons and Tradeoffs," In *Crested Wheatgrass*, Johnson, ed., 331. Bernard DeVoto, "Scared Cows and Public Lands (Harper's Magazine, July 1948)," In *DeVoto's West: History*,

In the proceedings of the crested wheatgrass symposium no one, other than Abbey, referred to crested wheatgrass as a weed, however the symposium had convoked specifically to discuss crested wheatgrass's weediness. At the end of the proceedings Johnson reiterated the same point on which Don Dwyer had begun: crested wheatgrass should be called a "North American range plant," speaking this time in ecological rather than historical terms. They wanted to accept it on the same level as native plants in the classification schemes of range condition and health and to cease labeling it as an introduced or exotic species. But neither Johnson nor Dwyer would have the final word.⁷

In the 1990s opposition to livestock grazing on public lands increased. The Western Watersheds Project (WWP), founded in 1993, presents perhaps the best example of organized opposition to agricultural landscapes on public lands. This group's mission is to "protect and restore western watersheds through education, public policy initiatives and litigation." To this end they have brought lawsuits against the Bureau of Land Management in several cases, forcing public land managers to comply with grazing laws and regulations. The WWP works with lawyers from the law firm Advocates for the West to bring cases against the BLM with regard to grazing access and the use of nonnative species in post-wildfire reseedings. These cases are built upon the findings and reports of many of the BLM's own scientists and land managers who recognize that livestock grazing damages some of the important remaining habitat for native plants and animals.⁸

Conservation, and the Public Good, Edward Muller, ed. (Santa Fe: Center for American Places, 2005), 113-35.

⁷ Johnson, "Social Values," 334.

⁸ Information about Western Watershed Project as well as litigation reports can be found at www.westernwatersheds.org, accessed 25 March 2008.

Range ecologists, land managers and land users have all recognized for several decades that livestock grazing damages plant communities and the wildlife that depend on them, that it pollutes water, and has long-term consequences like soil compaction and erosion. In the face of such obvious consequences livestock are still allowed to graze in public lands and in sensitive areas. Part of the reluctance on the part of land managers, may be due to the fact that they have had such success with crested wheatgrass in making the range support more livestock, even after overgrazing had reduced many diverse native-plant communities to dense stands of sagebrush. Livestock apologists continue to view western rangelands as agricultural landscapes in which crested wheatgrass belongs as part of the profit-producing conversion of resources. Those who are ready to remove cattle from western rangelands have a fundamentally different view of the landscape, a view that has more to do with ecological health and personal enjoyment than with profit-making. Both landscapes are supported by scientific research.

Changing Measures of Range Health

The first generation of range scientists, between 1900 and 1930, worked as researchers for the Forest Service or for state agricultural experiment stations in the western United States. These scientists included Arthur Sampson, who studied plant community composition and succession, and James Jardine, who studied grazing animals. For Sampson, the concept of vegetative succession led to a measure of range health observed through changes, caused by grazing, in the composition of plant communities. “The most rational and reliable way to detect over grazing,” Sampson wrote in a 1919 department bulletin, “is to recognize the replacement of one type of plant cover with

another.” Sampson’s bulletin provided some of the earliest training material for range managers throughout the West and in time Sampson earned the title of the father of range science.⁹

The related concepts of plant succession and climax were developed by Henry Cowles of the University of Chicago and Frederic Clements of the University of Nebraska between 1895 and 1916. Cowles introduced the idea of succession into the science of ecology through his study of plants growing along the sandy shores of Lake Michigan. Cowles observed spatial variation in vegetation relative to distance from the water’s edge. This spatial variation provided the basis for understanding temporal dynamics in plant community organization. Cowles explained vegetative succession in a four-part article that appeared in the *Botanical Gazette* between February and May 1899. He introduced his study as an examination of “plant formations... which are rapidly transforming into other types by reason of a changing environment.” For Sampson, the study of succession provided a measure of range health as long as he could determine what normal, healthy succession was.¹⁰

To determine the normal, healthy pathway that succession should follow, Sampson turned to the concept of climax as presented by the botanist Frederic Clements.

⁹ James Young, “Range Research in the Far Western United States: The First Generation,” *Journal of Range Management* 53 (January 2000): 2-11; James Jardine and M. Anderson, “Range Management on the National Forest,” *USDA Bulletin 790* (Washington, D.C.: Government Printing Office, 1919); Arthur Sampson, “Plant Succession in Relation to Range Management,” *USDA Bulletin 791* (Washington, D.C.: Government Printing Office, 1919).

¹⁰ Henry Cowles, “The Ecological Relations of the Vegetation on Sand Dunes of Lake Michigan, Part I,” *Botanical Gazette* 27 (February 1899): 95-117; “The Ecological Relations of the Vegetation on the Sand Dunes of Lake Michigan, Part II,” *Botanical Gazette* 27 (March, 1899): 167-202; “The Ecological Relations of the Vegetation on the Sand Dunes of Lake Michigan, Part III,” *Botanical Gazette* 27 (April, 1899): 281-308; “The Ecological Relations of the Vegetation on the Sand Dunes of Lake Michigan, Part IV,” *Botanical Gazette* 27 (May, 1899): 361-391; Donald Worster, *Nature’s Economy: The Roots of Ecology* (San Francisco: Sierra Club Books, 1977), 205-220. Hall, *Earth Repair*, 92-130.

Clements studied with Charles Bessey at the University of Nebraska, and later worked as a professor until 1907 when he moved to the University of Minnesota for a decade before going to the Carnegie Institute in Washington. Clements proposed that soils and vegetation eventually progressed together to a final climax state. “The climax formation,” Clements wrote, “is the adult organism, the fully developed community, of which all initial and medial stages are but stages of development. Succession is a process of the reproduction of a formation, and this reproduction can no more fail to terminate in the adult form in vegetation than it can in the case of the individual.”¹¹

Related to the idea that plant communities and soils matured together into a climax state, Clements proposed that the vegetation of the climax state could be described as a complex organism, also referred to as the biotic community. Though some, like the English ecologist Arthur Tansley, took exception to Clements’s concept of the complex organism, Sampson seems to have considered the development of vegetation to the final climax state as the ultimate standard against which to measure range health.¹²

Sampson’s work led range scientists and managers in following generations to think of health in terms of changes in vegetation communities and as a measure of the presence or lack of plants associated with the native climax communities. Before Sampson offered a scientific definition of range health, livestock owners and Forest Service officers had very little basis for understanding the dynamics of forage plants. Sampson’s guide contained lists of plant species, photographs and diagrams that he used

¹¹ Frederic Clements, *Plant Succession: An Analysis of the Development of Vegetation* (Washington, D.C.: Carnegie Institute of Washington, 1916); see also Worster, *Nature’s Economy*, 209.

¹² Worster, *Nature’s Economy*, 211; Arthur Tansley, “The Use and Abuse of Vegetational Concepts and Terms,” *Ecology* 16 (July 1935): 284-307.

to describe the desirable climax communities and the various stages of succession. He also provided the framework for thinking about range health in terms of condition and trend as measures of the rangeland's potential, as indicated by comparison to conditions found at sites with similar soils and climate.

By 1940, several range scientists in both the Forest Service and the Soil Conservation Service were trying to provide specific and practical indicators of range condition and trend. In 1941 R.R. Humphrey and P.B. Lister of the Soil Conservation Service offered a measure of range condition which they derived through comparing the plant composition of grazed areas with the composition of what they believed to be the native climax plant communities. Like Sampson, they too tried to measure the potential of a specific site based on soils and climate, where health was perceived as deviation from the potential climax. They described six different classes, A through F, and provided lists of species and relative composition in addition to photographs of representative examples of each class. They intended their work to be a reference for range managers in the Pacific Northwest and as a model that could be constructed for rangelands in other regions where the native climax vegetation differed from what they had observed in the hills and mountains of Washington.¹³

Range scientists in the 1940s wanted to provide sounder principles to guide range management. The Forest Service called together a meeting in 1944 to discuss the methods and techniques of range management and in the conference agreed upon a

¹³ R.R. Humphrey and P.B. Lister, "Native Vegetation as a Criterion for Determining Correct Range Management and Run-off Characteristics of Grazing Lands," *Journal of Forestry* 39 (October 1941): 837-42; Lincoln Ellison, "The Ecological Basis for Judging Condition and Trend on Mountain Range Land," *Journal of Forestry* 47 (October 1949): 787-95.

definition of range condition. “Range condition is range health,” the conference decided. “It is the relative position of a range with regard to a standard set by management objectives within the practicable potentialities of the site.” This definition reaffirmed that range health was a measure and reflection of the potential of a specific site. In the years that followed this meeting, researchers presented different ways to understand and measure the potential of the site and they argued over whether condition was a temporary measure that changed from year to year based largely on annual variations in climate or whether condition was a measure that reflected health over longer periods of time.¹⁴

Humphrey and Lister’s article represent the standardizing impulse that reduces a wide diversity of conditions and complex interactions between living and environmental factors into a systematic classification scheme that range managers can use for quick reference and that result in standardized treatments. In contrast to Humphrey and Lister’s move toward simplified, standardized and easily recognizable criteria, Lincoln Ellison presented an ecological basis for judging condition and trend on mountain rangelands that relied much more on the observation of long-term changes at specific sites and which depended much more on individual range managers’ ability to recognize health as an “*essential balance*” in nature.¹⁵ The ability to recognize balance in ecosystems required a high level of familiarity and a good bit of intuition. Ellison believed that the methods researchers used to determine condition and trend often obscured rather than revealed the true health of the system.

¹⁴ USDA, Forest Service, “Proceedings of Conference on Methods and Techniques Relating to National Forest Range and Wildlife Management,” December 4-16, 1944, quoted in Ellison, “Ecological Basis,” 790; R.R. Humphrey, “Field Comments on the Range Condition Method of Forage Survey,” *Journal of Range Management* 2 (January 1949): 1-10.

¹⁵ Ellison, “Ecological Basis,” 788.

Ellison defined balance using the term “essential balance” because he believed it was different than balance as generally understood by ecologists at the time, as “a condition in which orderly, constructive change can take place, in contrast to the chaotic sequences which follow imbalance.” In nature, processes of change were generally constructive and periodic disturbances such as floods or droughts were subsumed in a generally constructive trend as in the “slow, persistent, concurrent development of vegetation and soils.” Humans, on the other hand, could disrupt the balance and cause destructive change unlike anything found in nature. These human caused destructive changes, still recent arrivals to western rangelands in the 1940s, were “something new under the sun.”¹⁶

Ellison offered a definition of succession and destructive change that sounded very much like Clements. He even used the same analogy, comparing an ecosystem to a human being that grows from child to adult. Ellison also believed that the best measure of range health was to compare grazed areas to “natural areas” that had never been grazed. “In their natural state,” Ellison wrote, soils and vegetation, “provide an index to their environment – a summary of their experience, if we could but read it.” In 1943 Ellison wrote to Reed Bailey, who was in charge of the Forest Service in the Intermountain Region, asking that a concerted effort be made on all of the national forests to identify and preserve natural areas for scientific study. Natural areas, when defined as places that had never been grazed, probably did not exist, so Ellison encouraged researchers and land managers to piece together from historical records and oral histories the best picture they

¹⁶ Lincoln Ellison, “Applications of Ecology – Concluding Statement,” *Ecology* 38 (January 1957): 63-4; “Our Weight in the Balance of Nature,” *Utah Academy Proceedings* 32 (1955): 14; “Ecological Basis, 789-90.

could of what the range had once looked like. Ellison suggested using history as a surrogate measure of range health because he believed that nature was healthier before livestock came and damaged it.¹⁷

Throughout this discussion Ellison offers the same arguments and definitions as other scientists at the time. However, in one respect he was breaking new ground. He argued that balance had to be restored before the range could ever be considered truly healthy and balance meant that rangelands had to be restored to natural conditions. Restoration, in Ellison's mind, was a matter of the health of the whole system. "If condition of the range may properly be likened to health of an individual," wrote Ellison, then "variations due to weather are analogous to an individual's moods. An invalid may be cheerful, and at times a healthy person is depressed. A mood is hardly a valid indication of the true 'mode or state of being,' and so it is with weather and range condition." Furthermore he concluded that "In judgment of range condition soil stability is paramount in importance; forage value is secondary."¹⁸

Unfortunately, Ellison's desire for natural balance as the goal of range management did not gain widespread popularity. The same year that he published his ecological basis for measuring condition and trend E. J. Dyksterhuis, of the Soil Conservation Service in Lincoln, Nebraska, published "Condition and Management of Range Land Based on Quantitative Ecology." Dyksterhuis presented a system that grouped all plants into three categories based on the plants' response to grazing. He

¹⁷ Lincoln Ellison to Reed Bailey February 23, 1943, Lincoln Ellison Papers, Merrill-Cazier Library Special Collections, Logan, Box 9 fd 15; Ellison, "Ecological Basis," 790; George Stewart, "Historic Records Bearing on Agricultural and Grazing Ecology in Utah," *Journal of Forestry* 39 (April 1941): 362-75.

¹⁸ Ellison, "Ecological Basis," 788-9.

called these categories “decreasers,” increasers” and “invaders.” Both decreaser and increaser species were commonly found in stable or climax plant communities, while invaders were not. Decreasers became less abundant in native plant communities under grazing pressure while increasers displayed the opposite trend. Dyksterhuis made a diagram that plotted the relative percentage of species from each category and divided range condition into four classes: excellent, good, fair and poor. Dyksterhuis’s scheme became the primary method for judging range condition, while Ellison’s argument for a measure that examined more than forage production did not gain popularity among range managers or livestock owners. Range management textbooks through the 1980s continued to teach Dyksterhuis’s method for calculating range condition.¹⁹

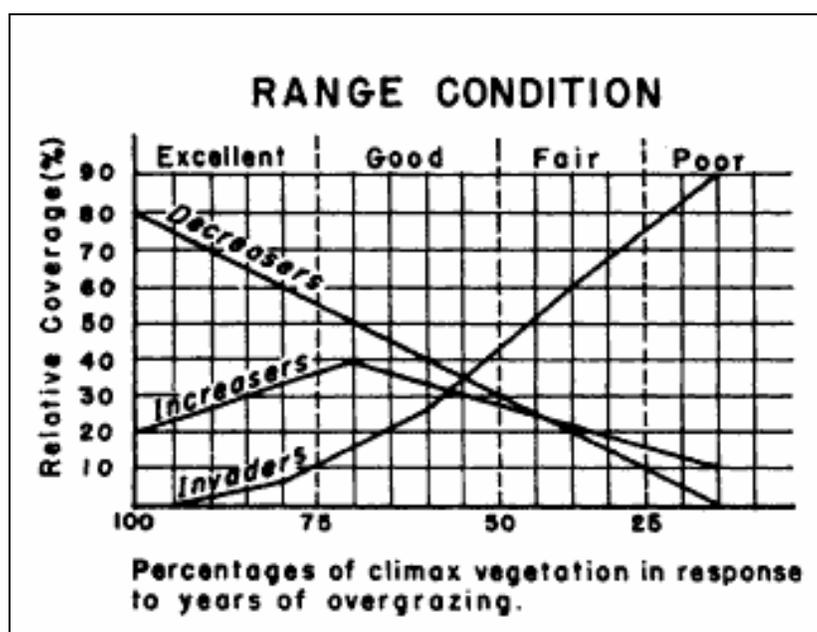


Figure 12. Percentages of Climax Vegetation in Response to Years of Overgrazing, Source: E.J. Dyksterhuis, “Condition and Management,” 109.

¹⁹ E. J. Dyksterhuis, “Condition and Management of Range Land Based on Quantitative Ecology,” *Journal of Range Management* 2 (July 1949): 104-115; Linda Joyce, “The Life Cycle of the Range Condition Concept,” *Journal of Range Management* 46 (March 1993): 132-8; Laurence Stoddart, Arthur Smith, and Thadis Box, *Range Management*, 3rd ed. (New York: McGraw-Hill Book Company, 1975).

Recreation and Range Health

Ellison's view of nature and his belief in essential balance derived as much from his recreational experiences as from his ecological studies. Ellison recorded in his diaries and personal letters to his wife Laurel several recreational experiences through which he felt he knew the environment and his self in relation to it. Four days after arriving at his new assignment at the Great Basin Experiment Station, Ellison wrote: "I managed to steal off for two and a half hours in the woods, writing letters and trying to realize the forest." Ellison was a trained student of ecology, he believed in the value and integrity of science and he trusted both the methods and the results of objective experimentation, yet at the same time Ellison sought for a subjective, intuitive knowledge of the forest that he believed was his best mentor.

Ellison wanted to "realize" the forest, a word he underlined in his own handwriting. To realize the forest was a process of spiritual connection, of awakening and rebirth. He wrote: "It takes more than a few casual hours to erode this crust I've accumulated – long days in the hot sun, with the creak of pack sack leather, evening and morning walks, the being alone, amongst huge mountains, over a fire, and the dropping of the sleep many nights 'with the starlight on our faces.' I must bring that consciousness back."²⁰

As Ellison searched for the natural landscape he looked both to the pockets of the range where sheep and cattle rarely went and to the memories and recollections of those who had lived longest in the area. Ellison believed that natural areas provided a place to view nature as it should be, as an intact and balanced organism. To Ellison natural areas

²⁰ Lincoln Ellison, Journals and Fieldnotes, 10 July 1938, Ellison Papers, box 2, fd 7.

offered much to the science of ecology and to the spiritual development of humanity. On November 24, 1939 Ellison wrote in his diary: “My purpose, I think, is social: to lead people toward sanity and wisdom by recovering the primitive environment.”²¹

His experience during that first summer on the Wasatch Plateau convinced Ellison that the natural environment he sought after would not be found in the landscapes created by and for grazing cattle. During the first week of September 1938, Ellison walked with his wife Laurel up to the top of Ephraim Canyon above the experiment station. As they neared an elevation of 10,000 feet they entered the alpine meadows where most of the wildflowers neared the end of their summer florescence. They passed a small alpine field station and turning just before they reached the top of the plateau they walked across the south ridge passing an area known as Philadelphia Flats. Since the Great Basin Station opened in 1912 researchers had conducted a number of different experiments with reseeded and vegetation manipulations at Philadelphia Flats and in other nearby areas in the canyon. “We took our time,” Ellison wrote, “and I believe I saw more than I have been able to see in half a summer of scurrying about on official trips. A lovely clear day: we could see ranges and ranges, and all in great beauty. My one continual sorrow, tho [*sic*], was that all this plateau country is completely accessible to livestock: there are no crags, and hence striving to achieve an aristocracy is impossible.” Ellison’s use of the word “aristocracy” is unclear, but it probably refers to his desire to find naturally occurring climax vegetation.²²

²¹ Lincoln Ellison, quoted in Liane Ellison Norman, *Lincoln Ellison: Director, Great Basin Branch Experiment Station 1938-1945* (Pittsburgh: Smoke and Mirrors Press, 2005), 7.

²² Lincoln Ellison, Journals and Fieldnotes, September 4, 1938.



Figure 13. C.L. Forsling, **Sheep Grazing on Erosion Area B** [Wasatch Plateau], Manti-La Sal National Forest, 1 August 1925, Courtesy of FS Region 4 Ogden, Utah.

The post-agricultural landscape, known variously as natural areas, primitive areas and wilderness, is the product of a particular ecological history. Just as grazing livestock and raising hay had created the agricultural landscape, wilderness, as a belief and an experience, created a landscape of its own. In the post-agricultural landscape, crested wheatgrass was both a product and an agent of disruption. When ranchers and land managers finally became successful at removing sagebrush and planting crested wheatgrass, land users with interests other than agriculture found reason to object.

The crested wheatgrass symposium met in 1983 because the rising popularity of the post-agricultural landscape threatened land managers' authority to use crested wheatgrass. Don Dwyer, Kendall Johnson, and others at the symposium spoke and wrote

about the history of crested wheatgrass in its defense. That same history was responsible for opposition to the use of the grass. Dwyer and Johnson could write about how valuable it was in saving the livestock industry and in recovering a productive landscape from failed dry farms. They could argue for its ability to compete with weeds and for its hardiness even in the harshest conditions, but these arguments would not interest the growing opposition from people who wanted to protect and to create post-agricultural landscapes.

The immediate results of the popularity of crested wheatgrass had been obvious and viewed largely as positive developments in the landscape and in rangeland management. Erosion and weeds were curbed and high-quality feed provided for livestock. However, scientists and land users who shared Ellison's desire to experience primitive landscapes rejected the value of feeding livestock as the most important measurement of belonging. Ecologists were concerned with a deeper measurement of the land's health that they believed could be read through studying the relationships between organisms and their physical environments. For Ellison the clearest measure was in the erosion of soils. For other researchers, health would be a measure of relationships between plants and wildlife or between plants and insects or between soils and microorganisms. For wilderness enthusiasts, health would be a measure of nativeness, in other words the presence of native species which were inherently good and belonged in the environment and the absence of alien species which inherently did not belong.²³

²³ Marcus Hall, *Earth Repair: A Transatlantic History of Environmental Restoration* (Charlottesville: University of Virginia Press, 2005), 139-46.

In spite of Professor Dwyer's certainty that crested wheatgrass was a “range plant” and deserved to receive its naturalization papers, there were those who would not be convinced. Groups like the WWP would take their inspiration from wilderness experiences and from essays by authors like Aldo Leopold, Edward Abbey, Bernard DeVoto and Debra Donahue. The arguments surrounding crested wheatgrass today exist in this framework of colliding worldviews.²⁴

New Ecologies of Crested Wheatgrass

One long-standing argument against the use of crested wheatgrass comes from those who believe that the grass creates a biological desert. The WWP website displays an image, under the title “Sagebrush Loss and Fragmentation 2,” which shows a crested wheatgrass seeding where the grass has turned to nothing but golden seed stalks. A feature that researchers have long recognized about crested wheatgrass is that the leafy growth produced in the early spring, which provides the most nutritious feed for cattle and some types of wildlife dries out and dies in midsummer. The photograph’s caption reads: “Barren monoculture of crested wheatgrass with seeding rows visible, lacking sagebrush and diverse flowering plants that produce essential food for grouse chicks. These seedings are biological “dead zones” devoid of most native wildlife species.”²⁵

This photograph and picture of crested wheatgrass tells part of a true story about crested wheatgrass in western rangelands. Reseedings of the grass involved bulldozing,

²⁴ The homepage of the Western Watersheds Website displays quotes from Aldo Leopold’s *A Sand County Almanac*, from Edward Abbey and from Bernard DeVoto’s column “The Easy Chair,” which *Harpers Magazine* featured from 1935 until DeVoto’s death in 1955. Deborah Donahue wrote *The Western Range Revisited* with the explicit purpose of arguing for the removal of livestock from public lands in order to protect biodiversity.

²⁵ Western Watersheds Project, “Jarbidge: BLM Public Lands and Wildlife at a Crossroads,” Photo-Essay, 2006, 25 March 2008, <http://www.westernwatersheds.org/jarbidge/jarbidge.htm>.

chaining, railing, spraying and burning sagebrush and other native plants in order to decrease competition for young crested wheatgrass seedlings. These activities destroyed the habitat needed to support many different species of wildlife. Several species, known as sagebrush obligates because they depend specifically on sagebrush for survival and reproduction, have suffered because of these changes. Perhaps the most well known species and certainly the most studied is the sage grouse.²⁶

Sage grouse require a particular mixture of habitat types for their various mating and nesting activities. Male sage grouse need open areas where they can display their sharp, fanned tail feathers and inflate the yellow or olive-green air sacs which they conceal in the white collar of feathers that encircles their chests and necks. For nesting and for protection in the winter, sage grouse also need stands of sagebrush. Researchers and land managers knew that the bulldozing, plowing, burning, chaining and spraying destroyed the sagebrush habitat that these birds required before they knew how crested wheatgrass itself affected the birds.

In the Curlew Valley, one manager of the Curlew National Grassland, Wendell Johnson, began in the late 1960s to plan a landscaping project that would make the 30 thousand acres of crested wheatgrass he managed into more useful habitat for wildlife, especially sage grouse. Johnson's development plan proposed plowing and ripping 1,310 acres of tall and dense sagebrush in order to create shorter and more dispersed stands. He also proposed planting Russian olive trees and wild rose bushes to cover up the cattle

²⁶ John W. Connelly, Kerry P. Reese, and Michael A. Schroeder, *Monitoring of Greater Sage-grouse Habitats and Populations, Station Bulletin 80* (Moscow, ID: College of Natural Resources Experiment Station, 2003) online at http://sagemap.wr.usgs.gov/docs/grouse_habitat_book.pdf. The "literature cited" portion of this report contained nearly 100 citations of studies related to sage grouse.

fences and to provide food and cover for pheasants, partridges and sharptailed grouse. This type of redesign in the landscape proposed that crested wheatgrass could provide valuable resources to wildlife if the proper structure existed. The grass itself was harmful only in so far as it prevented the mixed structure of brush cover and open grass areas that wildlife needed for successful nesting and breeding.²⁷

Wildlife biologists, hunters and land managers all noticed a decline in the number and types of wildlife in western rangelands. They blamed habitat conversion through range improvement and other agricultural projects for these declines. Crested wheatgrass had been the main grass used for reseeding and while habitat conversion certainly reduced wildlife populations it was not clear how crested wheatgrass itself was harming or helping wildlife. To determine this, researchers had to ask several questions about crested wheatgrass. How long does the grass, if planted as a monoculture, stay a monoculture? Do rodents and rabbits, the major prey species for birds of prey, use crested wheatgrass for food and for habitat?

Wildlife biologists Richard Howard and Michael Wolfe published a paper in 1976 that addressed both questions in the setting of the Curlew Valley. Howard and Wolfe started observing nesting ferruginous hawks in Curlew Valley in 1972 and 1973. After finding about 50 nesting pairs of hawks in the valley they took a topographical map and plotted the locations of the nest sites. Then using aerial photographs they characterized the vegetation surrounding the nest sites. More than 90 percent of the hawks nested in

²⁷ Wendell Johnson, *Curlew National Grassland Development Plan* (Caribou National Forest: United States Forest Service, 1970), 30-32.

juniper trees and hunted in the surrounding stands of desert-shrub and crested wheatgrass.²⁸

Howard and Wolfe determined that most of the diet of ferruginous hawks (*Buteo regalis*) in the Curlew Valley, about 80 percent by weight, consisted of black-tailed jackrabbits (*Lepus californicus*). A study published in 1972 reported black-tailed jackrabbit populations in the Curlew Valley were about 3 per hectare in sagebrush vegetation types and were less than 1 per hectare in crested wheatgrass. The jackrabbits used crested wheatgrass stands, but for the most part only at the periphery within 300 meters of sagebrush stands. In the Curlew Valley there was enough juniper for the hawks to nest. In fact, the range of juniper was expanding. Hawks had enough nest sites. Therefore Howard and Wolfe concluded that the hawks' habitat was not the limiting factor. Rather, the loss of jackrabbit habitat and the coincident decline in jackrabbit populations had the biggest effect on the hawks' reproductive success.²⁹

Though their conclusions did not represent all hawks and all parts of the West, Howard and Wolfe did write that "results from the present study indicate that past crested wheatgrass seedings have not adversely affected reproduction of ferruginous hawks [because] reversion to native vegetation occurring in these areas has created suitable habitat within a period of 6-8 years following treatment."³⁰ They suggested that this six to eight years it took for sagebrush to reinvade the stands of crested wheatgrass could be

²⁸ Richard Howard and Michael Wolfe, "Range Improvement Practices and Ferruginous Hawks," *Journal of Range Management* 29 (January 1976): 33-7.

²⁹ Lawrence Stoddart and R.D. Anderson, "Biomass Density of Lagomorphs," U.S. International Biological Program, Curlew Valley Validation Site Report Number RM72-1, 1972, cited in Howard and Wolfe, 35.

³⁰ *Ibid.*, 36.

shortened to three or four years and could benefit both livestock and wildlife if the seedings covered smaller more dispersed areas rather than large uniform tracts.

Other wildlife biologists studied the effects of crested wheatgrass on non-game birds and on large grazing animals like elk, antelope and deer. These scientists reached similar conclusions: the destruction of habitat, nesting sites and food sources and not necessarily crested wheatgrass itself posed the real threats to wildlife populations. Since the early 1970s biologists have studied the effects that range improvement practices have had on songbirds including both those, like the Brewer's sparrow (*Spizella brewerii*) and the sage thrasher (*Oreoscoptes montanus*), that are considered sagebrush obligates and those, like the horned lark (*Eremophila alpestris*), vesper sparrow (*Pooecetes gramineus*) and western meadow lark (*Sturnella neglecta*), that tolerate and perhaps even benefit from some sagebrush treatments.³¹

In 1982 John Castrale published a study of the effects that different types of range improvement had on bird populations in northern central Utah. He looked at the differences between areas that had been variously burned, chained or plowed and found that in areas where sagebrush was burned for range improvement the effects appeared more immediate and long-lasting. Sagebrush recovered relatively quickly on the chained area and comparably on areas that had been plowed. At the time of the study, sagebrush plants on treated areas stayed smaller than on the surrounding patches of untreated sagebrush. When Wendell Johnson planned to make the Curlew National Grassland into better wildlife habitat he preferred smaller sagebrush to the tall and dense stands. The

³¹ Louis Best, "First Year Effects of Sagebrush Control on Two Sparrows," *The Journal of Wildlife Management* 36 (April 1972): 534-44.

burned site had the greatest percentage of grass cover and the plowed site had the least. The chained site had the most heterogeneity in terms of interspersed patches of grass and sagebrush.³²

Castrale reported differences in three areas that had been treated but his study overlooked the differences between treated and untreated areas. Several researchers at Colorado State University compared the responses of nongame wildlife to range improvement that removed pinyon and juniper and found that bird densities were less than half in the improved range than what they were in untreated woodlands.³³

By the mid-1970s it was clear to rangeland scientists that habitat conversion affected both the density and diversity of wildlife and that several of the practices that land managers and ranchers used to create agricultural landscapes threatened wildlife. It was still not clear however, how crested wheatgrass figured into the equation. Late in the 1970s scientists like Timothy Reynolds, at the time a doctoral student at Idaho State University, began to direct their questions to aspects of the ecology of crested wheatgrass other than how to make it grow.

Reynolds's dissertation examined the response of native vertebrate populations to crested wheatgrass planting and to grazing by sheep on lands owned and managed by the Department of Energy at the Idaho National Engineering Laboratory Site west of Idaho Falls. Reynolds picked four different areas to study based on grazing and reseeding with crested wheatgrass. He called the non-reseeded-ungrazed area the control. The other three

³² John S. Castrale, "Effects of Two Sagebrush Control Methods on Nongame Birds," *The Journal of Wildlife Management* 46 (October 1982): 945-52.

³³ Timothy O'Meara, et al., "Nongame Wildlife Responses to Chaining of Pinyon-Juniper Woodlands," *The Journal of Wildlife Management* 45 (April 1981): 381-9.

areas included nonreseeded-grazed, crested wheatgrass-ungrazed and crested wheatgrass-grazed. Livestock had grazed the control area prior to 1950 but had not been allowed to graze there for more than 25 years. The control area contained 31 different plant species, more than 3 times the number of species found in any of the other areas. The area of ungrazed crested wheatgrass, which was planted in the summer of 1960 after flood water killed the sagebrush in the area, contained only 3 species with crested wheatgrass providing 98 percent of the canopy cover. Sagebrush had reinvaded the grazed crested wheatgrass area but still provided less than 1 percent ground coverage. Sagebrush density had increased in the nonreseeded-grazed site while species diversity decreased to less than one-third of the number of species found in the control site.³⁴

The conditions of crested wheatgrass stands resulted in fewer wildlife species. The only birds Reynolds saw in the grazed crested wheatgrass sites during his observation visits were four horned larks. In the ungrazed crested wheatgrass site he saw four horned larks, four meadow larks, one short eared owl (*Asio flammeus*) and one vesper sparrow. In the native sagebrush communities, both grazed and ungrazed, Reynolds saw three times this number of birds representing nine different species. Reynolds encountered four different reptiles. In the control plot he found fifty-four lizards, of two different species, while in the neighboring crested wheatgrass he found only nine. The number and diversity of mammals was also less in crested wheatgrass and in grazed areas.

³⁴ Timothy Reynolds and Charles Trost, "The Response of Native Vertebrate Populations to Crested Wheatgrass Planting and Grazing by Sheep," *Journal of Range Management* 33 (March 1980): 122-5.

Clearly crested wheatgrass limited biodiversity in both plant and animal communities. However, discrepancies existed in the reports of how long crested wheatgrass remained a monoculture and how quickly or completely native plants could reinvade the seedings. Howard and Wolfe reported that native plants returned in as little as five years and under certain management practices this duration might be shortened to perhaps as few as three. At the same time Reynolds visited sites that remained virtual monocultures after fifteen years. Those who have the most experience with crested wheatgrass in the field will say that both cases are true. Depending upon the conditions of the site and the methods used to remove native plants and plant the grass. It also depends upon whether crested wheatgrass was planted alone or in mixtures, and if seeds of other plants can easily reach the reseeded area from nearby sources.³⁵

Valuing Biodiversity

In Washington D.C., on September 21-24, 1986, more than sixty biologists, economists, agricultural experts, philosophers, agency officials and other professionals gathered for the National Forum on BioDiversity. Hundreds of people attended the panel discussions and proceedings of the final evening's events reached more than 5,000 people through teleconference. E.O. Wilson, a Harvard biologist, edited the volume of the forum proceedings and became one of the leading philosophers and spokesmen for the conservation of biodiversity.³⁶ Also in 1986 the scientists concerned with matters of biodiversity formed the Society for Conservation Biology. This branch of scientific

³⁵ Asay and Johnson, personal communication, 22 February 2008.

³⁶ E.O. Wilson, ed., *Biodiversity* (Washington, D.C.: National Academy Press, 1988).

inquiry is directed at understanding and preserving the diversity of ecosystems, species and gene pools.³⁷

Throughout the 1960s and 1970s, scientists who studied new ecological aspects of crested wheatgrass were discovering and reporting the practical ecological importance of biodiversity. In the 1960s when black grass bug outbreaks threatened the largely mono-specific stands of crested wheatgrass, scientists explained that greater diversity of plant and animal life could act as a guard against such devastation. E.O. Wilson explained in 1999 that “Recent experimental studies on whole ecosystems support what was long suspected: in most cases, the more species living in an ecosystem, the higher its productivity and the greater its ability to withstand drought and other kinds of environmental stress.”³⁸

Even while scientific experiments supported the valuing of biodiversity on ecological terms, the “clinching argument” for biodiversity, to use Wilson’s term, was moral. Essentially, humanity shares the responsibility to protect biodiversity because the earth is a wonderful creation. “Each species around us,” Wilson argued, “is a masterpiece of evolution, exquisitely adapted to its environment. Species existing today are thousands to millions of years old.” Who are we to destroy the planet’s creation?³⁹

Like wilderness, biodiversity developed as an aesthetic that connected real human emotions to real biological and physical environments through a creative process where the mind imagined and experienced a re-creation. Wilson described this connection in the final pages of his book, *The Diversity of Life*, in a section he titled “The Environmental

³⁷ The website for the Society of Conservation Biology is www.conbio.org.

³⁸ E.O. Wilson, *The Diversity of Life*, 2nd ed. (New York: W.W. Norton and Company, 1999), xxiii.

³⁹ Ibid.

Ethic.” Wilson called this connection, which human beings subconsciously, and often consciously, seek with the rest of life, *biophilia*. Wilson also linked biophilia with the idea of wilderness which he defined as “all the land and communities of plants and animals still unsullied by human occupation.”⁴⁰

According to Wilson, humans value biodiversity and wilderness because in escaping humanized landscapes we find new life and wonder. “Wilderness settles peace on the soul because it needs no help; it is beyond human contrivance. Wilderness is a metaphor of opportunity, rising from the tribal memory of a time when humanity spread across the world, valley to valley, island to island, godstruck, firm in the belief that virgin land went on forever past the horizon.”⁴¹

Wilson speaks for those who want to make western rangelands more diverse, wild and non-agricultural. Making this new western landscape involves the preservation of organisms and environments that have not been removed by plowing and grazing or by building highways and cities. It also means restoring native species and, where possible, restoring species that have local genetic identities. To most people who value diversity in ecosystems and in gene pools, crested wheatgrass stands in the way.⁴²

Crested Wheatgrass and Restoration

At the Sage Grouse Habitat Restoration Symposium held in June 2001 in Boise, Idaho, Mike Pellant, who serves as the coordinator of the Great Basin Restoration Initiative and works for the BLM, presented a paper with Cindy Lysne in which they

⁴⁰ Ibid., 350.

⁴¹ Ibid., 351.

⁴² Katie Fite, “RE: A Question about Grasses,” March 22, 2008, personal e-mail.

discussed the possibilities of restoring diversity to crested wheatgrass stands. They outlined three steps for diversifying crested wheatgrass seedings. First, reduce the competition of crested wheatgrass; second, introduce the desired plants as seeds or seedlings; and third, implement appropriate management and monitoring to maintain plant diversity.⁴³

Pellant and Lysne arrived at these suggested steps through examination of the literature and through practical experience in rangeland ecosystems management. However, it remains unknown whether this will work, how well it will work or how much it will cost. Researchers in Utah, Nevada and Oregon are currently trying to answer some of these questions and the new buzzword in crested wheatgrass research is “assisted succession,” especially in post-wildfire settings.⁴⁴ The hope is that after crested wheatgrass is growing in mixtures with other grasses and plants that it can eventually be made to give way to more diverse plant communities, dominated by native species.

Although A.C. Hull, George Stewart and others in the 1940s had experimented with the concept of using crested wheatgrass to replace cheatgrass and other annual weeds on western rangelands, assisted succession’s end goal is not perennial grasslands for grazing but native shrub-dominated communities for wildlife habitat and biodiversity. In 2004 Robert Cox and Val Jo Anderson published a study they conducted at the Dugway Proving Grounds southwest of the Great Salt Lake in Tooele County, Utah. Their methods consisted of two steps: first, removing cheatgrass competition and planting

⁴³ Mike Pellant and Cindy Lysne, “Strategies to Enhance Plant Structure and Diversity in Crested Wheatgrass Seedings,” *Sage-grouse Habitat Restoration Symposium Proceedings; 2001 June 4-7; Boise, ID* (Fort Collins: USDA Forest Service, Rocky Mountain Research Station, 2005), 81-92.

⁴⁴ Robert Cox and Val Jo Anderson, “Increasing Native Diversity of Cheatgrass-Dominated Rangeland Through Assisted Succession,” *Journal of Range Management* 27 (March 2004): 203-10.

crested wheatgrass and second removing crested wheatgrass competition and planting native grasses and shrubs.⁴⁵

The first step they called site capture. Crested wheatgrass proved valuable in site capture first because it could compete with cheatgrass and second because it was relatively resistant to fire. Fire and cheatgrass have a mutually-beneficial relationship and as a result fire frequency in cheatgrass-dominated rangelands has increased so that many areas burn every few years. Fires occurred in native sagebrush communities only once or twice every century. Scientists have long recognized and valued crested wheatgrass's potential to aid in site capture but only recently have come to hope that crested wheatgrass's tenure in plant communities could be made temporary. In the experimental landscape, researchers like Johnson Sarvis and Arthur Dillman chose crested wheatgrass over the native slender and western wheatgrass because crested wheatgrass demonstrated the greatest longevity and continued to produce forage and seeds in stands like those Reynolds examined that were more than two decades old.⁴⁶

Currently assisted succession will be used to justify the continuing use of crested wheatgrass even though its use is highly disputed. Rangeland fires have increased in size and frequency in the past three decades and post-fire treatments, including reseeding with crested wheatgrass, have increased. There was a time in the late 1970s and early 1980s when the BLM used crested wheatgrass almost exclusively to reseed rangelands burned by fires. Mike Pellant referred to these times as the Dark Ages of crested wheatgrass because, while livestock owners benefited through increased forage, biodiversity

⁴⁵ Ibid.

⁴⁶ See also A.C. Hull and G.J. Klomp, "Longevity of Crested Wheatgrass in the Sagebrush-grass Type in Southern Idaho," *Journal of Range Management* 19 (January 1966): 5-11.

suffered. During this time, some livestock owners purposefully set fire to brush communities, knowing that the BLM would replant them with forage grasses.⁴⁷

The mid-1980s marked a change in BLM's policy toward native species, and instead of reseeding with crested wheatgrass alone, they started to include and emphasize the use of sagebrush and other native plant seeds. This decreased the incentive for ranchers to start fires, but fire frequency increased all the same. Often land managers' desires to use native seeds have been limited by short supply. When land managers exhaust the supply of natives they revert to the abundant and much less expensive supply of crested wheatgrass. The issue of supply led to the creation of the Great Basin Native Plant Selection and Increase Project in 2001.⁴⁸

In August of 1999 more than 1.7 million acres of rangelands in Utah, Nevada and southern Idaho burned. This disastrous fire season led to the creation of the Great Basin Restoration Initiative. Before fire fighters had control of the blazes, experts in rangeland ecology and management met in Boise, Idaho at the regional office of the BLM. The experts reached several conclusions about the causes of increased fire frequency. Basically, they determined to place the blame on annual weeds, especially cheatgrass, and on the failure of traditional fire-rehabilitation efforts. They determined that the fire problem was fundamentally ecological and that it could only be curbed by restoring the resilience and resistance that had existed in native-plant communities.⁴⁹

⁴⁷ Mike Pellant, Great Basin Restoration Initiative Coordinator, personal communication, 14 March 2008, Boise, Idaho.

⁴⁸ The Great Basin Native Plant Selection and Increase Project falls under the Forest Service Rocky Mountain Research Station but is part of the Great Basin Restoration Initiative which is coordinated by the BLM. <http://www.fs.fed.us/rm/boise/research/shrub/greatbasin.shtml>.

⁴⁹ Mike Pellant, "Great Basin Restoration Initiative-Briefing Statement," US Department of Interior, Bureau of Land Management website, <http://www.blm.gov/nifc/st/en/prog/fire/more/gbri/briefing.html>.

At the beginning of the twenty-first century Mike Pellant, who became coordinator of the new restoration initiative, was convinced that the best way to restore and protect native plant communities in the Great Basin was to replace non-native species with natives. A few years later he presented the paper about introducing native species into crested wheatgrass-dominated sites. After the 2007 fire season, some of Pellant's feelings about crested wheatgrass have changed, largely due to his observations on the ground at the site of the Murphy Complex Fire that burned more than 653,100 acres of rangelands on the border between Idaho and Nevada. On March 14, 2008 Mike Pellant had, on his desk in the BLM state office in Boise, several aerial images of patches of unburned vegetation within the Murphy Complex Fire. These patches contained the only remnant sagebrush within more than 600 thousand acres of scorched land. These remnant sagebrush communities were surrounded by crested wheatgrass.⁵⁰ The fire which blackened the surrounding area only fingered into the stands of crested wheatgrass, protecting the patches of sagebrush that were encircled by the grass. "My feelings about crested wheatgrass have come full circle," Pellant said.⁵¹

Other range ecologists and managers concur with Pellant's observations. These observations provide the basis for Cox and Anderson's site capture and assisted succession models and they argue that crested wheatgrass still belongs on the range. While researchers and land managers may be proceeding in the course of action that seems to them to be both logical and objective, some land users continue to object to the

⁵⁰ Deanna Darr, "Of Cattle and Fire," *Boise Weekly* 15 August 2007, Online at BoiseWeekly.com, accessed 31 March 2008, <http://www.boiseweekly.com/gyrobase/Content?oid=oid%3A286204>; Pellant, personal communication, 14 March 2008.

⁵¹ Pellant, personal communication, 14 March 2008.

use of crested wheatgrass. Their objections are not simply a rejection of a non-native species, or even opposition to the destructive methods once used to cultivate it. Their objection to crested wheatgrass represents a rejection of the entire agricultural landscape and the values and ideas that created and supported it.

The Western Watersheds Project base their objections on values that they describe in terms of biodiversity and naturalness. Their understanding and appreciation of rangelands comes through a different avenue than the traditional art and science of rangeland management. They share much more in common with ecologists like Ellison and Leopold and authors like Edward Abbey. Their connection to landscapes comes through the recreation experience, through escaping a world that is trammled by seeking a world they can believe is not. They approach the landscape as Ellison did, both through his understanding of ecology and his intuition.

In the post-agricultural landscape of wilderness, crested wheatgrass has almost no belonging because it represents human interference. Regardless of the specific harms and benefits derived from the plant itself the grass does not belong because it originally evolved somewhere else and because it was brought and planted here by people.

The post-agricultural landscape is the product of two different trajectories of thinking. One that developed out of wilderness recreation and the other that developed out of the observations and experiences of wildlife enthusiasts. The primary concern of this second discourse was the loss of wildlife habitat and the associated decline of wildlife species. Unlike those whose primary objective is wilderness and the protection of biodiversity, the wildlife enthusiasts' primary objectives are creating suitable habitat for

popular species either for hunting or for viewing. This group would include land managers like Wendell Johnson who figured that the 30,000 acres of crested wheatgrass in the Curlew National Grassland would make good wildlife habitat if interspersed with shrubs and trees. Johnson's primary interest and approach to the post-agricultural landscape was structural and functional rather than spiritual. For Johnson, crested wheatgrass belonged as long as it was useful, regardless of its origins.

Today debates about where crested wheatgrass belongs in the post-agricultural landscape are often marked by conflicting opinions of these two discourses. On the one hand are those who completely object to the use of crested wheatgrass and on the other hand are those who see the grass as useful in terms of specific ecological functions and structures. Don Dwyer and others at the crested wheatgrass symposium argued that crested wheatgrass should be considered as valuable as, and perhaps even more valuable than, native grasses. Their view of rangelands made no distinction between agricultural and post-agricultural landscapes. To them it was all the same environment. But today a growing number of rangeland users are looking for a different landscape, one that is dominated by native plants and animals and not by grasses that are good for forage or any other plant they consider to be a weed.

CHAPTER V

EPILOGUE

The decision of whether or not to use crested wheatgrass to reseed rangelands after fires, like the decision to remove crested wheatgrass where it already grows, reflects our understanding of different conditions and needs both the needs of wildlife and the needs of land users, both agricultural and post-agricultural uses. Belonging is not just an ecological question. To try and reduce belonging to measures of ecological conditions, or measures of economics, or even measures of personal preference fails to understand belonging itself. Belonging is often based on inherited prejudice, arrogance and ignorance.

Wendell Berry writes about the distinction between things that are empirically known and empirically knowable and everything else. Some knowledge is rightly beyond the realm of materialist and reductionist thinking, which might also be called scientific-industrial-technological thinking. Some things we know because we experience them, not through the pathways of the mind that we have learned through “enlightenment” but through the experience that comes when we confront the world on its own terms, by listening, watching, *feeling*, and as Berry says, by being present in its presence.¹

When I began this thesis I hoped that by crossing disciplines in my approach I might be able to answer the question of crested wheatgrass’s belonging. The more I have studied the science and the history of the grass the more I have felt an awe of the immensity and complexity of belonging and the less I believed that I might be able -- or

¹ Wendell Berry, *Life is a Miracle: An Essay against Modern Superstition* (Washington, D.C.: Counterpoint, 2000), 44.

that anyone would be able -- to provide a finally sufficient answer to that question. I have ceased believing that there can ever be an answer to belonging because belonging is a function of specific times and places and no time or place is ever exactly like any other.

Several aspects of the conversation of belonging have encouraged me, however, that we might be able to continue to act, even in the face of uncertainty. One of the most encouraging discussions came to me through a paper by Tom Jones, a research geneticist at the Forage and Range Research Lab in Logan. In "The Restoration Gene Pool Concept: Beyond the Native Versus Non-Native Debate," Jones introduces a working approach to that hopefully can assist restoration by determining what belongs based on *site-specific* evaluations of both the conditions and the objectives of restoration projects. Jones provides an example of how to move reconcile the decision-making process that attempts to be hierarchical and objective with the biological and physical world that appears to be infinitely diverse and to the multiple, often competing, subjective connections that different people and discourses of people have to the same places.²

By approaching landscapes as unique and individual places that are known through science, through labor and through recreation, crested wheatgrass might be used in places where it belongs. Science and experience each offer some insight and it is important that what we do know and what we have learned is not abandoned. Those who organized the crested wheatgrass symposium did so because they feared that what they had gained materially and what they had learned was being abandoned. As crested wheatgrass's apologists defended its belonging they stated their reasons in the language

² Thomas A. Jones, "The Restoration Gene Pool Concept: Beyond the Native Versus Non-Native Debate," *Restoration Ecology* 11 (September 2003): 281-90.

of science and in references to past uses of the grass. What they did not say is that crested wheatgrass belongs because we know this plant, because we have invested our lives in it and we have gained affection for the grass because it is familiar. This language escaped the presenters at the symposium yet we might reasonably assume that their affection for the plant, as a purely subjective measure, was one reason they did not want to see it excluded from western rangelands.

Affection for things that are unique and diverse and apparently unconnected to humans was the major reason for opposition to crested wheatgrass. Thad Box urged researchers at the symposium to try to understand this affection, which he said they had grossly underestimated.³ If rangeland scientists and university professors overlooked this element of belonging, they did so because affection lies outside of the cold objectivity for which science and history, as disciplines and academic pursuits, were seeking.

In that light, I failed to do that which I set out to do, because I thought that belonging could be measured objectively, when in fact it cannot. Belonging can be described in terms and measured in experiments that attempt objectivity. Some researchers, recognizing the importance of subjectivity and affection have attempted to describe or measure these aspects of belonging through surveys of how people feel and what they believe about things. Mark Brunson and Brent Steel conducted one such study in 1994 when they conducted a survey of national attitudes toward federal rangeland management. In writing *The Western Range Revisited*, Debra Donahue referred to Brunson and Steel's study and its reflection of the public's affection, and perhaps lack of

³ Thadis Box, "Capstone Address: Crested Wheatgrass: Its Values Problems and Myths; Where Now?" In *Crested Wheatgrass*, Johnson ed., 344.

it, for federal rangelands. When asked if they favored a total ban on livestock grazing on public lands, nearly half of respondents said they were neutral toward the concept. It seems reasonable to assume that many of those who responded in this way did so because they felt they lacked understanding of the issues and feared to make a judgment that might lead to actions with consequences that they did not comprehend.⁴

That which we do and do not know gains importance as we frame it within the stories we tell about the plants and about the landscapes and about ourselves: what we are doing here and what we can and should attempt to accomplish. To create these stories we rely both on imagination and observation. “Only imagination,” Berry argued, “can give our home landscape and community a presence in our minds that is a sort of vision at once geographical and historical, practical and protective, affectionate and hopeful.” Through imagination we create the visions of landscape that exist in our minds and in our conversations. “If that vision is not repeatedly corrected by a fairly accurate sense of reality,” Berry continued, “then both we and the landscape fall into danger; we may destroy the landscape, or the landscape (especially if damaged by us in our illusion) may destroy us.” At first glance it may seem that Berry exaggerates the threat. However, this exaggeration falls into perspective as we consider the damaging wildfires, now yearly occurrences of increasing scale and intensity, that burn rangelands and homes and that

⁴ Mark Brunson and Brent Steel, “National Public Attitudes toward Federal Rangeland Management,” *Rangelands* 16 (1994):77-81, cited in Debra Donahue, *The Western Range Revisited: Removing Livestock from Public Lands to Conserve Native Biodiversity* (Norman: University of Oklahoma Press, 1999), 9, 61, 88, 284-6.

largely result from the spread of cheatgrass, which is directly linked to our use and attempts to manipulate the landscape.⁵

The post-agricultural landscape represents the re-writing of our stories. If the agricultural landscape was a story of unlimited expansion and continuous growth then the post-agricultural landscape is about limitations, both those that exist as functions of ecological systems and relationships and those that we create and self-impose because of our values and beliefs about what the landscape should be like and what we should and should not do because of the consequences of our actions on the rest of life and living things. When Donald Worster rewrote the history of the Dust Bowl the lesson he emphasized was that “Nature, it should be clear, has limits; they are neither inflexible nor are they constant, but they do exist.” Limits, is another way of saying there are things with regards to nature, that we cannot or should not do. How we create and comprehend these limits depends largely on the stories we write, we tell ourselves and we choose to believe.

The history of crested wheatgrass on one hand is the story of extending nature's limits. Agricultural researchers, soil conservationist, ranchers and public land managers all valued crested wheatgrass because it allowed them to continue to use the landscape in ways that native-plant communities could not support. Crested wheatgrass covered up the mistakes and the damage that resulted from the failure of the small-dryfarming system. A failure caused by misunderstanding the landscape and by the pressure of capitalist consolidation and expansion that pushed owners of small farms into poverty, causing them to abandon the land that they had so drastically altered in order to farm. This story

⁵ Berry, “Life is a Miracle,” 85.

continues to play an important role in the use of crested wheatgrass in agricultural landscapes. Ranchers continue to use crested wheatgrass to increase forage, and farmers who enter their acres into conservation reserves programs, which are operated by the Natural Resource Conservation Service in much the same way as the earlier Soil Bank, still use crested wheatgrass in mixtures to hold their soil and keep out the weeds.

On the other hand the story of crested wheatgrass is one of the destruction of native sagebrush communities, which includes the loss of rare plant and wildlife species and the loss of recreational opportunities. In several recent emails Katie Fite, the Biodiversity Director of the WWP, described the use of crested wheatgrass in a recent range rehabilitation project in Vale, Oregon. The project “destroyed vast areas of sagebrush in Vale BLM lands – sprayed, burned, plowed up – and planted cwg in many areas - all for some welfare ranchers cows to keep from reducing AUMs – and now much of the country is going to weeds. And is utterly destroyed. We are now seeing that pattern repeated again – but with different excuses – ‘hazardous fuels reduction’, ‘trying to grow forbs for sage grouse’, etc. Behind it all is trying to keep public lands ranchers on life support – by killing sagebrush and planting cow forage grass.”⁶

There is not one story of crested wheatgrass. There are many. Understanding the origins, the values and the consequences of these stories is, I believe, a move in the right direction of making the best decisions we can, given what we know and what we do not know. I believe we are also moving in the right direction when these stories are tied to specific biophysical landscapes and even to specific sites within those landscapes. We

⁶ Katie Fite, “RE: A Question about Grasses,” e-mail correspondence, 22-24 March 2008.

can use history to understand these stories and we can use the experience gained through a century of growing crested wheatgrass to make decisions that will use the grass judiciously. We may continue to hope that crested wheatgrass will help in restoring habitat for native plants and animals.

In the stories that created the agricultural landscape crested wheatgrass was a miracle, in the post-agricultural landscape crested wheatgrass is considered an invader. Land managers have to make land management decisions by considering both stories and in many places they are doing so. As of August 1997, the BLM has been using a system of standards for rangeland health that separates rangelands into eight different categories based on their current ecological condition. This system provides standards that apply more directly to specific sites: native-plant communities have a different set of standards than reseeded areas and areas that are dominated by exotic plants other than reseeded species.⁷

The best uses will come from decisions that are made in regard to specific places and conditions and that consider the different values and needs of land users. Best uses is necessarily a relative term rather than one that can be applied to all places. Best uses recognize the diversity that exists in landscapes, in plant materials, in economic and political conditions and in human connections to living things.

⁷ US Department of Interior, Bureau of Land Management, "Idaho Standards for Rangeland Health and Guidelines for Livestock Grazing Management," Boise: Idaho State Office BLM, 1997. J.T. Romo, P.L. Grilz, and L. Delanoy, "Selective Control of Crested Wheatgrass (*Agropyron cristatum* [L.] Gaertn, and *A. desertorum* Fisch.) in the Northern Great Plains," *Natural Areas Journal* 14 (October 1994):308-9.

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