Plant Community Development in a Dryland CREP in Northeastern Oregon

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Abstract

Riparian areas in dryland crop regions of the Intermountain Pacific Northwest have largely been converted to cropland or pasture during the last 140 years. Some formerly cultivated floodplains have become difficult to farm; enrollment of these lands into conservation programs provides the opportunity to use them as wildlife habitat and as buffer areas near streams. Our objective was to evaluate vegetation development on an USDA Conservation Reserve Enhancement Program site planted in 1999 in northeastern Oregon. We established permanent line transects to quantify vegetation cover as a measure of plant community composition adjacent to three stream segments based on the degree of channel incision. We collected data in 2000-2001 and 2007-2008. Vegetation cover in 2000-2001 was 100%, dominated by tall wheatgrass. Living plant material cover decreased from 98% in 2000-2001 to 33% in 2007 and 68% in 2008; dead plant residue significantly increased and tall wheatgrass cover decreased. Native species were present in similar percentages from 2000 to 2008, there was a shift from target to nontarget species. The 1999 seeding can be judged a success, especially with respect to providing ground cover for soil conservation and the establishment of tall wheatgrass. The increased ratio of dead to living plant material suggests that more active management (i.e., fire, grazing, or mowing) of the tall wheatgrass stand is needed to maintain its productivity and/or a healthy mix of multiple species.

Keywords: Conservation buffers, plant community, riparian management, weed control,

Introduction

Although riparian areas comprise less than 2% of the land area in the arid and semiarid western United States, they contribute disproportionately to physical and biological processes. They serve as pathways for the flow of energy, matter, and organisms through the landscape, acting as ecotones between the terrestrial and aquatic zones and corridors across regions (Forman 1995). Riparian vegetation plays important roles in trapping soil eroded from uplands and removing nutrients from surface and soil water (Pearce et al. 1998, Baer et al. 2009), stream morphological dynamics (Bennett et al. 2002, Corenblit et al. 2007), and aquatic, avian, and large game habitat requirements (Kauffman and Krueger 1984, Knopf et al. 1988, Gregory et al. 1991).

Since the late 1800s, dryland small grain production has been practiced on nearly all the arable land of the inland Pacific Northwest (McGregor 1982). Before widespread motorized mechanization of farming practices in the 1940s, the bottomland of second and higher order streams in this region were used extensively for grazing livestock, particularly draft horses, mules, and oxen. Beginning in the 1940s, much of this bottomland was converted to small grain production, resulting in the elimination of natural stream channels and riparian areas and the disruption of flood plains.

Infrastructure (roads and railroads) maintenance requirements, the need for farm operation efficiency, and government incentives led to the channelization of many of the streams in this region. Channelization creates steep banks unprotected by vegetation cover or consolidating root structure. Deep, channelized storm flow saturates unprotected stream banks, creating positive pore pressures that cause bank failure when the storm flow recedes (Simon and Collison 2001), and concentrates energy to transport soils eroded from uplands, stream banks and bottoms to deposition areas. Whereas the goal of stream channelization is to drain soil water more efficiently, the effect is to disconnect the hydrologic flux between stream channel and adjoining land. In forest or rangeland situations, this change in hydrology facilitates the establishment of opportunistic weed species. In croplands, the rapid draining of soil water short-circuits chemical and biochemical processes that would occur if the water were resident longer. For example; if water is stored in a floodplain from 2 to10 days, nitrate concentrations would be reduced through denitrification (Rassam et al. 2006).

Functioning riparian areas are necessary to create multifunctional production systems as described by Jordan et al. (2007). Until the late 1990s, efforts to restore or rehabilitate riparian areas occurred primarily in forests and rangelands on public lands through the efforts of USDA-Forest Service, USDI-Bureau of Land Management, and USDI-National Park Service, with smaller scale private land projects sponsored by nongovernmental organizations such as The Nature Conservancy. The introduction in 1998 by the USDA of the continuous Conservation Reserve Enhancement Program (CREP) provided crop producers with the opportunity to reestablish some of the structure and function of former riparian areas (Baer et al. 2009). CREP is a voluntary land retirement program intended to help agricultural producers protect environmentally sensitive land, decrease soil erosion, restore wildlife habitat, and safeguard ground and surface water. Where this program applies to lands bordering waterways, the stream must provide current or historical habitat for threatened or endangered fish species and must not be located above a permanent barrier to fish passage. The program also applies to any area with a completed agricultural water quality management area plan, as well as reservation and tribal trust lands. Eligible practices include planting and maintaining riparian forest buffers, filter strips, wetland restoration, fencing, off-site watering and others. Contracts are generally 10 to 15 yr in duration. CREPs are designed by the USDA-Natural Resources Conservation Service (NRCS) and funded through the USDA-Farm Service Agency (FSA). Technically, CREP projects are not considered ecological restoration, because native and non-native species are used (Bradshaw 1996, Kauffman et al. 1997), but are known instead as rehabilitated production systems (RPS) (Baer et al. 2009). The first CREP project in northeastern Oregon was established in 1999.

After initial post-implementation evaluation by NRCS of the sediment filtering effectiveness of the seeded grasses and establishment success of shrubs, CREP projects are visited periodically to assure compliance with contractual agreements. Few systematic plant community, soil sampling, or soil erosion studies are conducted in RPS to evaluate project success in terms of structure and function, although numerous studies on larger ecological issues have used data gathered from these sites (Baer et al. 2009). For example, much of the research on land enrolled in conservation programs has been conducted as habitat evaluations of lands enrolled in the Conservation Reserve Program (CRP) (e.g., Millenbah et al. 1996, Greenfield et al. 2003). Systematic studies of individual CREP projects, particularly in the Pacific Northwest, are lacking, although a statewide evaluation was recently conducted in the state of Washington (Smith 2006). The objective of this research was to conduct a multi-year vegetation study to describe plant community development in Gerking Flat CREP.

Materials and Methods

Study Site

Gerking Flat is approximately 17 miles northeast of Pendleton, Oregon (45° 49’ 41” N, 118° 32’ 49” W). In the early 1960s, Gerking Flat was brought into small grain production in an annual spring barley system. After flooding in December 1964, Gerking Creek was straightened to improve surface runoff efficiency, soil drainage for early-season field access, efficient operation of farm machinery, and to reduce the impact of salt accumulation on crop production. In subsequent years, drain tiles were installed to further assist draining of wet areas. However, barley yields were low because of excess soil water, salinity, and high soil pH. Flooding and channel migration in 1996 and 1997, combined with poor barley yields, led the landowners to conclude that barley production was no longer economically feasible, and in 1999, they enrolled a portion of Gerking Flat in a 15 yr CREP contract to retire unproductive land, contribute to soil and water conservation, and create bird habitat.

The project area was divided into three zones based on current topography: 1) active stream channel, 2) floodplain, and 3) upland. A mix of willows, other trees, and shrubs were to be planted in zones 1 and 2 (Table 1), and grasses, forbs and shrubs in zone 3 (Table 2). In this article, we describe our results in terms of target/nontarget-native/nonnative species, where target species are those that were planted and nontarget are volunteer or invasive (Baer et al. 2009). The project plan called for a density of 200 live trees per acres. Based on NRCS and Pheasants Forever planting lists, a total of 200 cottonwoods[1], 500 willows, and 875 shrubs of various species were planted (Table 1). Trees and shrubs were planted from 3 to 14 feet or an average of 8 feet on each side of the channel in April, 2000, and January, 2002. Shrubs and trees were hand watered once after planting.

Prior to seeding, weeds were controlled with herbicides and disking. The grass/forb mix was seeded in the spring of 1999 at 20 lb/ac. Post-seeding weed control was conducted on the entire site by mowing in the spring of 2000 and 2001. In 2002, the eastern, upstream quarter of the site was disked lightly to control weeds and eliminate the heavy mat of dead vegetation that had developed. The landowner, in consultation with NRCS personnel, concluded that burning some portion of the site annually would not damage the established grasses, and would result in less open ground for nontarget species invasion. Subsequently, spring burns were conducted before bird nesting season on approximately one-quarter of the site from 2002 to 2005. Exact records of burn dates and specific areas burned were not kept. Alleyways were also randomly cut through the site each year to provide upland game bird hunting access.

[1] Latin names for plants provided in tables.

Table 1. Tree and shrub species planted in 1999 in the Gerking Flat CREP (source: USDA-Natural Resources Conservation Service and Pheasants Forever).

Species	No. planted
Black cottonwood (*Populus trichocarpa*)	200
Willow (*Salix exiqua, Salix* spp.)	500
Woods rose (*Rosa woodsii*)	75
Nootka rose (*Rosa nutkana*)	75
Snowberry (*Symphoricarpos albus*)	100
American plum (*Prunus americana*)	75
Chokecherry (*Prunus virginiana*)	100
Elderberry (*Sambucus racemosa*)	50
Golden current (*Ribes aureum*)	50
Buckbrush (*Ceanothus cuneatus*)	50
Western white clematis (*Clematis ligusticifolia*.)	25

Table 2. Target grass and forb species planted in 1999 in the Gerking Flat CREP.

Species	Symbol	% of mix
Non-native		
Meadow foxtail (*Alopecurus pratensis*)	ALPR3	13
Alfalfa (*Medicago sativa*)	MEDIC	10
Yellow sweetclover (*Melilotus officinalis*)	MEOF	8
Tall fescue (*Festuca arundinacea*)	SCPH	22
Tall wheatgrass (*Thinopyrum ponticum*)	THP07	11
Native		
Basin wildrye (*Elymus cinerus*)	LECI4	6
Streambank wheatgrass (*Elymus lanceolatus*)	ELLAL	4
Western wheatgrass (*Agropyron smithii*)	PASM	5
Alkali sacaton (*Sporobolus airoides*)	SPAI	21

Gerking Creek is an intermittent tributary of Wildhorse Creek, the major northern tributary of the Umatilla River, draining predominately rainfed agricultural lands. Gerking Creek enters the project site as an incised channel, broadens into a multi-channel stream in the mid-section of the project, and then once again becomes an incised channel in the lower one-third of the site. The flood plain was only 6-12 feet wide in the incised segments. The channel length through the project was 1.4 miles, and extended 164 feet on either side of the channel, encompassing a total project area of 110 acres (Figure 1).

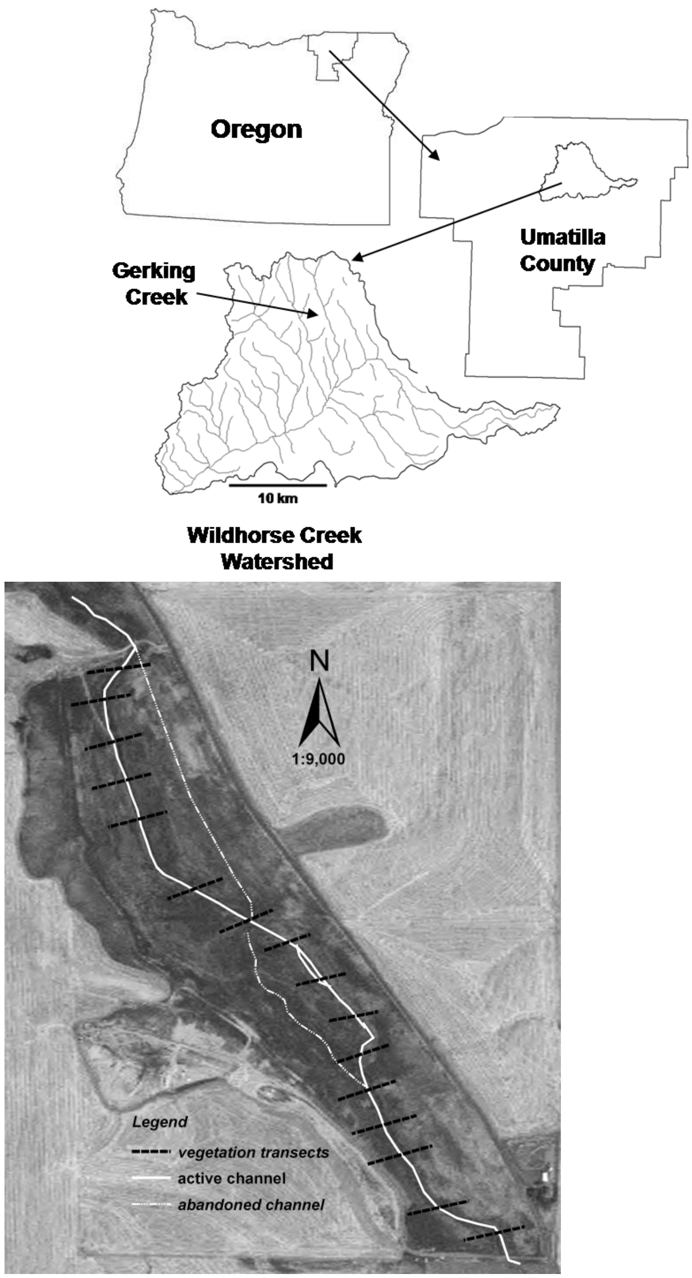

Figure 1. Location of Gerking Creek within Oregon, and 2008 aerial photograph of Gerking Flat CREP, channels, and vegetation transects.

Meteorological records dating from 1931 at the USDA Columbia Plateau Conservation Research Center and Oregon State University Columbia Basin Agricultural Research Center, 9 miles south of the research site, show minimum and maximum air temperatures of −29 and 115˚F, with a 71 yr average mean annual temperature of 52˚F. Annual frost-free days range from 135 to 170 (Johnson and Makinson 1988). Approximately 70% of precipitation occurs between November and April, with annual precipitation averaging 16.6 inches. Snow cover is transient, with accumulated snow subject to rapid melting by frequent marine warm fronts from the Pacific Ocean. Soils are Hermiston silt loams (coarse-silty, mixed, mesic Cumulic Haploxeroll) and

Pedigo silt loam (coarse-silty, mixed, superactive, mesic Cumulic Haploxerolls), formed in silty alluvium from loess and ash on flood plains and low terraces. These soils overlay the fractured Miocene basalt layers of the Columbia Plateau, and slopes range from 0 to 3% (Johnson and Makinson 1988).

Monitoring and Sampling Procedures

We established permanent line-point transects (Bonham 1989) extending 164 feet perpendicularly east and west from the active channel edge to quantify plant cover by species. Transect locations were established at regular intervals of about 328 feet throughout the project area using survey grade GPS equipment. Because the channel sections were of unequal length, the transects were distributed according to relative channel length, with six in the upper section, four in the midsection, and seven in the lower section. Each 164 foot transect was stratified by distance from the channel edge in 16 feet increments, and five points were randomly sampled within each of these increments. Cover, by species, litter, or bare ground was recorded at each point. Plant species were referred to as target-native, target-nonnative, nontarget-native, and nontarget-nonnative, where target species were those that had been planted under the CREP program (Baer et al. 2009). We sampled in May and June in 2000, 2001, and 2008, and in July and August in 2007. Individual trees and shrubs in the project area were counted in August, 2008; willow species were identified separately from this census.

Experimental design and statistical procedures

The study reported here is descriptive. Data were graphically and statistically analyzed to determine if there were differences in species composition and vegetation cover among years in any stream segment, side of the stream, or in the distribution of species at distance from the stream. We calculated Simpson's diversity index (N_2),

$$N_2 = N(N - 1) / \Sigma n_i(n_i - 1),$$

where n is the total number of organisms of a particular species and N is the total number of organisms of all species, and the Simpson equitability index (E),

$$E = N_2 / S,$$

where S = the total number of species identified at time of sampling. These values were calculated, by year, for the entire site and for each stream segment (Green 1979). Analysis of stream segment data was conducted using a mixed-model, repeated measures ANOVA GLIMMIX procedure to model the response using a binomial distribution, and least square means separation tests where significant main effects and interaction terms were found (SAS 2008).

Results and Discussion

Weather conditions were warmer and drier than normal from 2001 through 2008, relative to the previous 70 yr. Mean annual temperatures were higher than normal in all years except 2004 and 2005 and total annual precipitation was below the long-term average in 2001, 2002, 2003, 2005, and 2008.

Construction of a building and pasture establishment eliminated two transects (16 & 17) between 2001 and 2007. We were, however, able to conduct a census of trees and shrubs planted within 33 feet of the channel in these areas.

We identified 32 individual species of grasses and forbs in the permanent transects over the course of the study (Table 3). Not all species were present every year, with 15 in 2000, 18 in 2001, 18 in 2007, and 21 in 2008. Across the site N_2 was 1.6 in 2000 and 1.5 in 2001, increasing to 5.3 in 2007 and 4.4 in 2008. N_2 for each of the stream segments in 2000-2001 was between 1.4 and 1.9, increasing to 3.0 to 5.4 during 2007-2008. This change in N_2 indicates an increase in species diversity. However, an increase in diversity alone is not sufficient grounds to judge a rehabilitation project a success. We will discuss this concept further in this article. No shrubs or trees were found in any of the line transects.

Total ground cover was nearly 100% during all years of sampling, with means and standard errors of 99.8 ± 0.1%, 99.9 ± 0.1%, 97.1 ± 0.5%, and 97.3 ± 0.8% for 2000, 2001, 2007, and 2008. The decrease in cover from 2001 to 2007 was significant ($P \leq 0.05$) and corresponded to an increase in bare soil (Figure 2). There was also a significant increase in detritus (dead and down material) from 2001 to 2007 (Figure 3). In 2000 and 2001, species distribution across the site was undifferentiated between stream sides (east and west), and as a function of distance from stream channel. From 2007 to 2008, significant year by distance interactions developed in stream segment 3 at 98 feet, 148 feet, and 164 feet (Figure 4) and direction by distance interactions with less cover from 16 feet to 66 feet on the east side and from 131 feet to 164 feet on the west side (Figure 5).

Table 3. Nontarget species identified in Gerking Flat CREP.

Species	Symbol
Nonnative	
Wild oat (*Avena fatua*)	AVFA
Kochia, Mexican fireweed, mock cypress, Mirabel (*Kochia scoparia*)	BASC5
Ripgut brome (*Bromus diandrus*)	BRDIR
Downey brome (*Bromus tectorum*)	BRTE
Canada thistle (*Cirsium arvense*)	CIAR4
Hairy fleabane, wavy-leaf fleabane, flax-leaf fleabane, asthmaweed (*Conyza bonariensis*)	COBO
Prickly lettuce (*Lactuca serriola*)	LASE
Oxeye daisy (*Chrysanthemum leucanthemum*)	LEVU
Catnip (*Nepeta cataria*)	
Scotch thistle, Scotch cottonthistle (*Onopordum acanthium*)	NECA2
Rabbitfoot polypogon, annual rabbitsfoot grass (*Polypogon monspeliensis*)	POMO5
Tumble mustard (*Sisymbrium altissimum*)	SIAL2
Pineapple weed, disc mayweed (*Matriciacaria matricarioides*)	MADI6

Lambsquarters (*Chenopodium album*)	CHAL7
Fiddleneck Tarweed (*Amsinckia lycopsoides*)	AMLY
Cutleaf Nightshade (*Solanum triflorum*)	SOTR
Black Mustard (*Brassica nigra*)	BRNI
Native	
Willowweed; dwarf fireweed (*Epilobium latifolium*)	CHLA13
[Canadian] Horseweed (*Conyza canadensis*)	COCA5
False quackgrass (*Elymus × pseudorepens*)	ELPS
Field horsetail (*Equisetum arvense*)	EQAR
Hardstem bulrush (*Schoenoplectus acutus* var. *acutus*)	SCAC3
Common cattail, broadleaf cattail (*Typha latifolia* L.)	TYLA
American speedwell (*Veronica americana*)	VEAM2

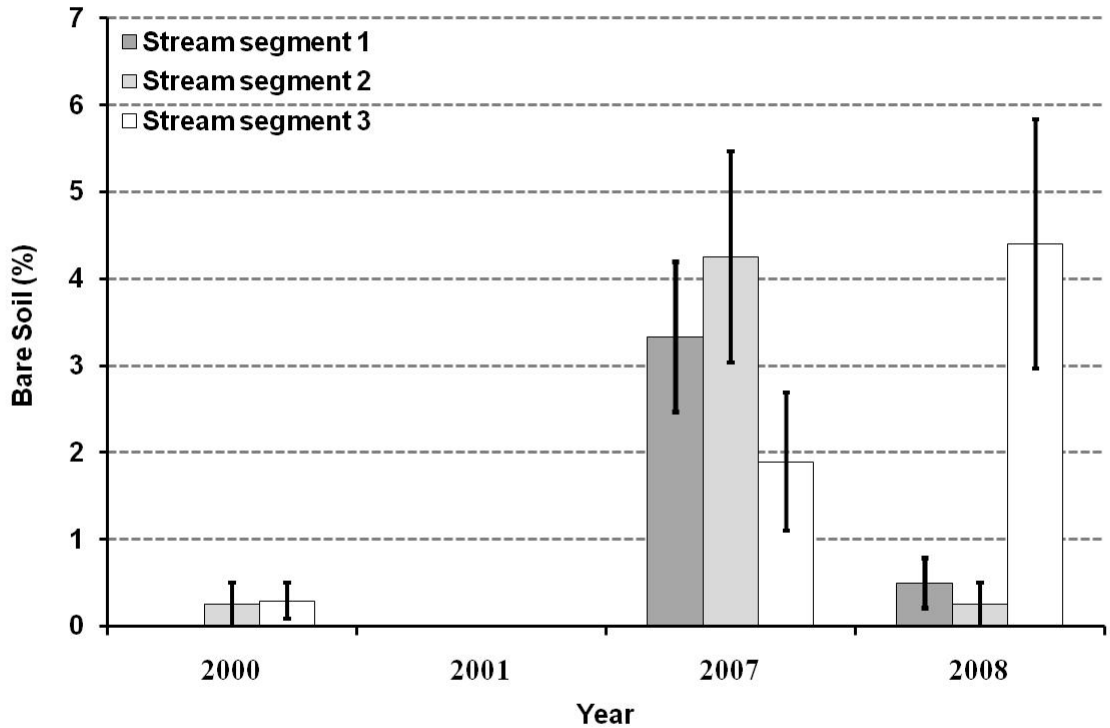

Figure 2**.** Changes in bare soil demonstrating increased plant community complexity from 2000 through 2008.

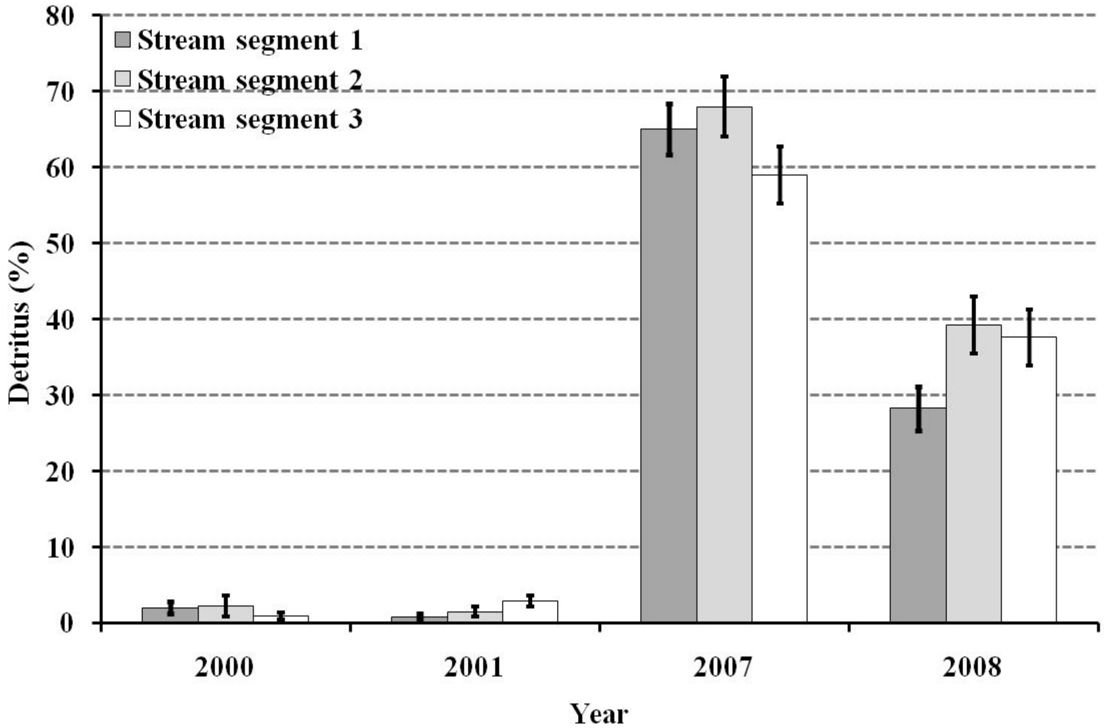

Figure 3. Ground cover contribution by detritus from 2000 through 2008.

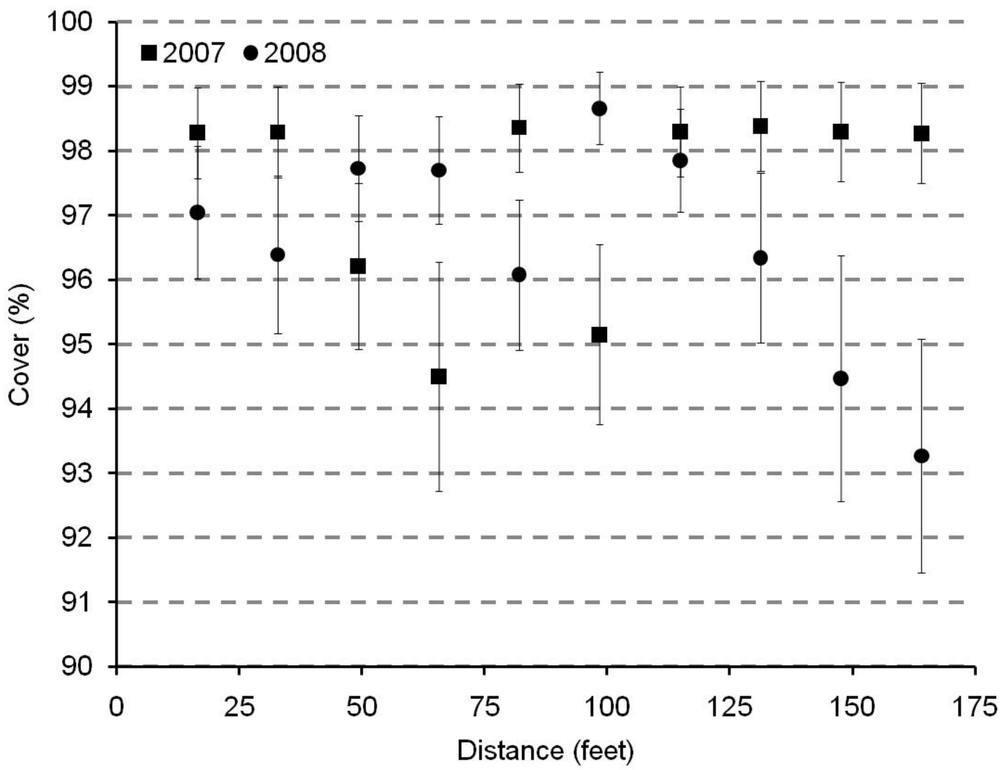

Figure 4. Change in total ground cover with distance from stream, stream segment 3 (2007, 2008).

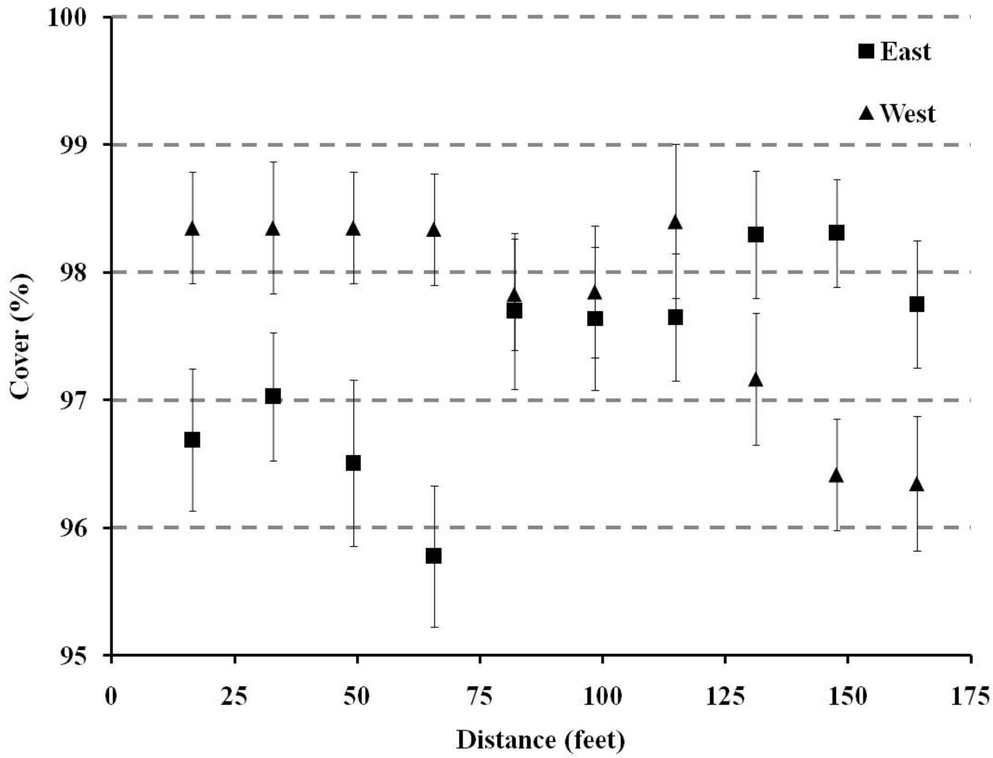

Figure 5. Total ground cover values relative to side of stream.

Target-nonnative species comprised significantly more of the vegetation cover than all other classes ($P \leq 0.05$), during 2000 and 2001 (Figure 6), with the predominant contribution by tall wheat grass (Figure 7). The relative contribution of tall wheatgrass in individual stream segments changed over time, with less tall wheatgrass in stream segment 1 than stream segments 2 and 3 in 2000, and more tall wheatgrass in stream segment 1 than stream segments 2 and 3 in 2007 and 2008 (Figure 7).The relatively even distribution of tall wheatgrass in 2000 and 2001 changed to a greater contribution ($P \leq 0.05$) on the east side of the channel in 2007 and 2008. In stream segment 1, tall wheatgrass cover in the first 16 feet from the stream channel was significantly less than at any other distance during 2000, 2001, and 2007; however, in 2008 the only significant differences among distances were between 33 feet and 131 feet, and 131 feet and 164 feet. This pattern was similar in stream segment 2 ($P \leq 0.05$), with smaller differences in stream segment 3.

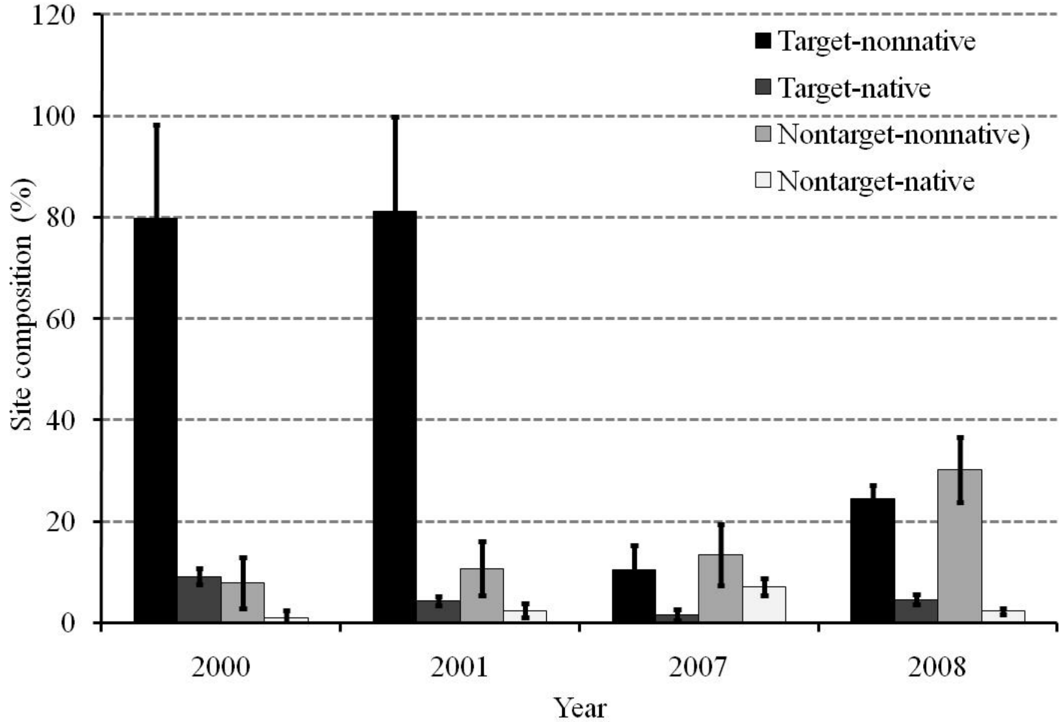

Figure 6. Plant cover composition by target-nontarget native-nonnative species.

Of the remaining four target-nonnative species, none contributed more than 2% cover during any year of sampling and none were present in 2008. Only two of the four target-native species, basin wildrye and alkali sacaton remained present in 2008, contributing 5% and 2% cover, respectively. Twenty-four nontarget species were identified, of which 17 were nonnative and 7 were native species. From 2000 to 2008, there was a shift from target-nonnative toward nontarget-nonnative dominance at the site (Figure 6), with the greatest contributions by wild oats, kochia, Canada thistle, and tumble mustard. The occurrence of these species progressively increased through each year of sampling.

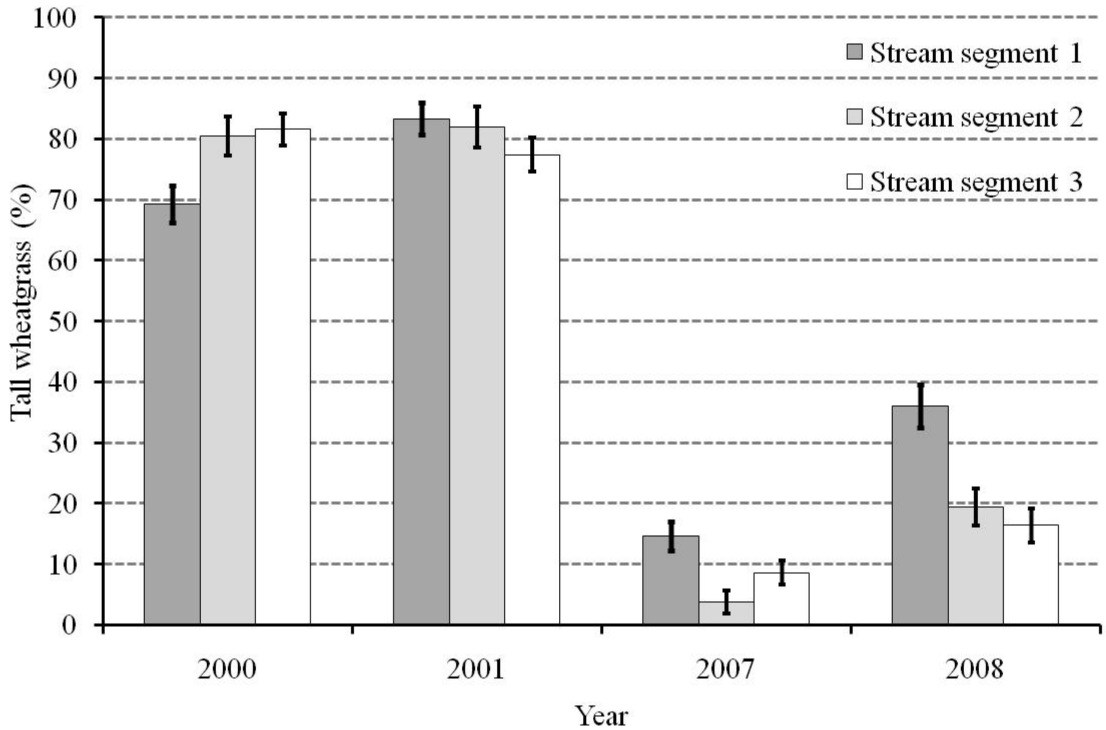

Figure 7. Tall wheatgrass contribution to plant cover.

The planting ratio of target native to nonnative species was 36:100 (by seed weight), the resulting total contribution by native species to plant cover was < 6% during any year, decreasing in stream segment 1 after the first year and increasing in stream segment 3 (Figure 8). Six nontarget-native species contributed 3% and 17 nontarget-nonnative species contributed 16% of the plant cover by 2008 (Table 3). The contribution by target and nontarget native species significantly decreased in stream segment 1 and increased in stream segment 3 from 2000 to 2008. ($P \leq 0.05$). There was significant interaction between year and stream segment in stream segments 1 and 2. In stream segment 1, native species decreased significantly at 16 feet, 33 feet, 49 feet, 66 feet, 82 feet, 98 feet, 115 feet, 131 feet, and 148 feet between 2000 and 2008 (Figure 9). In stream segment 2, differences were limited to a significant decrease in native species cover between 2000 and 2001, and 2000 and 2008 at 33 feet, with a significant increase in native vegetation cover between 2000 and 2008 at 66 feet. In stream segment 3, there were significant increases in native species as a percentage of total plant community cover at 33 feet, 49 feet, and 82 feet, between pooled values for 2000-2001 and 2007-2008.

Results of the tree and shrub census appear in Table 4. We recorded one nontarget-native species, red osier dogwood. The following species apparently did not survive after planting: Nootka rose, American plum, chokecherry, elderberry, golden current, buckbrush, and western clematis (Table 1).

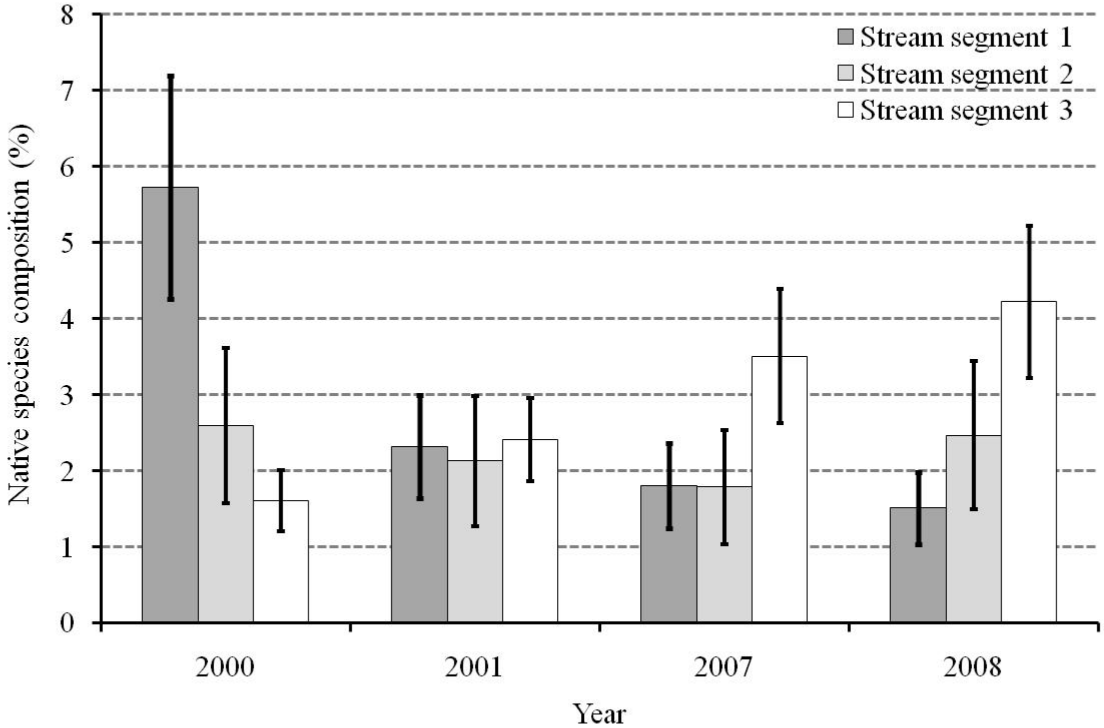

Figure 8. Native species contribution to plant cover showing decreasing contribution over time in stream segment 1 and increasing contribution in stream segment 3.

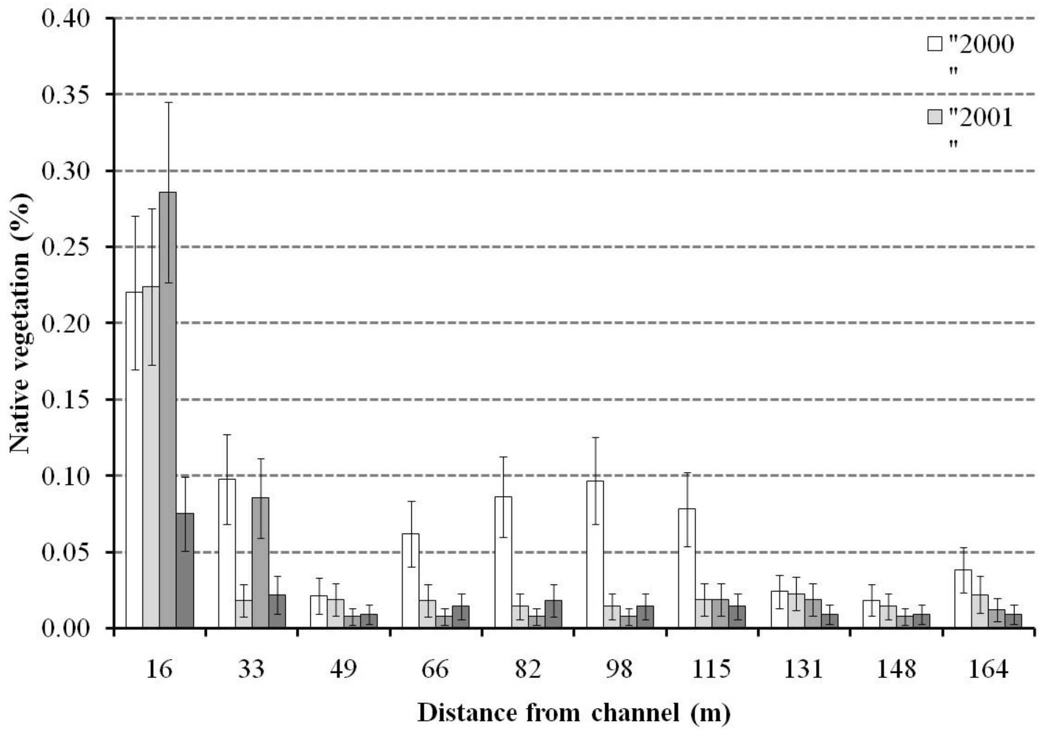

Figure 9. Year by distance interaction in stream segment 1, overall decrease in plant cover by native species beyond 16 feet and passage of 6 years, except at 148 feet and 164 feet in 2007.

Table 4. Trees and shrubs found in zones 1 and 2 (described in text) in a September, 2008, census.

Species	Number
Willows (*Salix* spp.)	279
Pacific willow (*Salix lucida* ssp. *lasiandra*)	
Scouler willow (*Salix scouleriana*)	
Coyote willow (*Salix exigua*)	
Dusky willow (*Salix melanopsis*)	
Booth's willow (*Salix boothii*)	
Woods rose (*Rosa woodsii*)	15
Snowberry (*Symphoricarpos albus*)	15
Red osier dogwood (*Cornus sericea*)	5
Black cottonwood **(***Populus trichocarpa***)**	4

Tall wheatgrass dominated the site during the first 2 yr following seeding, and after 8 yr, it continues to be the predominant species. The other targeted species, native and introduced, contributed ≤10% to total cover and only basin wildrye contributed > 1% cover in 2008. The most substantial change at the site occurred with the increase in detritus, followed by nontarget-nonnative species. Low species diversity and evenness values (on Gerking Flat $N = 32$, $N_2 \leq 5.5$, and corresponding $E \leq 0.29$) are commonly found in rehabilitated agricultural systems (Baer et al. 2009). Generally, these values are reported with a reference value from local native remnant plant communities as a measure of project success. For our purposes, and because we lack a native comparison site, we rely on the general definition of the indices to conclude that the Gerking Flat RPS has low species diversity and evenness. The relevance of these values to the functioning of plant communities is the center of an ongoing debate (Ives and Carpenter 2007), although it is important, from a managerial perspective, to understand that fully functioning ecosystems generally score higher in both indices.

Nontarget-native species can alter the intended development trajectory of an RPS (Baer et al. 2009). On Gerking Flat, four of the nontarget native species were early colonizers of moist, primary successional sites (field horsetail, hardstem bulrush, common cattail, and American speedwell). Although considered weed species in croplands, all might be expected to contribute to native riparian habitat. Two nontarget natives, Canadian horseweed, and dwarf fireweed or willowweed, were found sparsely distributed throughout the site. False quackgrass, a nontarget native found in 2001, was not found in 2007 or 2008.

Nontarget-nonnative species, predominately Eurasian annuals typically found in disturbed semiarid and arid landscapes, increased substantially on Gerking Flat by 2008 (Figure 6). These species are exceptionally well adapted for invading disturbed areas where soil conditions and lack of native seed sources reduce competition from native plants. Once established, these communities of invasive species tend to persist unless there is substantial management intervention (Baer et al. 2009). Management options in CREP are limited to light soil surface disturbance (disking), mowing, burning, and limited herbicide use. The producer managing Gerking Flat mowed the site after the first year to control seed production from nonnative annuals. An attempt at disking part of the site was judged counterproductive, and the producer opted for burning some portion of the site each spring. Burning eliminated the thick mat of dead material that was accumulating, but apparently had no effect on slowing the increase in nontarget-nonnative species. In Mississippi, Greenfield et al. (2003) were able to improve bobwhite habitat by disking or burning a 10 yr old CRP field, but the improvement was short-lived and plant community composition was unaffected. Disking, mowing, and burning are effective if applied at the appropriate plant phenological stage, i.e., before seed set. These treatments must also be applied at a season that does not interfere with critical wildlife use, such as nesting. Grazing has been proposed as a means of upland weed suppression (e.g., McIver and Starr 2001), and can contribute to nutrient cycling advantageous to target species (Baer et al. 2009). However, grazing is restricted in most CREP contracts, and many of the CREP projects on the Columbia Plateau are managed by single commodity producers without the animal or managerial resources needed for grazing.

The project on Gerking Flat met the basic objective of providing ground cover, >90% in 2008, to conserve soil. Increased root and stem biomass slows erosion, both within and outside the stream channels, and traps soil eroded from surrounding fields and borrow ditches (Pearce et al. 1998, Harmel et al. 1999, Gran and Paola 2001, Toledo and Kauffman 2001). Of the 500 willows originally planted, we were able to identify 279 individual plants in 2008. These were located in the lower half of the project where most of the planting took place (Mr. Bud Schmidtgall, landowner, personal communication). In this area, a continuous canopy of willows now covers the channel. Thus, establishment of willows can be considered successful. The survival of other trees and shrubs appears to have been low, and completely unsuccessful with respect to cottonwood, Nookai rose, American plum, choke cherry, elderberry, golden current, buckbrush, and western clematis. The hydrological response to the willows is uncertain, pending repetition of a preproject survey to quantify channel shape, depth, and nick-point locations. An early concern with the planting of trees and shrubs in channels was they would be too effective and cause the channel to migrate. Although more sinuosity in a channelized stream might ultimately be a desirable objective, in the early phases of the project channel movement away from newly planted vegetation might have been considered undesirable. Such a scenario may be likely, considering that many of these projects were planted or planned around a channel that was likely to migrate back to the low area where it originally meandered. However,in this case the channel did not migrate.

Anecdotally, there seemed to be substantially more raptors and upland game birds at the site than in surrounding fields or adjacent to Gerking Creek above and below the project. This was expected, as avian communities increase with increasing plant community complexity, including variety in plant size and life form, and accumulation of detritus (Millenbah et al. 1996). Before the project was begun, the site was a monocropped agricultural field, and in 2000 and 2001 the site supported a monoculture of the targeted-nonnative tall wheatgrass. By 2008, we observed patchiness in the distribution of vegetation, with distinct areas of tall wheatgrass, nontarget-nonnative species (primarily annual or biannual forbs), and accumulations of detritus in various states of decomposition throughout the site.

Summary and Conclusions

The Gerking Flat CREP project planted in 1999 has fulfilled the primary objectives of establishing a plant community with sufficient cover to trap sediment from offsite, reduce erosion onsite, and provide cover and habitat for upland game birds. In the first 2 yr after planting, 2000 and 2001, the stand was dominated by a target-nonnative species, tall wheatgrass, with low overall diversity and evenness. After 6 and 7 yr, diversity values and evenness values both increased incrementally. Complexity of the site increased with an increase of detritus in various stages of decomposition, and patchiness within the community that was observed, but not captured by the sampling regime. Nontarget-nonnative species increased most at the site, which suggests that the current spring burning regime will have to be supplemented by other weed control measures to prevent conversion of the site to an annual nonnative plant community. Possible alternatives include well-timed applications of herbicide or intensive grazing management, and are decisions that must be taken in the context of landowner willingness to keep the land enrolled in this program. Although the immediate objectives of this project were met, establishment and development of plant communities dominated by nontarget-nonnative species create a seed source for infestation of surrounding crop land, potentially creating an economic drain on producers and ill will toward such projects. CREP projects are finite and depend on the competitiveness of program payments with alternate land uses and landowner satisfaction with project development and outcome. Arguably, participants will be challenged by economic pressures to return these sites to production (Napier 2009), even with successful establishment of healthy stands of targeted species. However, emerging resource concerns, such as downstream water quality issues and ecosystem service markets, including the carbon sequestration potential of restored CREP sites, may help counter such pressures. A more extensive evaluation of plant communities, hydrologic response, and other resource values in CREP projects should be undertaken, and lessons learned throughout the Pacific Northwest compiled to aide in future rehabilitation efforts.

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