

Implementation, management, and ecological benefits of ten conservation practices in the Conservation Reserve Program across the western United States

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Final Project Report

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Please note that this report is deliberately abbreviated because the results are currently in preparation for journal submission: Vandever, M.W., S.K. Carter, T.J. Assal, J. Welty, A. Wen, and R. Iovanna. In prep. Evaluating establishment of conservation practices in the Conservation Reserve Program across the western United States. Environmental Management.

Abstract

For more than thirty years the Conservation Reserve Program (CRP) has implemented practices that are intended to reduce soil erosion, improve water quality and groundwater recharge, and provide habitat for pollinators and wildlife. Given the significant government funds directed to the program, there is a need to evaluate to what extent the CRP has been successfully implemented on the ground and providing the intended benefits. To help address these needs, we identified a stratified random sample of currently enrolled CRP fields in ten conservation practices (CPs) across 14 western states. We then conducted edge-of-field surveys of 1786 fields in the summer through fall of 2016, 2017, and 2018. We found that 80% of fields across all practices had >50% canopy cover of grasses. Forb cover on most (84%) fields was $\geq 5\%$, with two practices (CP33 and CP42) that target habitat for upland birds and pollinators having particularly high forb cover (>50% on about 23% and 19% of the sampled fields, respectively). More than half (57%) of the sampled CRP fields had ≥ 2 native forb species present, with three practices that target habitat for ducks, upland birds, and pollinators (CP25, CP33, and CP42) having a notably large proportion of fields (75%, 84%, and 69%, respectively) with ≥ 2 native forb species present. Shrub and tree cover were both very low (<5%) on nearly all (92% and 93%, respectively) sampled CRP fields. Federal and State listed noxious grasses were present on 24% of sampled CRP fields, with CP10 having the highest percentage of fields (42%) with noxious grasses present. Federal and State listed noxious forbs were present on 61% of sampled fields. However, individual noxious forb species tended to constitute a small percentage of the vegetation cover in the field, with only 5% of noxious forb species occurrences constituting $\geq 20\%$ of the forb cover in the field. Most (86%) fields had no evidence of managed disturbance, with 8% having evidence of disturbance in the current year and 6% having evidence of disturbance in a previous year. The most common types of managed disturbance were haying, mowing, and grazing. Across practices, $\geq 99\%$ of fields had no evidence of rills, gullies, or pedestaling from erosion, and 91% of fields had <20% bare soil cover. Overall there is clear evidence that CRP fields are providing at least minimal structure and cover for targeted species and have very few erosional features. Manuscripts sharing these results are currently being drafted for submission to peer-reviewed journals.

Introduction

The Conservation Reserve Program has been in place for several decades providing technical and monetary support to farmers to implement practices that are intended to reduce soil erosion, improve water quality and groundwater recharge, and provide habitat for pollinators and wildlife, among other benefits. There is a need to evaluate to what extent different practices have been successfully implemented, and to what extent these practices are providing the intended benefits to people and wildlife both during and after the contract periods.

This project included three components focused on 1) which conservation practices had been successfully implemented on the ground across the western United States and are providing the expected benefits for people and wildlife (e.g., reduced soil erosion, grassland bird and pollinator habitat), 2) the extent to which different CRP practices and benefits persist after CRP contracts have expired, and 3) field validation of an edge-of-field survey method used to explore 1 and 2. This report focuses on component #1.

Methods

We acquired spatial data on currently enrolled CRP fields from the U.S. Department of Agriculture (USDA; Rich Iovanna, unpublished data, April 2016). We worked with USDA to identify geographic areas and conservation practices of primary interest to the agency. We then identified the population from which samples (i.e., currently enrolled CRP fields) would be drawn by identifying all fields in the dataset that met the following five criteria:

1. A target conservation practice had been implemented (CP1, 10, 2, 4D, 38, 25, 42, 33, 23, 37) and documented in the spatial dataset,
2. The field was located in one of 14 western states: WA and OR (eastern), ID, MT, ND, SD, MN, IA, MO, CO (eastern), NE, KS, OK (western) and TX (panhandle),
3. The field was within 25 m of an existing road centerline (this distance accounts for the width of the road and adjacent right of way),
4. The field was at least 5 acres in size (an exception to this rule is CP42, for which we set a minimum size of 2 acres to reflect the smaller acreage generally enrolled in this practice and to achieve an adequate sample size across multiple states), and
5. The field had been enrolled in CRP for > 3 years (contract end date \leq 2022 in data file).

Sampling sites were selected from this population using a stratified random design (stratified by state) to ensure that results would be statistically valid and able to be interpreted in individual states and across the western United States. To focus the evaluation for each conservation practice on states in which that practice is commonly implemented and ensure statistical validity, we only sampled those conservation practices in each state for which there were at least 50 fields enrolled in the practice and meeting the above criteria.

Edge-of-field surveys were used to evaluate the sampled fields across the 14 states and 10 conservation practices of interest. Edge-of-field surveys estimated cover of grasses, forbs, shrubs, and trees overall and by individual species; cover of bare soil; forb species richness; disturbance (amount, type, and timing); presence of windbreaks/shelterbelts; presence of erosional characteristics (rills, gullies, pedestaling); field heterogeneity; habitat metrics for grassland birds (usable bare soil and cover of vegetation of different height classes), and survey

confidence. Surveys were conducted from June through early October of 2016, June through early November of 2017, and June through early October of 2018.

Here we briefly summarize results by conservation practice (e.g., CP42) across the western United States. Complete results will be presented in the manuscript currently in preparation.

Results

We visited 1793 CRP fields to evaluate CRP implementation and were successful in sampling 1786 fields across 14 states (Table 1). Note that 47 fields were excluded from our analyses of vegetation cover because they were disturbed (e.g., hayed) to an extent that prevented accurate assessment of vegetation cover and identification of species, thus limiting our sample size to 1739 fields for all vegetation cover analyses.

Table 1: Total fields sampled to evaluate on-the-ground implementation of conservation practices (CP1: Permanent introduced grasses/legumes, CP2: Permanent native grasses, CP4D: Permanent wildlife habitat, CP10: Established grasses, CP23: Wetland restoration, CP25: Restoration of rare and declining habitat, CP33: Habitat buffers for upland birds, CP37: Duck nesting habitat, CP38: State acres for wildlife enhancement, CP42: Pollinator habitat). A diagonal line indicates there were too few eligible fields enrolled in the practice in that state to meet our criteria for sampling.

	CP 1	CP 2	CP 4D	CP 10	CP 23	CP 25	CP 33	CP 37	CP 38	CP 42	Grand Total
Colorado	20	20	20	20	/	/	/	/	21	21	122
Idaho	14	19	21	19	/	/	/	/	24	21	118
Iowa	20	20	20	20	18	21	20	/	20	19	178
Kansas	21	20	20	20	20	21	20	/	20	20	182
Minnesota	20	19	20	20	24	21	/	13	20	/	157
Missouri	17	20	/	19	12	18	20	/	20	19	145
Montana	17	19	/	20	/	/	/	/	/	/	56
Nebraska	19	20	20	20	/	20	20	/	20	20	159
North Dakota	20	17	20	20	19	22	/	20	20	21	179
Oklahoma	21	20	/	20	/	20	/	/	/	/	81
Oregon	19	25	20	21	/	/	/	/	/	/	85
South Dakota	18	19	20	22	21	16	/	16	19	/	151
Texas	20	20	20	6	/	/	18	/	/	19	103
Washington	16	17	21	16	/	/	/	/	/	/	70
Total	262	275	222	263	114	159	98	49	184	160	1786

Grass cover on CRP fields: The vast majority (96%) of fields across all practices had >20% canopy cover of grasses, with 80% of fields having >50% grass cover (Fig. 1). Grass cover was lowest in CP33, with 32% of fields having low ($\leq 50\%$) cover of grasses. The most commonly occurring dominant (i.e., constituting >20% cover in the field) native grass species across all conservation practices were big bluestem, sideoats grama, switchgrass, and Indiangrass, while

the most commonly occurring dominant non-native grass species were smooth brome, crested wheatgrass, Kentucky bluegrass, and intermediate wheatgrass. CP25 had the highest proportion of fields (81%) with at least two native grass species (Fig 2).

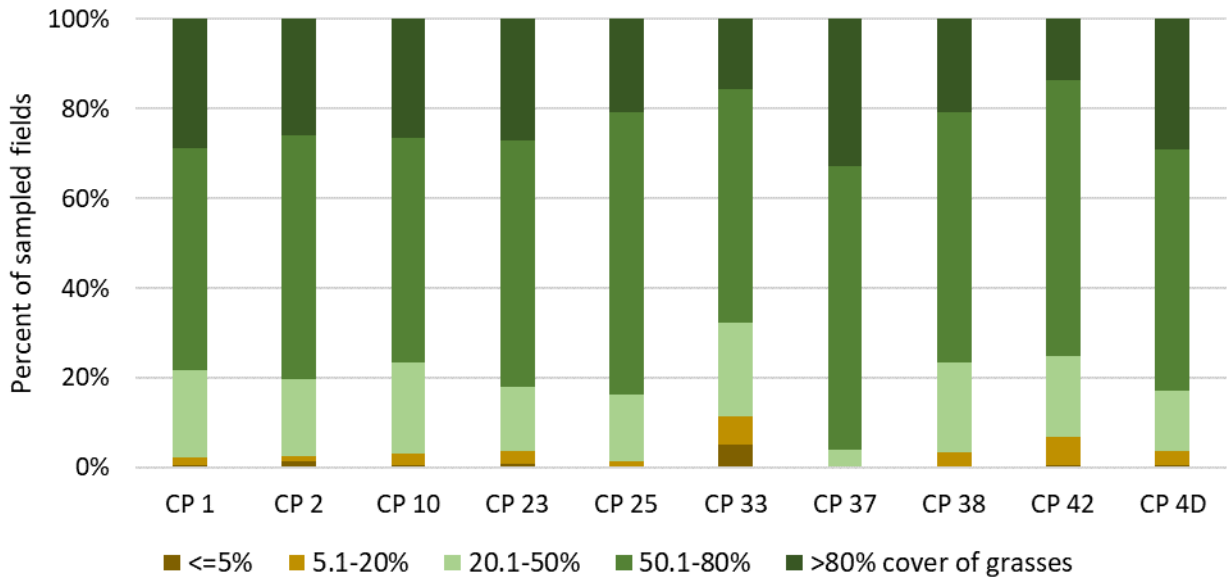


Figure 1. Grass cover on sampled CRP fields.

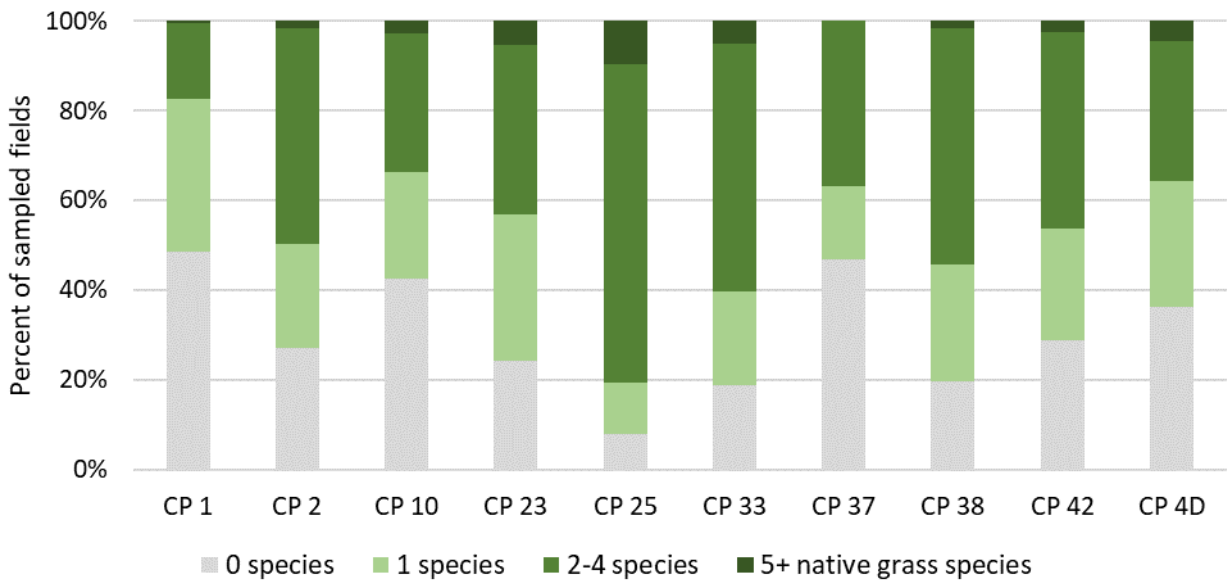


Figure 2. Native grass species richness on sampled CRP fields.

Forb cover and native forb richness on CRP fields: Forb cover on most (84%) fields was $\geq 5\%$ (Fig. 3), with two practices (CP33 and CP42) that target habitat for upland birds and pollinators having particularly high forb cover ($>50\%$ on 23% and 19% of the sampled fields, respectively). More than half of the sampled CRP fields (57%) had 2 or more species of native forbs present, with CP25, CP33, and CP42 having a notably large proportion of fields (75%, 84%, and 69%,

respectively) with ≥ 2 native forb species present (Fig. 4). The most commonly occurring forbs constituting $\geq 5\%$ cover on fields across all conservation practices combined were the native forbs Missouri goldenrod, goldenrod spp., and common sunflower; and the non-native forbs sweetclover and alfalfa.

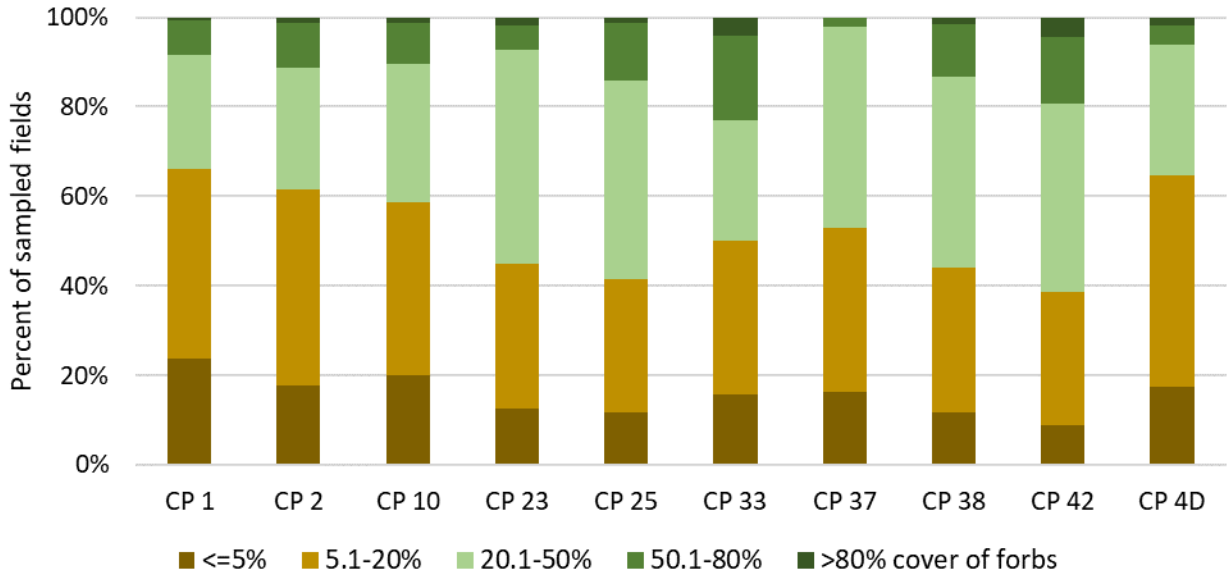


Figure 3. Forb cover on sampled CRP fields.

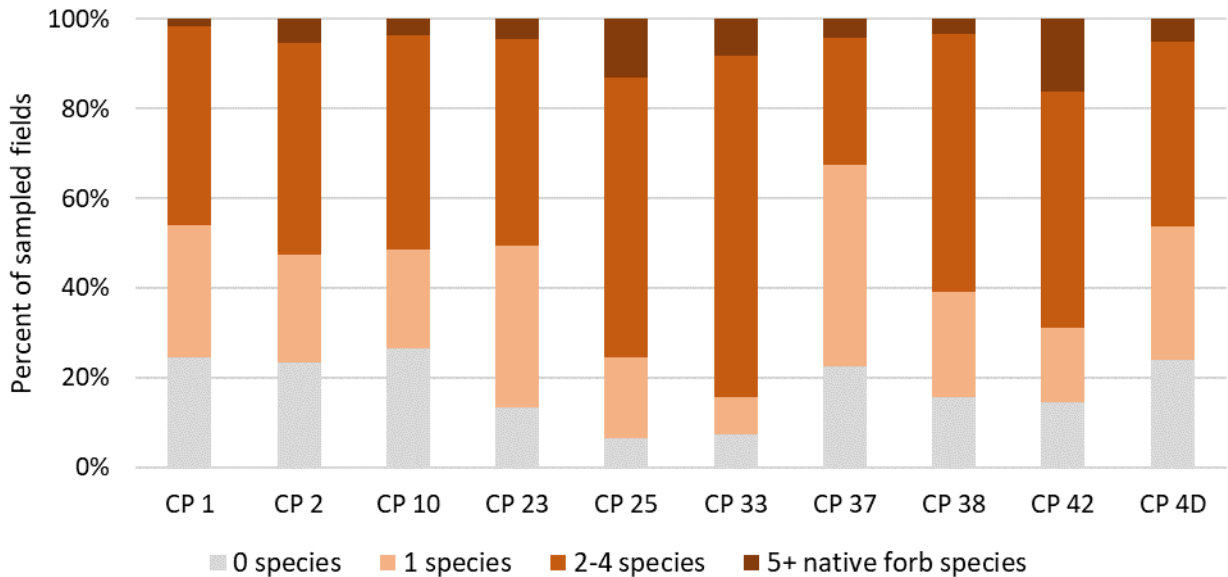


Figure 4. Native forb species richness on sampled CRP fields.

Shrub and tree cover on CRP fields: Shrub cover was $\leq 5\%$ on most (92%) of the CRP fields sampled (Fig. 5). The most commonly occurring dominant (i.e., constituting $>5\%$ cover) shrub species across all conservation practices combined were big sagebrush, rubber rabbitbrush, and yellow rabbitbrush. Tree cover was also very low ($\leq 5\%$) on nearly all (93%) sampled CRP fields

(Fig 6.). Only three practices had any fields on which tree cover exceeded 50%: CP4D, CP23, and CP33.

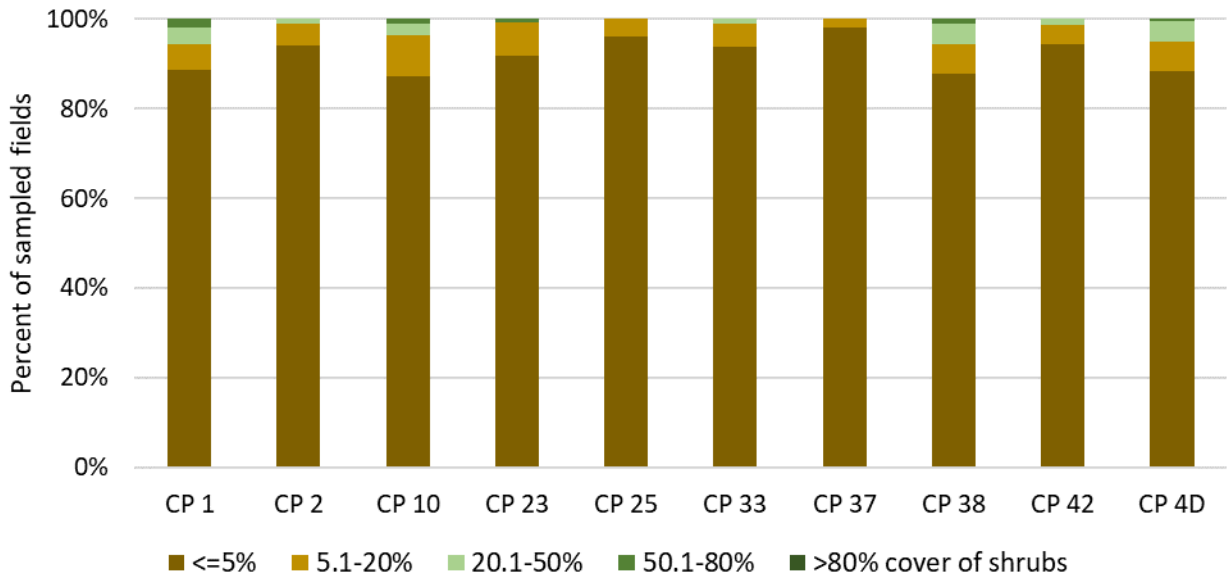


Figure 5. Shrub cover on sampled CRP fields.

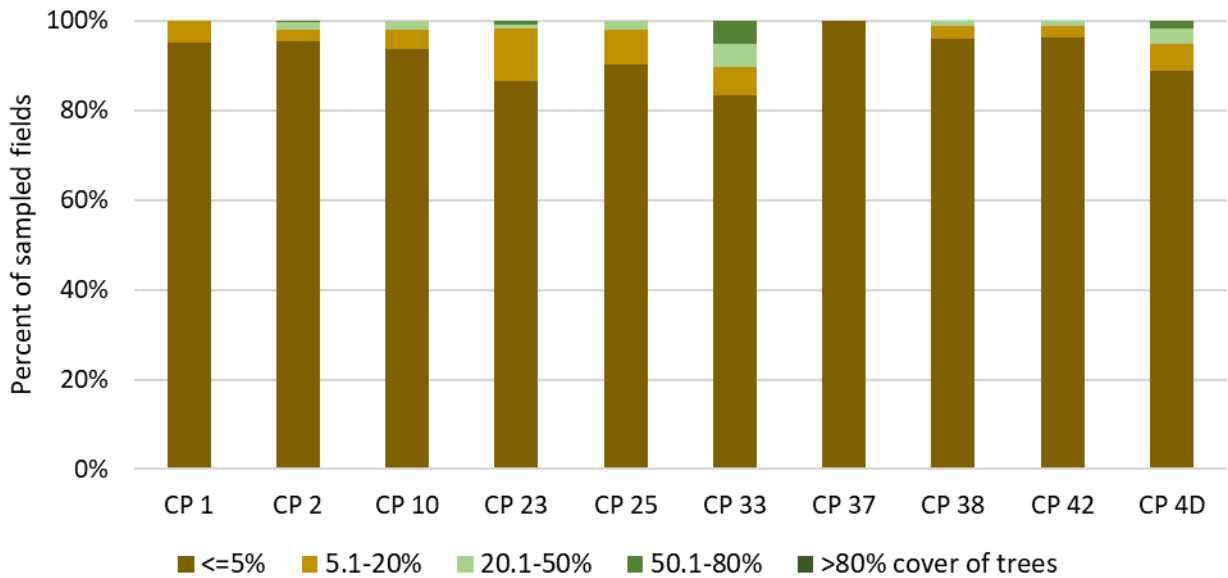


Figure 6. Tree cover on sampled CRP fields.

Noxious species on CRP fields: Federal and State listed noxious grasses were present on 24% of sampled CRP fields (Fig. 7). CP10 had the highest percentage of fields (42%) with noxious grasses present. Noxious grasses tended to have relatively high cover when present, with 31% of the occurrences of a noxious grass species comprising 20% or more of the vegetation cover in the field (Fig. 8). The most commonly occurring noxious grass species was cheatgrass.

Federal and State listed noxious forbs were present on 61% of sampled fields (Fig. 9). However, the percent cover of noxious forbs in the fields where they were present tended to be quite low: only 5% of noxious forb occurrences constituted $\geq 20\%$ of the vegetation cover of the field. The most commonly occurring noxious forb species (constituting $\geq 5\%$ cover) across all conservation practices combined were Queen Anne’s lace, Canada thistle, and burningbush.

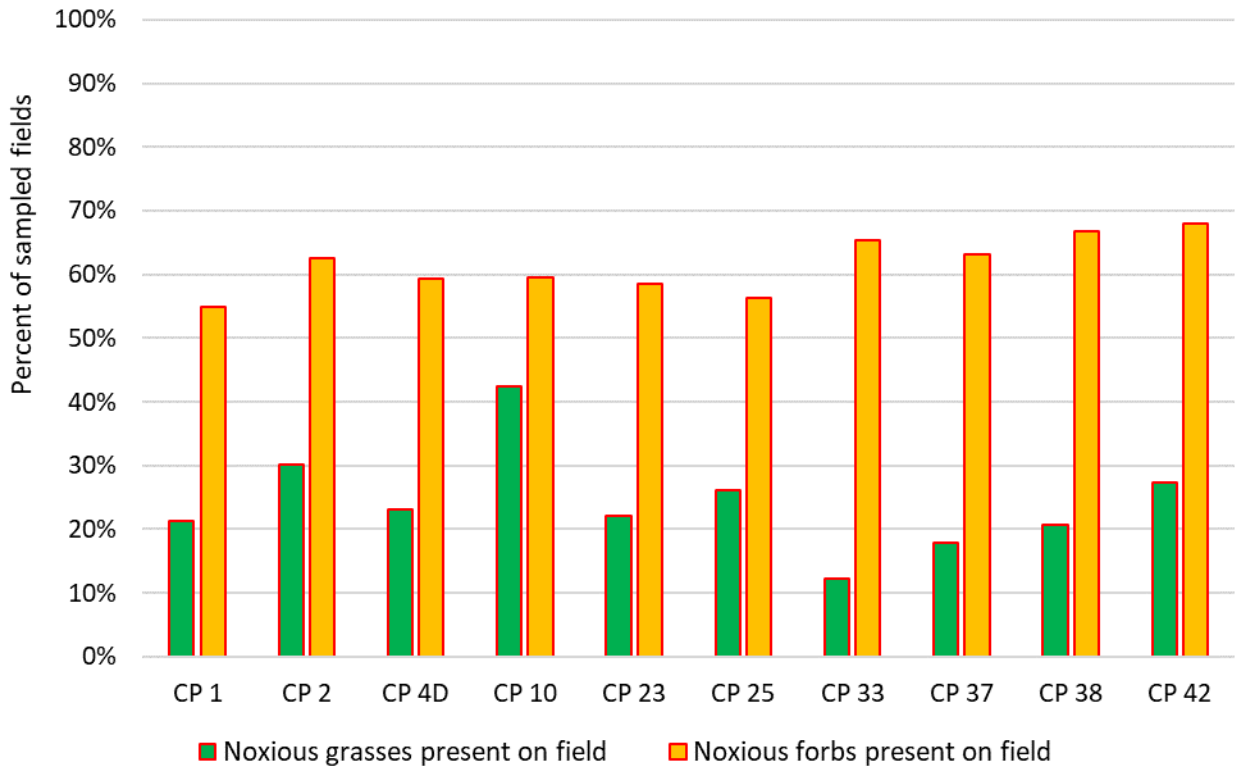


Figure 7. Percent of sampled CRP fields sampled with noxious grasses and forbs present.

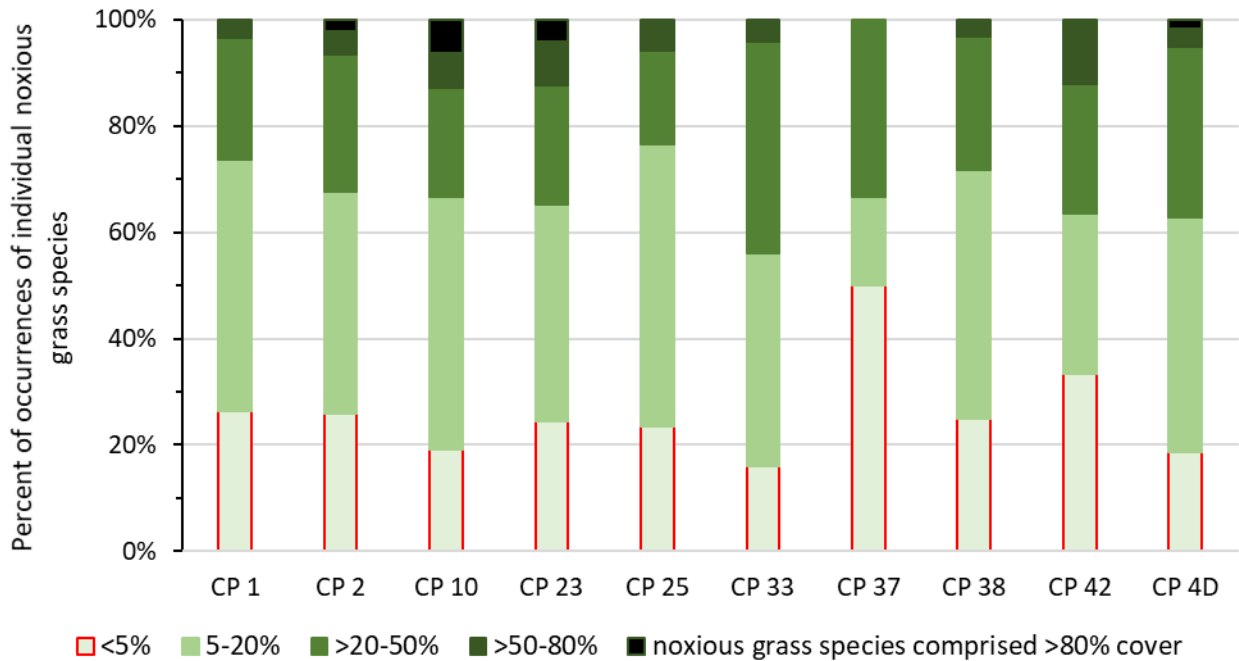


Figure 8. Percentage of occurrences of individual noxious grass species in each percent cover category on sampled CRP fields. That is, when a noxious grass species was present, how much vegetation cover did that species comprise in the field.

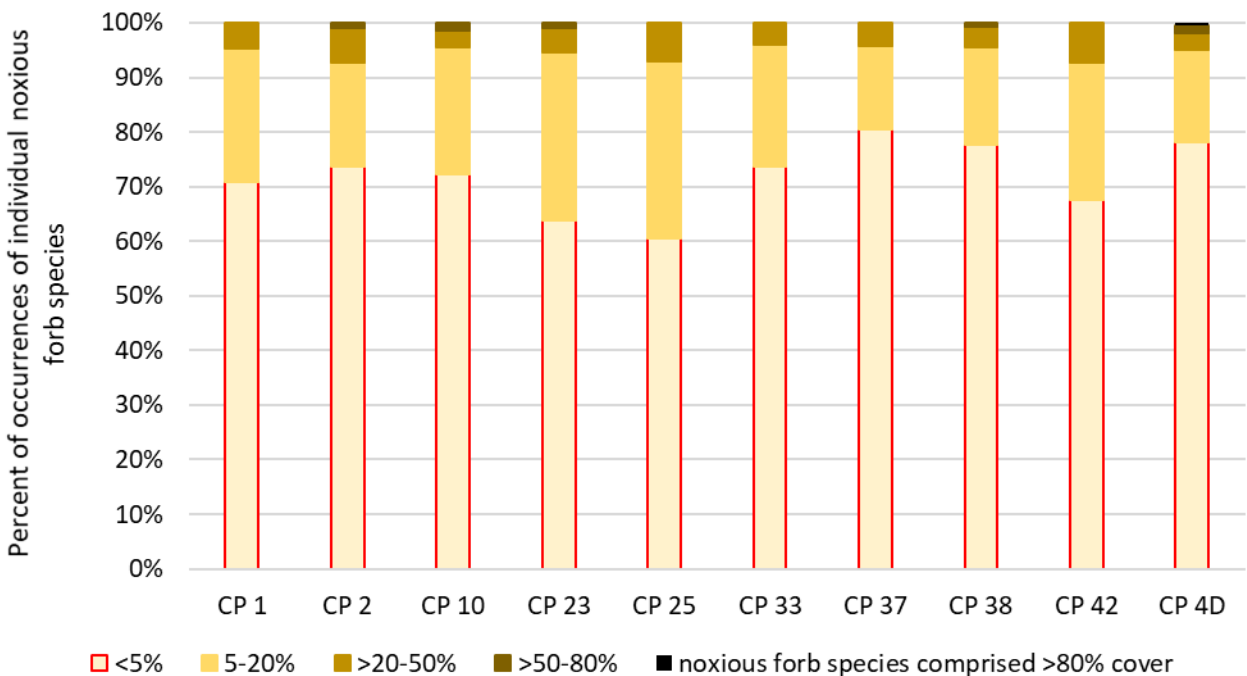


Figure 9. Percentage of occurrences of individual noxious forb species in each percent cover category on sampled CRP fields. That is, when a noxious forb species was present, how much vegetation cover did that species comprise in the field.

Management on CRP fields: Across practices, an average of 86% of fields had no evidence of disturbance, 8% of fields had evidence of disturbance in the current year, and 6% had evidence of disturbance in prior years (Fig. 10). Of those fields with evidence of disturbance in the current year, 47% had less than one third of the field disturbed, and 53% had more than one third of the field disturbed. The most common types of disturbance management evident across practices were haying, mowing, and grazing (Fig. 11).

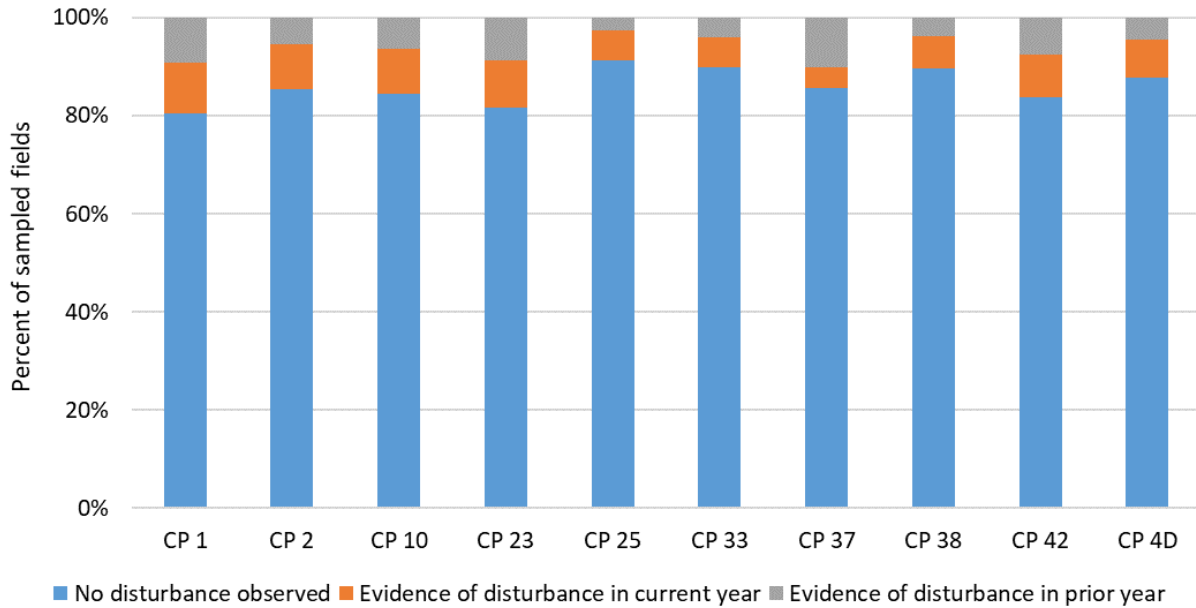


Figure 10. Management on sampled CRP fields.

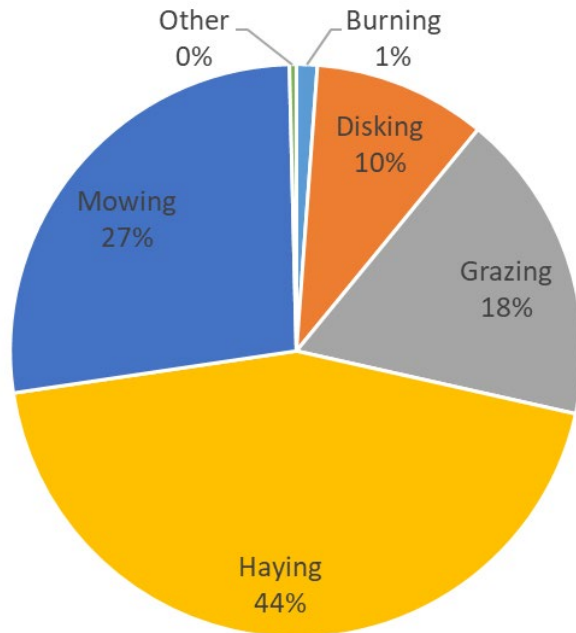


Figure 11. Type of disturbance management evident on sampled CRP fields.

Erosion on CRP fields: Across practices, the occurrence of rills, gullies, and pedestaling from erosion was very low. On average, 99% of fields had no evidence of rills, 100% of fields had no evidence of gullies, and 99% of fields had no evidence of pedestaling (Fig. 12). Total bare soil cover $\geq 20\%$ occurred on only 9% of fields on average across practices (range 2%-13%).

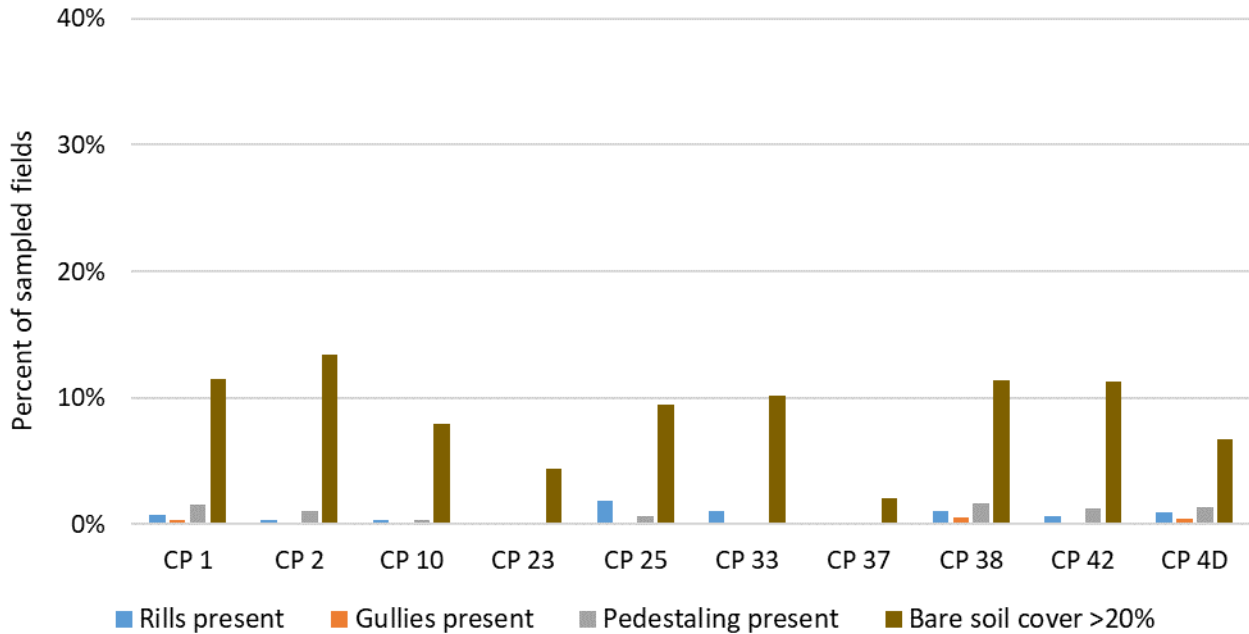


Figure 12. Erosion characteristics of sampled CRP fields. (Note that y axis only extends to 40% of sampled fields, rather than 100%).

Next steps

We are providing this final report to USDA to inform the agency of project results at the same time as we are drafting two peer-reviewed publications for journal submission.

These data are extremely valuable because of the statistically valid manner in which they were collected, the broad extent of the sampling across the western United States, and the numerous conservation practices evaluated. These data may be used for exploring a number of related questions, including identifying environmental factors (e.g., soil productivity, landscape context) that correlate with successful establishment of conservation practices, and the feasibility of using remotely sensed data to monitor CRP implementation and trends across the west.

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