CEAP Quantifies Conservation Outcomes for Wildlife and People on Western Grazing Lands

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On the Ground

- Maximizing efficiency and effectiveness of limited resources to conserve America's vast western grazing lands requires a science-based approach.
- Working Lands for Wildlife, USDA's approach for conserving America's working lands, co-produces scientific tools and quantifies outcomes that help guide future implementation and improve delivery.
- Quantifying outcomes in conservation provides accountability for investments, and illustrates to readers the role of science in working lands conservation.
- Together, diverse partners continue expanding into new technologies to further enhance the productivity, profitability, and sustainability of valuable grazing lands.

Keywords: Conservation Effects Assessment Project, co-production, Farm Bill, grazing, outcomes, productivity, targeting tools, wildlife, working lands.

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Conserving America's Western Working Lands

Vast grazing lands that span the western United States are irreplaceable assets, producing food and fiber, supporting rural economies, generating recreational revenue, and sustaining world-class wildlife populations. Working rangelands are the common thread that weave together these economic and societal values in the western half of our nation. Thus, keeping local ranchers productive, profitable, and sustainable in light of challenges they face—extended drought, commodity price swings, and societal pressures to produce more with less—is a top priority for this and future generations.

Tackling these challenges across the West presents an opportunity of monumental proportions; however, limited resources necessitate a strategic, landscape-scale approach that replaces patchwork fixes and "random acts of conservation kindness," which have historically fallen short of achieving desired outcomes.[1] In 2010, the U.S. Department of Agriculture (USDA)'s Natural Resources Conservation Service (NRCS) launched Working Lands for Wildlife (WLFW) as its premier approach for targeting voluntary and incentive-based practices to proactively conserve America's working lands. Fueled by Farm Bill technical and financial resources, this proven paradigm strategically implements existing NRCS programs across entire landscapes to restore productive agricultural lands and maximize their benefits for people and wildlife.

On western grazing lands, the WLFW approach has gained momentum and worldwide recognition as an example of how to strategically focus resources to yield the most effective and efficient conservation outcomes. As part of WLFW, the Sage Grouse Initiative (SGI) and Lesser Prairie-Chicken Initiative (LPCI) collectively have worked with 2,154 ranchers to conserve 7.5 million acres of grazing lands, equivalent to three Yellowstone National Parks, benefiting hundreds of rural communities, agricultural rangeland, and wildlife resources. Science plays two critical roles in the WLFW framework: 1) develop spatial targeting tools to help practitioners pinpoint where to invest in watershed-scale restoration, and 2) evaluate outcomes to quantify resulting benefits to grazing operations and wildlife.

Co-production: A Team Approach to Quantifying Outcomes in Conservation

Two emerging trends in natural resource management are co-production of science to increase its utility to conservation, and a renewed interest in conserving working lands to sustain wildlife and rural communities.[2,3] Scientists, natural resource managers, and producers are increasingly convinced that co-

produced knowledge enhances initial uptake and resulting durability of conservation.[4] WLFW's approach to co-production embeds scientists with ranchers, policy makers, and resource managers, who collectively identify the questions which if answered, would increase conservation effectiveness. Partners value resulting science because outcomes directly inform on-the-ground conservation (Fig. 1).

Because co-production is novel and examples are rare, we draw upon our roles in the USDA-led SGI, North America's largest effort to conserve private lands in the sagebrush biome, to show that evidence-based platforms are becoming more commonplace in Farm Bill-led conservation.[5] Some readers may feel that synthesizing outcomes in a scientific journal represents a conflict of interest; we disagree, and instead argue that quantifying outcomes in conservation brings accountability, and illustrates to others the role of science in working lands conservation.

Since 2002, the Conservation Effects Assessment Project (CEAP)—a multipartner effort led by NRCS—has been working to quantify effects of conservation practices and programs, improve the science base for managing agricultural landscapes, and translate science into practices that improve environmental quality. The wildlife component of CEAP (CEAP-Wildlife) works with scientists and managers to identify priority assessment activities specifically for fish and wildlife and to disseminate findings to improve conservation delivery. As such, CEAP-Wildlife was an early adopter of WLFW and continues to play an integral role in co-production and distribution of science-based tools and information across western grazing lands. In 2017, the grazing land component of CEAP (CEAP-Grazing Lands) joined as an active partner, building greater capacity in the development of spatial tools and aiding in quantification of conservation outcomes.

In total, CEAP has partnered with WLFW to produce 37 peer-reviewed manuscripts on conservation practices including woodland expansion, conservation easements, prescribed grazing, wet meadow and riparian restoration, and fence collision solutions for wildlife. Most recently, WLFW has branched out to include remote-sensed rangeland mapping of vegetation cover and productivity, habitat connectivity, and animal movement. Here we illustrate effectiveness of this approach with two practices that exemplify CEAP's role in strategic conservation delivery.

How CEAP-Wildlife Improves Rangeland Conservation Delivery

Tackling Woodland Expansion

Expansion of woody species, such as juniper (*Juniperus* spp.) and mesquite (*Prosopis* spp.), in sagebrush shrublands and prairie grasslands is a resource concern with well-documented impacts on wildlife, vegetation, water, nutrient and energy cycles, and carbon storage. As a result, woodland management has been a common practice implemented across western rangelands. Recent efforts just through WLFW have helped landowners strategically treat >780,000 acres of woodland expansion in priority grouse habitats. CEAP-Wildlife has played an integral role in developing targeted tools to guide conservation delivery and quantify ecological outcomes of these restoration efforts.

In 2017, CEAP-Wildlife and partners organized and published a 17-manuscript special issue on woodland

Figure 1. Rancher and NRCS staff planning out a grazing system in central Montana.

expansion on western grazing lands in the Society for Range Management's journal *Rangeland Ecology & Management* (REM).[6] One CEAP-Wildlife co-sponsored study in this compendium provides managers with an improved view of tree canopy cover across an 11-state region.[7] Resulting canopy cover maps for conifer (primarily juniper species) and mesquite provide the first and most geographically complete, high-resolution (1 m) assessment of tall woody plant cover in sagebrush-steppe and prairie ecosystems. Resulting spatial data are served up via the SGI Interactive Web Application (hereafter SGI Web App; https://map.sagegrouseinitiative.com), which enables managers to quickly and easily visualize canopy cover, determine potential areas in need of treatment in their jurisdiction, and assist in broad-scale outcome assessments.[7]

Five other REM papers, coupled with the newest science co-sponsored by CEAP-Wildlife, further advance our knowledge of the benefits of reducing the threat of expanding woodlands on prairie birds. In Kansas, lesser prairie-chickens (*Tympanuchus pallidicinctus*) avoid placing nests in grasslands with >2% tree cover.[8] Similarly, prairie-chickens also avoid areas with >15% canopy cover of mesquite.[9] In southern Oregon, population growth is +12% higher for greater sage-grouse (*Centrocercus urophasianus*) in grazing lands where advancing trees have been removed.[10] Population-level benefits are the result of nesting birds that are quick to recolonize restored habitats made available by conifer removal.[11] Within 3 years of initiating treatments, 29% of marked females were nesting within and near restored grazing lands; no such response occurred in the nearby control where trees were not removed. Nesting probability in newly restored sites increased by 22% annually, and female (+7%) and nest (+19%) survival were both higher in the treatment compared with the nonremoval control area.[12]

In this same Oregon study landscape, abundances of Brewer's sparrow (*Spizella breweri*), green-tailed towhee (*Pipilo chlorurus*), and vesper sparrow (*Pooecetes gramineus*) doubled following mechanical tree removal.[13] Lastly, scientists expanded findings to regional scales using North American Breeding Bird Survey data and relevant habitat metrics to construct abundance maps for sagebrush songbirds; 85% of conifer removal for sage-grouse in the Great Basin coincided with high abundance centers for the imperiled Brewer's sparrow.[14] Eventually treated areas will require additional management, and practitioners can use the annually mapped tree layer in CEAP-sponsored Rangeland Analysis Platform to aid in timing of retreatments (as discussed below in A Look to the Future).

Stemming the Loss of Intact Rangelands

Converting native rangelands to more intensive land uses such as cultivation, housing, or energy development typically spells the demise of many ecosystem functions and values, including ranching operations that depend upon wide-open, intact grazing lands. Once converted to monoculture crops, industrial, or residential uses, the restoration of grazing land is a difficult and expensive process that may not be possible on some arid rangelands. Conservation easements are one tool provided in the Farm Bill that can help reduce these threats with producers who voluntarily agree to keep working lands undeveloped in exchange for financial incentives. To date, SGI and partners have secured over 200 individual easements that conserve in perpetuity >567,100 acres of working lands, and implemented another 3.6 million acres of improved grazing strategies to keep ranching operations profitable and productive. Pace and extent of easements has accelerated in the sagebrush ecosystem since WLFW's SGI became a national priority for NRCS. From 2010 to 2013, for example, easements increased >1,800%, providing the certainty for current and future generations that grazing lands will remain grazing lands.[15] Since 2013, CEAP-Wildlife and partners published six manuscripts to help target conservation easements and to evaluate their effectiveness in maintaining intact rangelands for grazing operations.

In Wyoming, which is one of 11 sage-grouse states and supports 37% of the range-wide population, NRCS and partners place easements to remove the range-fragmenting threat of housing developments. Easements complement Wyoming's approach to managing oil and gas development, wherein the Governor's Executive Order reduces the energy threat inside of sage-grouse strongholds to 1 well/mi^2 and ≤5% surface disturbance to maintain populations. CEAP-Wildlife's outcome-based assessment predicts that a conservation strategy with $250 million in targeted easements can slow grouse declines from 14% to 29% without conservation to 9% to 15%, cutting anticipated losses by roughly half statewide and nearly two-thirds within grouse population strongholds.[16] Targeting maps from this evaluation help practitioners focus easements in the most biologically important grazing lands (Fig. 2). In a follow-up evaluation, CEAP science found that measures taken for sage-grouse have also conserved 75% of priority habitats for two world-class populations of migratory mule deer (*Odocoileus hemionus*).[17] Multiple benefits are the result of conservation easements, additional conservation measures made possible through the Governor's Executive Order, and U.S. Forest Service purchases or withdrawals of oil and gas leases. More recent evaluations reaffirm that keeping grazing lands intact also conserves important dispersal and migratory pathways for wildlife.[18,19]

In eastern Montana, the western Dakotas, and northeast Wyoming, 70% of sagebrush grazing lands are privately owned, and the primary threat to ranching and wildlife is cultivation of intact grazing lands. A CEAP-sponsored assessment in this landscape found that 96% of active sage-grouse breeding grounds are surrounded by <15% cropland, and that additional cultivation would decrease the region's populations by 5% to 7%.[20] And the reach of impact is striking—a single square mile of native ground converted to cropland negatively affects sage-grouse in a landscape 12 times that size. Researchers found that optimal placement of a $100 million easement investment can prevent most range-losses, and that clumped easements rather than scattered ones yield

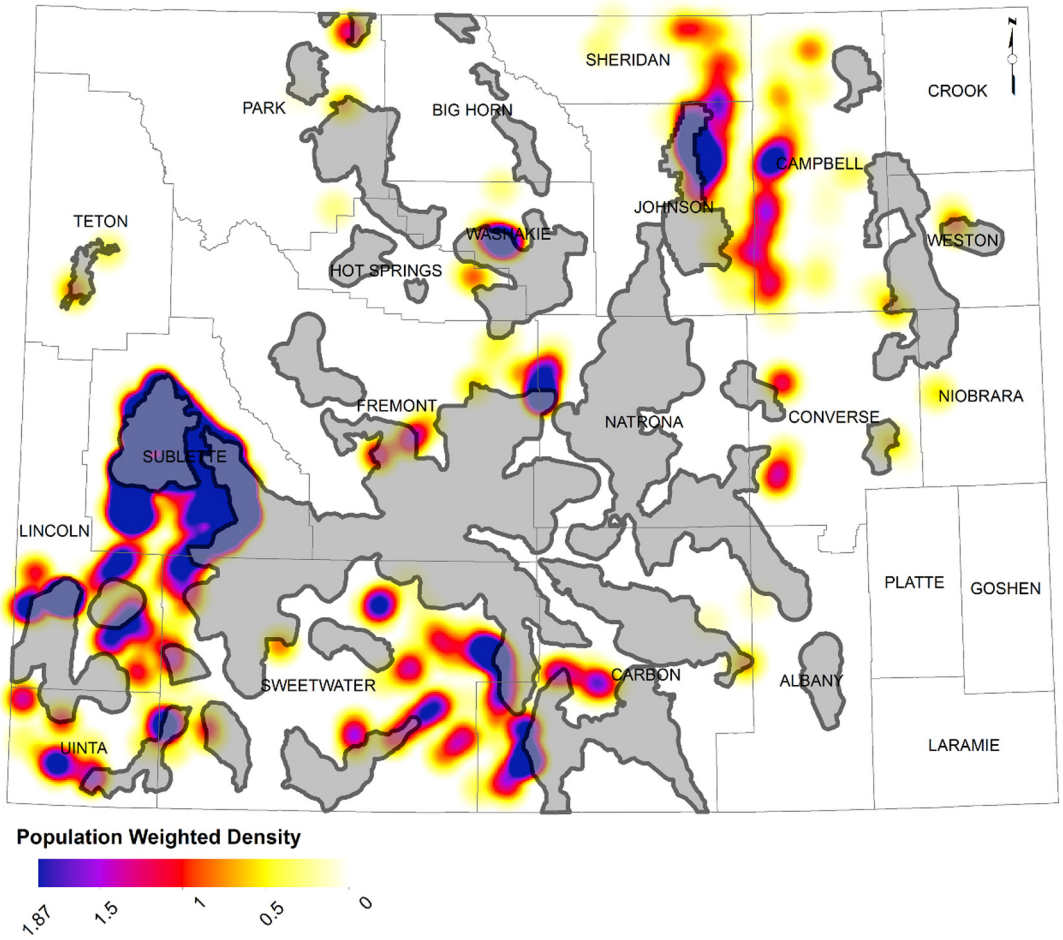

Figure 2. A CEAP-funded spatial targeting tool to aid in placement of conservation easements in Wyoming. Darker purple and pink shading depicts grazing lands where easements to reduce ranch subdivision threats would yield highest return on investment. Grouse population strongholds are depicted as gray polygons (adapted from Copeland et al. 2013).

higher return on conservation investment. The cultivation risk layer, built as part of this study by The Nature Conservancy, uses climate, soils, topography, and other attributes to estimate tillage conversion risk. Available on the SGI Web App, this layer is helping practitioners pinpoint where to target easements to best maintain native rangelands. Through WLFW, SGI and partners have conserved for generations 140,000 acres of at-risk grazing lands in Montana since 2015 and 190,000 since SGI's inception in 2010, a six-fold increase in total acreage kept in grazing lands for rural communities in all years preceding the initiative.

Putting Science at Practitioners' Fingertips

Another hallmark of WLFW's approach is a commitment to bridging the gap between science and implementation. CEAP-sponsored work is not complete until new technology, tools, and scientific findings are made readily accessible and useable by land managers. Together with the NRCS West National Technology Support Center and partners, WLFW is constantly expanding its technology transfer toolbox that empowers landowners and managers to prioritize and plan science-based projects that conserve grazing lands. This includes working with partners and agency field staff to identify what science they need to keep America's grazing lands productive. Resulting tools and resources are publicly accessible, relevant across ownership boundaries, and available in a variety of formats to maximize adoption and application.

The SGI Web App is a perfect example of how NRCS translates emerging sagebrush science into formats accessible for conservation practitioners. This free, online mapping tool —made possible by a partnership between NRCS and the Bureau of Land Management (BLM)—is accelerating grazing land conservation and creating on-the-ground efficiencies by allowing practitioners to easily visualize, download and interact with resource data across the West.

The Web App uses the latest satellite imagery to perform instantaneous custom analyses, letting users quickly identify, compare, and evaluate opportunities for grazing land restoration or threat reduction. It shows both a landscape-level view, as well as site-specific data for individual parcels. Data layers are continually added to the Web App, which currently provides valuable rangeland maps such as high-

resolution conifer cover, resistance to invasive weeds and wildfires, and changes in wet meadow and riparian resources over time.

On semiarid rangelands of the West, water is life, and following WLFW's business model, NRCS has created a cooperative venue for ranchers to restore and enhance water resources (stream sides, wet meadows, and other wetlands) for ranching and wildlife in sagebrush country. CEAP-Wildlife supported the foundational science that underpins this new strategy. Findings suggest that sage-grouse position their breeding grounds near water resources where birds go to raise their chicks. Sage-grouse too cluster 85% of their breeding sites within 6 miles of these wet habitats.[21] Private lands are central to water conservation because, although these wet summer habitats cover <2% of the landscape, >80% are located on privately managed ranchlands.[21] The WLFW science team then mapped these wet resources in time and space across the West and provides these data through the

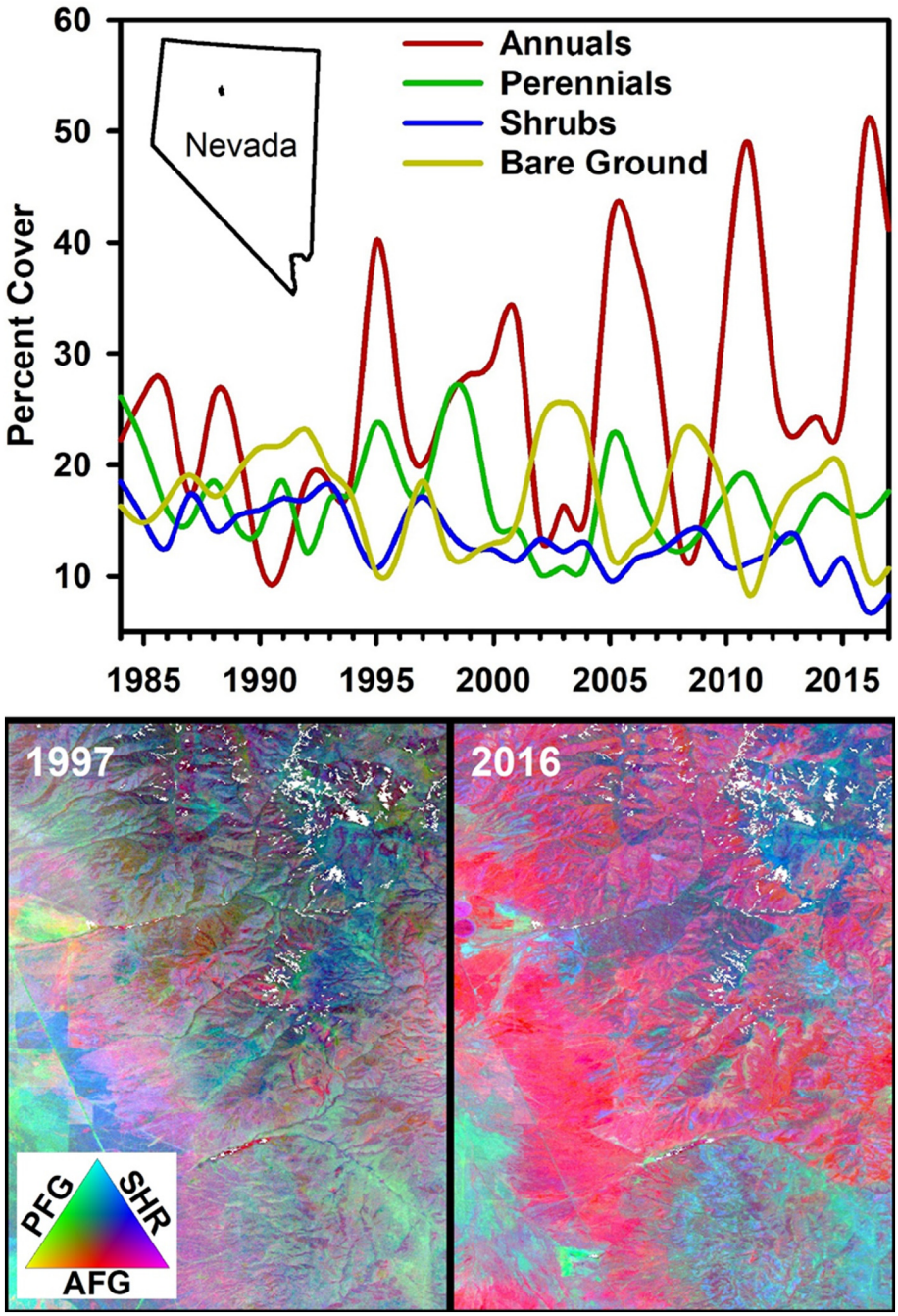

Figure 3. Annual mean percent cover of four land cover classes in northern Nevada (black polygon and images). Land cover images from 2 years (1997 and 2016) display annual forbs/grasses (AFG), perennial forbs/grasses (PFG), and shrubs (SHR) mapped to a red, green, and blue color palette, respectively. Gradient of colors depict pixel level heterogeneity and dominance of land cover classes as shown in the triangle.

Web App to enable all partners to better understand the location of these resources and to identify management opportunities. Armed with this new tool, landowners can more efficiently choose from and implement a suite of conservation actions to improve function and resiliency of wetlands.

However, the iterative science partnership didn't stop there. Identified as barriers to widespread adoption, practitioners voiced their need to know if proposed practices would work, and to be properly trained in restorative practices. In response, CEAP-Wildlife co-sponsored an evaluation of low-tech riparian and wet meadow restoration methods (Zeedyk structures, beaver dam analogs, and grazing management) to provide practitioners with insights about potential outcomes of restoration investments. Results revealed that these restoration practices increase vegetation productivity by up to 25%.[22] Moreover, improvements in productivity over time since restoration suggest that elevated resilience provides dual benefits of increased forage production and enhanced wildlife habitat. Documented outcomes provide practitioners and landowners with evidence to judge the anticipated benefits of investing resources in these restoration efforts. Finally, NRCS's West National Technology Support Center and other organizations are helping transfer new technology and information to field practitioners through workshops, webinars, and technical manuals to help them determine how and where to implement these practices to obtain the biggest return for wildlife and livestock.

A Look to the Future: Harnessing Technology for Everyone

WLFW was born out of a desire to more effectively deliver voluntary, incentive-based conservation to help America's agricultural producers benefit their working lands, improve habitat for at-risk species, and obviate the need for additional regulations under the federal Endangered Species Act. This model has proven popular and successful as demonstrated through results on the ground[15] and contributions toward easing potential regulatory burdens.[23] Looking to the future, WLFW now embraces its larger role in providing outcomes more broadly for western grazing lands, beyond just wildlife-centric needs, to benefit the common denominator of sustainability: resilient rangelands.

One example of this is a new endeavor between WLFW, CEAP-Wildlife, CEAP-Grazing Lands, and the University of Montana (UM) to harness emerging technology to map plant cover and productivity of western rangelands in the United States through time. CEAP-sponsored scientists at UM are merging machine learning and cloud-based computing with historical remote sensing and field data to provide the first-ever moderate resolution (30 m), annual percent cover maps (1984 to 2017) of plant functional types across U.S. rangelands.[24] This novel approach combines the historical Landsat satellite record, gridded meteorology, and field plots to predict per pixel percent cover of annual forbs and grasses, perennial forbs and grasses, shrubs, trees, bare ground, litter, and rock (Fig. 3). The process is dependent on over 30,000 NRCS-National Resource Inventory and BLM-Assessment, Inventory, and Monitoring field plots that span the western half of the United States. The resulting maps provide exciting new opportunities to expand and improve rangeland conservation and open new doors for scientific evaluation and investigation through an unprecedented blend of time, space, and scale.

Powered by Google's Earth Engine, this mapping technology is being delivered to partners via the Rangeland Analysis Platform (RAP), a free online tool that launched September 2018 (https://rangelands.app). The RAP enables producers, scientists, and managers to view rangeland plant cover groups and how they have changed through time at regional, ranch, and pasture scales. Online users are able to customize boundaries for analysis, print maps within areas of interest, and receive data on the percent change in cover through time (Fig. 3).

Through WLFW and CEAP, the NRCS is improving the efficiency and effectiveness of Farm Bill-funded conservation programs so that they better address rangeland and wildlife concerns. These partners are providing widely accessible science and innovation that enhance the productivity and profitability of the American West's valuable grazing lands.

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