



The range has changed: My viewpoint on living in the Sagebrush Sea in the new normal of invasives and wildfire

By Matt Cahill

On the Ground

- This Special Issue of *Rangelands* describes the Defend the Core framework, based on a December 2020 symposium focused on the impacts of wildfire and invasive annual grasses in Oregon, the Northern Great Basin, and sagebrush ecosystems across the West.
- Invasive annual grasses, wildfire, and climate change are changing ecosystem processes in the sagebrush biome at a pace and scale requiring an assessment of where processes can be saved, where they can be regained, and where they are lost.
- Confronting these threats is the primary focus of restoration and management efforts, guiding policy creation, project prioritization, and action on the ground.
- The new Defend the Core framework helps land managers, landowners, and policy makers to use the tools or management actions most likely to improve conditions.

Keywords: adaptive management, defend the core, ecosystem management, invasive annual grass, resilience, sagebrush.

Rangelands 44(3):242–247

doi 10.1016/j.rala.2022.01.004

© 2022 The Society for Range Management. Published by Elsevier Inc. All rights reserved.

Overview

I offer a viewpoint here not typical of a journal article in tone or style. I include a series of personal anecdotes, observations, and connections that I hope brings you, the reader, out into the sagebrush of the American West to sense the current plight of the range. I use the concepts of a new Defend the Core framework to highlight the topics raised during a De-

cember 2020 symposium hosted by the High Desert Partnership in Burns, Oregon; the SageCon Partnership of Oregon; and Oregon State University. I present my thoughts on how land managers, landowners, policymakers, and other people living in and caring about the Sagebrush Sea could embrace the Defend the Core framework. My intent is for you to finish reading my viewpoint feeling thoughtful or agitated, in agreement or provoked, ready to read the papers in this Special Issue for the first time or the second, honed to the big themes shared by the authors—we cannot lose the intact sagebrush we have left, we need to prioritize native perennial bunchgrasses at every opportunity, we need to support people while making big changes that require collaborative, creative, and compassionate action. I worry we are in denial regarding how major ecosystem threats, especially by invasive annual grasses and wildfire, are destroying the Sagebrush Sea. I want you to be agitated, restless, and inspired.

The cornerstone issue: reframing invasive annual grass management for a new normal

The Sagebrush Sea, a vast landscape of broad valleys, stark mountains, and endless plains with a hazy blue green canopy of sagebrush out to the horizon, is evaporating. In the Northern Great Basin of Oregon, Idaho, Nevada, and Utah, this change is driven by introduced invasive annual grasses and the catastrophic wildfires they induce.¹ Ecologically, socially, and climactically, the start to this new normal is behind us. What exactly caused these changes and when they occurred is ambiguous. Perhaps on 8 July 2012, when lightning sparked the Long Draw Fire, Oregon's first sagebrush megafire,² which set a new scale for disaster, or maybe 28 June 1934, when President Franklin Roosevelt signed the Taylor Grazing Act into law, which created oversight and organized management of the open range. The 1861 arrival of cheatgrass (*Bromus tectorum* L.) in Pennsylvania looms large,³ it spread to every US state and Canadian province, but so does the 1493 return of Columbus to the New World with the first cattle in the Americas stowed aboard his ships that then spread equally far. The philosophical among us might look to 8,000 years ago

when the first livestock were domesticated, or 18,000 years ago when modern temperate grasslands appeared at the end of the Pleistocene. Although the beginning of this new normal is complex, the outcomes are clear. Wildfires are more frequent, burn more acres, kill more perennial vegetation, and foster more introduced annuals, leaving land managers perpetually behind (see Boyd).⁴ What we understood as normal over the past 70 years, the context for today's management practices, is better seen as a passing lull, a recent and deceptive calm spanning a handful of generations. The range has changed, and that quiet is gone.

Our world, our western rangelands, our Sagebrush Sea, is currently defined by ecosystem dysfunction,⁵ social upheaval,⁶ and a warming climate.⁷⁻⁸ Wildfires, fueled by annual grass infestations destroy habitat for species like greater sage grouse (*Centrocercus urophasianus*), stress rural communities with ranching economies like Lakeview, Oregon or Elko, Nevada, and choke downtown cities like Boise, Idaho and Salt Lake City, Utah with smoke. Confronting these changes demands we reconsider how, and how rapidly, our management priorities change. This is a catalyzing moment because, like rising floodwaters, the costs of inaction are clear. Collaboration is essential. Everyone is implicated, including each federal and state agency office, landowner, and group with interest in and oversight of rangeland. Everyone needs to consider management of invasive annual grasses as a cornerstone. To be achievable, we need to know what to do and where to do it, as well as a framework that hews to the possible—focused on its goal, simple in its steps, and actionable in its findings. These are three characteristics provided by Defend the Core.

The Defend the Core framework organizes rangeland condition into three categories: where ecosystem function remains with minor threats, where ecosystem function is being lost with rising threats, and where threats are dominant. These categories are called Defend the Core, Grow the Core, and Minimize (or Mitigate) Risks, characterized by the needed action (see Creutzburg et al.).⁹ This framework is promoted by the National Resource Conservation Service, the Idaho Cheatgrass Challenge, and the Oregon Invasives Strategy. It is the organizing principle of this Special Issue.

I explore how the Defend the Core framework organizes our collective actions to address the annual grass and wildfire dynamic, probing each category in turn. We need this framework to understand the lessons learned from management and restoration project successes and failures (see Schroeder et al.)¹⁰ by working within the limitations of a complex world. Some places may be impossible to break—rebounding after any disturbance—whereas others are impossible to recover because their dynamics are tied to the resilience of specific soil and climatic properties.¹¹ The Defend the Core framework gives us clarity for where, why, and how to protect what remains of the Sagebrush Sea—the core—and shore up the core margins with improved management, while being proactive but pragmatic with the rest. Our new normal is where we prioritize every action toward resilient rangelands of diverse and productive perennial plant communities.

Defending the Core: protecting the value of intact landscapes

My partner and I often spend our weekends on dusty roads, watching the light fade across the distant hills from our tailgate, a temple of stars opening above us. We sleep high on a mountainside where the heat, heavy and scented with sage and wafting up from the valley, breaks apart in the cool evening breeze. These crisp mountain evenings keep the purple lupine (*Lupinus* sp.), scarlet paintbrush (*Castilleja* sp.), and yellow asters (Asteraceae) glowing among the blue sagebrush deep into the belly of July. Unlike the lowlands below, already dry and golden in summer drought, the landscape is verdant, thick with flowers, tended by enough flies and bees to register a soft hum across the landscape. This mountainside, our home for the night, is part of the core, rangelands healthy with native perennials and the lumpy canopies of sagebrush, places where cheatgrass and other invasives barely register.

After dark, with no phone reception, we turn to books. We read *The Oregon Desert* by E.R. Jackman and R. Long, in which Long fills passages with his childhood memories of the great empty of central Oregon's Fort Rock Desert at the turn of the 20th century.¹² He describes growing up in an impossible world, where his family, like hundreds of others, attempted to settle claims by plowing through the thin desert sod while their cattle wandered for bunchgrass tufts amid glaring heat and blowing snow.

During Long's childhood, livestock managers pulled wealth from the landscape to survive in the dry and merciless sage without knowing its limits. Livestock herds swelled to hundreds of thousands of head; sheep, cattle, and horses flowing as a tide over the sage, siphoning up what forage and water existed, and as Long described it, turning profit for only a few. Today we know the costs of that use, the denuded hills, the scoured streams, but Long's contemporaries learned this hard lesson for the first time; it is possible to break a landscape as endless as the Sagebrush Sea. Bankrupt farmers leaving sagebrush country became a common site, as when Long asked one who was leading his wagon out of southeast Oregon in 1920. The farmer remarked with surprise because the very look of his sorry state was enough to tell "everybody else I've met [that] I was from Harney County,"¹² a large county in southeast Oregon that saw significant early 20th century homesteading and subsequent overgrazing. In a brief two decades came drought, the Great Depression, and exodus from grazing lands in the Great Basin. US federal law created course correction with the Taylor Grazing Act, which organized rangelands, instituted permitted grazing, and initiated the legal framework for rangeland management.¹³ By the end of the 1920s and Long's childhood, many families had moved on from Oregon rangelands, with drifting dust covering their leaky cabins.¹² Remarkably, rangelands regrew in many places, though not where cheatgrass had arrived, such as the Snake River Plain in Idaho or Columbia Plateau in Washington and Oregon. Despite the livestock pressure and a lack of manage-

ment, in the absence of invasive species, the native perennial vegetation only needed rest. At the turn of the 20th century, the core comprised most of the range.

Before the widespread invasion of annuals, use and recovery of sagebrush ecosystems was a basic equation: when the grass was gone the livestock herd moved on and both returned with rain. Resilient native perennial bunchgrasses maintained ecosystem function, even after unthinkable grazing pressure: in 1901, 2.5 million sheep grazed in eastern Oregon alone,¹⁵ 50% of the nationwide total today. Bunchgrass species still provide this vital roll (see Johnson et al.),¹⁴ but cheatgrass and other invasive annual grasses upended the easy deal and made the math between available forage and appropriate utilization much harder (see Boyd).⁴ Competition and frequent wildfires spurred by annual grass invasions have led to uncertainty about if native bunchgrasses will continue to be resilient to these pressures. Cheatgrass is too nimble, too prolific, too good at what it does for laissez-faire management. Today, we can no longer take chances with the remaining Sagebrush Sea core that remains.

Defend the Core, the first framework category, describes where ecosystem function remains, and threats are sparse. In these areas, we must be exceedingly cautious to prevent new invasions. In the Northern Great Basin, core sagebrush ecosystems are greatly reduced. Less than half of southeast Oregon's 6.5 million hectares (16 million acres) of sagebrush retain core characteristics,¹⁶ which does not even consider the state's long-lost northern regions of sagebrush ecosystem along the Colombia River. Often, the access for cheatgrass and other invasive annual grasses into core areas is along the cuts (e.g., roads) we make on the landscape. We must be judicious in creating new corridors through core areas by limiting fuel breaks or roads. Existing corridors need to be patrolled to treat early infestations and exhaust annual grass seed banks (see Maestas et al.).¹⁷ Recovering ecosystem function is expensive and fraught, making protection of what core remains our best option. When development must occur in core areas, mitigation principles are our fairest and most transparent tool to limit damage to a shared resource. We need to make it very expensive to create disturbance in a near-priceless landscape.

Our most pressing need is to defend the remaining core, which are those places where native perennial bunchgrasses hold together a tapestry of color and diversity. In the first half of the 20th century, we simply did not know what we did not know—that you could use up the range, that dainty weeds could prove a menace, that there was such a thing as an ecosystem or a climate, and that we could break them both. In the lag of our learning, we took more wealth than could regrow and cheatgrass changed the rules. Today we live with the consequences—core sagebrush ecosystems are shrinking, threatened on all sides by invasive annual grasses. While there's no good or honor in blaming the past, there is likewise no good or honor ignoring it. We cannot afford to lose the Sagebrush Sea core.

Grow the Core: priority landscapes for active and adaptive management

In April 2021, I went on a backpacking trip into southern Utah's Canyonlands, at the very edge of the Sagebrush Sea. My reasons were typical, I wanted adventure, solitude, novelty, and quiet. These are the promises of wilderness when we capitalize it, how untrammelled earth helps us better judge our tangled, busy lives. I spent my nights along Salt Creek, a canyon which, before it scours down into a narrow and deep seam of cottonwoods (*Populus* sp.) and brambles as it nears the Colorado River, is a broad and open terrace, edged in glowing sandstone cliffs and enigmatic arches. Dark green pinyon pine (*Pinus* sp.) crowd the rim, and sagebrush flats cover the broad canyon floor, hiding flocks of secretive sparrows (Passerellidae) and startled jackrabbits (*Lepus* sp.). The horizon to the north opens enigmatically, the terrain dropping abruptly out of sight like a river at a waterfall's lip, falling into deeper worlds. It is a wild place, at first feeling untouched, far removed from the affairs of people, preserved by the mission of the National Park Service.

But then I see the homes. They are seven centuries old but still standing, carefully constructed with earthen bricks, curving naturally into alcoves on and under the cliffs, some so intact the darkness behind their doorways leaves me feeling watched. There are more walls and windows, granaries and paths, faded artwork and symbols and messages tucked into each sheltered site. As my eyes acclimated to the patterns, I started imagining humans, everywhere, as if through a veil. By evening sitting on the lip of my tent, I imagined the voices of hundreds of ancestral Puebloan people taking in the nighttime air too. Fires flickering in the alcoves, children yelling and laughing, dogs barking, turkeys gobbling, voices singing, and acres of earth with the first green of maize and squash. It was the same place as in the afternoon but with a different understanding. Salt Creek—now isolated, uninhabited, wild—was farmland.

Reflecting on the paradox of Salt Creek's human history, how a densely populated agricultural valley became protected as wilderness where footprints of people are felt lightly, I experienced the canyon's environmental condition with new awareness. I saw cheatgrass and other introduced annuals filling the understorey of the sage flats. In places salt cedar (*Tamarix ramosissima* Ledeb.) choked the stream, while in others the channel was eroding and deeply scoured to bedrock. Between the wonders of Salt Creek's old normal were the woes and weeds of a new normal. The ecology of the canyon was highly altered, now as obvious as the indigenous agriculturalists. These contradictions are familiar to the land manager, however, values rarely align cleanly to the available options. Managing for resilient rangelands requires active and adaptive efforts often involving difficult choices. We must consider our own histories anew and, asking questions like what wilderness means if people have always been here, we must consider our work with similar openness. What does protection mean if weeds and wildfire follow us unabated?

We can better understand the difficult choices and contradictions we face in conserving the Sagebrush Sea by using the Defend the Core framework to bring focus and clarity on where and how we recover lost ecosystem function. The second category of the framework, Grow the Core, is where our active and adaptive management is needed most. Resiliency remains, in the form of native perennial bunchgrasses (see Johnson et al.),¹⁴ but threats are increasing, for example, through established and expanding invasive annual grass infestations. Grow the Core is also a prioritization of place meaning our management grows out from existing core landscapes, buffering them from wildfire impacts and building larger intact landscapes. Most importantly, Grow the Core focuses on the how of management. Negative trends in ecosystem functioning means time is limited, hence perfection cannot be the enemy of the good.

We have the tools we need to Grow the Core with a focus on promoting the health and abundance of perennial vegetation to support the monitoring, adaptations, and retreatments needed to ensure success. These tools, available to land managers, are not surgical in approach and require compromise. For example, reducing infestations involves treating invasives with large amounts of herbicides (see Schroeder et al.)¹⁰ and purchasing high-quality native seed at steep costs (see Baughman et al.).¹⁸ Improved herbicides and greater quantities of locally sourced or adapted seed are improving both approaches, but in the meantime, action is needed. To Grow the Core, we need more grazing in the dormant season to reduce fine fuels and attenuate wildfire risks (see Davies et al.)¹⁹ and less grazing in the growing season to provide rest for stressed bunchgrasses to recover. These differences in seasonal timing depend on greater flexibility in grazing than currently permitted on public land. Furthermore, a lack of funding and capacity inhibits effectively monitoring and revisiting each project where we Grow the Core. We need to prioritize spending these limited resources. Grow the Core focuses on perennial vegetation at the margins of existing core locations with the intent of long-term investment rather than dooming a good project to a single year's weather or funding.

Grow the Core is a time-limited effort, but the rigidity of management structures, both formal and customary, can slow or limit adaptive efforts. In the case of Salt Creek, the same designations important for protecting culturally sensitive sites and prioritizing a wilderness experience can make ecosystem management challenging. Management actions addressing key threats and improving ecosystem function should only be restricted with strong justification. Collaborative decision-making gives a voice to all stakeholders and offers a better approach with less risk of conflict using the tools needed to revive native perennial bunchgrasses (see Smith et al.).²⁰ Although we cannot designate our way out of ecosystem dysfunction, we can make real gains by focusing on the margins of the core, but it will require the most compromise. The threats we face are agnostic to our values. Where invasive annual grasses occur, they will persist, unless and until we grow the core back.

Minimizing risk: finding a best worst outcome

I enjoy spending a morning each spring in May watching greater sagegrouse do their mating dance, but I am a fair-weather lekker. By May, the conditions suit me—the birds are still active though less earnest, the weather is warm and calm, and the sage is alive with pink blossoms and rambling birdsong. In 2020, I visited a lek (i.e., a greater sagegrouse courtship ground), that was ideal to me. A mile walk from a quiet gravel road, I could see the birds clearly without disturbing them. The hills I wandered over blocked all sight and sound of people save one homestead in the distance. A dozen male grouse paraded and preened through the dawn, their pointed black tail feathers intermittently fanning while their chests inflated in jerky shudders followed by their odd acoustic pops faintly carrying through the dawn. The grouse were engrossed with each other but were in fact keenly tracking their environment: ignoring a visiting raven, hesitating as a lone coyote trotted by, and diving for cover when a prairie falcon circled too closely, landing moments later on the abruptly empty and now seemingly unremarkable patch of dirt.

While the sagegrouse tracked their predators and chose when to dance and when to hide, their choice for lekking grounds were limited because the geography was constrained by highways and woodlands. But the performing males had no options at all to fix the rough condition of the surrounding landscape that would determine the fate of any hen they might mate with would face in raising her brood. That landscape, a field of cropped crested wheatgrass (*Agropyron cristatum* [L.] Gaertn.) with power poles along one side, was not ideal for sagegrouse. They were on private land and I watched them from the fence line. The mile of public Bureau of Land Management land I crossed to view them looked decent to me, with ricegrass (*Oryzopsis hymenoides* Ricker ex Piper) and bluebunch (*Pseudoroegneria spicata* [Pursh] Á. Löve) tufts showing intermittent signs of grazing, growing under mature sagebrush. But across the fence line the private land was broken. The swales were mostly cheatgrass and the bunchgrasses mostly stubs. Annual grasses carpeted the base of the few remaining shrubs. Taken together the patch appeared to be one wildfire away from a full state conversion to weeds.

I am unfamiliar with the permits or plans for how these pastures are grazed, but the story, to me, looks familiar, where a fence line and a deed separate acres grazed too hard and too long from others with forage to spare. In this dry region of Oregon, bunchgrasses and their resiliency were lost decades ago, a lingering legacy in need of investment. This situation creates a paradox: leave the fine fuels standing and you are playing wildfire slots and you know the house always wins. Stop the grazing and you could lose your grazing permit or be forced to sell part of your herd. There is little hope that the entrenched problems improve on their own. Change for the better takes money (see Smith et al.).²⁰ Money for viable seed and adapted to the site, for watering improvements and fence repairs, to cover short-term losses when seeking long-term gains, and to attend collaborative meetings to work toward

shared solutions. Beyond the core and away from its margins we have few options to consider.

To Defend the Core is to choose where you can no longer defend, those places where nearly all ecosystem function is lost and threats from invasive annual grass infestations and repeated wildfires are pronounced. It is easy to think these places are forsaken, forgotten, or abandoned, but that ignores the people living and working in them. Federal and state agencies are responsible for the public land in them, and in a connected landscape every acre is a risk for the remaining acres. These places are in the third framework category called Minimizing Risk (or Mitigate Risk, though the name causes confusion with habitat mitigation programs that we do not want applied to these places). Minimizing Risk means organizing management to reduce the likelihood of threats worsening, especially the frequency and severity of wildfire. In the future, a technique or advancement may allow for full recovery of these places, but for now we are Defend the Core by focusing on abating the worst outcomes of wildfire.

Like the Grow the Core framework category, Minimizing Risk focuses management decisions on specific vegetation characteristics. Instead of promoting native perennial bunchgrasses, Minimizing Risk includes reducing fuel loads, especially fine fuels, and controlling annual vegetation invasions. This entails maintaining adequate fuel breaks with herbicide and mowing to provide a defensible space to fight the inevitable flames (see Wollstein et al.),²¹ or targeted or temporarily heavier grazing to reduce abundant dry fuels standing between the fuel breaks (see Davies et al.).¹⁹ Restoration frequently fails in areas managed for Minimizing Risk due to harsh and unpredictable growing conditions that degraded this area initially, but another strategy is anchoring pastures with seeded perennial vegetation. As research leads to producing native seed capable of reliably establishing in these areas, we will continue to need introduced improved perennial species like crested wheatgrass and forage kochia (*Bassia prostrata* [L.] A. J. Scott.) that remain green longer into the sweltering summer months, curtailing severe wildfire conditions by critical weeks. Furthermore, these tactics should be linked to the overall Defend the Core framework—larger fuel breaks in degraded areas should be prioritized based on the core areas downwind they can protect and instead of building those breaks inside the core areas. Greater grazing flexibility to reduce fuels means more growing season rest elsewhere to Grow the Core where bunchgrasses are stressed from grazing or drought.²² Lastly, plantings to triage invasive monocultures should support temporary closures for restoration of natives where success is likely.

These are not perfect solutions. However, they support the overall Defend the Core framework and give land managers and landowners clarity to confront the complex dynamics of ecosystem threats, which supports the best options when there are no good ones. Truly good options that move degraded landscapes away from Minimizing Risk are, as a rule, hard, expensive, and likely to fail.¹ Moving more acres from Minimizing Risk to Grow the Core takes enormous investment, equal or greater in magnitude to what the past 150 years of

bad decisions, hard lessons, and lost opportunities have cost us. Instead of wasting resources on efforts unlikely to succeed, or abandoning places altogether, the Minimizing Risk category shows us how to best manage long-degraded landscapes.

Adopting the Defend the Core framework may make the costs to reverse ecosystem decline more transparent by identifying the spatial extent where threats exist, thereby linking those places to specific actions and summing the cost. In doing so, we can tally the costs for a robust, well-stocked, efficient native seed system, to fully staff and fairly support agency personnel, and to create jobs doing restoration by cutting conifers, spraying infestations of invasive annual grasses, enhancing infrastructure, and monitoring outcomes. Until and unless we secure the funding to cover these costs, we need to focus on Defend the Core, Grow the Core, and everywhere else, Minimizing the Risks.

Conclusion: Defend the Core as a path to action

I want to bring us back to the new normal that is now. We are not in 1850 anymore: the new normal set by invasive annual grasses and climate change are stark (see Boyd).⁴ We can prioritize resilient and perennial rangelands, or we can watch them convert into erratic and wildfire-prone annual systems. The path forward is like a two-track road: straightforward to follow but very rough to drive. Moving forward means keeping to the possible, which means Defend the Core from further decline, Grow the Core by reversing threats surrounding the core, and Minimizing the Risks of catastrophe on the greater landscape but accepting we cannot reverse loss everywhere, or all at once.

We know meaningful action entails change—change to our public agencies, grazing practices, and expectations for and of each other. At its worst, change is political or poisonous. It can divide and deter, grinding us down into apathy or stalemate. Our lands and waters, our businesses and communities, they are exposed to this juggernaut of disruption that is apolitical, impersonal, and unavoidable. Invasive annual grasses are here to stay and left unmanaged will continue to do what they do best: establishing after disturbances, producing abundant seed, and facilitating increased wildfire frequency and spread.⁸ If we choose division and force, we should expect that while we fail to act, flames fueled by cheatgrass will ride the dry winds of summer to turn the Sagebrush Sea into smoke, thousands of acres at a time.

We have other options. We can act collectively, with singular focus, to protect what remains of the Sagebrush Sea, to reverse the decline while there is still time, and to minimize costs where the most damage is done. The ideas detailed in this Special Issue and my thoughts in this viewpoint are meant to unravel the options we have to collectively manage against threats and promote existing resiliency. We have a profound opportunity if we recognize our challenge is learning to live within this new normal, already here and happening. As we do

so, we can care for people. As wild and empty as the Sagebrush Sea can appear, people have lived here since time immemorial. Through partnership and collaboration, we can change policy to make that living easier. We can find flexibility for management, fund research in restoration, and support meaningful work to keep the Sagebrush Sea verdant and whole. Ultimately Defend the Core is about banding together. How well we confront and reverse these threats will determine if deer and antelope, if grouse and cows, if we the people can have a home on the range.

Declaration of Competing Interest

The content of sponsored issues of *Rangelands* is handled with the same editorial independence and single-blind peer review as that of regular issues.

Acknowledgments

I thank the High Desert Partnership in Burns, Oregon, Oregon's SageCon Partnership, and Oregon State University for organizing the 2020 Invasive Annual Grass Workshop and this Special Issue of *Rangelands*, especially the commendable efforts of Vanessa Schroeder and Dustin Johnson to keep the authors motivated and connected. I have deep appreciation for the kind and careful reviewers who took the time to review this unusual manuscript and help improve it dramatically. Many colleagues offered feedback and improvements to this viewpoint, and I am grateful for their guidance.

References

1. DAVIES KW, LEGER EA, BOYD CS, HALLETT LM. Living with exotic annual grasses in the sagebrush ecosystem. *J Environ Manage.* 2021; 288. doi:10.1016/j.jenvman.2021.112417.
2. NORTHWEST INTERAGENCY COORDINATION CENTER (NWCC). *Northwest Annual Fire Report 2012.* 2013. Accessed December 2022. https://gacc.nifc.gov/nwcc/content/pdfs/archives/2012_Annual_Fire_Report.pdf.
3. STEWART G, HULL AC. Cheatgrass (*Bromus tectorum* L.) An ecologic intruder in southern Idaho. *Ecology.* 1949; 30(1):58–74. <https://www.jstor.org/stable/pdf/1932277.pdf>.
4. BOYD CS. Managing for resilient sagebrush plant communities in the modern era: we're not in 1850 anymore. *Rangelands.* 2022; 44(3):167–172.
5. DAVIES KW, BOYD CS, BECK JL, BATES JD, SVEJCAR TJ, GREGG MA. Saving the sagebrush sea: an ecosystem conservation plan for big sagebrush plant communities. *Biol Conserv.* 2011; 144(11):2573–2584. doi:10.1016/j.biocon.2011.07.016.
6. SHERIDAN TE. Embattled ranchers, endangered species, and urban sprawl: the political ecology of the new American West. *Annu Rev Anthropol.* 2007; 36:121–138.
7. CREUTZBURG MK, HALOFSKY JE, HALOFSKY JS, CHRISTOPHER TA. Climate change and land management in the rangelands of central Oregon. *Environ Manage.* 2015; 55(1):43–55.
8. POLLEY HW, BRISKE DD, MORGAN JA, WOLTER K, BROWN JR. Climate change and North American rangelands: trends, projections, and implications. *Rangel Ecol Manag.* 2013; 66(5):493–511.
9. CREUTZBURG M, OLSEN A, ANTHONY M, ET AL. A geographic 542 strategy for cross-jurisdictional, proactive management of invasive annual grasses in Oregon. *Rangelands.* 2022. doi:10.1016/j.rala.2021.12.007.
10. SCHROEDER V, JOHNSON D, O'CONNOR R, ET AL. Managing invasive annual grasses, annually: a case for more case studies. *Rangelands.* 2022. doi:10.1016/j.rala.2022.01.002.
11. ROUNDY BA, CHAMBERS JC, PYKE DA, ET AL. Resilience and resistance in sagebrush ecosystems are associated with seasonal soil temperature and water availability. *Ecosphere.* 2018; 9(9):e02417.
12. JACKMAN E, LONG R. *The Oregon Desert.* Caxton Press; 1964.
13. ROSS JVH. Managing the public rangelands: 50 years since the Taylor Grazing Act. *Rangelands.* 1984; 6(4):147–151.
14. JOHNSON DD, BOYD CS, O'CONNOR R, SMITH D. Ratcheting up resilience in the northern Great Basin. *Rangelands.* 2022. doi:10.1016/j.rala.2021.12.009.
15. OREGON STATE UNIVERSITY. *Special Report 841 Oregon's High Desert: The Last 100 Years.* 1989. Accessed January 2022. <https://ir.library.oregonstate.edu/downloads/xw42n8990>.
16. CREUTZBURG, MK. The Oregon SageCon Dashboard. *SageCon Partnership.* 2021. Accessed December 2022. https://oe.oregonexplorer.info/externalcontent/sagecon/SageCon_Dashboard.pdf.
17. MAESTAS J, PORTER M, CAHILL M, TWIDW ELL D. Defending the core: maintaining intact rangelands by reducing vulnerability to invasive annual grasses. *Rangelands.* 2022. doi:10.1016/j.rala.2021.12.008.
18. BAUGHMAN OW, KULPA SM, SHELEY RL. Four paths toward realizing the full potential of using native plants during ecosystem restoration in the sagebrush steppe of the Intermountain West, USA. *Rangelands.* 2022. doi:10.1016/j.rala.2022.01.003.
19. DAVIE S KW, WOLLSTEIN K, DRAGT B, O'CONNOR C. Grazing management to reduce wildfire risk in invasive annual grass prone sagebrush communities. *Rangelands.* 2022; 44(3):194–199.
20. SMITH BS, UNFRIEND J, DEFREES D, WOOD D. Prioritizing limited resources in landscape scale management projects. *Rangelands.* 2022; 44(3):235–241.
21. WOLLSTEIN K, O'CONNOR R, GEAR J, HOAGLAND R. Minimize the bad days: wildland fire response and suppression success. *Rangelands.* 2022. doi:10.1016/j.rala.2021.12.006.
22. KACHERGIS E, DERNER JD, CUTTS BB, ET AL. Increasing flexibility in rangeland management during drought. *Ecosphere.* 2014; 5(6):e02417. doi:10.1890/ES13-00402.1.

Author is from: Author is Sagebrush Sea Program Director, The Nature Conservancy, Bend, OR 97702, USA