The Nature Conservancy

Defending Wyoming's Core Sagebrush Rangelands Against Cheatgrass

Current Practices, Challenges, and Knowledge Gaps



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About

This report presents a thorough, in-depth view of the current practices, challenges, and knowledge gaps that were raised in a series of interviews with managers working on cheatgrass management in western and central Wyoming. In the companion Opportunities and Actions report, we share ten key opportunities and corresponding specific actions to better enable a proactive, defend-the-core approach to invasive annual grass management. We encourage you to consult parts or all of this report for topics you want to understand in-depth, and the Opportunities and Actions report for recommendations about how to overcome the challenges identified by managers.

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Defending Wyoming's Core Sagebrush Rangelands Against Cheatgrass: Opportunities and Actions



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Table of Contents

Introduction **4**

Key concepts and terms defining proactive management *6*

Common acronyms *7*

I. Current Practices **8**

A. Prioritizing areas for IAG management *8*

B. Importance of partners and working groups *11*

C. Deciding on herbicide treatment *13*

D. Data collection efforts *13*

II. Challenges to Proactive IAG Management **15**

A. Funding availability: insufficient and episodic *16*

B. Challenges tied to institutional policies *18*

C. Insufficient human capacity *22*

D. Technical challenges *27*

III. Knowledge Gaps **31**

A. The herbicide-cheatgrass interface *32*

B. Native plant and ecosystem responses to herbicide versus cheatgrass *34*

C. Cheatgrass spread as a function of genetics, seed ecology, and climate change *35*

D. Restoration in highly-Infested or disturbed areas *37*

IV. Opportunities and Actions **38**

Appendices **40**

Appendix 1: Recommended Manager Checklist: Operationalizing IAG Management to Defend Your Core *40*

Appendix 2: Funding Sources for IAG Treatments *42*

Appendix 3: Resources for Planning Seed Mixes *44*

Introduction

Invasive annual grasses (IAGs), including cheatgrass (*Bromus tectorum*), Japanese brome (*Bromus japonicus)*, Ventenata (*Ventenata dubia*), and medusahead (*Taeniatherum caput-medusae*), collectively represent one of the most significant and rapidly-expanding threats to Wyoming's rangelands. These species are transforming native plant communities into flammable systems with reduced diversity and forage value, fundamentally altering ecological processes and services across the state. As IAGs establish and dominate, they degrade wildlife habitat, reduce forage for livestock, threaten watershed function, and increase the frequency and intensity of wildfires. The devastating consequences of annual grass invasions can be seen across the Great Basin states to the west of Wyoming and provide a cautionary tale.

The ecological and economic consequences are substantial. A recent report estimated that 10% of Wyoming is "impacted" by cheatgrass (high cover causing ecological degradation), whereas 78% of the landscape is at risk if the invasion intensifies and/or spreads[1]. Cheatgrass is currently costing an estimated $30 million in annual losses to agricultural productivity, and IAGs as a whole are costing $76 million in annual losses. Future potential losses due to the spread of IAGs could escalate to deplete as much as 43% of the state's agricultural value. This is not including loss of wildlife habitat and associated wildlife value, which are significant. Big game in Wyoming are estimated to be worth nearly $6 billion.

"My biggest concern is operating at a scale that at least matches the rate of infestation and ideally exceeds it. There are more acres being infested every year than we are able to treat. And if you play that out over a longer period of time, that only results in one thing, and it's bad things for wildlife, bad...for our future. And so at some point, we're going to have to operate at a scale that's commensurate with the need."

"Prevention is worth a pound of cure, and we are in the position to do a lot of prevention if we can stay on top of it."

Further, the shift from native perennial systems to annual grass dominance creates fine fuels that dry early in the season, increasing and extending wildfire risk and challenging fire management efforts. Fire poses an grave risk to our economy, livelihoods and infrastructure.

Cheatgrass and other invasive annual grasses are spreading in Wyoming at a faster pace than the pace of action. At the same time, Wyoming is home to the largest amount of "core sagebrush area" – the highest-condition sagebrush – left in the West[2]. Approximately half of the 33 million acres of core sagebrush remaining are in Wyoming. These are areas where IAGs have, so far, had little or no impact.

Prevention and early intervention are the most cost-effective and ecologically sound strategies for managing invasive annual grasses. Proactive management—often described as "Defend the Core," "Hold the Line" or "Maintain"—focuses on maintaining intact, resilient ecosystems and addressing invasions at their early stages, before invasive grasses outcompete native plants, degrade the ecosystem, and make restoration difficult to impossible even with substantial investment. This approach needs to be balanced with more reactive management, which include post-fire recovery efforts, improving areas by reducing invasives where feasible, and containing more heavily-invaded areas to reduce spread and reduce risk of fire spread.

Scientists advocate for a Defend the Core strategy[2-3], largely focusing on maintaining the condition of

the least invaded core sagebrush areas as top priority, followed by improving rangeland condition where success is most likely. Managers, funders, and other decision-makers, however, have many questions about how best to implement these strategies in practice, and many potential obstacles to ideal implementation.

To better understand this gap between recommended and implemented strategies, we assembled this qualitative situation assessment based on interviews with 22 land managers who work across western and central Wyoming. This assessment focuses on cheatgrass as the primary invasive annual grass currently threatening this region, although we emphasize that containing ventenata and medusahead to not spread beyond northeastern Wyoming is also critical to an overall IAG strategy for the state. Japanese brome is a less-widespread player, often co-occurring with cheatgrass, and for the sake of convenience we group these two *Bromus* species together.

We used in-depth, semi-structured interviews, averaging 1.5 hours each, and a thematic coding process to identify common themes and ideas about cheatgrass management. Participants were selected for their professional expertise and geographic relevance. They provided critical insights into the challenges, opportunities, and decision-making processes that shape cheatgrass management on the ground. This study was designed to improve understanding of how land managers approach different stages of cheatgrass invasion—from early Maintain actions to more complex restoration efforts—and to inform the key, actionable steps that can be taken to enhance and expand work to defend Wyoming's sagebrush rangelands.

By elevating practitioner experience and identifying constraints to proactive cheatgrass management, this assessment provides a foundation for improving coordination, resource allocation, and strategic action to address one of the most pressing ecological threats facing the state.



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Key concepts and terms defining proactive management

The landscape of cheatgrass and IAG management in the sagebrush ecosystem involves many different contexts, degrees of invasion, and concepts and terminology. This can easily lead to confusion. In this report, we will use some key concepts and terms; we define them here, and we suggest that all parties discussing IAG management should align their vocabulary and understanding of the current state of invasion (intensity and extent in space) with each other when talking about management options.

Degree of invasion

The **degree of invasion** is often measured as **aerial cover** (percent of the ground covered by the invasive species when looking down from above). It can vary widely, from zero or very low cover (<5%) to very high cover (>50%). Management actions and goals differ depending on the degree of invasion. Currently, scientists and managers often classify IAG cover <15-20% as "low" or "moderate"– conditions prioritized for proactive management, especially if perennial plant cover is relatively higher or much higher[3-4]. Recent approaches use a ratio of IAG cover relative to perennial vegetation as a measure of both degree of invasion and recovery potential of desirable perennial vegetation.

However, the degree of invasion can also vary substantially in space, at different spatial scales. There can be large areas with homogenous level of invasion, or a highly patchy mosaic of different invasion levels, or small patches of more-invaded area within a larger landscape that is less-invaded. For example, a generally low-invasion landscape can contain highly invaded hillsides, or a generally uninvaded landscape can contain small patches of invasive annual grasses.

Maintain, Improve, Contain

We suggest the terminology and framework of Maintain, Improve, and Contain[3] are useful for aligning strategies under the overall umbrella of Defend the Core. **Maintain** indicates rangeland areas in high condition where the priority is to keep them in this high condition by preventing worsening invasion or "holding the line" to prevent further spread. **Improve** indicates rangelands where IAGs are present and having negative impacts, but controlling them and allowing native perennial plants to recover can improve the rangeland condition. A variety of management actions can fall under the "improve" umbrella. **Contain** indicates rangelands with a high level of invasion, where improvement will be difficult; management here focuses on reducing fire and seed spread to adjacent areas that are in better condition.

Proactive management

A proactive management approach focuses on less-invaded areas where Maintain strategies are most commonly-needed. However, because of spatial variation in degree of invasion, all strategies are relevant.

Proactive management can include several different approaches, depending on the context, ranging from less to more invaded:

- **Early detection, rapid response (EDRR)**: finding and treating new, small, and/or limited areas of invasion (patches) within an otherwise uninvaded or minimally-invaded landscape, with the goal of preventing further spread at this early stage of invasion. Even though elimination of cheatgrass and other IAGs is probably impossible, early detection and rapid treatment is considered a key part of a Maintain the core strategy.
- **Early-stage treatment**: treating larger areas with overall low IAG cover (<15%) and high (>20%) perennial grass cover, with the goal of keeping IAG cover as low as possible to minimize IAG negative impacts on other plants.
- **Spray-and-release restoration**: treating areas that have moderate to high IAG cover (typically >15%) but also high cover and/or presence of perennial plants, with the goal

of reducing IAG cover and allowing existing perennial plants to grow back and increase in cover and productivity.

Areas with high IAG cover that have few perennial plants left are beyond proactive management. In these situations, the main management approach is:

- **Active restoration**: re-establishing perennial plants by seeding and/or transplanting, while also managing IAGs with herbicide treatments; this is a difficult task because herbicides suppress all seedling emergence, regardless of species.

While early detection and early-stage treatment are the most proactive, all of these management approaches are being used and were discussed in interviews.

Treatment and herbicides

Currently, the only truly effective way to control IAGs is through the use of herbicides. While there are many other strategies that can have some effectiveness, this report will assume that "treatment" means herbicide application. Throughout the report, both the chemical names and trade names will be used interchangeably, to reflect how interview participants used these terms. The two most common herbicides are indaziflam (Rejuvra) and imazipic (Plateau).

While much research is focused on the effectiveness of these two herbicides in controlling cheatgrass and other IAGs, we acknowledge that relatively much less documentation exists about their long-term impacts on perennial plants, insects, other vertebrate fauna, or human health. While any herbicide treatment comes with associated risks and impacts, most managers felt that the benefits of treatment far outweigh the detriments.

Common acronyms

AIM – Assessment, Inventory, and Monitoring program of BLM

BAER – Burned Area Emergency Response – an immediate post-fire response by federal agencies to stabilize burned sites

BLM – Bureau of Land Management

EDRR – Early detection, rapid response

ESR – Emergency Stabilization and Rehabilitation – a post-fire planning process conducted by federal agencies

EQIP – Private land improvement funding program under NRCS

IAG – Invasive annual grass

IMAGINE – Institute for Managing Annual Grasses Invading Natural Ecosystems, University of Wyoming

NEPA – National Environmental Policy Act

NPS – National Park Service

NRCS – Natural Resources Conservation Service

USFS – United States Forest Service

WGFD – Wyoming Game and Fish Department

I. Current Practices

This section synthesizes the current management practices across western Wyoming for cheatgrass and other invasive annual grass (IAG) management. Here we summarize how managers prioritize intact, high value, and high recovery sagebrush landscapes—especially where wildlife, rare plants, and fuels intersect—for management efforts. Other common themes also included identifying and limiting vectors of spread, selecting herbicides with longer lasting chemistry, implementing landscape scale partnerships, and engaging in active restoration activities (above and beyond herbicide application) when needed.

A. Prioritizing areas for IAG management

i. Defend-the-core and hold-the-line areas

The prevailing strategy recommended to managers is to prioritize IAG management in intact or lightly invaded sagebrush systems first, then expand outward: start at less invaded, often higher elevation and/or higher precipitation zones, and work toward more invaded areas. The idea is that this simultaneously works to contain spread and leverage the higher resilience in more intact areas where the chances of successfully maintaining desirable and native vegetation are greater.

Manager responses confirmed that they support and work to implement this strategy, within the constraints of landowner willingness, funding, and other considerations.

Managers collectively shared a common operational pattern:

1. Identify "your core" – informed by local conservation priorities. Overlay various geospatial layers that capture estimates of cheatgrass cover, wildlife corridors and critical habitat, fire polygons, and the Sagebrush Conservation Design to provide a coarse strategy, then narrow in on priority areas. If additional resources are available, aerial vegetation reconnaissance by drone or helicopter, as well as inventory and monitoring by ground crews, are used to further refine priority areas. Factors that elevated priority level included:
    a. Concern for wildlife habitat
        i. Sage grouse core habitat and lek sites
        ii. Migration routes and winter ranges for mule deer, pronghorn, elk, and bighorn sheep
    b. Areas with intact perennial plant communities, characterized by lower cheatgrass cover (generally <15%)
    c. Areas important for livestock forage productivity
    d. Areas containing known populations of rare or sensitive plants
    e. Areas where cheatgrass is present at low cover or in small patches and is expanding into previously uninvaded areas
    f. Areas with higher resistance and resilience, indicating abiotic conditions more likely to support

"We want to prioritize those places where you have a higher likelihood of success."

"You have limited ability to inventory everything. You have limited ability to fund treatments, so you have to prioritize. So, we're only probably looking at a fraction of what we could be [looking at in terms of managing] cheatgrass establishment and invasion. There are some areas that are probably heavily infested, but it's probably a waste of time to do something because it's too infested."

strong native plant community response

g. Areas with strong interagency and partner collaboration, recognizing that intact landscapes span jurisdictional mosaics and that a "defend the core" strategy is inherently collaborative.

2. Determine which areas with core/priority areas will be designated for treatment, what funding sources are available for treatment, and which areas should be monitored as vulnerable to cheatgrass invasion. Over time, push the treatment line outward from the core habitat into increasingly invaded areas. This helps ensure containment, and even incremental expansion of intact habitat edges.
3. Address vectors that lead to the accelerated spread of cheatgrass across the landscape.
    a. In areas of low to no cheatgrass presence, monitor areas of disturbance (roads, trails, parking lots, salt licks and water tanks, and oil/gas pads) for early cheatgrass occurrence, and treat if present. Roads and vehicles are especially noted as a primary vector of IAG seed into uninvaded areas, leading managers in many geographies to spray herbicide along roadsides if cheatgrass is present even at low cover.
    b. Remain on high alert for new invaders such as ventenata and medusahead which currently are largely found in the northeastern and eastern sides of the state; in western Wyoming, confirmed detections of ventenata or medusahead would lead to immediate treatment with herbicide to prevent further establishment.

ii. Moderately invaded areas where IAG management action is taken

In more moderately invaded landscapes, managers treat cheatgrass strategically, acknowledging that multiple treatments will likely be needed, and that native plant communities often take longer to rebound or may never rebound completely.

"So our approach was: Where's the invasion, what do we want to protect, and who's willing to participate? That's where we really established the core."

"We prioritize those areas that are most important for wildlife, which wouldn't be everybody's priority goal, but we wanted to work where we were going to influence that the widest variety of wildlife species."



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"Maybe you prioritize not losing ground, and you can't take on a new project. You have to protect the investments you've already made on another project."

Examples of moderately invaded landscapes where managers prioritize herbicide treatments include areas that:

1. Sit within key wildlife corridors and/or crucial ranges
2. Protect prior investments, such as previous Plateau or Rejuvra applications, conifer removal, and habitat enhancement work
3. Function as gateway barriers where treatment can slow spread into high value areas, or are more heavily invaded areas within a priority (overall less invaded) area
4. Pose concerns due to the elevated risk of fire that comes with cheatgrass invasion – in these areas, managers treat cheatgrass specifically to reduce fine fuels and protect adjacent areas (communities, infrastructure, wildlife habitat)
5. Host or buffer rare plant habitat

iii. Restoration, post-fire action, and high-invasion strategies

While "defend the core" is the often-stated priority for IAG management, managers are, in some places, actively engaged in restoring post-fire or high-cover cheatgrass areas, especially when critical wildlife value, major disturbances, or prior investments are involved. Due to the higher and cooler geographies of Wyoming relative to the rest of the sagebrush biome, the state is lucky to have fewer places in need of such resource-intensive intervention than some other geographies in the West. Situations that are leading to active restoration efforts are:

a. Post-fire response and restoration. Wildfires create urgent, high-stakes response landscapes, both ecologically and financially due to the limited funding window that follows a burn. Many untreated burn scars, specifically those with prior IAG invasion or with IAG seeds present, are considered at risk of converting to high-fuel IAG monocultures that perpetuate reburn cycles. As large-scale rangeland fires become more common in Wyoming, efficient and targeted disaster response practices are being developed at county and state-wide scales.
b. Priority areas within lower elevation, low precipitation basins where long-term cheatgrass dominance has reduced native seedbanks. Priority areas for active restoration tend to be big game migration pathways and winter ranges or sage-grouse lek sites.
c. Highly disturbed sites within defend-the-core areas, such as road corridors, pipelines, roadside right-of-ways, and other areas where cheatgrass invasion is advanced and active restoration effort is needed to re-establish ecological functions. These areas tend to be managed to limit them as a seed source, rather than with hopes of restoration. This type of vector management is also considered a key part of proactive management, especially when adjacent to core areas.



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B. Importance of partners and working groups

Effective management of cheatgrass across Wyoming is partnership-driven. Managers emphasized that collaboration determines not only the scale at which treatment efforts can occur, but also the likelihood of long-term success. Several themes emerged around how partnerships influence cross-boundary treatments, funding opportunities, monitoring capacity, and adaptive management.

When considering partnership more broadly, managers also highlighted the crucial role of private landowners, along with the importance of education and outreach made possible through these collaborations and working groups.

i. Collaboration is often a practical necessity for landscape-scale IAG management

Because cheatgrass infestations span many land-ownership types, such as BLM, Forest Service, state, tribal, National Park, and private lands, managers must work across boundaries to be effective. Many participants stressed that treatments cannot stop at the fence line; doing so simply results in reinvasion. Several counties have developed multiagency agreements, planning and coordination schedules, shared monitoring days, and/or county-wide spatial prioritization maps.

Face-to-face engagement—whether through small coordination calls or larger, county-level working groups—was described as invaluable for strengthening communication, trust, and clarity around roles. These roles include drawing treatment polygons; conducting landowner outreach; coordinating applicators; securing permits and completing agency-specific paperwork; obtaining funding; organizing and facilitating meetings; and coordinating inventory and monitoring efforts.

The most successful working groups are characterized by long-term continuity among partners, high levels of trust, and a shared identity centered on protecting sagebrush landscapes.

ii. Partnership shapes the funding landscape

Collaboration is one of the strongest drivers of funding. Many statewide and county-level efforts began when new funding sources became available—e.g., Sage Grouse Initiative dollars, Wyoming Wildlife and Natural Resource Trust funds, or fuels reduction budgets. Through collaborative, multi-agency partnership, these sources can then be leveraged to secure additional funds and grants. Conversely, we found a recurring theme: Without money, even strong partnerships cannot strategically scale treatments (see Section II: Challenges to Proactive IAG Management).

> *"This is our life. This is our passion...and this is something really important. So, we all came together, no ego, no drama. This is a team: what can you do, versus what can you do, versus what can you do. And even though you're the Forest Service guy, you know this landowner better, so can you talk to them? And we dissolved arbitrary lines, whether it be land ownership or agency roles or supervisor versus subordinates. We just made all that go away. It didn't matter. We were a team. We were working toward a goal."*

Interviewees described a layered funding environment where multiple sources are often patchworked together and used as leverage to secure other sources (see Appendix 2 for more information on funding sources):

- Weed & Pest districts often serve as the contracting hubs and implement most aerial or ground treatments
- Wyoming Wildlife and Natural Resources Trust funds Weed & Pest District treatments on both private and public lands

- NRCS EQIP brings funding for both private and public land
- BLM fuels programs, and USFS provide major dollars for large-scale treatments on their lands
- Wildlife NGOs (Muley Fanatics, Wild Turkey Federation) increasingly fund proactive and preventative treatments
- Private landowner contributions provide match and show owner buy-in

iii. Shared responsibility for monitoring, science, and adaptive learning

Collaborative monitoring — of cheatgrass presence and cover, spread, and response to treatments — helps partners measure success, document treatment needs, and justify future funding.

Partnerships with university, NGO and federal scientists contribute remote sensing tools, mapping products, and improved detection of early invasions. These science partnerships help prioritize where treatments will have the most impact.

iv. Landowner willingness and community buy-in are essential

Comprehensive, landscape-scale cheatgrass management often depends on private landowner involvement and broader community buy-in. Strategic treatments need to take place on private lands to successfully implement a defend-the-core strategy. Community members and landowners play important roles by voluntarily reporting new infestations, supporting county and agency aerial treatment efforts, and advocating for increased legislative funding for cheatgrass and other IAG management.

Landowner willingness is influenced by:

- Trust in agencies
- Perceived treatment success
- Neighbor relations ("my neighbor treated and saw good results")
- Financial feasibility
- Cultural attitudes toward chemical use and government assistance

"Sometimes we'll work with one landowner and the adjacent landowner, they'll talk and say 'we sprayed cheatgrass and had financial support', and then that adjacent landowner comes in and says, 'Hey, I heard you helped so and so. I have some cheatgrass on my property. Can you come take a look?' And then that's kind of how things that get started there."

"The fires have helped [raise awareness]. You yell 'fire,' and the dollars come, so I think that that's helped. And seeing how much the treatment of those fires, just putting out fires cost, I think that's helped move the conversation to, what do we do to prevent the need for putting out fires?"

When cheatgrass management first began in Wyoming, many landowners didn't recognize cheatgrass or understand its risks. Outreach and site visits, increased fire frequency and severity in some regions, Weed & Pest programs, and partner networks, have increased recognition. Still, many individuals do not yet understand connections between cheatgrass, increased fine fuels, and larger, more destructive fires. This fire-related outreach gap was highlighted as a priority moving forward (see Section II: Challenges to Proactive IAG Management). The risk of ventenata and mudusahead spread pose a new education challenge – to make sure a vigilant public helps detect any early establishment of these invaders new areas.

C. Deciding on herbicide treatment

The primary objective of herbicide treatment is to suppress IAG establishment and growth, thereby releasing existing perennial grasses, shrubs, and forbs from competition and promoting their growth. In western Wyoming, the two herbicides most commonly used for cheatgrass management are imazapic (Plateau) and indaziflam (Rejuvra).

Managers reported that they select the herbicide type and application timing based on disturbance context, non-target concerns, and long-term vegetation goals. In general, imazapic provides shorter-term (~1 year), lower-cost ($30/ac) control with greater risk of non-target impacts, especially to shrubs and forbs. Indaziflam offers longer-term (~3-5 year, sometimes longer) control at higher cost (~$50-$80/ac), with fewer effects on established vegetation. While active in the soil, indaziflam prevents germination of all seeds—both invasive and native—so it is not suitable in situations where seeding of desirable species is needed.

In general, indaziflam tends to be the preferred herbicide for cheatgrass control in western Wyoming. In some places, managers use a "5+5 tank-mix" of 5 oz/ac imazapic and 5 oz/ac indaziflam for fall treatments, to get the better first-year control of imazapic combined with the longer-term control of indaziflam. However, this approach has more potential for non-target impacts to desirable vegetation. The details of optimal herbicide timing and composition are subjects of active research across the West.

D. Data collection efforts

i. Rationale for including data collection in IAG management

Cheatgrass managers across western Wyoming collect vegetation data, typically focusing on the cover and diversity of all plant species as well as cheatgrass and Japanese brome presence and percent cover (a measure of degree of invasion) in order to:

1. Document pre/post-treatment conditions and outcomes
2. Prioritize where to treat next
3. Determine when to retreat
4. Guide grazing plans and compliance inspections
5. Be ready to support postfire response, in the event of fire
6. Provide transparent evidence to funders, landowners, and the public
7. Help inform adaptive management

ii. Data collection is often a multi-party effort

Managers reported that data collection effort is distributed across agencies and partners: BLM (including AIM crews), USFS (including contracted botanical surveys and seasonal technicians), WGFD, NRCS (EQIP-linked monitoring and grazing plan support), County Weed & Pest, IMAGINE seasonal crews, TNC Wyoming staff, National Park Service seasonal technicians, NRCS staff, as well as private landowners who receive funds from NRCS. Capacity limits are common, so monitoring is often shared, delegated, or "outsourced" to those with crews on the ground.

In many areas in western Wyoming, there is not sufficient capacity to collect data on conditions



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before or after IAG treatments. (See more about monitoring challenges in Section II: Challenges to Proactive IAG Management).

iii. Field methods and data management

Collectively, managers report using a variety of methods for data collection, depending on scale, capacity, and purpose. These include Line-point intercept (LPI) transects, photo points, visual estimates of cover in a radius around central points, and other methods.

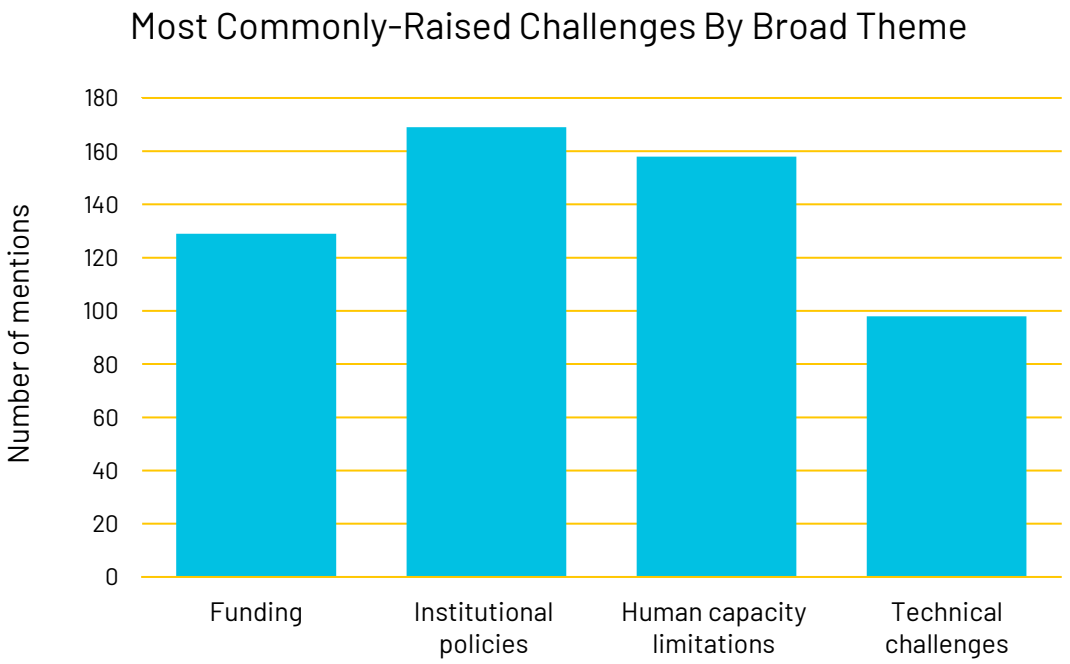
Data management, storage, and degree of sharing is variable. Because maintaining systems can be time-intensive, some managers exclusively maintain local datasets while others have capacity to share summaries with wider groups to identify priority edges/cores or contribute to national databases such as the BLM AIM. While most managers agree that collecting, managing, and sharing vegetation is valuable, there are numerous practical obstacles. Data-related challenges are detailed more in Section II: Challenges to Proactive IAG Management.



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II. Challenges to Proactive IAG Management

Interview participants identified a variety of challenges they face in defending the core sagebrush habitat in Wyoming against invasive annual grasses. These fell into distinct themes, summarized in these graphs and charts, which represent the number of times the challenge was raised in interviews. These factors interact with each other, leading to a greater, cumulative effect that limits our ability to hold the line and maintain ecosystem function at scale.





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A. Funding availability: insufficient and episodic

Managing cheatgrass is an expensive endeavor. Interviewees cited treatment costs of approximately $60–$90 per acre for indaziflam treatments. These per-acre costs often increase in high-elevation or patchy terrain where aerial application is more challenging. Drones offer a more nimble option for treating small areas, but they can require six-figure startup investments and higher labor costs per acre. In areas where cheatgrass is well-established and native and perennial vegetation are sparse, herbicide treatments alone can be insufficient, and the need to reseed with native species to achieve restoration goals drives costs even higher.

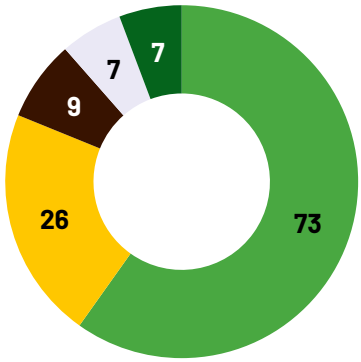
Given the state's vast rangeland extent and the high cost of treatment, it is not surprising that interviewees consistently identified funding as the primary barrier to managing invasive annual grasses, with some particular funding barriers to implementing Defend-the-Core proactive management.

i. Funding gap between what's available and what's needed

Managers consistently emphasized that available funding falls short of what is required to manage cheatgrass at meaningful scale. Many also stressed that cheatgrass-infested acres are increasing faster than treatment capacity; operating "at the scale of the problem" will take tens to hundreds of millions of dollars over ~20 years, reliably and dependably delivered so implementers can plan sequences of initial treatments and retreatments. Available and anticipated funding does not meet the expressed need.

One interviewee, responsible for 1.8 million acres, estimated that about 80% of that landscape now contains some level of cheatgrass. To maintain cheatgrass levels below 10–15%, they would need to treat 200,000–250,000 acres every year with

Funding-Related Challenges



- Funding insufficient to meet the need
- Lack of durable funding
- No dedicated funding for retreatments
- Ongoing budget cuts
- Funding not aligned with timing of need

"At some point, we're going to have to operate at a scale that's commensurate with the need, and we're going to have to be treating enough acres that we are making a meaningful difference."

"If you can't find funding, you can be a dreamer and not accomplish anything. And I'm somebody that wants to accomplish things. I don't want to just dream.... you can't accomplish these kinds of impressive, proactive management strategies without money. Everybody can be completely on board, and all the landowners and grazing permittees want to do the same thing, but if you don't get money, you can't do it."

imazapic—an effort costing roughly $6.2 million annually at current rates. Switching to indaziflam would raise costs to approximately $14 million per 225,000 acres treated. Another participant managing a 5-million-acre region estimated that fully treating their priority cheatgrass areas would cost on the order of $20 million for a single indaziflam treatment.

Taken together, these figures underscore how even maintaining current conditions requires sustained, large-scale, and long-term investment. For comparison, BLM currently has about $2 million dedicated to invasive species work across all 18 million acres of BLM-managed surface lands in Wyoming. This highlights the significant gap between funding availability and on-the-ground need.

ii. Lack of durable funding

The Bipartisan Infrastructure Law (BIL) and Inflation Reduction Act (IRA) created a flush of funding, but participants expected these opportunities to wind down, with uncertainty about what will follow. Participants worried about "cheatgrass fatigue" and waning appetite for the continuation of other funding sources. Another concern is state legislature cuts to property taxes, resulting in budget cuts to Weed and Pest Districts and associated personnel. The lack of durable funding makes it difficult to plan into the future or feel confident about the durability of current work.

"I've been around for long time, and I've seen all these cycles. We start projects, then they're not the latest buzz, so they lose funding, and then we're back where we started. That's one of my concerns with cheatgrass is we're going to pour all this money into this program, and all of a sudden it's going to go away."

iii. No dedicated funding for retreatments

Most available grants and funds support only a single herbicide treatment. This structure is understandable, as herbicide and labor costs can fluctuate significantly over a 3–5-year period, making it difficult to accurately budget for retreatments. However, it also means that managers frequently lack the resources needed to retreat sites when needed. This funding gap often results in reduced IAG control, reinfestation, and ultimately the need for more intensive and costly restoration efforts.



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B. Challenges tied to institutional policies

i. Fragmented prioritization and action

a. Lack of coordinated strategy

Management of IAGs occurs at the county, district, and office levels, resulting in fragmented, patchwork approaches rather than being tiered under a unified statewide framework. While this structure allows for locally-responsive, culturally-attentive management, adjacent counties or field offices can vary widely in readiness, staffing, priorities, and willingness to participate, creating gaps in treatment continuity. As a result, cheatgrass management can sometimes operate in isolated pockets of success rather than as an integrated system.

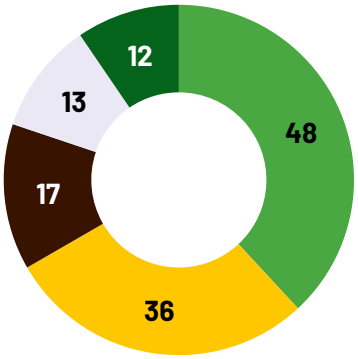
Fragmentation also occurs in trying to manage across administrative borders, especially the checkerboard private and BLM lands across southern Wyoming, and at state borders. Fragmented efforts can slow implementation and undermine the ecological effectiveness of treatments.

b. Cheatgrass not a state-designated weed

Many interviewees highlighted how geographical inconsistencies in priority and approach to cheatgrass management are reinforced by this species not being listed as a state-designated noxious weed. Medusahead and ventenata are listed at the state level, and cheatgrass is listed on 20 out of 23 county lists. Some, including some interviewees, are reluctant to list cheatgrass as a noxious weed due to concerns about the impacts this listing would have for agricultural producers and counties' ability to manage other priority weeds.

Since cheatgrass is not listed as a state-designated noxious weed, counties differ in whether and how they prioritize cheatgrass. This lack of formal designation also diminishes the capacity of the state to secure funding for cheatgrass treatments. For example, Wyoming Department of Transportation (WYDOT) funds are allocated to counties for the treatment of state-designated weeds within right-

Challenges Tied to Policies



- Piecemeal approach to NEPA process
- Lack of coordinated strategy across jurisdictions
- Other Federal and State review requirements
- Insufficient regulation of seed contamination
- NRCS deferred grazing requirement

"You know, that's the challenge we have is that there's limited resources, both financially and in manpower, work power. And I think we need to share a unified strategy on where the priorities are and what we're going to do."

"We need to think statewide. I think people realize that you need to look beyond your little walls at times and make great decisions for the bigger cause and the bigger picture – biologically, you can have a real success story there."

"We would like to coordinate across state lines, but most of that's not federal ground. If we could treat over there, it would definitely help on our side, but we just don't currently have the funding or necessarily the willing partnership."

"I think from a new person looking from the outside in, it automatically raises that flag. Well, why is it not on the state list? So that creates question and doubt, and I look at it as a way of unifying the Weed and Pest districts on a common issue. And without that, we don't seem unified. We seem fragmented, which makes us weak."

of-ways. Because cheatgrass is not state-listed, it does not qualify for these funds unless it co-occurs with a listed species. Consequently, counties must rely on alternative funding sources to manage cheatgrass along county rights-of-way—one of the primary pathways for seed dispersal.

ii. Policies and regulatory structures that create challenges

a. Prioritization structures that disincentivize proactive action

Some policies enable funding and action only once cheatgrass has reached a moderate to high cover level. This can mean that less of the limited funding gets applied for proactive management in places with low cover and higher chances of being maintained or improved through cheatgrass control. Some policies prioritize fire risk management – widely deemed necessary, but with the risk of using up all of the available funding on reactive treatments of infestations while earlier-stage, less-costly interventions are overlooked.

"So for NRCS right now, the practice standard is 15% cheatgrass cover... there's been some discussion of is that 15% what it should be or not. Maybe if you addressed [cheatgrass] sooner, then you wouldn't have as much [cheatgrass] cover."

Managers specifically commented that in Wyoming, NRCS EQIP funding is only available for places with cheatgrass cover exceeding 15%, whereas most Maintain strategies focus on keeping cover below 15%. This threshold was put in place by NRCS out of concern about non-target impacts of herbicide on desirable plants, and to avoid applying herbicide to areas where cheatgrass cover could remain at a stable, low level without treatment. Some debate this logic, citing that invasive species like cheatgrass build up their seed bank slowly and then rapidly cross a threshold to higher cover level, at which point it becomes much more difficult to manage.

b. Insufficient regulation of seed contamination

Some participants noted a wish for more strict statewide seed standards to prevent cheatgrass contamination in seed mixes. Contamination leaves restoration projects vulnerable to inadvertently reintroducing the weed. For example, post-fire reseeding efforts can further spread cheatgrass, even in areas where substantial treatment investments have already been made. This problem complicates restoration decisions and creates hesitation about reseeding strategies that might otherwise support long-term ecosystem recovery. On the other hand, participants acknowledged that completely eliminating cheatgrass or other IAG seeds from restoration seed mixes is not feasible, and creating stricter limits of allowable cheatgrass seed could create economic challenges for seed growers and hinder restoration in more disturbed areas.

c. Deferred grazing and other NRCS requirements

Currently, use of NRCS EQIP funding requires that treated areas are set aside for rest for a year after treatment, unless an exemption can be justified and approved. This stipulation significantly limits proactive IAG management by reducing private landowner willingness to participate, thereby hindering landscape-scale coordination across different land ownerships. The NRCS deferred grazing requirement is designed to protect the

"If you're going to defer grazing, there's going to be no cows on that entire place.... Because there's not a lot of cross fencing, it means people have to defer grazing on that whole pasture, which could be 1000s of acres, which...makes it harder for people to want to sign up for that."

"[The NRCS] program requires the growing season following, a rest from grazing, to get the cost share. A lot of producers can't accept that, they can't work around that. And so we had several landowners wanted to do it, but then they bailed last minute because they didn't want to deal with NRCS."

investment in cheatgrass treatments by allowing existing plants a chance to grow robustly post-treatment without cheatgrass competition, rather than being grazed immediately. This is intended to increase resistance to re-invasion. However, the large scale of many pastures in Wyoming makes it difficult for landowners to close off entire pastures for a whole year.

Iii. Administrative challenges

a. Administration of funding

Federal government freezes or delays can leave managers unable to implement treatment during critical seasonal windows, such as during months with reliable precipitation. These funding delays have also led to herbicide contractors accepting other jobs while agencies awaited funding confirmations.

"We still have not seen, 'Yes, your agreement has gone through, and yes, you're going to get the money.' .... It's just a frustrating process. It's long and tedious. Sometimes, you have the project, and you have the people to spray and still have no funding. It's like, you just want to beat your head against the wall."



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b. Piecemeal approach to NEPA process

The most often-mentioned institutional challenge was the NEPA process and requirements. Navigating these is time-consuming and cumbersome, often slowing or constraining treatment planning on public land and thereby making large-scale efforts infeasible. Securing NEPA approval for aerial herbicide applications is a significant barrier—even when indaziflam has already been authorized for other units of the same agency. National Forests and National Parks have to conduct a NEPA process for each individual Forest or Park. Wilderness areas present some of the most restrictive hurdles and face pushback from conservation groups and the public.

"I think that cross-boundary partnership is a pretty big deal. If we all have the same tools available to us without restriction, and I'm thinking specifically of the NEPA piece... Having the ability to treat state and BLM and Forest Service all in the same flight would really help, and we know that, and we're trying, but we just haven't quite hit our stride there."

c. Other Federal and State environmental review processes

Additional layers of review, including environmental stipulations such as wildlife timing restrictions and mandatory cross-program consultations, can further delay treatment implementation or require less-than-strategic treatment timing. At the same time, extensive permitting and paperwork adds administrative burden and erodes project momentum. While many of these checks are important and necessary, the process of going through them can create a barrier to invasive grass management.

"Treatment has been in August and September... [because of] the wildlife stipulations...and it's just the sacrifice that we're probably going to not get that first year of control."

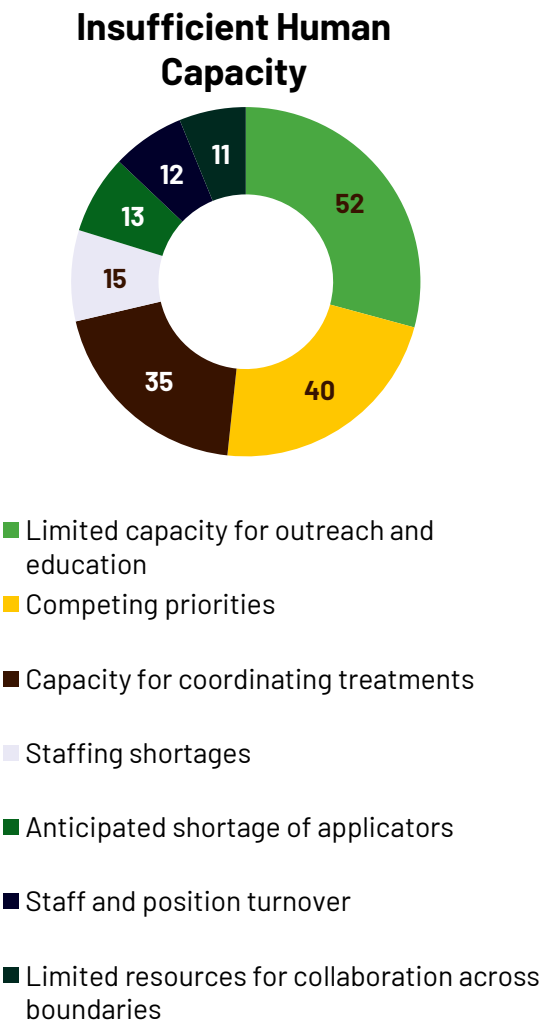
"Our biggest hurdles is timing stipulations. In each area, they're different—they're just [written] a little bit different from area to area."



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C. Insufficient human capacity

Human-capacity shortages, including staff shortages and position turnover, monitoring crew and applicator scarcity, as well as administrative overload and collaboration barriers, constitute one of the primary barriers to effective cheatgrass management in western Wyoming. These constraints shape every aspect of management, including strategic planning, funding applications and utilization, data quality, community engagement, cross-boundary cooperation, and the ability to scale treatments.



i. Chronic staffing shortages and eroding institutional knowledge

Managers reported being on "skeleton crews" with vacant positions, hiring freezes, and personnel losses from early retirement or other federal workforce reductions. High position turnover compounds the loss of capacity, and when experienced staff retire or transfer, institutional knowledge disappears, partnerships weaken and coordination is delayed, and new personnel require long lead-time to regain lost momentum. As a result, fewer people are responsible for more work.

"I just lost 21% of my budget in three months... I'm looking at releasing full-time employees. I reduced my seasonal crew 33% for next year. We do not have the manpower."

"We've had 10 Supervisors in the 10 years that I've worked here. That's a lot of turnover. So, the support and continued drive to complete a really large planning project like that is tough to maintain when your leadership is constantly changing."

"We haven't had a NEPA coordinator for almost about three years. Pretty tough to lead a big project when you don't have a dedicated lead, and limited capacity."

"It often feels like our fingers are in 10 places in the dam, trying to hold stuff together and [we need] having other people that are also looking and helping us understand the state of things in a systematic way."

ii. Competing priorities

Managers often balance multiple responsibilities, such as fence and livestock management, water and irrigation management, prescribed burns, wildlife habitat protection, reclamation, and control of multiple different noxious weed species. These mandates can take precedence over cheatgrass management or demand more urgent action.

iii. Implementation bottlenecks

a. Capacity for managing treatment projects

Managing cheatgrass treatment projects, even within administrative jurisdictions, is labor-intensive and requires extensive administrative steps. Managers must identify treatment areas and prepare GIS polygons, fulfill administrative application and reporting tasks, coordinate with partners and landowners, and supervise herbicide application operations. Many treatments require NEPA processes, pesticide-use proposals, safety plans, contracting steps, and specific reporting; meeting these requirements involves dozens of people. The capacity and know-how to complete all of these steps is sometimes not present to meet the pace of treatment need or funding timelines.

"Anybody cannot just call up the helicopter pilot and be like, 'we want you to come do this and we'll write out a check.' There are many checks and balances in the process, other programs that have to get involved, safety plans that have to be reviewed, pesticide use proposals have to be reviewed and go through contracting. You have to have people who can enter the budgetary side of it. One helicopter contract might have been touched by 50 other people. So ... that person who wants to implement it on the ground has to follow that process through, has to have the time for that, the knowledge on how to navigate the parts of the process. ... and then they have to balance it and all their other work."



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b. Insufficient time and resources for data collection to support planning

Participants widely felt that data collection, or monitoring, to support planning before potential treatments and document outcomes of treatments is important but hard to support with existing time and staffing.

Many cheatgrass inventory and detection efforts are based on opportunistic field observations rather than systematic or strategic protocols. Existing regional maps of cheatgrass cover have limitations in their accuracy, making ground or helicopter surveys necessary for planning treatments in a specific project areas. Many managers lack the time to keep abreast of new maps and planning tools or to understand how much to rely on them versus ground data, let alone the time to collect ground data. Limited capacity particularly hinders early detection rapid response (EDRR) efforts to find new, emerging, and low-level cheatgrass outbreaks that will not easily be detected from road, air, or satellite.

Similarly, capacity for collecting data before and after treatments to evaluate their effectiveness is also limited. In some places, IMAGINE teams have been able to provide this service. Documenting and understanding treatment outcomes under different conditions is essential for planning future management strategies and anticipating funding needs in the future.

"Monitoring is probably the most neglected thing that we do, not because we don't want to, but we have limited capacity to do so."

"If we had a partnership with someone who could help us with the geospatial side of things, I think that would help us greatly. That would take less time on our end trying to understand the geospatial stuff."

"We are honestly, three, four rednecks, doing whatever we can to put as much money into treatment on the ground as possible to try to keep this at bay until there is a better solution that comes out. It's not a super technical resource or research-based plan that we have for this project."

Even when data collection does occur, limitations in data management systems and analytical capacity often prevent effective storage, analysis, and use of the information.



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c. Anticipated shortage of aerial applicators

An emerging implementation bottleneck was also identified by interviewees: there was growing concern that Wyoming has a relatively small pool of aerial herbicide applicators, many of whom rotate among multiple counties and states. Treatment windows in Wyoming are short due to weather, elevation, and phenology, creating competition for limited aerial crews. Aerial application companies may be reluctant to increase their size and capacity given the cyclical and uncertain nature of funding for IAG treatments. Increases in funding for cheatgrass treatments, while needed, may not be able to bring treatments to fruition fast enough if there are not more applicators. This highlights the need not only for more funding, but for sustained funding over many years.

iv. Capacity for collaboration and communication

a. Insufficient time for collaboration across lines

Landscape-scale cheatgrass control requires coordination across counties, agencies, and landowners, yet limited human capacity makes such collaboration difficult. Interviewees described an absence of unified, cross-agency strategies, resulting in reactive and haphazardly located treatments. Some participants also noted meeting fatigue, feeling resentful of expectations to spend scarce time and resources in discussions that rarely produce concrete actions and require long timelines to generate progress, diverting attention from individually recognized priorities where meaningful work could occur.



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"If we continue to see increases in funding and get more and more and bigger and bigger projects, there's going to end up being a shortage of applicators. And I think right now, even, it's borderline, these guys are running around like crazy trying to get everybody's stuff done."

"How can we do better to collaborate between all these different agencies who are trying to do the same thing? We've been needing do that for a while."

"I think that the partnerships that we have are great and could always be made stronger and more robust. But I feel like every partner within these partnerships is pulled in so many different directions. We don't have the number of people we need to really be able to plan, step it down, get the funding and get it implemented."

b. Limited time for outreach and education

While participants reported dedicating time to outreach and relationship building, limited capacity often leaves these efforts underdeveloped. This reduced ability to provide education and outreach has contributed to a knowledge gap among western Wyoming residents, many of whom are unaware of the scale of the threat posed by IAGs. As a result, several misconceptions persist, including misunderstandings about herbicide risks or treatment objectives; de-prioritizing weed management relative to shorter-term operational needs; and perceiving cheatgrass as a tolerable or even beneficial early-spring forage without recognizing its long-term impacts on forage and fire risk.



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"The number two barrier is [the need to create] buy in and making sure that everyone understands the importance and wants to be part of the solution. And so I think if we can continue to generate awareness and buy in from affected parties, and I'm not talking just about landowners, I want people who don't know anything about cheatgrass today to know that it's a problem, and even if they don't have land, they want to figure out a solution."

"I think ranchers recognize it, farmers recognize it, land managers recognize it. And I think a lot of people recognize it because it sounds like a bad weed, cheat. That doesn't sound good. That's not nice. You don't cheat... but like, do they understand the implications of it? I don't know. But it's also called grass. So grass is good, right?"

"So, if we were to frame the issue in terms of AUMs, which is what livestock producers care about... that needs to be communicated, because it's an existing fear that they're not going to be able to run as many cows out there because of these other things, but they're not maybe as aware of cheatgrass."



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D. Technical challenges

Efforts to proactively manage IAGs in Wyoming face a wide range of technical barriers that interact across biophysical, operational, and logistical limitations. Interviewees consistently emphasized that data gaps, herbicide challenges, the state's landscapes and climatic patterns, and operational constraints complicate treatment success and long-term planning. These challenges intersect with high costs and long-term funding uncertainty to constrain the scale and consistency of treatment.

i. Data and knowledge gaps

Specific knowledge gaps are more detailed in Part III: Knowledge Gaps, but we highlight here general patterns of critical gaps that hinder management decisions and actions.

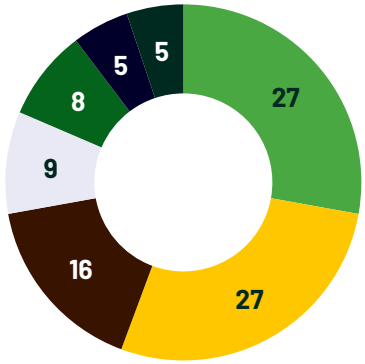
a. Local ecology

Interviewees emphasized the need for more research and knowledge from their geographic areas and Wyoming in general. Managers do not have full confidence in using research from other states for their planning, given ecological differences between Wyoming and other geographies. Land managers described adapting their strategies as real-world results emerge—an approach that supports adaptive management but complicates long-term planning and project justification for partners and funders. Topics that interviewees specifically wanted more local knowledge about included treatment outcomes, herbicide effectiveness duration, and the economic impacts of cheatgrass invasion.

b. Spatial data gaps

Reliable information on where cheatgrass or other IAGs are occurring and at what percent cover are often missing. These detection and mapping challenges hinder proactive management. Roads are a common vector for IAG spread, but wildlife, livestock, and recreationists transport seeds into remote areas where low-density infestations escape

Technical Challenges



- Inadequate spatial data to plan treatments
- Landscape and climate obstacles to treatment application
- Unpredictable precipitation timing
- Insufficient local data to plan
- Insufficiencies of non-aerial herbicide application
- Limitations of herbicide application by drone
- Minimizing human disturbance post-treatment

"Until you get [the herbicide] on the ground, in the environment you're working on a grand scale, a lot of times it's hard to really know what [the retreatment interval] is. And I feel like that's one of the biggest challenges with doing all this cheatgrass work, in particular, is you just have to keep learning as you go."

"If we had more information in our area specifically... [such as] the grazing potential in an area that's pretty healthy and [has] limited impact by annual invasive grasses, versus a similar area that is impacted by it, and you could find out what the losses are associated with [annual grasses]..."

satellite-derived models and dashboard observations. Identifying these leading-edge invasions is ecologically critical, yet extremely difficult due to limited staff capacity and the lack of accurate, real-time, accessible mapping tools. Existing geospatial technologies—such as the Rangeland Analysis Platform (RAP) and USGS Early Estimates of Exotic Annual models—perform variably and are not accurate enough to plan treatment projects – often misclassifying red soils, missing small or sparse patches, or overpredicting IAG cover and presence. Interviewees also described struggling to keep up with rapidly evolving spatial technologies.

"Keeping up with what technology and spatial data is available is really challenging...our ability to process data, our ability to know which model we should be following or which one that we can use for the different applications... It's really hard to keep up with that and sort it out."

"My major concerns are we don't have much for tools available to us to arrest the spread at a leading front. And, for the same reason, we don't have great data to show us where that front is. We can see it on roads. We can see it in easy places. But what about all the other spots?"

"These sparse cheatgrass patches are something that we have struggled with because all of Western Wyoming has so much remote country that it's extremely difficult to even get into it to make observations."

ii. Spread into new and higher elevation areas

With cheatgrass reported above 9,000 feet, high-elevation environments pose added concerns due to the inherent difficulties of monitoring, accessing, and treating these areas. Treatment options may be more limited at these higher elevations. A warming climate creates conditions conducive for cheatgrass and other IAGs to establish in new places, which can accelerate spread. Seeds are often spread into new and sometimes remote areas by wildlife, livestock, and people and their vehicles and pets. It is not possible to completely control these vectors of spread.

"I definitely think [cheatgrass] is getting worse. It's going up in elevation. I think our climate is causing or creating a condition for it to get a leg up, by just the fact that now we're seeing it pushing 10,000 feet elevation up in the wilderness and in the Winds, in the Wyoming Range, there's some places where it's pushing way up high."



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iii. Treatment logistics and uncertainties

a. Precipitation timing and indaziflam

Indaziflam's first-year control, and potentially longer-term effectiveness, depends on receiving sufficient precipitation after application – about ½ inch of moisture for the herbicide to get incorporated into the soil. When this precipitation fails to arrive following treatment windows and before fall germination of IAGs, first-year IAG suppression is often weak, with visible control delayed until year two. This timing mismatch, when cheatgrass germinates before herbicide reaches the soil, creates inconsistent results and can undermine partner confidence, especially in high-investment, large-scale treatments where there is an expectation for quick, visible success.

"We treated...around the Fourth of July, and we had some good moisture up to that point, and that just stopped, and the [cheatgrass] control was terrible in [the first year after treatment], almost enough that it just crushed me. But I'm okay, because we've seen our test plots pick up [control] two years after, and it looks great, and that's consistently looking great."

b. Wyoming's climate and landscape

The physical and ecological character of Wyoming landscapes creates barriers to effective IAG management. Much of the western half of the state is defined by rocky, roadless terrain that restricts access and reduces treatment feasibility and efficacy, particularly in rugged mountain foothills, canyon country, and juniper or conifer woodlands.

Climate patterns intensify these challenges, with prolonged droughts limiting soil moisture needed for native plants to rebound. Dry years also reduce cheatgrass germination, making mapping and detection less reliable. Interviewees emphasized that these challenges limit their ability to forecast retreatment cycles or justify ongoing funding.

"The barrier for us here is that our springs are incredibly variable. This year, we could have sprayed in May. Two years ago, we couldn't have sprayed in June. Just depends on the weather, and that's really hard to plan around."

iv. Equipment and access limitations

a. Limitations of ground herbicide application

Aerial application of herbicide is not permitted in all places. However, ground-based herbicide delivery—using backpack sprayers, vehicle booms, or horse-mounted crews—is generally infeasible except to treat small patches or follow-up spot treatments, since most of Wyoming's terrain is roadless, steep, or obstructed by dense vegetation. Coverage from ground crews tends to be inconsistent, often leaving untreated pockets or exceeding target rates in others, and the labor required far exceeds available staff and treatment windows.

b. Limitations of herbicide application via drone

Drone technology is a promising emerging approach for aerial application in tight or hazardous environments and for smaller, targeted treatments. Drones are also being used for localized evaluation

"We need [aerial application] to solve this problem, because we cannot do it with trucks, we can't do it with backpacks. It's so clear, we need these hillsides. We have these problems on this hill, and the only way to get to these hills and spray the acreage we need is a helicopter."

"At the very beginning, we were hiking up these hillsides and having horses bring up herbicide to us and walk around with backpacks on—we're like, this is not gonna happen. It was soul crushing work."

of ground conditions. However, currently-available drones are limited by battery life, and tank capacity, making them unsuitable for large-area application. Administrative hurdles can also limit where and which drones can used. Drones also face some of the same wind and weather challenges as helicopters. On the other hand, drones could be very valuable for spot-treating smaller patches of cheatgrass much more rapidly than ground backpack crews can.

c. Operational challenges for helicopter pilots

Helicopter pilots face lift reductions due to temperature and elevation, wind and weather restrictions, mechanical limitations, and obstacles such as transmission lines, tree canopies, and concave slopes. These factors can force reduced tank loads, ground flights entirely, or significantly decrease application rates.

d. Post-treatment efficacy reduced by disturbance

In addition, uncoordinated post-treatment disturbances such as road grading or mowing can unintentionally redistribute soil or remove vegetation at critical moments, diminishing herbicide effectiveness unless agencies coordinate timing and operations.



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"Oh, it's steep, there's places where it's almost concave. And the herbicide just isn't getting on the ground."

"With large boulders and stuff, you have the shadow effect with helicopters flying over. You know, if there's cheatgrass up tight against a rock or a boulder, that's not going to get exposed to the treatment, so maybe they'll always be a little bit hidden there, unless you came back with a spot treatment..."

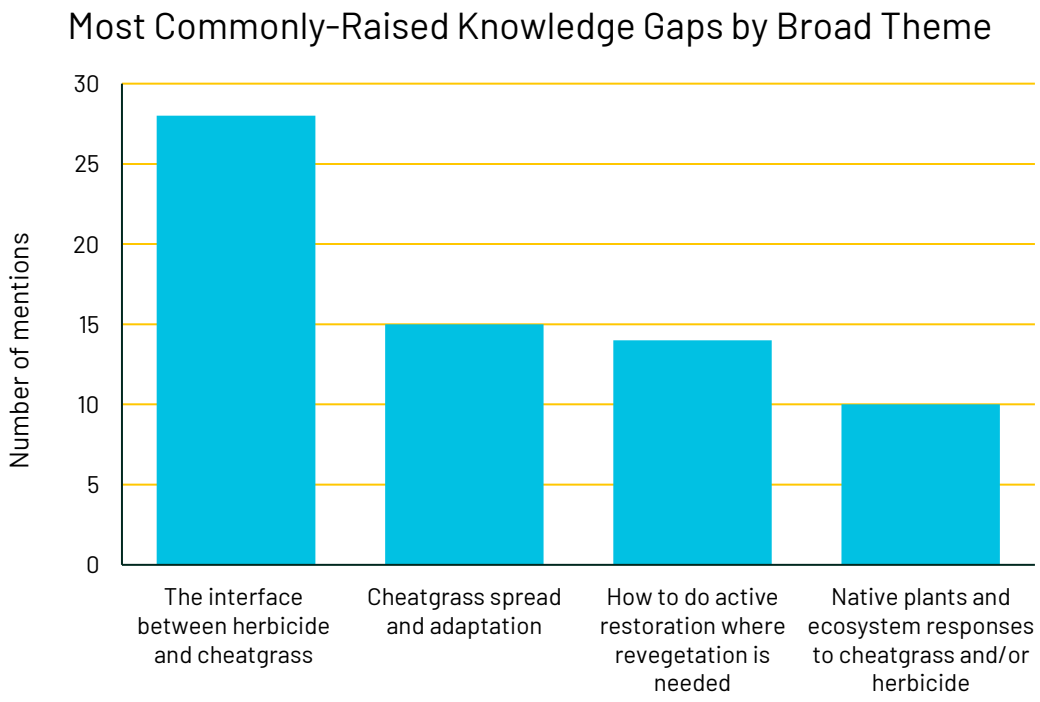
"So if the altitude gets too high, then they can't treat depending on the size of the helicopter and everything. And, as it gets hotter, the helicopters are less and less efficient. So, they have to keep dropping how much product they can take in a load. Eventually, it's not even worth it. So, then they're just grounded."



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III. Knowledge Gaps

This section synthesizes the knowledge gaps that arose during interviews, in addition to the often-mentioned need for more and better local spatial data and post-treatment monitoring discussed above. Some of these knowledge gaps point to areas of research need; others reflect interviewees' lack of access to current knowledge and underline the importance of effective outreach and tech transfer to share existing science, research, and collective manager knowledge.





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A. The herbicide-cheatgrass interface

Across interviews, the most frequently mentioned knowledge gaps concerned the long-term efficacy, optimal use, and reinvasion dynamics surrounding indaziflam (Rejuvra). Participants emphasized that the timeframe of effective control remains uncertain, and that this uncertainty makes long-term planning difficult for agencies making large financial investments.

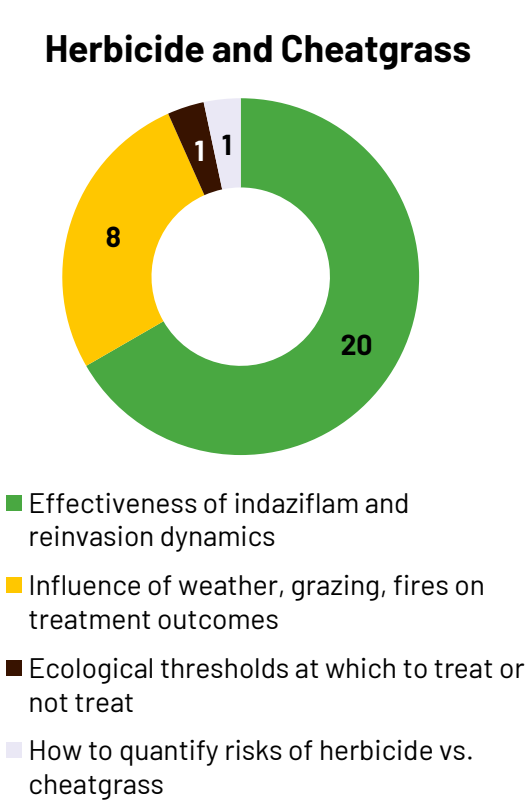
i. Effectiveness of indaziflam and reinvasion dynamics

Participants expressed significant unease about whether Rejuvra will function as promised (3–6 years), how weather affects outcomes, and what happens after control wanes. Interviewees wanted to know more about how to grapple with, plan for, and minimize the likelihood of eventual re-invasion by cheatgrass or other IAGs. Managers are looking for predictive tools to estimate where and when herbicide "breaks" are most likely to occur versus where herbicide application is most likely to successfully manage cheatgrass and other IAGs for longer time periods.

ii. Effects of precipitation, fire, and grazing on herbicide performance

Participants had questions about how precipitation variability, wildfire activity, and grazing patterns may alter the efficacy of and outcomes from herbicide application. These are pressing concerns as Wyoming's temperature and precipitation patterns become more variable, rangeland fires become more frequent and far-reaching, and grazing policies come up for revision.

We note that, while some managers were skeptical of the need for post-treatment grazing restrictions, others have raised concerns about Rejuvra weakening grass root systems similar to the way that Plateau does.



"We don't really know how long the positive effect is going to last, and then like so, particularly after two treatments, then what? How fast can it reinvade? Is it going to reinvade from that one seed that could last 10 years, or is it going to reinvade from a seed that falls off of a bike or a bird or a deer or something, and then what's that going to look like, is the system healthy enough to resist it?"

"We don't know the long-term success of our treatments and investment, and we won't know until we do it. So that's a factor. We're investing millions and millions of dollars on this stuff, and we don't know if it's gonna work long term."

iii. Treatment thresholds

There were also questions about thresholds of ecological impacts of cheatgrass and thresholds at which cheatgrass treatment is warranted, most effective, or less effective. While there is much research currently happening on these topics, the answers are not definitive and may take years to fully illuminate.

"It is always in the back of my mind, trying to figure out where, you know, the difference between sandy soils and clay soils, the difference between slope and aspect... and trying to figure out if there's a way to identify areas that are more likely to break earlier, or areas that we know we might get longer term control."

iv. Quantifying risk: herbicide vs. cheatgrass + fire

Participants highlighted the need for science that quantitatively compares the risk of herbicide effects against the much greater ecological risk of cheatgrass-driven fire cycles. The related theme of needing better ways to communicate these relative risks came up as a major outreach and education need.

"At what point do we need to treat in general?... I know we think we really need to catch it early, and I agree with that philosophy. But at what is early, right? Or what percentage is ideal? Is that 5% canopy cover? Is that 10? Is it 15? Are you too far gone at 20? You know, tipping points and thresholds ... And at what point have we essentially lost that battle?"



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B. Native plant and ecosystem responses to herbicide versus cheatgrass

i. Native and rare plants

Interviewees cited the lack of clear evidence around herbicide impacts to native plants and native plant seed banks that they need to reassure conservationists, landowners, and regulatory bodies that the negative effects of herbicide treatment are acceptable relative to the negative effects of cheatgrass.

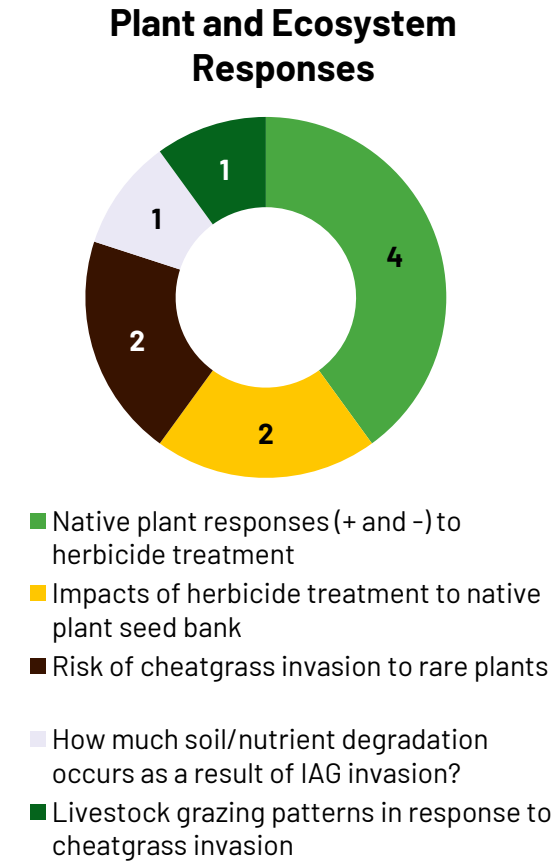
Managers also expressed a need to know more about how cheatgrass invasion affects rare and threatened plant species, which often get less attention than charismatic wildlife species. Although it did not come up in interviews, many members of the public have questions about the impacts of Rejuvra on insects and birds. A more complete understanding is needed to weigh up and communicate the consequences of invasion versus the consequences of herbicide application on native flora and fauna.

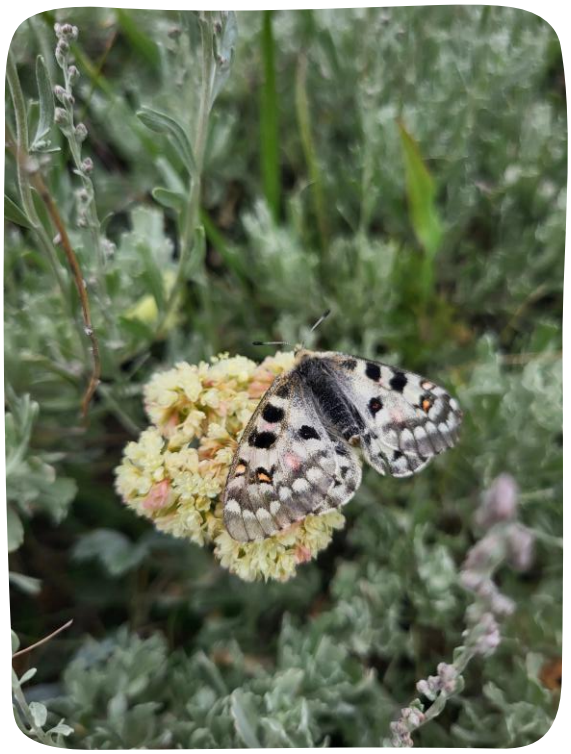
ii. Soil degradation and hydrology

Participants pointed out the unknown extent to which cheatgrass-dominated systems have lost soil function or nutrient capital, and how this might affect restoration processes and outcomes.

"Even the rare plants and sensitive species, everything did better in the following five to seven years post treatment... But I would like a little bit more science to back that up, so that [people are] a little bit more open to me treating these areas."

"There's a lot of questions about how it impacts the seed banks that I'm not 100% able to answer."





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C. Cheatgrass spread as a function of genetics, seed ecology, and climate change

i. Conditions for resistance to cheatgrass

Some participants had questions about what protects intact plant communities. What roles do soil chemistry, species composition, and climate patterns play, and under what circumstances do native plant systems lose resistance to cheatgrass? Are there native plant communities or conditions that can resist cheatgrass? A

ii. Seed viability, distribution, and persistence

Interviewees reported hearing contradictory information about seed longevity. They also had questions about the potential for cheatgrass seed to disperse. In particular, interviewees wondered how rapidly seeds spread and if we should assume they are already everywhere or if some areas are truly seed-free.

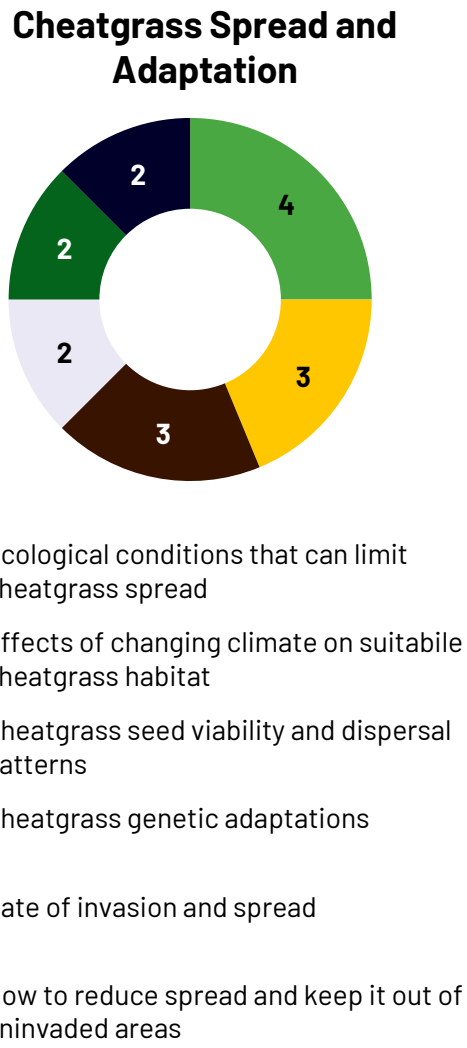
iii. Genetic adaptation

Interviewees expressed concern that cheatgrass is rapidly adapting to new soils, moisture regimes, and elevations, potentially expanding into historically resistant habitats. How well this is being tracked, and whether or not we can predict these trends, was of concern for participants.

Note that a recent study concluded that cheatgrass is not evolving in North America but rather already has high genetic diversity and adaptation to diverse conditions thanks to multiple introductions from its native range[5].

iv. Protecting "clean" areas

Several questions came together in the question of how to actually keep uninvaded areas uninvaded. This relates to questions of how rapidly spread



"Under what situation, whether it's a soil type, an aspect, a certain plant community type, where's the threshold for that where cheatgrass invasion will overtake [the plant community], especially if that plant community's in good shape?"

"That area from Atlantic City to Sweetwater Station above the Beaver Rim, you know, it doesn't seem to be as impacted by any of annual invasive grasses at the moment. Why is that? Is that an ecological function?"

happens, how to manage vectors of spread and how to manage for resistance.

v. Wildlife, livestock, and other vectors

Interviewees raised questions about how best to manage livestock and wildlife movement as vectors of spread, as well as other disturbance vectors that are known to disseminate cheatgrass seed.

"[Cows] are probably grazing it on some of the bad areas and like the more disturbed areas ..But if those cows are then moving up to these pristine range units, what can we do to stop that kind of transfer?"



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D. Restoration in highly-Infested or disturbed areas

i. Re-establishing plants

Managers had questions about how to balance treating for cheatgrass, after a fire or other disturbance, or in places with low native plant cover, with wanting to seed desired species. Since herbicides suppress all seedling emergence, re-establishing plants from seed is not feasible while the herbicide is active. Re-establishing plants while controlling cheatgrass requires a more complex approach than simply re-seeding.

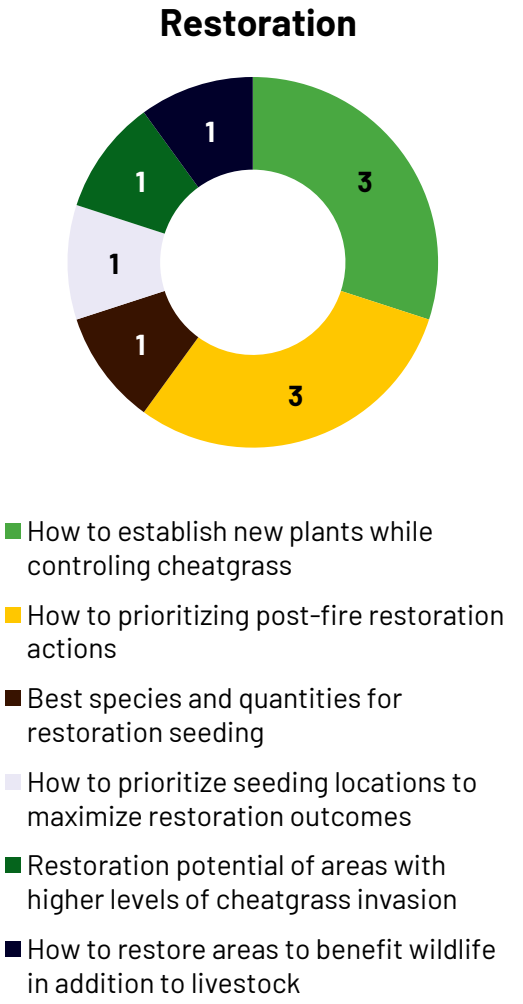
ii. Post-fire prioritization and feasibility

Managers reported struggling with how to prioritize deploying limited resources after large wildfires, especially given the scale of some fires and uncertainty about the post-fire climate. Furthermore, there were questions about what are feasible and realistic outcomes from post-fire restoration.

iii. Seed mix design and availability of species

Questions arose about how best to select seeds for restoration and when and how to distribute them depending on different goals. Interviewees also highlighted that availability of seed is a challenge in Wyoming's limited native seed economy.

Some may not be aware of the existing information and resources that support designing seed mixes. These include online trainings and tools as well as native seed supply companies that can provide advice; more details are given in Appendix 3.



"How do we restore the areas that need it? What species should we put in there? What's method should be used? Is the drone broadcast seeding viable? ...And how do we ensure that we don't have cheatgrass in those mixes?"

"We had a fire go through, and we can purchase seed from these commercial vendors, and we can go fly it on and just hope something happens and it gets moisture. And it's like... that's weak, you know?"

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IV. Opportunities and Actions

The collective voice of the managers interviewed for this report points to multiple opportunities and actions that would accelerate a proactive, defend-the-core agenda in Wyoming. We share a more in-depth look at the following ten key Opportunities and give associated specific recommended actions in the companion Opportunities and Actions report.

1. Funding systems to match the scale of the problem

2. Coordinate actions across boundaries

3. Align policies

4. Increase workforce capacity and implementation support

5. Expand education and outreach

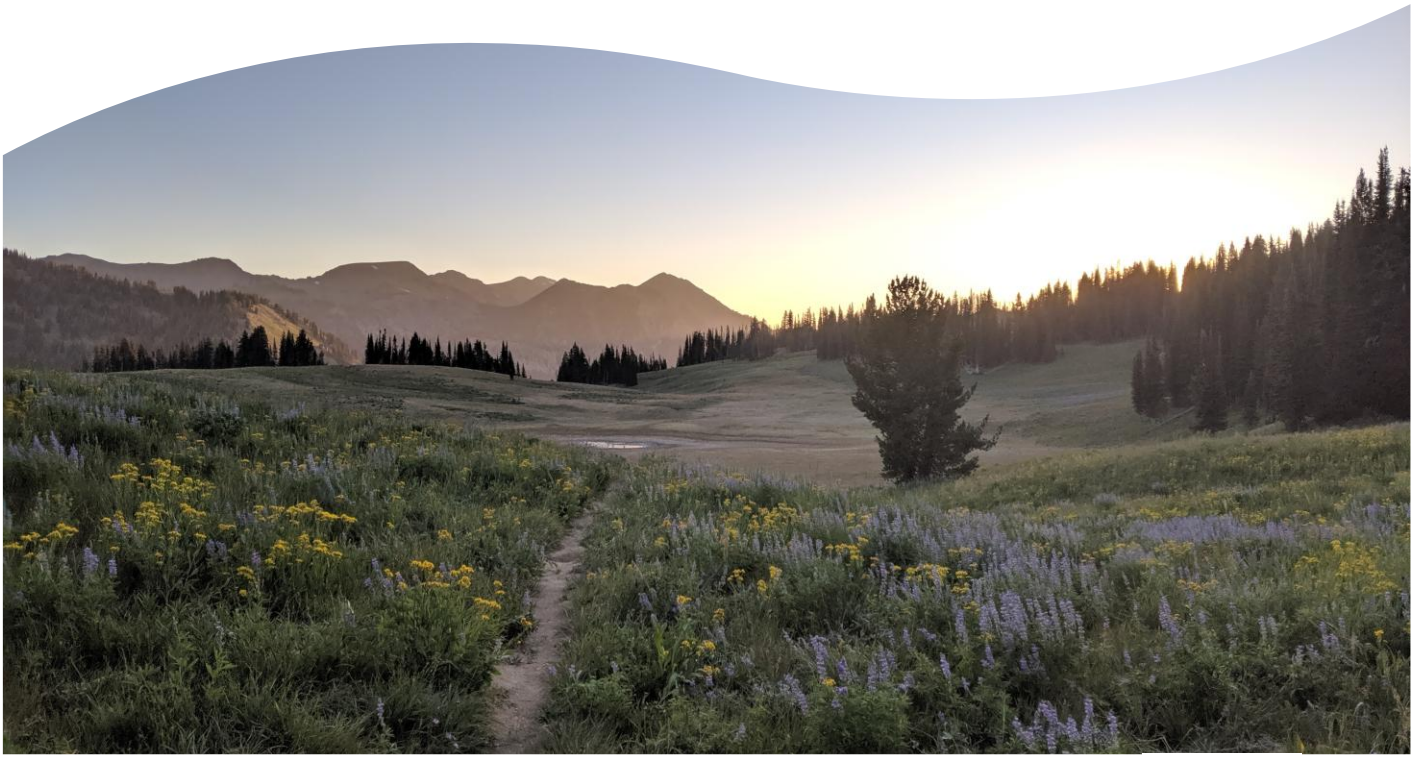
6. Support planning with data

7. Address knowledge gaps

8. Manage spread

9. Anticipate fire

10. Operationalize true defense



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Appendices

Appendix 1: Recommended Manager Checklist: Operationalizing IAG Management to Defend Your Core

This appendix provides a working draft set of recommendations for how to operationalize a defend-the-core strategy at a local level. Many additional resources and trainings are available through the IMAGINE Tech Transfer Partnership.

1. At the landscape scale (County, BLM Field Office, National Forest District, National Park, etc.) map "your core"
    a. Identify priority areas. Stack wildlife, rare plant, agricultural value, fire polygon, IAG maps, and any other relevant layers; select polygons where treatment helps multiple values.
    b. Include vectors: include roadsides, oil or infrastructure pads, salt licks or watering tanks, and any construction corridors near priority areas; if funding is tight, at a minimum include ingress routes.
    c. Protect prior dollars: if imazapic has been applied previously or other investments have been made such as prescribed fire or conifer thinning, cap with indaziflam if budget, capacity, and native plant conditions allow.
2. Identify which parts of the landscape fall into categories and prioritize both "Maintain" areas where targeted actions can have the greatest long-term benefit, and "Improve-Recover" areas where improvement is most feasible:
    a. Highest priority for action
        i. Maintain – Prevent: Priority for EDRR
        ii. Maintain – Recover: diverse native perennials present at high cover, low IAG cover, high recovery odds. Priority for further ground data collection and treatment planning.
        iii. Improve – Recover: moderate to high native perennials present, low to moderate IAG cover, strong recovery potential. Priority for treatment.
    b. Priority for action if additional high values or risks are identified
        i. Improve – Restore: some perennial plants present, IAG cover moderate to high, unknown recovery potential. Treat if high priority but accept risks that treatment may not recover native plants.
        ii. Improve – Revegetate: high IAG cover, native plant cover unlikely to sufficiently recover without additional seeding or transplanting. Only prioritize if contained within larger intact, core area.
        iii. Contain – Accept: highly altered and invaded landscape that may never be recovered. Potentially treat boundaries to contain spread and/or fire risk.
3. Use ground data collection to supplement remotely sensed maps and models of IAG cover
    a. Especially in places with predicted low cover, as remote-sensing-derived models perform poorly in these places
4. Choose herbicide and timing for treatment areas.
    a. Where budgets allow and active restoration (seeding) is not deemed necessary for ecological recovery, use indaziflam for greater IAG control and limited non-target effects.
    b. Treat when precipitation is still likely, preferably in the spring, or later in the fall if timing restrictions prevent spring application.

    c. In more degraded areas lacking native shrubs and forbs, where reseeding is a necessary component of restoration, imazapic can be used strategically for short-term control to facilitate seeding within a few years.
    d. Develop a post-treatment monitoring plan to inform treatment outcomes and retreatment intervals.
6. Identify funding to resource your project. See list of funding sources (Appendix 2).
    a. Determine dollars needed to treat acreage of designated polygons (steps 1&2), based on herbicide, applicator, and timing (step 3).
    b. Consider including funds for (1) ground-truthing treatment polygons and monitoring to inform retreatment; (2) early detection rapid response (EDRR) capacity (field crew and drone budget), especially for ventenata and medusahead.
    c. Set aside funds to treat any medusahead/ventenata detections immediately.
7. If a rangeland fire occurs, triage quickly postfire: prioritize areas with lower burn severity, native plant holdovers, lower IAG cover, relatively higher elevation-heatload-indices, and sage grouse lek and/or big game winter range overlap; align with ESR/BAER timelines and fuels dollars.

Appendix 2: Funding Sources for IAG Treatments

Funding outlook note: The recent BIL/IRA "flush" that funded many IAG projects across the west is expected to wane, putting more weight on the need for state-level funds.

Funding sources by provider

Federal land management programs

1. **BLM**
    c. **BLM – Hazardous Fuels Reduction**
    Larger cheatgrass treatments framed as fuels reduction; often the primary pot for aerial spraying on BLM acreage.
    d. **BLM – Postfire programs (ESR & BAER)**
        i. ESR (Emergency Stabilization & Rehabilitation): Immediate postfire actions, plan must be submitted by BLM field offices within 21 days of fire containment. Funds are often granted but need to be spent within 13 months of containment. Commonly goes to weed treatments or anything tied to threatened or endangered species. Does not include seeding or planting efforts.
        ii. BAER (Burned Area Ecological Rehabilitation): Line item in federal budgets, first come first serve availability. Funds available for the first 5 years after a fire is contained, and can be requested on a yearly basis. Includes all vegetation treatments, including seeding and planting.
    e. **BLM – Weeds program (base)**
    Smaller noxious weed projects; amount varies by field office—best for gapfilling around larger fuels/ESR actions.
    f. **Industry mitigation** – **Powerlines, pipelines, oil & gas** (e.g., Pinedale Anticline, Jonah Interagency Office)
    Mitigation dollars most commonly routed via BLM → WWNRT → local sponsors. Good fit for corridor treatments and offsite mitigation near disturbances.
2. **USFS**
    Funding for IAG treatments on USFS land. Funding pots include Burned Area Emergency Response, Burned Area Rehabilitation, State and Private Forestry, and Joint-Chiefs Forest Service grants. Contact local office to determine what's available in your geography.
3. **U.S. Fish & Wildlife Service (FWS) – private lands funds/trusts**
    Filling cost-share gaps and retreatments where threatened or endangered species are present. Also for treatments on private, tribal, and public lands.
4. **Bureau of Reclamation (BoR)**
    Targeted reservoir/right-of-way areas and partner projects. Often smaller but strategic add-ons.
5. **USDA & Related (NRCS/FSA)**
    a. **NRCS – EQIP (Environmental Quality Incentives Program)**
    Cheatgrass treatment on private and public lands. Pays flat per acre rate that often cover ~60–75% of costs; partners or landowners fill the rest. Requires application, ranking, and scheduling, as well as monitoring and reporting; funds allocated via county/state pools. Includes 1 year of required deferred grazing after herbicide treatment.
    b. **NRCS – CSP (Conservation Stewardship Program**
    CSP: Management oriented contracts that can include weed control in some counties.
    c. **NRCS-RCPP (Regional Conservation Partnership Program)**
    Partnership pools active in parts of western WY; can fund cheatgrass work alongside EQIP.
    d. **Inflation Reduction Act (IRA) / "Climate Smart" addons (now consolidated)**
    Have been stacked with EQIP recently (e.g., late 2024) to expand IAG work; stacking options narrowed as pools were consolidated in 2025–2026.

e. **Farm Service Agency (FSA) – Grassland Conservation Reserve Plan (with NRCS grazing plans)**
Can be paired with EQIP; NRCS prepares the grazing plan and monitoring; helpful on working rangelands with cheatgrass issues.

State of Wyoming programs

1) **Wyoming Wildlife & Natural Resource Trust (WWNRT)**
Major grants for IAG management, postfire response, and restoration efforts; frequently funds monitoring requirements; board is hands-on and often performs site visits. In the past, has been leveraged at ~5:1 match. Total amount available is determined annually by the Wyoming Legislature. The Legislature's $9M fire mitigation allocation (2025–2026 cycle) is already pushed out to projects. $27-$34 million available for 2026-2027 cycle.
2) **Wyoming Game & Fish Department (WGFD)** – Commission/Trust/Big Game License Coalition Invasive annual grass treatment funding (e.g., NFWF), focused on migration/winter range priorities and commission lands; typically embedded in partner projects with counties.
3) **WYDOT – State right-of-ways**
Limited funding available for roadside noxious weed control delivered by county Weed & Pest; currently ≈ $550k statewide/year for all noxious weed control, allocated across districts—good for vector control around treatment blocks.

County & local

1) **County Weed & Pest mill levy (Wyoming)**
County weed and pest districts use their mill levy funding for drones/equipment, staff time, small cost share programs, and occasionally for herbicide purchases; often pair with grants for helicopter/aerial work. Some districts cap per landowner cost share (e.g., $3k).

NGOs

1) **NFWF (incl. America the Beautiful, State Action Plans)**
Big game migration and winter range projects; typically 1:1 nonfederal match—often paired with WGFD/WWNRT and EQIP to unlock funding for larger treatment blocks.
2) **Conservation NGOs** – **TNC**, **Rocky Mountain Elk Foundation**, **Muley Fanatics**, **Wyoming Wild Sheep Foundation**
Smaller, gap-filling grants and targeted pots (e.g., emergency set-asides after burns, or species-focused work). Not usually the primary funder, but critical to match and close budget gaps.

Funding recommendation based on type of IAG project.

1. **Wildlife-focused treatments:** Applicable federal funds (BLM, USFS, etc) combined with state funds (WWNRT, WGBGLC) and NGO funding.
2. **Fuels reduction on big landscapes:** BLM Fuels, often stacked with WWNRT/NFWF for match.
    a. **Immediate postfire stabilization/seeding:** If on BLM, ESR, then BAER for multiyear monitoring/follow ups and native reseeding.
3. **Private lands treatments at scale:** NRCS EQIP (flat per acre rates) + USFWS or WWNRT/WGFD to close the cost gap; mind deferred grazing when required.
    a. **Roadside/vector control**: WYDOT → Weed & Pest, augmented by county mill levy and other project funds

Appendix 3: Resources for Planning Seed Mixes

There are various tools and resources available to help land managers and restoration practitioners select and create the best available native seed mixes for their specific applications.

Working directly with native seed suppliers such as Wind River Seed Company, Granite Seed Company, and Millborn Seed Company is often the most streamlined approach as they have the most up-to-date knowledge on which species are available and the origin of those seedlots. They also have a wealth of knowledge on what species would be most appropriate for which applications and what seeding rates should be used to achieve the desired vegetation outcomes.

Training programs like the Wyoming Seeding Specialist Certification program hosted by the Wyoming Department of Environmental Quality (DEQ) Abandoned Mine Land Division (AML) can help practitioners learn the skills needed to create diverse and appropriate seed mixes and ensure that seeds are applied correctly for the best chance of success.

There are also online tools:

- Seedlot Selection Tool from the USDA identifies appropriate seedlots for projects in specific geographies.
- EcoRestoreMT from the University of Montana can assist practitioners in selecting species and seeding rates based on soil type, restoration goal, lifecycle and more.