



**Wyoming Game & Fish Department**

# **2021 STRATEGIC PLAN**

**INVASIVE ANNUAL GRASS  
IMPLEMENTATION PLAN**



# INTRODUCTION

## INTRODUCTION

Cheatgrass (*Bromus tectorum*), and other Invasive Annual Grasses (IAGs), represent the most prevalent issue facing Wyoming's wildlife, landowners and land managers today. These species have a tremendous footprint in Wyoming, estimated to be in the millions of acres. Unfortunately, their expansion is continuing at an alarming rate, altering native rangelands and important wildlife habitats. This continued expansion poses a very real threat to wildlife and domestic livestock by negatively altering forage quantity and quality, increasing fire return intervals and decreasing species diversity. The presence of IAGs severely restricts the options and tools used to conduct habitat enhancements. The Wyoming Game and Fish Department (the Department) has a long and proud history of systematically addressing threats to natural resources, this document outlines practical steps to begin reversing these trends in IAGs within Wyoming's most important habitats.





## EXECUTIVE SUMMARY

Following the Department's mission statement, "Serving People, Conserving Wildlife," the Department is committed to proactively working with partners to reduce the spread of IAGs within Wyoming's most important habitats. The Department continues to prioritize IAG control as demonstrated by the ~85,000 acres of IAG treatments completed by the Department and partners in 2020. Despite this, it is apparent that the current approach will not halt the spread of IAGs. This document outlines a new and adaptable path for the Department and our partners to follow. While daunting, the Department envisions an opportunity to strategically and proactively improve efforts to reduce the threat to Wyoming's natural resources by implementing the strategies outlined below.

The Department's Invasive Annual Grass Implementation Plan will:

- Raise the profile of impacts associated with IAGs in Wyoming
- Prevent the spread of IAGs through direct actions and public outreach
- Quickly treat IAGs within the most important habitats
- Strengthen cooperation among state, federal, and local partners to develop and implement a state-wide strategy for managing IAGs
- Contribute to applied research with partners focused on combating IAGs
- Leverage and facilitate new partnerships to increase efficiency in treating landscapes

The Department and partners will accomplish this by:

- Promoting the idea that prevention is more cost-effective than rehabilitation
- Adaptively mapping the most important habitats in Wyoming using a combination of science, technology and local knowledge to inform management
- Assessing important habitats at predetermined intervals using remote sensing and ground based methods to determine treatment areas and post-treatment efficacy
- Utilizing the Invasive Annual Grass Prioritization Tool to ensure projects occurring in the most important areas are funded and implemented
- Ensuring invaded habitats receive treatment as soon as possible after infestations are discovered and contain remnant native perennial species necessary for long term success
- Systematically applying the most effective herbicides when IAGs are found within important habitats
- Ensuring herbicide treatments are well timed and properly applied for maximum effectiveness
- Prioritizing follow up treatments to eliminate the soil seed bank associated with IAGs
- Monitoring treatments to inform when and where to deploy future resources



## RECOMMENDATIONS

The Department recommends the following strategic steps to achieve success:

- Obtain high resolution aerial imagery within important habitats to build a statewide IAG occurrence map and set a return interval schedule for collection of this data every five years to assess treatment success
- Use the Department's Invasive Annual Grass Prioritization Tool to direct treatments or management actions in important habitats
- Establish a long-term, diverse and sustainable funding pool to implement the highest priority projects
- Utilize the WYIdlife Fund to fundraise and serve as the fiscal implementation agent for this effort
- Foster continued collaborative project development with partners such as weed and pest and conservation districts
- Maintain statewide vendor contracts with approved aerial applicators to gain efficiencies
- Work with federal partners to gain efficiencies in NEPA processes and prioritize IAG management actions within existing programs
- Seek funding for regional contract personnel positions to assist with project assessment, implementation and monitoring of IAG treatments
- Improve public understanding of the impacts of IAGs through a strategic education and outreach program
- Ensure alignment of this document with other efforts including the Wyoming Governor's Invasive Species Initiative (GISI) and the University of Wyoming's Institute for Managing Annual Grass Invaded Natural Ecosystems (IMAGINE)





## BACKGROUND

Invasive annual grasses, such as cheatgrass, medusahead (*Taeniatherum caput-medusae*) and ventenata (*Ventenata dubia*), are rapidly converting Wyoming ecosystems. Habitats that were once biologically diverse and productive are now struggling to persist with the arrival and spread of IAGs. These species out-compete desirable grasses, forbs and shrubs by germinating in early fall, furthering root development over the winter and initiating rapid above ground growth while native perennial plants remain dormant. This effective invasive strategy has long-term, negative implications for native species.

Cheatgrass and other IAGs are classified as winter annuals. Winter annuals germinate and begin growth during winters when daytime air temperatures hover above 40° for a two week time frame. Under ideal conditions, these grasses have the ability to germinate, grow and produce seed within a two to three week time span. A combination of early germination, rapid growth potential and rapid seed distribution re-

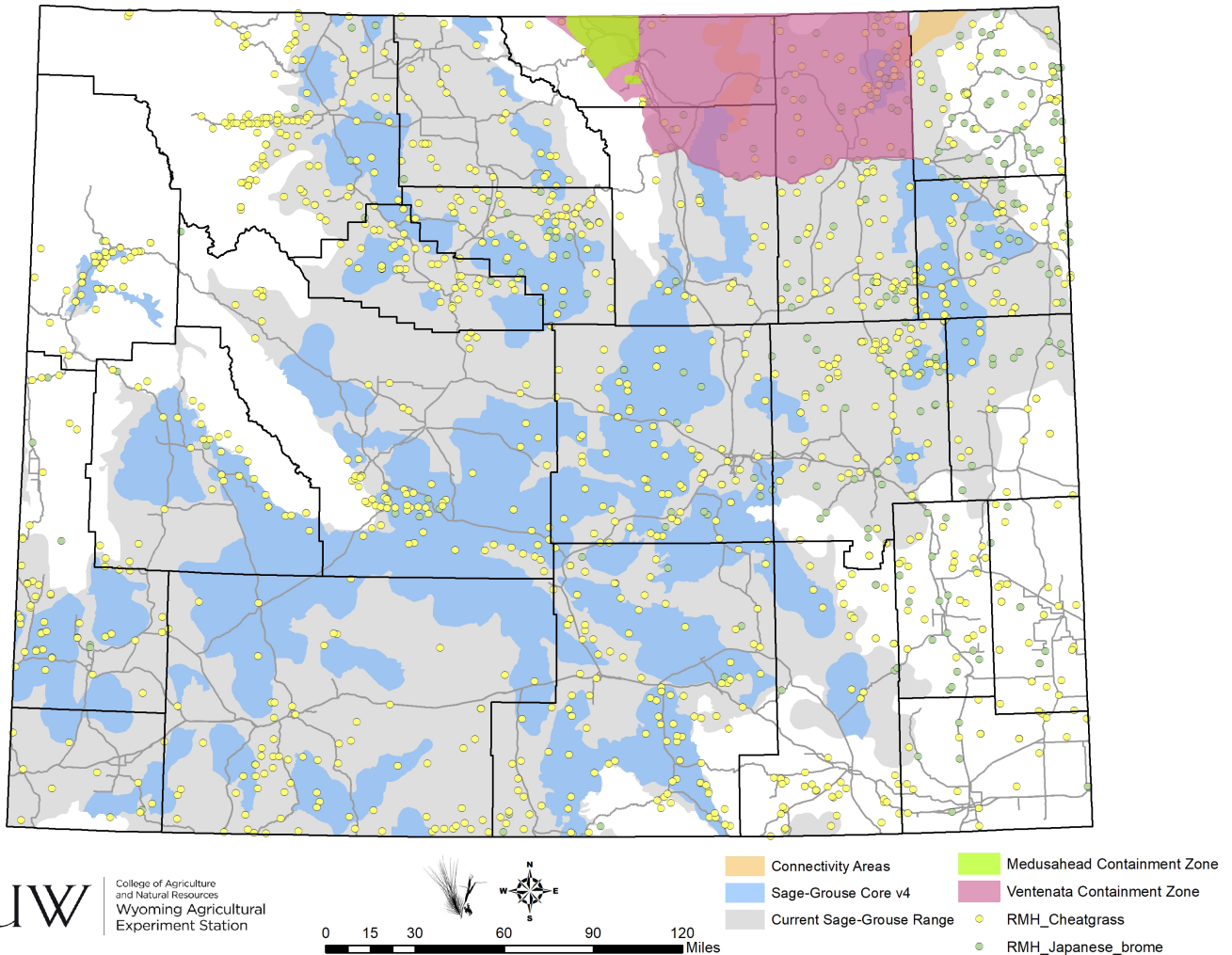


sults in small numbers of the initial invaders quickly producing sufficient biomass to overwhelm native grasses, forbs and shrubs. Available soil moisture influences plant height and seed production, however, even small amounts of well-timed moisture is all that is necessary to initiate growth and produce seed. Prolific seed production and viability ensures these grasses are effective at invading virtually all soil types. IAGs can occur across a wide spectrum of elevations, slopes and aspects. Initial occurrence for cheatgrass is often associated with well drained south and west facing slopes. Given time, this expansion often permeates into the following community types: sagebrush-grassland, mountain shrubland, salt desert shrubland, and some riparian areas.

While cheatgrass is arguably the most impactful and widespread IAG at this time, ventenata and medusahead are less palatable and potentially more ecologically concerning. Self-sustaining populations of medusahead and ventenata were confirmed for the first time in Wyoming in 2016. These species currently occur in northeast Wyoming on less than 5% of the state's land area, but suitable habitat abounds statewide and overlaps with some of the best Greater Sage-Grouse habitat in the country (Figure 1).



## BACKGROUND

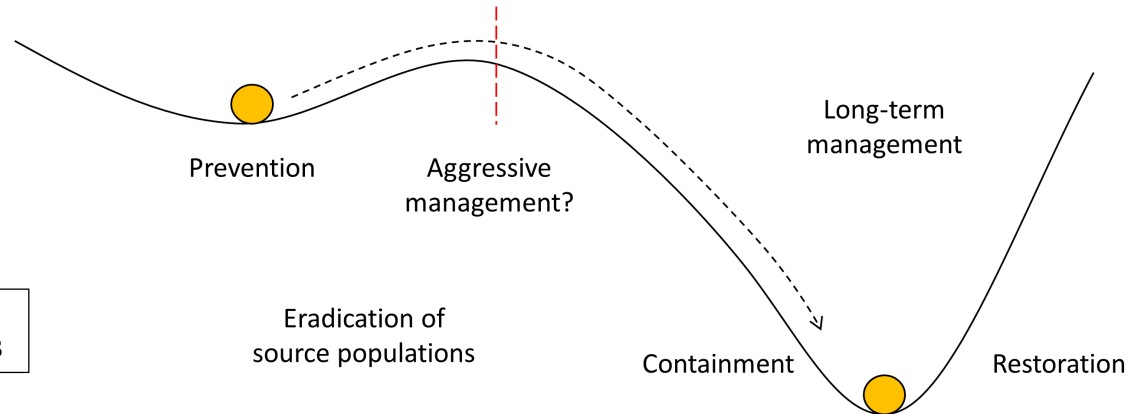


**Figure 1.** Medusahead and ventenata priority containment zones displayed with cheatgrass and annual brome occurrence points overlapping version 4 Greater Sage-Grouse core area. Species point data do not represent comprehensive distribution of each species.

Cheatgrass and other IAGs have converted large expanses of the Great Basin ecosystem including portions of Nevada, Utah and Idaho. Diverse sagebrush grasslands have converted to annual grass rangelands that experience frequent, large wildfires and provide poor quality wildlife habitat. The Department recognizes the need to move beyond controlling a single, problematic species. Addressing the problem at the later stages of infestation, Levels 4 or 5 (Figure 2), requires a long-term restoration program focused on restoring both functional and structural alterations caused by IAG dominance. In many places in Wyoming, there is still the ability to halt the invasion at lower stages of infestation, further justifying the need for proactive management. While parallels can be drawn between the Great Basin IAG rangelands and Wyoming's current IAG infestations, the difference lies in Wyoming's current recovery potential. The majority of our impacted rangelands still retain desirable perennial species that can recover when IAG prevalence is reduced.



Invasion State	Cheatgrass Free	Trace	Mild Infestation	Moderate Infestation	Cheatgrass Dominated
	There is no cheatgrass present on the site. Desirable Community is thriving; functional and structural groups are represented.	Cheatgrass is present (1-5% cover) but manageable. Desirable community is thriving; functional and structural groups are represented.	Cheatgrass is common (6-25%). Desirable community is still present and functioning.	Cheatgrass is approaching dominance (26-50%). Desirable community is impacted with some structural and functional groups missing.	Cheatgrass comprises a majority of the vegetation (51-100%). Desirable community is rare or non-existent.
Level*	Level 1	Level 2	Level 3	Level 4	Level 5



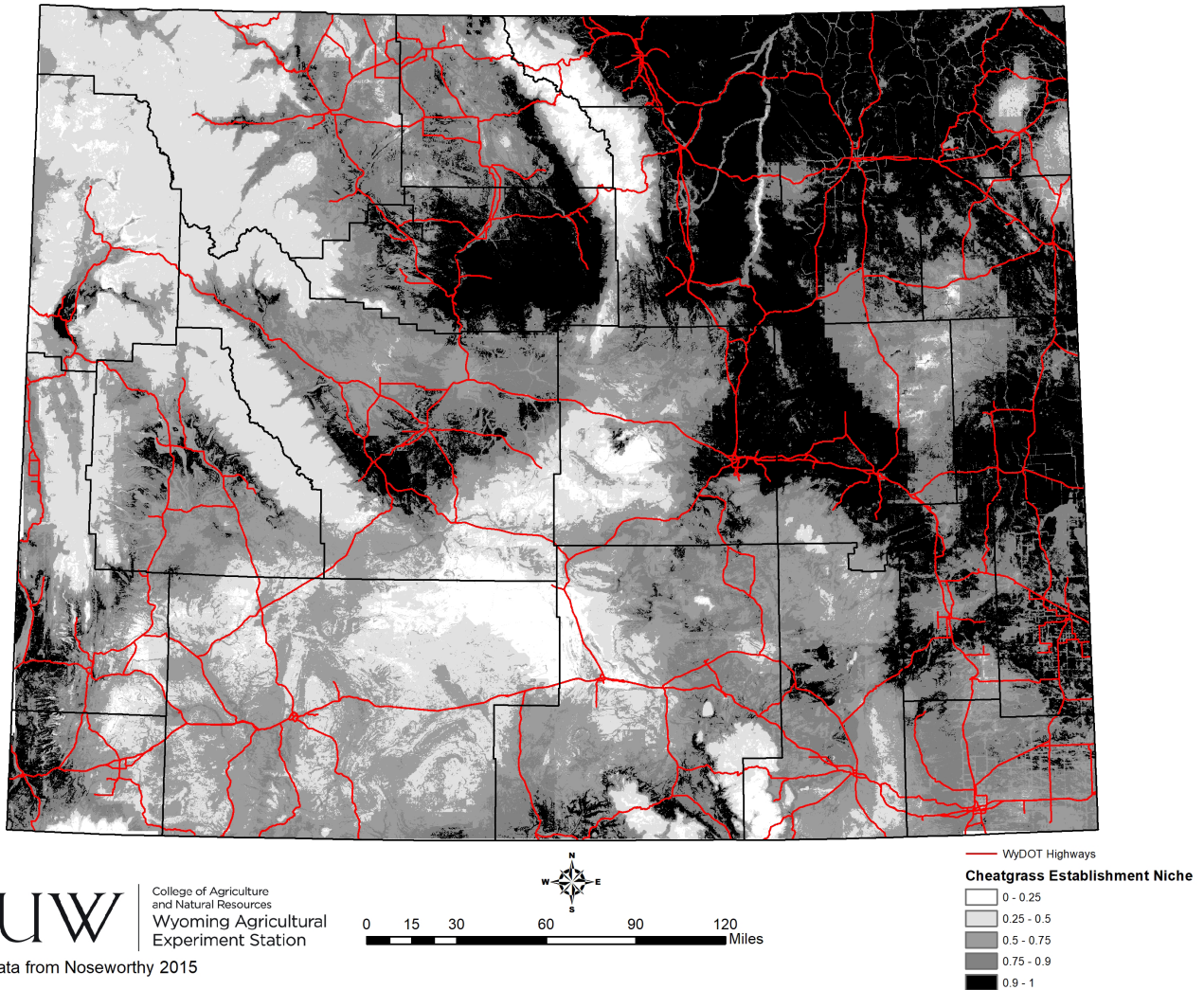
Adapted from Meador et al. 2013

**Figure 2.** Meador treatment prioritization matrix.

Previously, researchers hypothesized that Wyoming would be relatively immune to the severe impacts associated with IAGs. Experience, research and on-the-ground management over the past 20 years indicates otherwise. Much of Wyoming provides suitable habitat for IAGs.



## BACKGROUND



**Figure 3.** Cheatgrass probability of occurrence modeled for Wyoming.

One of the greatest concerns is the change in wildfire cycles as a result of IAG invasion. In some instances, fire frequency has increased from historic fires occurring every ~50+ years to fires now occurring every five years or less. Beyond increased frequency, wildfires have become more intense and fast moving, at least partially due to the proliferation of IAGs. Many shrub species, such as Wyoming big sagebrush (*Artemisia tridentata*), are not adapted to increased fire return intervals. Repeated disturbance, such as wildfires, combined with the aggressive nature of IAGs creates little opportunity for shrubs that require specific conditions for seedlings to establish. This cycle is perpetuated with repeated IAG-driven fueled wildfires and it becomes increasingly more difficult to return a site to its potential ecological state.





Sagebrush once covered nearly 250 million acres in western North America, but now occurs on approximately half of these original acres. In many places, the remaining sagebrush habitats are very different than they were historically. Fragmentation and IAGs are rapidly converting sagebrush into less desirable habitats. Wyoming has some of the most intact and functional sagebrush habitats remaining in the world. Efforts to retain sagebrush on the landscape, including efforts to reduce IAGs, will have far reaching positive implications for wildlife.

The west is divided into seven sage-grouse management zones covering portions of 13 western states. Wildfires occurring since 2000 have had a significant impact on all but the Wyoming Basin, covering the western and southern portions of Wyoming. This statistic is changing in the Wyoming Basin as IAGs continue to expand and associated wildfire activity increases.





## BACKGROUND

The consequences of IAG wildfires are far-reaching and have negative impacts on local economies, agricultural producers and the 350 wildlife species that occur in the sagebrush biome. Fire suppression activities alone costs the federal and state governments billions of dollars annually. IAG wildfire impacts often extend to long term impacts to watersheds, ecosystem function, property damage, and potentially human lives. As IAGs continue to expand, these losses will become more likely in Wyoming communities. Several factors contribute to the rising costs of combating wildfires. Longer periods of hot and dry conditions have contributed to a lengthening of the wildfire season. High suppression costs can be attributed to above average fine fuel loads, and the increasing number of resources necessary to protect homes, ranches, communities, livelihoods, and habitat.

The Department and partners have expended considerable resources over several decades to research and treat IAG infestations in Wyoming. This work has been conducted in the absence of a statewide strategic vision. Through this implementation plan, the Department seeks to unify partners and approaches to combat these invasive species.

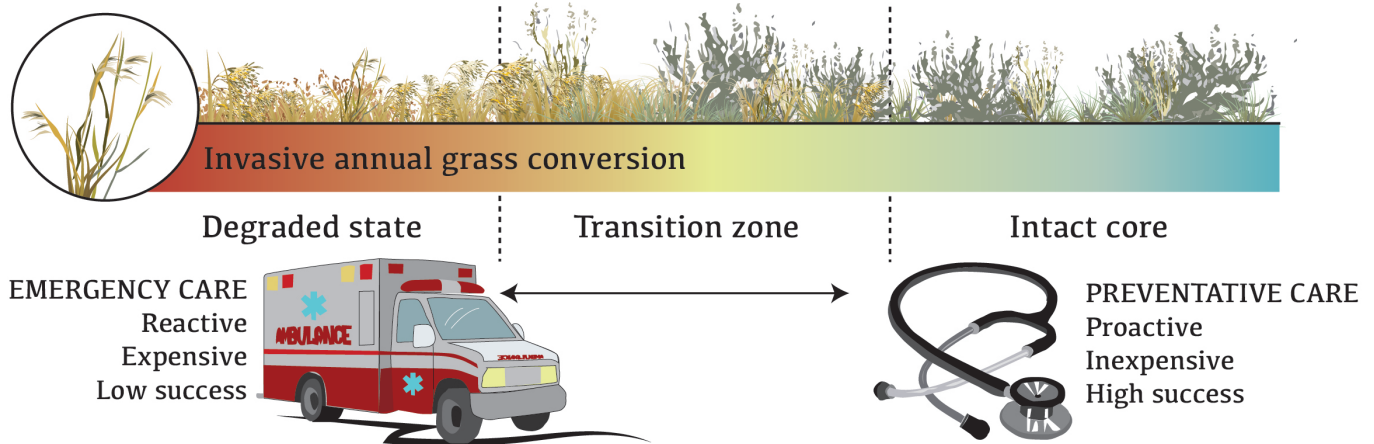


*(Photo by Savannah Monterro, Winnemucca, Nevada, District Fire Program)*



## PREVENTION AND ESTABLISHMENT

The Department acknowledges that prevention is more cost-effective than rehabilitation, and therefore, proposes to focus efforts on the prevention of IAG establishment in important habitats through a combination of education, public outreach and direct actions.



Credit: USDA-NRCS, Working Lands for Wildlife

## EDUCATION AND OUTREACH

Participation in IAG management can be challenging for the public, sportspeople, and land and wildlife managers due to the long-term commitment and slow process in which IAGs degrade habitat. A cohesive education and outreach component is integral to informing Department personnel and the public about the threat that IAGs pose for wildlife and their habitats.





## INTERNAL EDUCATION AND OUTREACH

The Department will take steps to ensure personnel are aware of the threat of IAGs and the negative impacts their presence has on Wyoming's diverse habitats. Play-Clean-Go strategies have been adopted by some Department personnel and have the potential to serve as a consistent platform for internal education. Across the state, field personnel are performing work that entails driving, walking, and hauling equipment through areas where IAGs are present. IAG seeds can easily become attached to vehicles, clothing and equipment, and if not properly cleaned, these seeds can be spread to other locations. Cleaning equipment and vehicles after field work can help reduce the spread of IAGs. Cleaning equipment after every field outing is difficult, but Department personnel can be strategic when gauging if a deep cleaning is required. Driving on highways, gravel roads, and two tracks with little vegetation pose a lower risk of picking up IAG seeds and a deep cleaning is probably not necessary. When driving, hiking, or moving equipment off road in places where heavy infestations of IAGs are known, a thorough deep cleaning of equipment and vehicles should occur. By taking the time to clean vehicles and equipment in these circumstances, the Department can help reduce the spread of IAGs from one location to another.





## EXTERNAL EDUCATION AND OUTREACH

The impacts of IAGs are far reaching and threaten all outdoor recreational activities including hunting. IAGs impact the overall carrying capacity of important habitats and, over time, reduce the number of animals available for harvest each year. The Department Communications Team will engage sportspersons in the fight against IAGs by raising awareness through on-line education tools and hands-on events centered on IAGs at external events such as EXPO. The Department will create visual aids to highlight portions of Wyoming and other states where IAGs have dominated the landscape to better showcase the importance of IAG infestation prevention.

The Department will evaluate using contract personnel and volunteers to assist at game check stations. At these check stations, if a hunter comes in with a dirty vehicle/ATV/UTV, the contract personnel or volunteers could offer to wash it with portable high pressure washers and engage about the threat of IAGs.

The Department will continue to incorporate general statements into comments in Wildlife Environmental Reviews (WER). WERs are used to convey information on potential wildlife impacts to project proponents. Any activity that engages in ground distur-



bance and brings in heavy equipment to a job site will include standard comments on cleaning of equipment before and after the project, monitoring project sites after completion for IAGs and development of a plan to treat infestations if they are found. Many project proponents include these activities as part of Best Management Practice plans, but ensuring that these comments are in all WERs will relay the importance of reducing the spread of IAGs. Due to the known presence of medusahead and ventenata, WERs for projects occurring in Sheridan, Johnson and Campbell Counties now contain this language and this approach can be expanded to other areas.



## INVASIVE ANNUAL GRASS PRIORITIZATION TOOL

In an attempt to help Department personnel prioritize IAG projects for funding, an Invasive Annual Grass Prioritization Tool has been developed by an Intra-Departmental Team. The Department combined science, technology and local knowledge to adaptively map the most important wildlife habitats in Wyoming (Figure 6). This tool will be used to prioritize IAG treatments and track success moving forward. This tool has five primary components that are scored and added together to obtain a final score of up to 140 points for each project (see Appendix A). The components within the tool include: Ecological impact (0-40 points), resistance and resilience (0-20 points), trend in distribution and abundance (0-20 points), coordination of treatments (0-20 points) and other considerations (0-40 points). The Department's Habitat Technical Advisory Group (HTAG) will utilize the tool to evaluate project applications for funding allocation yearly.





## ECOLOGICAL IMPACT

For this component, the Department has developed a heat map that uses overlapping habitat attributes to create a visual depiction of important habitats, as represented by Figure 6. In this model, the Department has incorporated the following habitat attributes: Mule Deer Initiative herds, sage-grouse core, connectivity habitats and winter concentration areas, designated and identified migration corridors, Commission owned Wildlife Habitat Management Areas (WHMA) and Public Access Areas (PAA), Statewide Habitat Plan (SHP) Enhancement Areas, crucial ranges for big game species and Species of Greatest Conservation Need (SGCN). The potential for up to eleven overlapping attributes exists. Treating IAGs in those areas with significant ecological impact ensures the Department and partners are managing the most important wildlife habitats throughout the state with the limited funding currently available.

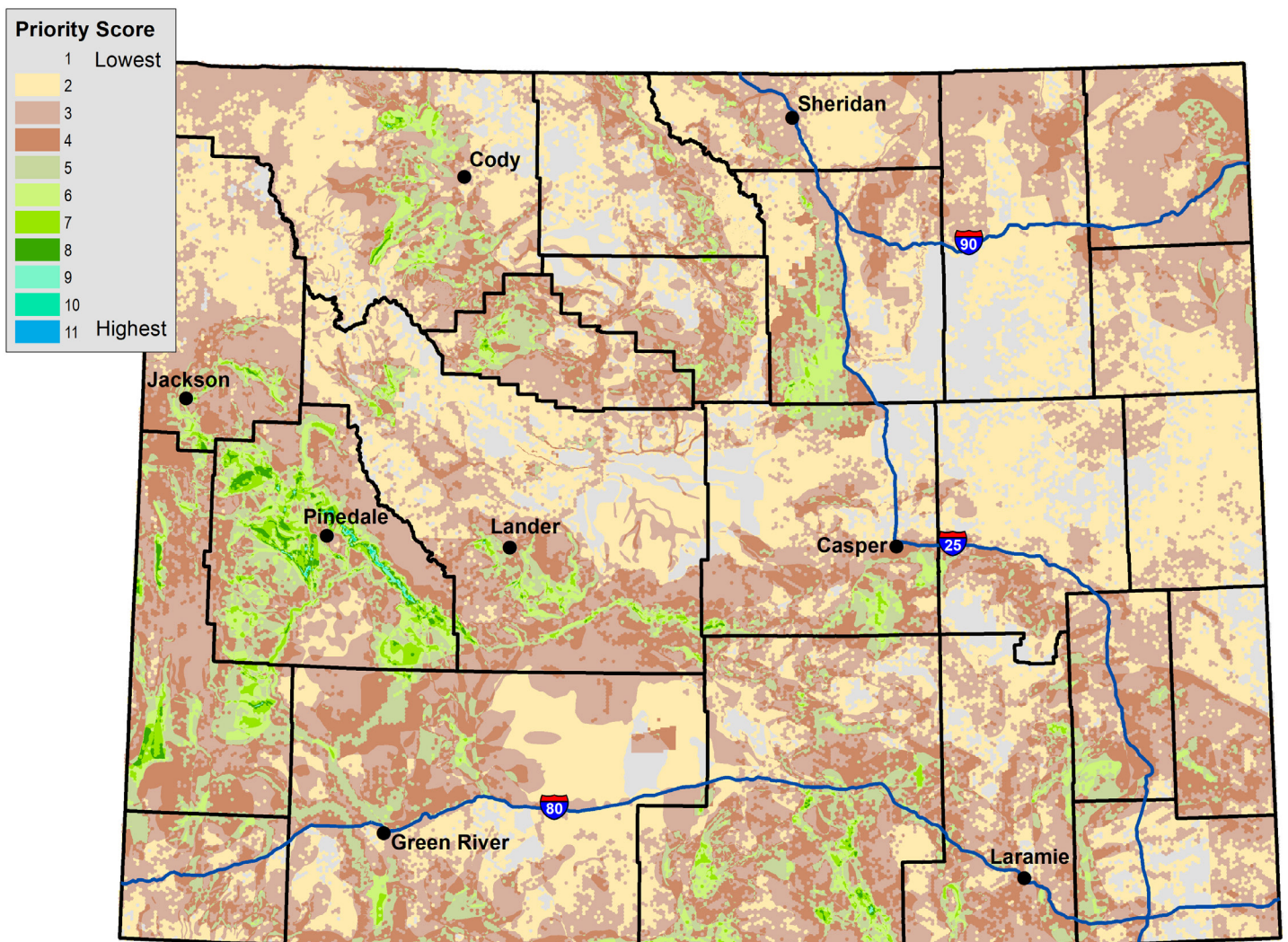


Figure 6. Interactive mapping tool used to inform Department management actions



## RESISTANCE AND RESILIENCE

The Department used information compiled by the Natural Resource Conservation Service (NRCS) led Sage-Grouse Initiative's Resistance and Resilience Tool to evaluate climate, soil type, aspect, elevation, and productivity to develop a Wyoming specific map (Figure 7). The concept of resilience refers to the capacity of an ecosystem to regain its fundamental structure, processes and functions when altered by stress and disturbance. Resilient ecosystems reorganize after stressors like drought and disturbances like wildfire without crossing a threshold to an alternative state with different structure and function. Resistance refers to the capacity of an ecosystem to retain its fundamental structure, processes, and functions (or remain largely unchanged) despite stressors, disturbances, or invasive species. Resistance to invasion is a function of the attributes of ecosystems that limit invading species. Treating IAGs in areas with high or medium resistance and resilience is the priority of the Department and ensures a higher likelihood of successful response to treatments.

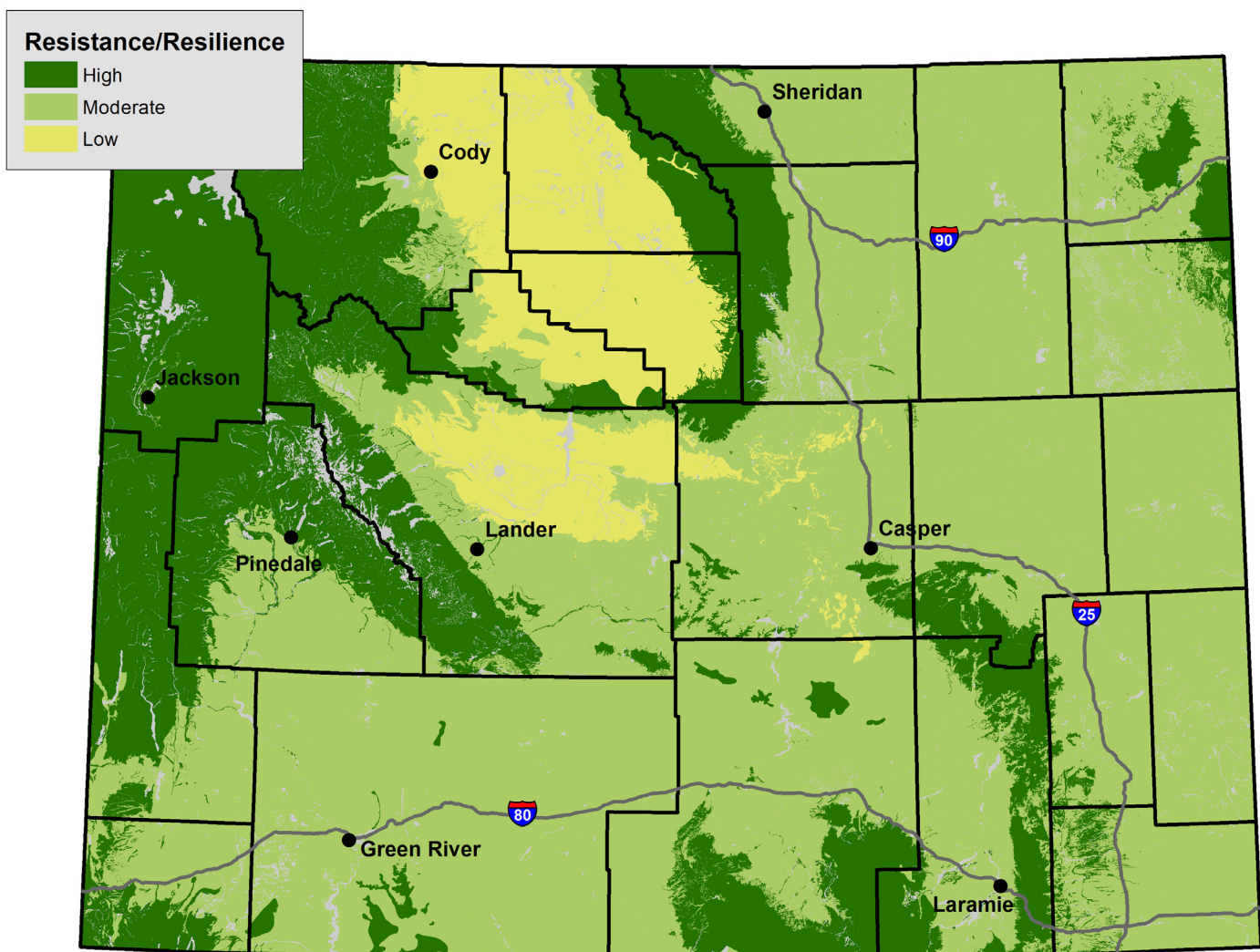


Figure 7. Resistance and Resilience values map for Wyoming





# INVASIVE ANNUAL GRASS PRIORITIZATION TOOL

## TREND IN DISTRIBUTION AND ABUNDANCE

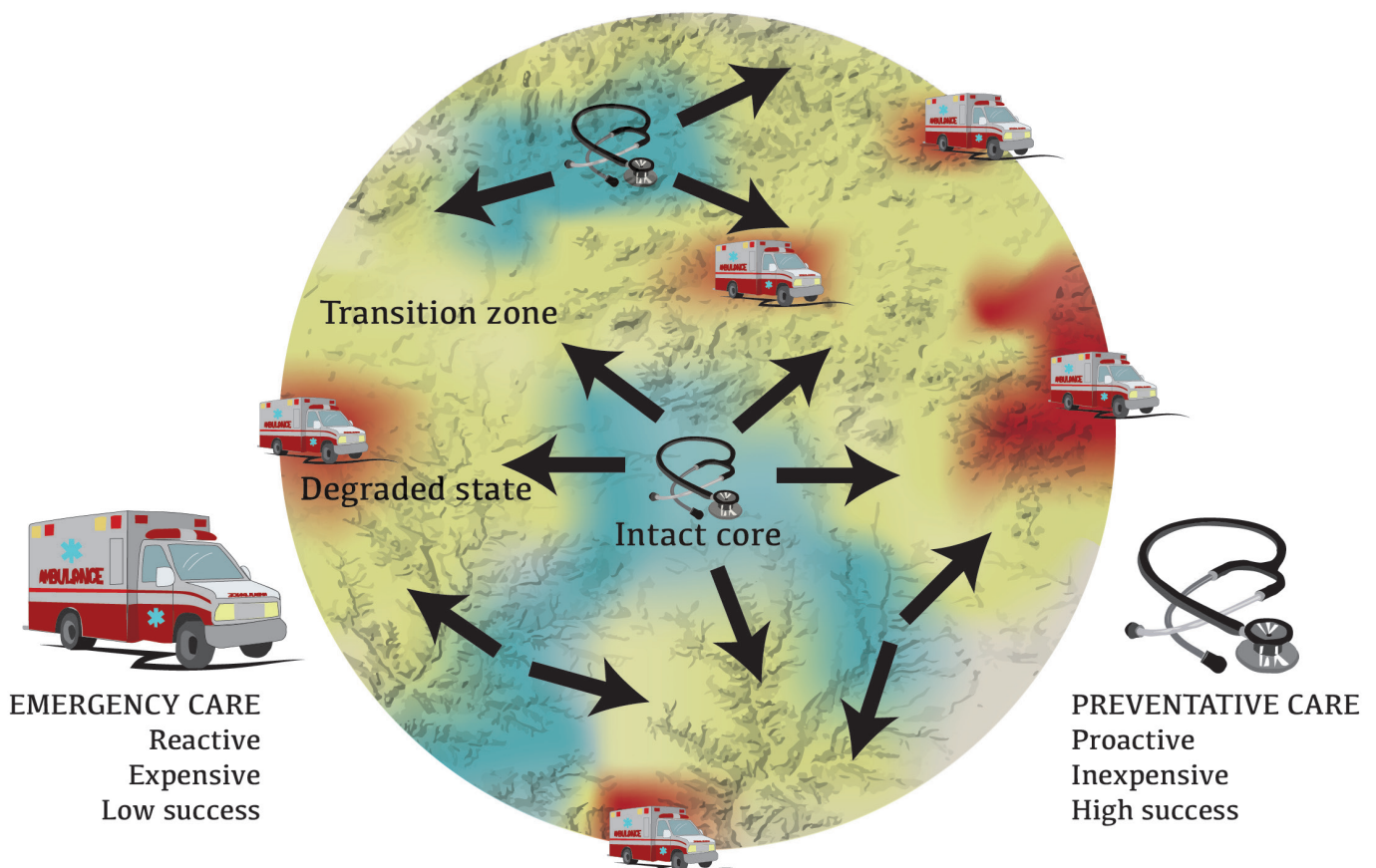
This component contains two sets of criteria that are evaluated for each proposed project. In the infestation establishment and size section, additional points are awarded to Early Detection and Rapid Response (EDRR) projects, vectors such as roads and trails and smaller sites (e. g. expansion areas, leading edge of infestation) that are easier to successfully manage. In the species composition within treatment area component, members of HTAG will compare characteristics of the infested site's habitat and ecological quality to similar communities (reference sites). Additional points are awarded to sites containing low to moderate amounts of IAGs or those projects that continue to prevent invasion.

## COORDINATION OF TREATMENTS

This component has two sets of criteria that are evaluated for each project. Under the ownership sub-component, projects intentionally working across landownership boundaries receive additional points. Under the proximity to other treatments sub-component, projects that are collaboratively developed receive additional points, as well as those that are located in close proximity to other treatments in order to prevent spread of IAG seeds across the landscape.

## OTHER CONSIDERATIONS

Under this component, points are awarded to projects containing unique or high priority circumstances, such as: Medusa-head or ventenata projects, re-treatments of a previous herbicide application, projects occurring on land managed by the Department, treatments to protect important sagebrush habitats threatened by IAGs, or other site specific considerations.





### MAPPING, ASSESSMENT AND MONITORING METHODS

Assessing important habitats at predetermined intervals using a combination of newer remote sensing techniques and ground based methods assists with determining the extent of the infestation, potential treatment areas and eventually assist with determining treatment efficacy.

Understanding the dynamics of IAGs including current distribution, potential for invasion and response to treatment, is necessary to effectively manage Wyoming's native rangelands. Prior to selecting a management prescription, a pre-treatment assessment should be conducted to identify the extent of invasion and to assess recovery potential. This step is crucial to guiding resources appropriately in the future. Multiple options are available for assessing habitats including remote sensing technologies, aerial surveys and on the ground techniques. For treatment planning at a regional level, the distribution and prevalence of invasive species should be assessed through aerial or remote sensing techniques combined with strategically placed ground-based surveys to more efficiently identify large treatment areas.

### GROUND BASED MONITORING APPROACH

A repeatable and consistent monitoring program must be conducted over time to determine if the plant communities are trending in a desirable direction. Effective monitoring will inform adaptive management strategies. The time and effort required to conduct monitoring can vary greatly from photo points to more labor intensive techniques. It is important to consider and utilize monitoring methods that do not exceed the Department's capacity to perform. Line-point intercept (LPI) is the preferred on-the-ground method used to quantify vegetative canopy cover and bare ground. The LPI method captures yearly fluctuations and helps inform re-treatment needs. Monitoring protocols should be established jointly with affected land managers and agencies within the region. This approach creates buy in, assists with adaptive management strategy development and lightens the monitoring burden for any one entity or agency.





### USE OF SCIENCE AND TECHNOLOGY - REMOTE SENSING APPROACH

A variety of techniques exist to remotely detect and map IAGs. The success of these techniques relies on fine scale and high quality imagery and the ability to process this data into a useable format. Many of these techniques require field monitoring and ground truth methods to ensure the processing software is correctly interpreting the imagery. This process will be further defined as the results of several concurrent efforts to map and assess habitats in Wyoming and throughout the west become available. Processing this data into a useable format for adaptive management will require additional funding.

#### **LIDAR**

Lidar (light detection and ranging) used in combination with color infra-red (CIR) imagery has the potential to produce data to map cheatgrass infestations. Making use of this cutting edge technology at a statewide scale would involve a significant financial investment, but could produce a wide variety of benefits. Not only would the Department gain from knowing the true extent of the problem, it would also gain efficiencies from targeted treatments, identifying areas of widespread infestations and mapping areas of smaller infestations. Collecting this data could benefit the Department with other efforts including aquatic habitat delineation, fine-scale vegetation mapping and enhanced engineering designs. The data would also support other state and federal agencies and their missions, producing wide ranging benefits.



## TREATMENTS AND COST

Following initial mapping, remote sensing technology could be used for change detection as a means of tracking the progress and control of IAGs within treatment areas.



## TREATMENTS AND COSTS

### HERBICIDES

Several herbicides have been developed that are used for IAG control, either alone or in tandem with one or more herbicides in tank mixes. The newest and most effective herbicide is indaziflam (Esplanade® or Rejuvra®). Indaziflam is a cellulose biosynthesis inhibiting herbicide that prevents primarily root growth. Indaziflam is effective in controlling IAGs through the inhibition of germination. Indaziflam appears to have little to no impact on established perennial rangeland plant species. Indaziflam inhibits the germination of all rangeland plant species, but the impact is low to the long term health of the rangeland. Many perennial plant seeds exhibit a long life, and most perennial grass production is carried out through tillering rather than seed germination. Residual control of indaziflam appears to be longer than previously used herbicides, exhibiting control for two to three growing seasons following application. There have been reports of extended control for up to four years.



## TREATMENTS AND COST

Indaziflam should be applied as a pre-emergent any time before IAGs germinate, which typically occurs during the fall, though application of this herbicide can occur as early as June. In August 2020, Bayer, the company that manufactures indaziflam, was notified that Rejuvra® had completed the necessary requirements for EPA approval of a rangeland label, which allows the product to be applied on rangelands grazed by livestock. Typically, the recommended rate for indaziflam is 5 oz per acre. Costs for indaziflam range from \$40 to \$47 per acre.

Historically, the Department used imazapic (Plateau® or Panoramic®) for IAG treatments. Imazapic is a selective herbicide for both the pre- and post-emergent control of some annual and perennial grasses and some broadleaf weeds (i.e. leafy spurge, Dalmatian toadflax). Imazapic kills plants by inhibiting the production of branched chain amino acids, which are necessary for protein synthesis and cell growth. It is relatively selective when used at low rates (<9 oz/acre), resulting in effective control of IAGs while minimizing damage to desirable native perennial forbs, grasses and shrubs. Tolerance of desirable non-target species to imazapic herbicide may be reduced when plants are stressed due to insect damage, disease, environmental conditions, shade, poorly drained soils or other causes.

Imazapic is most effective when applied as a pre-emergent in late summer or early fall. For efficacy, the herbicide must be in contact with the soil profile where it will inhibit plant growth and ultimately kill IAG sprouts in the early stages of germination. Adequate soil moisture is important for optimum herbicide activity. When adequate soil moisture is present, it will provide residual control of susceptible germinating IAGs. Imazapic typically exhibits one to two years of growing season control depending on soil type and other environmental factors. After one year, herbicide residual control diminishes, allowing for variable cheatgrass germination to occur depending on climatic conditions. Imazapic can also be applied post-emergence typically in late fall. The Department's experience with post-emergence treatment has shown post-emergence herbicide treatments to be inadequate to obtain desirable cheatgrass control. To improve post-emergence control, light rates of glyphosate herbicide may be added to tank mixes to control recently germinated cheatgrass. There may be risk of injury to native perennial vegetation when glyphosate is added, so caution must be used.

Imazapic herbicide rates typically range from 2 oz to 8 oz per acre. Lighter rates are recommended when non-target plant tolerance is suspected to be low, such as immediately following a wildfire or treatment following a seeding. Heavier rates are used in rangelands with a healthy establishment of native perennial vegetation. Based on information from recent cheatgrass control efforts conducted by the Department, 6 oz to 8 oz per acre appears to be the preferred rate. Typical costs of imazapic range from \$7 to \$11 per acre.

Surfactants are common with many herbicide treatments. Surfactants are chemicals that reduce the surface tension of water increasing the ability of the herbicide to attach to the plant surface. Because both herbicides need to reach the soil profile to be active, surfactants are often unnecessary unless conducting a post-emergent imazapic treatment, in which surfactants can increase foliar kill of germinated cheatgrass. Surfactants have been observed to cause injury to non-target plants such as chokecherry and bitterbrush. If conducting pre-emergent IAG herbicide treatments, surfactants should not be included in the herbicide mix.



## TREATMENTS AND COST

### APPLICATION

Although there are various ways to apply these herbicides, most landscape level IAG herbicide treatments involve treatments via fixed wing aircraft or helicopter. Fixed wing aerial herbicide treatments are less costly than helicopter application, but there are limitations with fixed wing herbicide applications. Fixed wing herbicide applications are limited to gentle rolling terrain. Treatment areas must be located within a certain distance of airports to be cost effective, due to the limited places fixed wing aircrafts can land. Herbicide drift can also be a bigger issue with fixed wing herbicide applications as the aircraft is required to fly a certain distance above ground. Aerial IAG herbicide application is typically done via helicopter. Helicopters are able to apply herbicide in a variety of different terrain. Most helicopter spraying services are set up to refuel the helicopter and replenish the herbicide tank via truck, allowing for IAG treatment in a variety of remote locations. Herbicide drift is also less of an issue due to the ability of the helicopter to fly lower to the ground and the downdraft created from the helicopter blades. Wind speeds over ten miles per hour often inhibits aerial application of herbicides. Depending on time and location of treatment, this may result in a significant barrier to completing treatments in a timely and efficient manner.

A cost factor associated with aerial herbicide application is the rate of water, known as the deposition agent, mixed with the herbicide. As the amount of water mixed with the herbicide increases, the cost of the application typically increases due to increased costs associated with fuel and time. Increases in water per acre results in fewer acres treated per flight. The standard deposition agent rate is 4 gallons of water per acre (GPA). As herbaceous plant material increases on a rangeland, an increase in GPA is recommended. Both indaziflam and imazapic must reach the soil to be effective for IAG control. Increases in herbaceous plant material, current annual growth or litter result in a greater chance that the herbaceous plant material will intercept the herbicide, thus limiting the amount of herbicide reaching the soil. Increasing the GPA allows the herbicide to better infiltrate the herbaceous canopy layer. A lower GPA can be used effectively in rangelands with low productivity or immediately following a wildfire, but as herbaceous canopy cover increases, a higher GPA of five to seven gallons of water is recommended. Costs for aerial application can vary widely depending on location. Typically, fixed wing application rates are between \$7 and \$16 per acre. Helicopter application rates range from \$12 to \$35 per acre.





### **FACTORS IN TREATMENT SUCCESS**

Depending on the location of a project, herbaceous canopy cover and litter can be a detriment to successful IAG herbicide treatment due to herbicide interception. If possible, removing herbaceous canopy and litter cover before treatment can increase the ability of the herbicide to infiltrate the residual plant canopy cover and litter, allowing the herbicide to reach the soil. If treating IAGs on grazed rangeland, allowing the livestock producer to graze the project area heavily before treatment can increase herbicide effectiveness. Grazing may need to occur during the early growing season to capitalize on the palatability of the annual grasses. Prescribed burning with herbicide treatment following immediately after is another option to reduce litter and herbaceous canopy cover on some sites. Burning can remove current litter and existing plant canopy cover. Depending on the temperature of the fire, prescribed burning can kill IAG seeds present on the soil surface, reducing the amount of IAG that germinate following the fire. Caution should be used with herbicide applied immediately post-fire as ash from the fire may bind the active ingredients, resulting in limited control. After at least one moisture event, the ash should be well incorporated into the soil or swept away by wind and control will again be possible. Following IAG herbicide treatments, the Department recommends deferment of grazing for two growing seasons (April through July). This allows perennial plants to recover from any negative effects from the herbicide, increase root growth and seed dissemination into barren soils. Although growing season deferment is recommended, site conditions and the collective knowledge of local managers greatly influences final decisions and additional research on this topic is needed. Weather conditions before and after herbicide treatments can play a large role in success. If weather conditions before treatment are optimal for IAG germination, it is best to either delay the treatment until the next year or proceed with the addition of surfactant or additional herbicides (glyphosate). Imazapic and indaziflam are dependent upon soil moisture to activate, and precipitation following herbicide treatment can increase the success of the herbicide application. If there is an extended lack of precipitation following a herbicide application, herbicide degradation may occur. Conversely, if immediately following a herbicide treatment a large precipitation event occurs, herbicide may be washed away with runoff, reducing its effectiveness. Although it is difficult to anticipate precipitation patterns following treatments, understanding these factors can help frame success of treatments.



## RE-APPLICATIONS



## RE-APPLICATIONS

Ensuring that treated areas receive subsequent follow-up treatments to eliminate the soil seed bank associated with IAGs is important. The key to long-term successful IAG management is follow-up treatments. One herbicide application will rarely keep IAGs from establishing in a project area long-term, unless the establishment of the IAG was recent, isolated from other IAG populations and the risk of introduction from outside sources is low. Managers should set management goals based on tolerable levels of IAGs, monitor project areas following herbicide treatments and re-treat when a “trigger point” or threshold is reached prompting another herbicide treatment. Ideally, after multiple treatments, IAG density should be reduced and conditions that result in a large germination of IAGs should become smaller and smaller.

The cycle of treatment, monitoring, and re-treatment may take many years, depending on the duration and density of the IAG infestation. Cheatgrass seed has a life expectancy of up to eleven years, medusahead and ventenata seed has a life expectancy of three to five years. A project area may need to be re-treated in two to five years, depending on weather conditions, herbicides used, and response from native perennial plant communities. Monitoring IAG density in project areas is necessary to ensure long-term success and control of IAGs.





### PARTNERS AND FUNDING

Invasive annual grass control requires significant financial, logistical and technical resources. Control efforts generally involve multiple partners, each contributing resources according to their capacity to ensure that adequate funding and the best available science combine to affect change. The most essential partner to a successful project will be the landowner or land manager. Control efforts should not be undertaken without a landowner or land manager that is committed to the project for the long-term, which includes the willingness to adjust land management practices and have a commitment to follow-up treatments if necessary.



Project proponents should take advantage of various entities that can provide logistical and technical assistance so the best available science is used and the contributions from all partners are fully utilized. Each of these partners may have a unique role in the planning, soliciting of funds, implementation, landowner relationships and monitoring of IAG control projects. Local weed and pest and conservation districts have experience working with multiple partners in weed management efforts and can provide valuable logistical and technical support for coordinating the various contributions and interests of all the partners. In some cases, they may have established or may be willing to establish Cooperative Weed



## PARTNERS AND FUNDING

Management Areas (CWMAs) or similar collaborative groups to facilitate the cooperation and coordination of partners. The University of Wyoming Extension is an invaluable source of the latest and best science on control and monitoring methods. There are often opportunities for the Department to partner with the University of Wyoming to integrate research into the control project in a way that benefits both parties. Herbicide companies have technical resources, including local representatives that can offer technical assistance tailored to the particular project site and circumstances. Other entities that may provide logistical or technical support are the NRCS, Agricultural Research Service, United States Geological Survey, Department of Agriculture, Department of Interior, local weed and pest and conservation districts, county governments, industry and private consulting companies, and various educational institutions in and outside of Wyoming.



*A pasture containing ventenata in Sheridan County, Wyoming.*



## CONCLUSION

Cheatgrass, ventenata, and medusahead will continue to invade precious native rangelands and important wildlife habitats unless immediate action is taken. This document outlines the steps necessary to begin reversing these trends within Wyoming's most important habitats. By focusing on preventing IAGs from establishing, utilizing the latest science and technology to make informed management decisions, and working collaboratively with our partners, the Department will strategically and proactively reduce these threats to Wyoming's natural resources.





Wyoming Game and Fish Department

Invasive Annual Grass Prioritization Score Sheet

Project Title:

Date:

Applicant:

Total Project Cost:

Funding Request:

<b>1. Ecological Impact</b>			
Mapped Habitat Value:	0- 40		
	Score		
<b>2. Resilience and Resistance</b>			
Mapped R&R Level:			
High.....	20		
Medium.....	10		
Low.....	5		
	Score		
<b>3. Trend Distribution and Abundance</b>			
Infestation Establishment and Size:			
New Isolated Infestation, EDRR (Early Detection Rapid Response) or vectors like roads/trails .....	10		
Leading Edge of Infestation (<20% of landscape) or projects preventing spread into adjacent uninfested areas.....	8		
Stable, Long-Term Established Infestation.....	3		
	Score		
Species Composition Within Treatment Area:			
Invasive Annual Grass (IAG) presence unknown or present at very low levels.....	10		
Potential: Recent (<2 years) disturbance/wildfire with potential for new IAG invasion .....	9		
Minor Component: IAG <10% of canopy cover with natural hydrologic function still intact.....	9		
Roadside: Roads or other right-of-ways serving as vectors through generally uninfested areas .....	8		
Co-Dominant: IAG is co-dominant with intact native species .....	5		
Degraded Condition: IAG dominates current vegetation .....	2		
	Score		
<b>4. Coordination of Treatments</b>			
Ownership:			
Treatment includes multiple landowners with good working relationship or infestation only occurs on single ownership.....	10		
Treatment includes multiple landowners, but not all landowners with this IAG infestation are treating through a coordinated plan .....	5		
IAG infestation is known to occur across land ownership boundaries but project is limited to one landowner.....	1		
	Score		
Proximity to Other Treatments:			
Treatment(s) within 1 mile of previous/concurrent project which minimizes seed spread into the current project or EDRR.....	10		
Treatment(s) pre- or post- vegetation management project (i.e., RX burn or Juniper thinning) or wildfire .....	9		
Treatment(s) > 1 mile of another project and includes pooled funding resources/partnerships .....	6		
Treatment(s) not near other treatments, without pooled funding resources/partnerships.....	1		
	Score		
<b>5. Other Considerations</b> Add points for each condition (except cannot receive both Medusahead and Ventenata points)			
Medusahead Project.....	40		
Ventenata Project.....	20		
Re-treatment Projects (any portion of the project) .....	15		
Commission Managed Land or Land within Management Nexus (i.e., WHMA, PAA, WIA, HMA, CE) .....	10		
IAG threatens remaining sagebrush habitats on crucial ranges or Greater sage grouse Core Areas where significant sagebrush has been lost due to wildfire.....	5		
	Score		
Monitoring Plan with Quantified Objectives and Methods in place (check one)	Yes	No	
Describe any unique considerations to assist with project evaluation (rarely necessary):			
<b>6. Total Score</b>			



The **2021 WGFD Strategic Plan, Invasive Annual Grass Implementation Plan** provides background information and rationale supporting this score sheet. This score sheet will be used by WGFD as a tool to strategically prioritize projects where Commission funds are spent on invasive species management treatments. The objective of this effort is to prioritize projects which will prevent the expansion of invasive annual grasses, treat infestations that are likely to be successful, leverage partnerships to improve effectiveness and prioritize funding to the most important wildlife habitats. Other funding sources with different objectives may evaluate projects differently than this tool to better suit their needs. The expectation is for projects to leverage matching funds to increase the effect of the Commission investment. Annual emergency situations will emerge and flexibility will be granted within project areas or at the statewide level to shift funds into these areas (i.e., wildfires, etc). Monitoring of treatments is a requirement to obtain funding. Monitoring Plans should include quantified objectives to inform when retreatment is necessary, and be repeatable before and after treatments.

Project polygons will be submitted in order for a score to be generated for Ecological Impact and Resistance and Resilience utilizing GIS. Polygons should be drawn as close as possible to reflect actual treatment areas in order to prevent untreated areas within the polygon to adjust the scores of these two categories. It is expected in most cases to have multiple polygons submitted together as one project for this evaluation. However, there will still be opportunity to have contractors make decisions in the air about the details of treatments within these polygons.

**1. Ecological Impact:** This analysis is the backbone of the score sheet. Projects will be scored based on overlap with high value wildlife habitats. High value wildlife habitats used in the “heat map” include; Crucial Winter Range (Mule Deer, Pronghorn, Elk, Moose, BH Sheep, Mountain Goat, Whitetail Deer), Big Game Designated and Identified Migration Corridors, MDI Herds, Sage Grouse Core, Connectivity, and Winter Concentration area(s), WHMAs, PAAs, Bird and Mammal SGCN, and SHP Enhancement Priority Areas. A score of 40 represents the highest potential ecological impact score. Individual project scores will be auto generated through a GIS application. The highest score generated anywhere within a project polygon will be the ecological impact score assigned to the project.

**2. Resistance and Resilience:** This criterion is used to determine the potential success of a project based on the mapped Resistance and Resilience layers (Chambers et al. 2016) which consist of High, Medium and Low areas. Treatments with a higher R&R score hypothetically have a higher likelihood of long-term success post-treatment. This value will be generated through a GIS application and will use the highest score from anywhere within the polygon to represent the entire project.

### **3. Trend in distribution and abundance:**

**Infestation Establishment and Size:** More points are awarded to Early Detection Rapid Response (EDRR) projects, vectors such as roads and trails as well as smaller sites (e. g. expansion areas, leading edge of infestation) that are comparatively easy to successfully manage. All species can be eligible for EDRR conditions and Ventenata projects should not all automatically be considered EDRR. Location and proximity to other known infestations should be taken into consideration. This consideration needs to be reserved for those areas that are truly new isolated infestations that need to be stopped in order to prevent a larger effort in the future. Leading edge is evaluated by considering how much of the larger landscape is invaded with the IAG. This could be considered on a drainage or watershed level, and needs to be done across all land ownership boundaries. Projects that have great potential to expand into large uninvaded landscapes need to be prioritized.

**Species Composition Within Treatment Area:** This criterion requires users to compare characteristics of an infested site’s habitat and ecological quality to similar (reference) communities. In project areas with variable infestation levels, this evaluation should represent the most typical infestation conditions. More points are awarded to sites with Level 1-3 Invasion State (Mealor et al. 2013) or those projects which continue to prevent invasion. Recent disturbances (within the last two years) on sites suitable for invasion from AIGs are considered important high priority treatments in order to prevent AIG expansion into additional areas. Roadside situations that serve as a vector to bring IAGs into areas that generally lack infestation should be prioritized even though hydrology and species composition is not necessarily typical of native rangeland or grassland landscapes. Sites which can support sagebrush should not be scored above the Co-

dominant level if sagebrush has been removed from the site. Projects with a Minor component should still have natural hydrologic function in place, based on site potential.

**4. Coordination of Treatments:** The intent is for projects to intentionally work across land ownership boundaries. However, those projects where the IAG only occurs on one landowner should not be penalized. An established working relationship may include previous collaboration on a management project, agreement to coordinate timing of treatments across boundaries, or landowner coordination of livestock management post-treatment. Projects that are implemented in close proximity to each other should prevent the spread of seeds into treatment areas, thus protecting the investment already made. If there are extenuating circumstances including smaller pilot projects in a new area, these components can be discussed in the Unique Considerations narrative.

**5. Other Considerations:** This criterion provides an opportunity for projects to generate additional points based on important site specific attributes not covered above. Projects containing both Medusahead and Ventenata should only be awarded points for one species. Re-treatments are project areas which have been previously treated with herbicide, and this proposal would prevent re-infestation on land where investments have already been made. Additional points for Commission managed lands (i.e., WHMA, PAAs) are intended to ensure investments into these properties, purchased for the benefit of wildlife, are prioritized for treatment. Lands where we have some influence over management (i.e., WIAs, HMAs, or WGFC-held Conservation Easements) will also be granted the same amount of additional points. Areas in north central or north east Wyoming where significant sagebrush has been lost due to wildfire will be given additional points to protect crucial ranges or sage-grouse habitat.

**Other Application Materials:** A complete application will include this Prioritization Score Sheet and additional materials entered into the web-based application tool. These additional required components of an application include a narrative, total project cost, funding request, list of funding partners and amount of contribution from each, actual treatment acres, project type (implementation, mapping/monitoring, research or other), chemical (imazapic, indaziflam, rimsulfuron, combination or other), monitoring plan, and any supporting materials such as maps or photos.

# INVASIVE ANNUAL GRASS IMPLEMENTATION PLAN

