UNIVERSITY OF WYOMING | IMAGINE

Institute for Managing Annual Grasses Invading Natural Ecosystems

2024 Annual Report

Dear friends,

It still seems ironic to me that a group of plants with puny root systems, short lives, and largely inconspicuous physical stature can wreak such havoc on natural rangeland ecosystems, but such is the case. We have continued to learn much, as a team and a large scientific community, about the ecology and management of invasive annual grasses in recent years. Some estimates indicate that the pace of spread is increasing and that the invasion is occurring even in the absence of wildfire. We may be losing over a million acres of high-quality sagebrush grasslands annually largely to impacts associated with invasive annual grasses. Through strategic partnerships, IMAGINE has grown to meet this challenge in several ways over the past year.

We continue to provide scientific support for land managers in Wyoming through the invasive grasses monitoring network by collecting vegetation data at thousands of locations across Wyoming, then analyzing, interpreting, and using those data to develop a diverse set of tools that improve our ability to manage from an informed perspective. Our research team builds upon this backbone of spatial data by developing, evaluating, and refining products such as annual grass distribution and severity maps derived from satellite imagery to treatment-response evaluations to better understand relationships between annual grass abundance, management efforts, and site-specific variables. As they continue to develop, we further see the benefits of these 'smart data' systems. As you read further you will see more details related to how these efforts directly aided in post-fire decision making in the historic wildfire year of 2024.

We've spent a lot of time hiking, counting, estimating, measuring, spraying, and doing the things that must be done to answer rangeland questions, and we have increased our commitment to sharing what we learn with our stakeholders in Wyoming and the western U.S. Our broad-reaching Invasive Annual Grasses Tech Transfer Partnership aims to empower land managers with information and support so they can plan and implement landscape-scale invasive annual grass projects with confidence. These efforts have been very rewarding and enlightening as we have engaged with land managers from many states to roll up our sleeves and develop strategies to reduce the impacts of invasive grasses in important habitats. Watch for more from this partnership in years to come as we develop new programs and projects specifically focused on conserving and enhancing western rangelands.
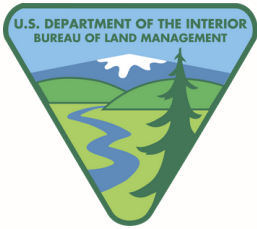
Finally, I want to recognize the amazing group of IMAGINE team members, partners, and funding supporters. We are a group of problem solvers by nature and commit to a lot of projects to work with partners to answer questions that matter. Our team of scientists, graduate students, and educators continues to grow to keep up with the need for information and support. We are largely funded through grants and gifts, and we sincerely appreciate the support we receive to do the good work we seek to accomplish.

Grace and peace,

Brian A. Mealor
Director – Institute for Managing Annual Grasses Invading Natural Ecosystems

PARTNERS AND COLLABORATORS

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invasivegrasses.com

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OUR MISSION

IMAGINE uses coproduced science, outreach, and education programs to develop, implement, evaluate, and adjust statewide and regional strategies for mitigating impacts of invasive annual grasses in rangelands while empowering informed decision making by landowners and managers. Our goals are to:

- Preserve iconic landscapes of the American West from transformation by invasive annual grasses
- Strengthen Wyoming's communities and agricultural economy by restoring or enhancing diverse and healthy rangeland vegetation
- Protect some of the most intact, high-functioning wildlife habitat within the western U.S.
- Enhance cooperation among state, federal, and local partners to develop and implement an effective state-wide invasive annual grass strategy
- Cultivate critical thinking and hands-on experience in the next generation of outstanding rangeland stewards and weed managers
- Change the narrative around invasive annual grasses by demonstrating that long-term, landscape-scale management is possible
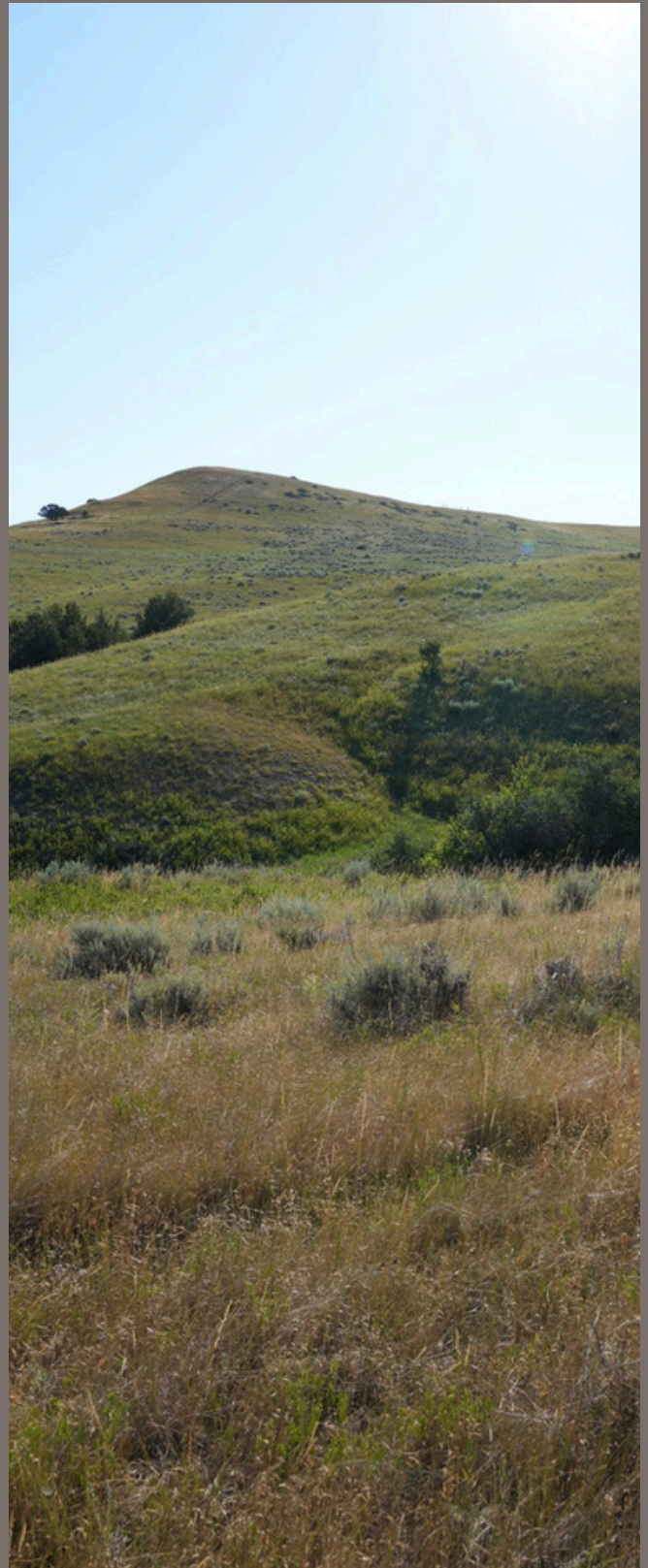
OUR TEAM

BRIAN MEALOR
Director of IMAGINE and Professor at UW Plant Sciences

Brian is the director of the Institute for Managing Annual Grasses Invading Natural Ecosystems and is a professor at the University of Wyoming. He has been working with various stakeholders and land managers to help reduce the spread of invasive annual grasses throughout the greater west.

JAYCIE ARNDT
Coordinator and Assistant Research Scientist

Jaycie is the coordinator for IMAGINE and NEWIGWG (Northeast Wyoming Invasive Grasses Working Group). Jaycie conducts rangeland and weed science research, develops educational materials, organizes the IMAGINE Monitoring Network, and facilitates annual grass workshops throughout Wyoming.

BETH FOWERS
Assistant Research Scientist

Beth manages the ShREC greenhouse to ensure research, educational, and infrastructure objectives are met. She provides research support to other principal investigators undertaking research at ShREC, including assisting with data collection, experimental installation, etc. Communicate updates on status of projects during their management, such as presenting at conferences or written publications, and facilitate educational programs with other partners.

OUR TEAM

MORGAN FROST
IMAGINE Postdoctoral Research Associate

Morgan is a plant community ecologist interested in the consequences of invasion for grassland ecosystems, especially under global climate change. Morgan is compiling and analyzing monitoring data associated with invasive grass species across the Northern Great Plains. She is working collaboratively with IMAGINE and Wyoming Natural Diversity Database (WYNDD) to both curate data and update existing models to better understand invasive grass management in this region.

CHLOE MATTILIO
IMAGINE Postdoctoral Research Associate

Chloe is developing maps of predicted invasive annual grass presence at landscape scales with partners across Wyoming. Using IMAGINE monitoring network observations to train frequently collected satellite imagery, she aims to capture the spectral signature of invasive annual grasses for accurate detection.

CLAIRE VISCONTI
Outreach Program Coordinator and Assistant Research Scientist

Claire is the outreach program coordinator of the Invasive Annual Grasses Tech Transfer Partnership (IAG TTP) and assistant research scientist. She helps to plan and implement invasive grasses workshops throughout the western US. She also collaborates with project partners to produce educational materials for land managers.

OUR TEAM

NANCY WEBB
Wind River/ Bighorn Basin District Invasive Annual Grass Coordinator

Nancy is the Invasive Annual Grass Coordinator for the Wind River/ Bighorn Basin District. Nancy works directly with the BLM District fuels team and other federal, state, and local partners. Nancy develops and implements strategic invasive annual grass programs throughout the region. She also provides monitoring support and coordination for land management.

PETER COLE
Masters Student and Monitoring Crew Lead

Peter is a masters student in the Plant Sciences department. His research focuses on the relationship between post-treatment recovery and grazing to determine whether deferment is necessary in the Big Horn Basin.

CASSIE HENGEL
Masters Student

Cassie is a masters student in the Plant Sciences department. Her research focuses on pre-treatment grazing to improve conditions for effective invasive annual grass management.

IMAGINE BY THE NUMBERS

|		
2,500 People Directly Engaged	2024	On-the-Ground Support in 17 Wyoming Counties
46 Extension/Outreach Activities	Hundreds of Agency, Private, and NGO Collaborators	Provided Strategic Support in NE, MT, CO, and SD
14 Scientific Meeting Presentations	6 Articles Published	SRM, WSWS, NAISMA, and ESA Membership
3,341 Website Visits	1,288 YouTube Channel Views	10 Active IAG Research Projects

Active and Engaged Support
Educational Support
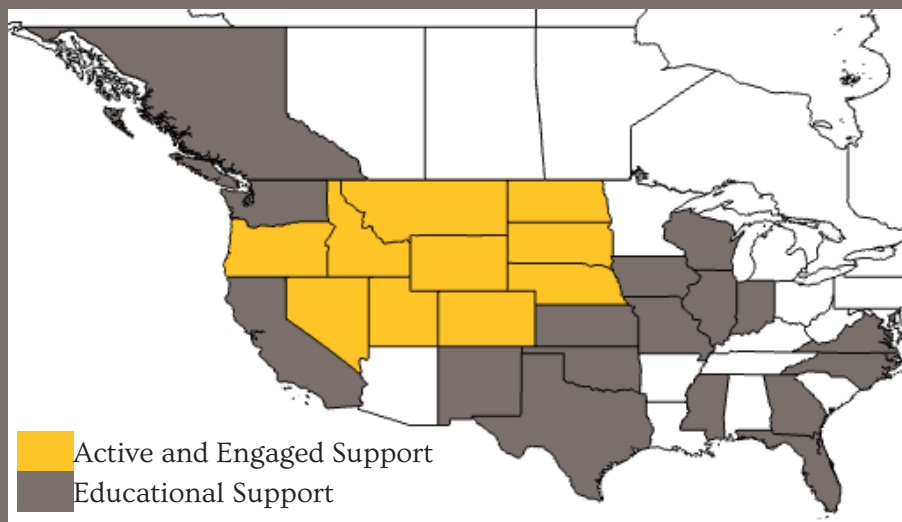
TECH TRANSFER PARTNERSHIP

The Tech Transfer Partnership (TTP) was created to support land managers, private landowners, and conservationists who are managing invasive annual grasses (IAG) in the western United States by providing educational materials and tools. These tools are supported by the most up to date scientific research, which is then put into a more stakeholder targeted format. This partnership also focuses on various workshops that span from basic education on IAG's and management to facilitating local working groups to create IAG management plans.

Workshops

A major focus of the TTP has been to facilitate various workshops across the sagebrush biome. These workshops were created to address various levels of detailed information about IAGs (see pyramid below). The Level 1: Virtual Workshop was designed to provide a baseline on IAG information for all stakeholders. The event was hosted live, and all videos and worksheets were made available on the website for participants and newcomers to review the material at their leisure. Then scaling up, the Level 2: Field Workshop was designed to provide both a hands-on experience and illustrate the complexities of managing IAGs at a local scale. Some of the field workshop components include herbicide application test plots, determining the level of invasion, and discussions on spatial prioritization and ground-truthing. Level 3: Local Working Groups provide a unique opportunity for local partners to work together to prioritize and manage their area based on the goals of the group. The outcomes of these discussions widely vary based on the history of the working groups, their goals, and their level of collaborative involvement.

Level 1: Virtual Workshop

The Virtual Workshop hosted 522 active participants representing 20 different states and Canada. This workshop provided over six hours of educational content on IAG's, management, and novel cultural changes across the west. The agenda topics included Why Now, Biology and Ecology of the Problem, Landscape Scale Planning, Project Scale Planning, Management, and a Call to Action. These different sections were presented through various formats, including PowerPoint lectures, question & answer periods, and panelists discussions.

Level 3:
Local Working Groups

Level 2: Field Workshop

Level 1: Virtual Workshop
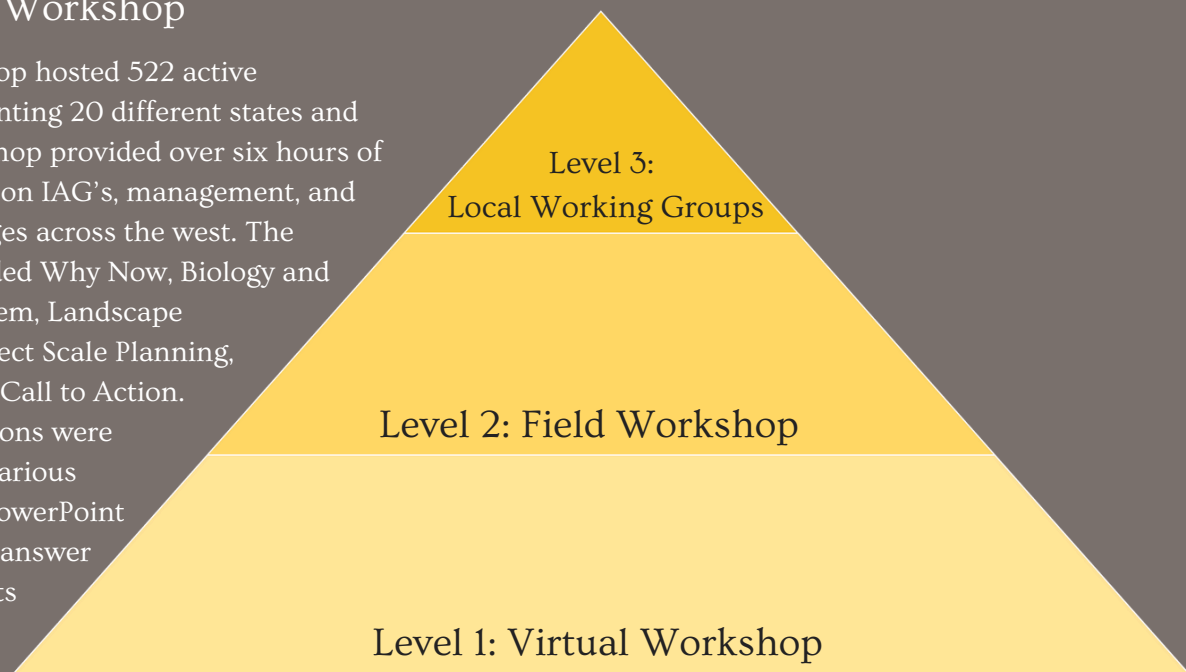
We chose speakers with a diverse range of experiences, which allowed for a wide range of perspectives on how to make decisions and manage invasive annual grasses. Our goal for the event was to have participants feel empowered to start trying to manage invasive annual grasses. According to our post-event survey, we did achieve our goal.

Level 2: Field Workshop

The Level 2 Field Workshop was a two-day event held in Sheridan, Wyoming. We had over 60 participants from 13 states. The focus of the event was to provide a hands-on experience where participants had the opportunity to learn more about spatial scales, herbicide treatments, and prioritization. Participants got to interact with a local rancher and an aerial herbicide applicator that have been active in managing invasive grasses in the area. The targeted field workshop paired with local perspectives showcase the unique challenges specific to managing invasive grasses at local scales.

Level 3: Local Working Groups

We hosted three Level 3 Workshops in 2024. They were held in Dillon, Montana; Gunnison, Colorado; and Cody, Wyoming. Each of these workshops was developed to meet the specific needs and goals of individual working groups. Some groups were in the early stages of formation which required more focus on concepts in collaboration and determining which partners need to be invited to the group. Other groups had more established programs which shifted the focus to treatment prioritization and long-term management decision making.

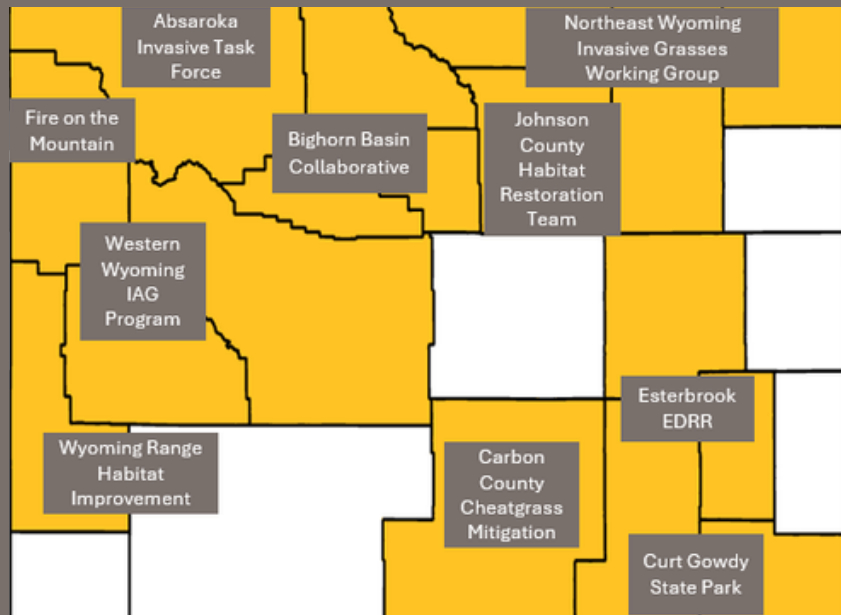For more resources and information, visit our website: invasivegrasses.com

MONITORING NETWORK

IMAGINE coordinates a statewide invasive annual grass (IAG) monitoring network. We provide vegetation monitoring support for stakeholders conducting landscape scale treatments. Our goal with the monitoring network is to improve landscape scale IAG management and decision making.

We conduct pre-treatment inventories that help land managers identify populations of IAG's. After identifying populations, we assist land managers in treatment decision making and prioritization. After application, we provide post-treatment monitoring to assess treatment efficacy, non-target impacts, and re-treatment needs.
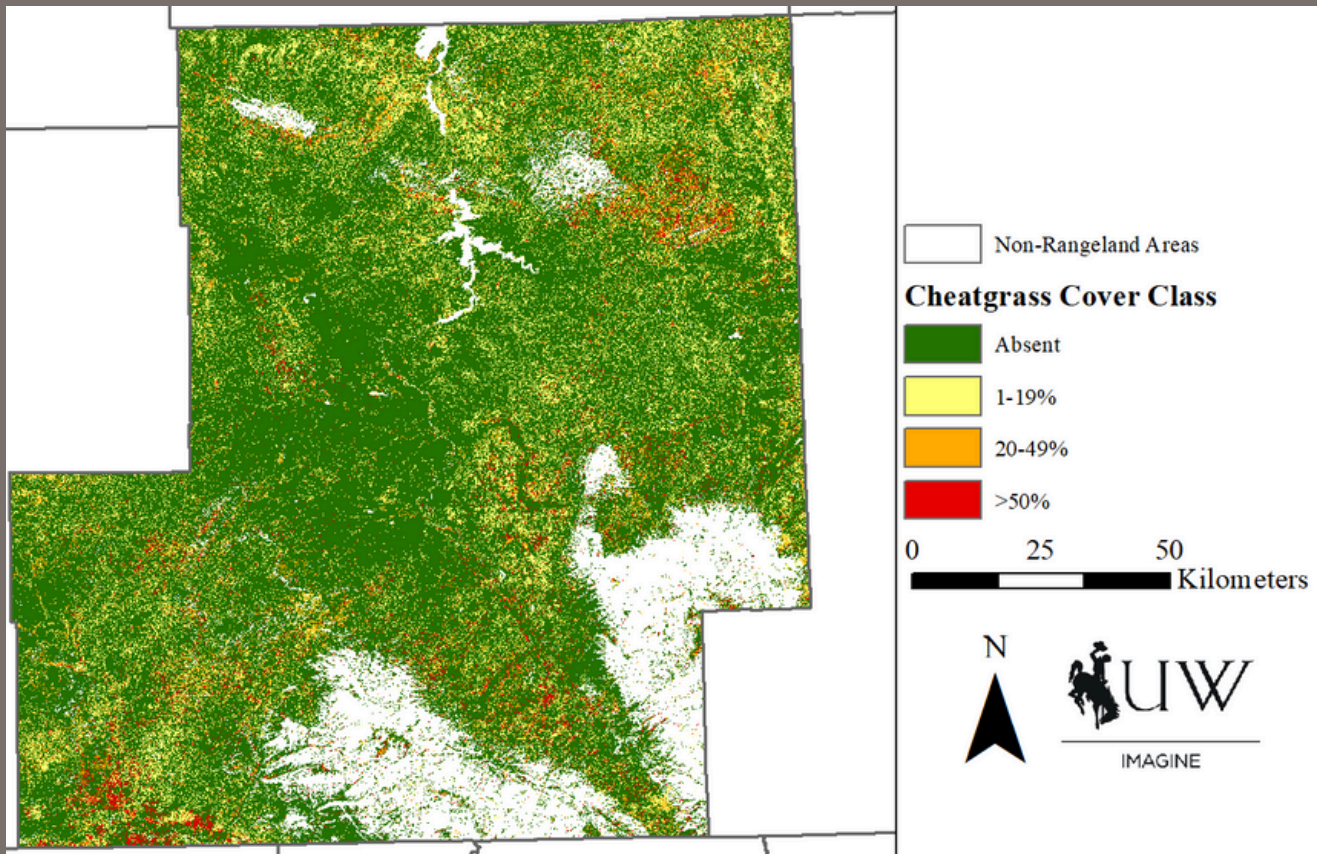
Collaboration

Currently, we collaborate with ten groups of stakeholders to identify, monitor, and manage IAG's in 17 Wyoming counties. In 2025 we plan to expand that to 20 counties. Projects vary in target species (cheatgrass, Japanese brome, ventenata, and medusahead), vegetation treatments, recreational and social interactions, and stakeholder involvement.

Absaroka Invasive Task Force

Northeast Wyoming Invasive Grasses Working Group

Fire on the Mountain

Bighorn Basin Collaborative

Johnson County Habitat Restoration Team

Western Wyoming IAG Program

Esterbrook EDRR

Wyoming Range Habitat Improvement

Carbon County Cheatgrass Mitigation

Curt Gowdy State Park

Data Collection

The monitoring network allows for standardized data collection across projects. This allows us to analyze practical annual grass management at a large scale while including perspectives from land managers and compiling lessons learned in real time. We use monitoring data to develop individual reports for landowners and larger landscape scale reports for partnering agencies. We analyze post-treatment monitoring data and use it to improve decision making in the future.

Data is also utilized as training data for developing and improving local and regional remote sensing models. Our goal is to build countywide models of IAG cover based on IMAGINE monitoring data, with the intent of accumulating enough data to develop a statewide model. In 2025 we plan to unveil a public monitoring form so that partners can submit data, which will maximize land coverage and improve modeling applications for a statewide IAG model. Data will be used to improve post-wildfire planning, identify new populations of IAGs, plan ground monitoring efforts, and develop supporting documentation for partners applying for funding.

Map of cheatgrass cover class across rangeland areas, with legend showing Non-Rangeland Areas (white), and Cheatgrass Cover Class: Absent (dark green), 1-19% (yellow), 20-49% (orange), >50% (red). Scale bar 0–50 Kilometers. North arrow and UW IMAGINE logo.

We have started developing a web-based central data clearinghouse to aid in sharing information and accumulating data from which we can enhance our management efforts. Our monitoring network will add to existing data and lessons learned to improve IAG management decision making.

Student Experience

The IMAGINE monitoring network provides experiential learning for college students. Many of these students have gone on to pursue graduate degrees and careers in natural resource fields including Weed and Pest, environmental consulting, federal land management agencies, and more.

WILDFIRE

In 2024, over 600,000 acres of rangeland burned in Northeast Wyoming. These wildfires have threatened some of the world's most intact sagebrush steppe and the wildlife and landowners that rely on these rangelands for their survival and livelihood. Although IMAGINE is primarily focused on invasive annual grasses, we also support research and decision making in rangeland restoration and sagebrush management. Since the biggest threat to the sagebrush biome is invasive annual grasses, our program ties neatly with land manager's wildfire mitigation goals in Wyoming.

IMAGINE collaborated with stakeholders in multiple efforts in education and post-fire decision making in 2024. Team members attended and presented information at an agency led field tour in October that included local, state, and federal agency personnel, private landowners, and non-government organizations. We have also been part of multiple educational workshops on post-fire management, including a special session at the 2024 Wyoming Stock Grower's Winter Roundup.

In response to large-scale wildfire impacts, we teamed up with the Johnson County Natural Resource Habitat Restoration Team (JCNRHRT), a local working group of agency partners, to prioritize restoration and weed management within the House Draw Fire (which burned 190,000 acres in Johnson County in August 2024).

IMAGINE monitoring data was used to develop remote sensing training models to help predict pre-fire invasive annual grass cover and big sagebrush presence. These predictions were compared with topographic layers to identify areas where big sagebrush seeding efforts may be more successful and where invasive annual grasses may be of high concern in future years.
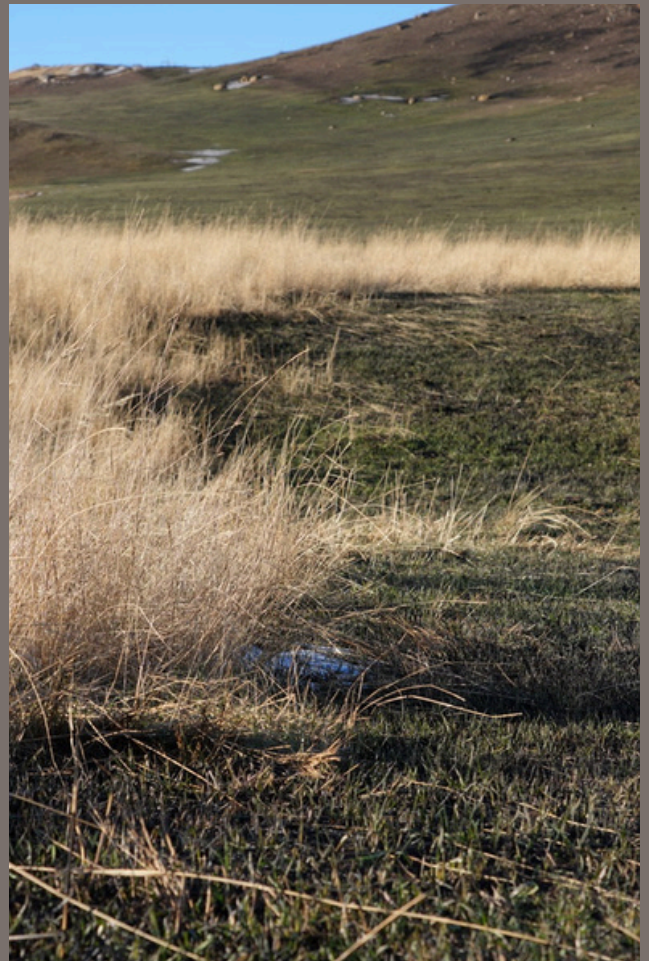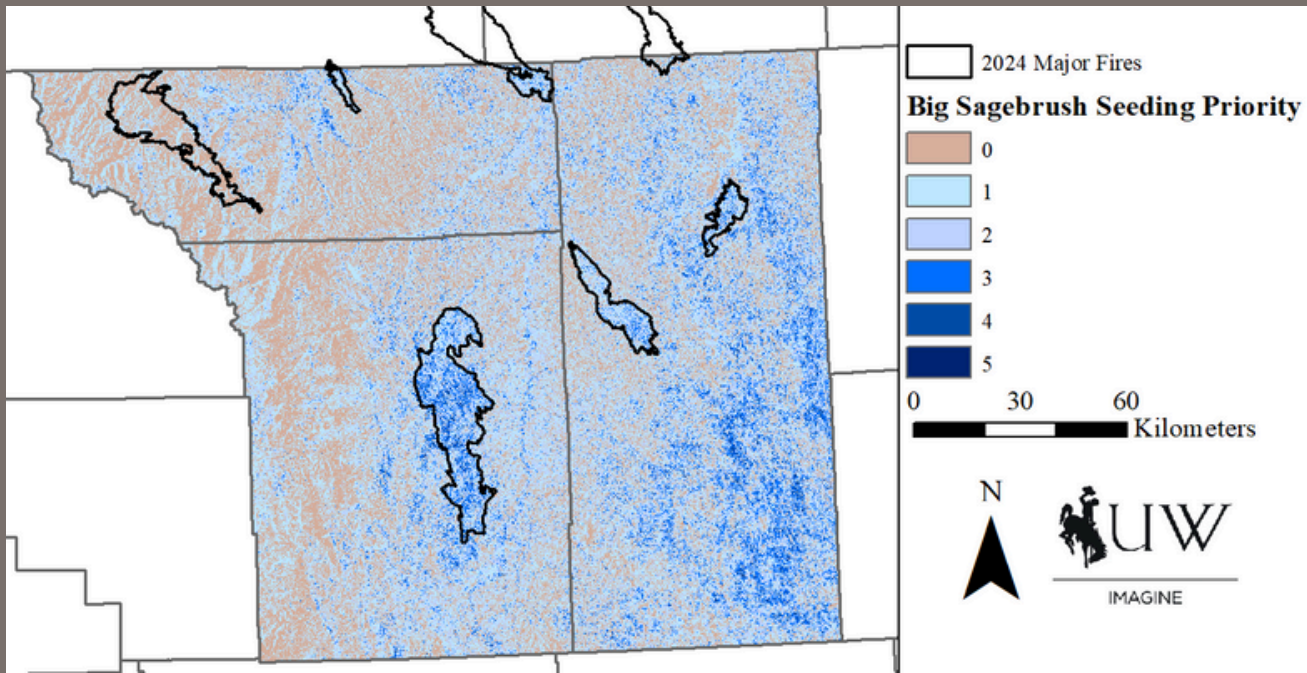
We specifically developed a big sagebrush seeding prioritization layer that compiles:
- Burned areas (calculated from post-fire normalized burn ratio index)
- Big sagebrush presence pre-fire (IMAGINE trained remote sensing models)
- <20% invasive annual grass cover pre-fire (IMAGINE trained remote sensing models)
- <5% slope (calculated from 10m USGS Digital Elevation Models)
- Northeastern aspects (derived from 10m USGS Digital Elevation Models)

We expect burned areas with high overlap of the last four characteristics to have higher likelihood of seeding success. The layer was also disseminated to JCNRHRT as a Google Earth Engine App, to be utilized at smaller scales for rapid decision making.

A CROSS-SCALE APPROACH TO QUANTIFYING ENVIRONMENTAL INFLUENCES ON INVASIVE ANNUAL GRASS CONTROL

Introduction

This report summarizes the progress made by Dr. Morgan Frost, Post-Doctoral Research Associate, from January 4 to December 19, 2024. Dr. Frost is working under the supervision of Dr. Paige Copenhaver-Parry and Dr. Kelsey Brock at the University of Wyoming. The project focuses on improving management strategies for invasive annual grasses (IAGs) in Wyoming, with a particular emphasis on evaluating herbicide treatment effectiveness across diverse environmental conditions. This research is critical for supporting the sustainable management of IAGs and their impacts on ranching, biodiversity, and ecosystem health.

Data Collection and Curation

Dr. Frost has made significant progress in curating and cleaning an extensive dataset of IAG monitoring data collected from across Wyoming during the growing seasons between 2011 and 2024. This dataset, compiled from 10 different research projects, includes 18, 318 plots that were treated with 18 distinct herbicide combinations alongside follow-up visits to compare IAG cover. These data provide valuable insights into the effectiveness of herbicide treatments across a range of environmental conditions, with a focus on four IAG species: Bromus japonicus (Japanese brome), Bromus tectorum (cheatgrass), Taeniatherum caput-medusae (medusahead), and Ventenata dubia (ventenata). The majority of these data come from an extensive monitoring effort that uses indaziflam as the herbicide treatment, with studies primarily based in Sheridan and Carbon counties. Importantly, we were able to integrate these finer scale plot data with coarser scale environmental data that is thought to influence herbicide effectiveness, including seasonal and annual climate data (extracted from PRISM Climate Data) and microtopographic data (derived from 1-meter LiDAR Digital Elevation Models). Data will continue to be analyzed to examine how these factors influence the success of herbicide treatments. All cleaned and curated data will be included in a finalized Microsoft Access database.

Collaborative Scientific Discussion

Dr. Frost is collaborating with multiple research teams, including the Wyoming Natural Diversity Database (WYNDD), the National Park Service (NPS), and IMAGINE. Notably, Dr. Frost works closely with the NPS team, which has been refining their Annual Brome Adaptive Management (ABAM) model.

This model serves to inform adaptive management of IAGs across the Northern Great Plains, especially post-fire. The goal for these collaborations is to discuss incorporating climate change into management strategies, improving herbicide treatment efficacy, and exploring the potential for future collaboration on decision support tools for land managers. These collaborations are crucial for aligning ongoing research with the needs of stakeholders, ensuring the data and models produced are actionable and relevant.

Novel Bayesian Hierarchical Modeling Approach

Dr. Frost has been developing a novel Bayesian hierarchical model to quantify how environmental factors—such as climate and topography—affect the success of herbicide treatments on invasive annual grasses. This modeling approach is unique in its ability to account for cross-scale interactions between environmental variables and treatment outcomes, providing more precise and data-driven management recommendations. The first phase of the model is a logistic hierarchical framework that quantifies the influence of environmental factors on herbicide treatment success. The second phase expands the model into a beta hierarchical framework, which allows for a more nuanced analysis of how environmental drivers influence IAG cover after treatment. By accounting for cross-scale interactions, the model provides precise, data-driven insights into treatment efficacy across diverse environmental settings. Knowledge of the scales over which environmental gradients impact treatment effectiveness, as well as precise quantification of effects at multiple scales, will enable managers and landowners to tune applications to the environmental conditions of their target landscapes in a manner that improves treatment effectiveness. The outcomes of this modeling framework will, for example, allow us to suggest whether different climate regimes across WY correspond to differences in small scale effects of herbicides due to underlying microtopographic variation. This then allows land use practitioners to adapt (e.g., change application patterns in wetter years on sloped areas due to anticipated decreased multiyear herbicide effects).

Why This Work Matters

The research conducted by Dr. Frost is pivotal in understanding how IAGs affect prairie ecosystems and how herbicide treatments can be optimized under a variety of environmental conditions. The novel Bayesian hierarchical modeling approach provides a more precise and data-driven tool for land managers to assess treatment outcomes, allowing for better-informed decisions in IAG management. In addition, the collaborative nature of this research ensures that the findings are scientifically rigorous and practically relevant. Partnerships with organizations such as IMAGINE, ABAM, and various government agencies ensure that the models developed are not only robust but also aligned with the needs of land managers. Future research will continue to refine these models and provide additional tools to aid in the long-term management of IAGs, ultimately contributing to sustainable land use and conservation efforts. Using large datasets, novel modeling strategies, and collaboration across vested interests and expertise, we can add knowledge and tools that enhance the ability of land use practitioners to effectively manage their lands for now and into the future.

ECONOMIC IMPACTS OF INVASIVE WEEDS IN WYOMING PILOT STUDY

While it is likely a fair assumption that invasive weed species negatively impact the economy of a region, attempts to quantify those impacts are not very common. The Wyoming Weed and Pest Council, specifically the Guiding Principles Committee, partnered with UW IMAGINE and the Department of Ag and Applied Economics to estimate grazing-related economic losses from 10 different invasive plant species in Wyoming. Focal species included a variety of growth habits ranging from invasive annual grasses, such as cheatgrass, ventenata, and medusahead, to long-lived perennial weeds like leafy spurge and Russian knapweed. We had two primary goals: 1) to estimate current agricultural losses (primarily loss in grazing productivity) from each weed species and 2) use habitat suitability models to estimate potential future losses if those weeds were allowed to occupy all suitable habitat across the state. We asked all Wyoming Weed and Pest Control District personnel in all counties to estimate infested and impacted acres in their counties, then combined estimated grazing losses with these acreage estimates and county-specific grazing values to estimate current losses from the weeds.

What we found was pretty striking. Cheatgrass, by far, has the highest estimated negative impacts to Wyoming's grazing-based economy at over $32 million annually from direct losses. Indirect losses (ripple effects through the economy through loss of spending) are around $24 million – further demonstrating this species' impact on the state. If left unmanaged to spread into all suitable habitat, direct losses may exceed $100 million annually. Surprisingly, ventenata (another invasive annual grass relatively new to Wyoming) had the second highest annual economic impact – higher than leafy spurge, Russian knapweed, or whitetop. Such losses are most likely a very conservative estimate of economic impacts of these invasive weeds in Wyoming because they only account for a single, specific sector of potential losses – lost grazing productivity. We did not account for other ecosystem goods and services impacted by these species such as wildlife habitat, recreation, or wildfire suppression costs. We are currently pulling together a team to further investigate these broader implications to Wyoming's economy.

BIG HORN BASIN

In March 2024, IMAGINE, in collaboration with Bureau of Land Management and Intermountain West Joint Venture, hired Nancy Webb as the Wind River/ Bighorn Basin District Invasive Annual Grass Coordinator. This hire is part of a statewide plan to eventually have an invasive annual grass coordinator for every region in Wyoming.

The role of an invasive annual grass coordinator is to assist agency partners and private landowners in landscape scale IAG management. Nancy has been responsible for establishing working relationships with Weed and Pest Districts, Game and Fish, Natural Resource Conservation Service, Conservation Districts, and private landowners in Washakie, Big Horn, Hot Springs, Freemont, and Park Counties. In 2024, Nancy hosted a Bighorn Basin Agency Partners Annual Grass Meeting where IMAGINE and agency partners discussed historical practices in the Big Horn Basin, opportunities for collaborative landscape scale IAG management, and monitoring needs for the group.

In the summer, Nancy initiated monitoring efforts at 10 different target locations for possible future IAG treatments. She also collected biomass samples from treated and non-treated sites to evaluate herbicide efficacy in Big Horn Basin bunchgrass communities and compiled a report for land managers. And finally, in conjunction with other IMAGINE team members, Nancy identified five sites for herbicide demonstration plots and treated them with three herbicide mixtures commonly used in invasive annual grass management. In future years, these demonstration plots will be a great educational resource to teach land managers, private landowners, and other stakeholders the importance of invasive annual grass management and treatment options.

These coordinator positions have been quite successful for IMAGINE, allowing us to improve our relationships with stakeholders throughout the state while meeting the research, education, and monitoring needs of individual partners. We plan to continue efforts towards implementing regional coordinator positions throughout Wyoming and therefore improving statewide collaborations and overall landscape scale invasive annual grass management.

GRADUATE RESEARCH

Jaycie Arndt

PhD student-
Plant Sciences

Wyoming rangelands are threatened every year by disturbances that damage native vegetation and promote the introduction and spread of invasive species. Once invasive species, particularly annual grasses, dominate a community, it becomes very difficult to restore an area to a healthy, functioning native community. My project concentration is on rangeland restoration via improvement of native plant establishment in highly disturbed areas.

We are evaluating the use of short and long residual herbicides to improve establishment of native grasses and forbs and maintain long term invasive annual grass control. We have established trials in various levels of degraded rangeland in Northeast Wyoming, and plan to expand research into the Bighorn Basin.

We are also evaluating Wyoming big sagebrush establishment using grass selective herbicides. Both native and invasive grasses compete with establishing sagebrush which regularly results in failed restoration seedings. We are implementing trials in various disturbance sites including post-wildfire, heavy cheatgrass invasion, and historical introduced perennial grass communities.
The results of this work will hopefully improve the success of rangeland restoration seedings and support land managers in restoration decision making.

Peter Cole

Masters student- Plant Sciences

As the invasion, and the problems associated with, annual grasses increase throughout Wyoming, more landowners are willing to chemically treat invasive annual grasses. However, many government agencies encourage a grazing deferment period of at least one, but often multiple, growing seasons after treatment. My focus is an extension of previous research investigating the relationship between post-treatment recovery and grazing, to assess if deferment is necessary. Whereas the previous project focused on sites in Sheridan and Johnson counties, my project will focus on sites in the Bighorn Basin, an area with different ecological conditions and bunchgrass dominated plant communities.

Another focus will be on the House Draw fire that burned in Johnson County in the summer of 2024. As restoration and weed management efforts continue in the area, my project will focus on post-fire vegetation monitoring. These data will help refine remote sensing models estimating recovery potential of the burned areas and assist in prioritizing vegetation treatments. We will also be monitoring the plant recovery of burned sites and adjacent unburned land to understand the long-term response to wildfire in Wyoming sage-steppe communities.

IMAGINE PUBLICATIONS

Published Papers

Boyd, C. S., Creutzburg, M. K., Kumar, A. V., Smith, J. T., Doherty, K. E., Mealor, B. A., ... & Cross, T. B. (2024). A strategic and science-based framework for management of invasive annual grasses in the sagebrush biome. Rangeland Ecology & Management, 97, 61-72.

Custer, G. F., Mealor, B. A., Fowers, B., & van Diepen, L. T. (2024). Soil microbiome analysis supports claims of ineffectiveness of Pseudomonas fluorescens D7 as a biocontrol agent of Bromus tectorum. Microbiology Spectrum, 12(1), e01771-23.

De Stefano, A., Mealor, B. A., Jones, L. C., Lehnhoff, E. A., Mangold, J. M., Prather, T., ... & Rew, L. J. (2024). Plot-Measured Variables Indicate Landscape-Scale Patterns of Annual Grass Invasion in Northwestern US Rangelands. Rangeland Ecology & Management, 92, 90-99.

Mattilio, C. M., Lepinard, O., Arndt, J. N., De Stefano, A., Billings, W., & Mealor, B. A. (2024). Evaluating High-Frequency, Moderate-Resolution Satellite Imagery for Assessment and Monitoring of Invasive Annual Grasses. Rangeland Ecology & Management.

Nagler, A., Ritten, J., Mealor, B. A., Lee, B. P., Kniss, A., & Hart, M. T. (2024). Current and Potential Economic Impacts of 10 Invasive Weed Species in Wyoming–A Pilot Study of Agricultural Losses.

Olsen, A., Creutzburg, M., McIntosh, M., O'Leary, D., Wollstein, K., Maestas, J. D., ... & Mealor, B. (2024). Crossing the chasm: using technical transfer to bridge science production and management action. Rangeland Ecology & Management, 97, 178-186.

Thesis Publication

Billings, W. T. (2024). Plant Community Effects of Grazing Deferment Following Invasive Annual Grass Management Using Indaziflam on Rangelands of Northeast Wyoming (Master's thesis, University of Wyoming).

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