# I. Develop drafts of the materials required to be entered into the GRFP Application Module.

The sections that are required include:

## Personal Information

Legal Name and Identifier: Samantha Joan Tetrault
Mailing Address: 2001 Kent Ct, Fort Collins, CO 80526
Phone number: 970-215-0685
E-mail address: samanthajoantetrault@gmail.com
Date of Birth: August 23rd, 2004
High School Location: Fort Collins, Colorado

## Education

**Colorado State University, Fort Collins, CO**
Fall 2023 - Anticipated Graduation Fall 2025
Bachelor of Science, Ecosystem Science & Sustainability
GPA: 4.0

**Front Range Community College, Fort Collins, CO**
Spring 2022 - Spring 2023
Associate of General Studies
GPA: 4.0

## Work and Other Experience

**Forestry Field Worker I**
City of Fort Collins, CO | May 2025 - present

- Responsible for watering over 300 trees every two weeks.
- Communicate in a friendly and informative manner with members of the public who approach with questions about tree health and pests (ie. emerald ash borer)
- Monitor beetle traps to identify which species may be spreading pine wilt nematode.
- Update tree inventory database when new trees are planted or existing trees are removed or exhibit a change in condition.

**Research Assistant**
CSU Department of Agricultural Biology, Fort Collins, CO | June 2024 - May 2025

- Prepared research materials and planted 2800 seeds for each of the three trials conducted.
- Collected and entered plant emergence, height, herbicide injury, and vigor data daily.
- Harvested the sprout, roots, and soil of individuals with true leaves for biomass measurements.
- Assisted with data sorting and analysis using Microsoft Excel and R.
- Led and presented a sub-project analyzing the relationship between emergence and functional group and emergence and seed weight.

**Undergraduate Teaching Assistant**
CSU, Fort Collins, CO | January 2024 - May 2024

- Supported a graduate teaching assistant for a LIFE102 lab section by retrieving lab materials, answering student questions, and facilitating group discussions.
- Provided demonstrations to students for hands-on activities such as pipetting.
- Taught a lab at the end of the semester to a group of 20 students.

**Transcript PDFs**

I saved the PDF to my computer, here are screenshots of the PDF:

Unofficial Transcript

# Colorado State University Unofficial Transcript for Samantha Joan Tetrault (835302665)

## Monday, October 13, 2025 7:11:40 PM

### Fall Semester 2025 Curriculum

**Program Code: ECSS-BS**
**Program Description: BS Ecosystem Science and Sustainability**
**Curriculum Level: Undergraduate**

| Type | Description | Code | Department | College |
|---|---|---|---|---|
| MAJOR | Ecosystem Sci & Sustainability | ECSS | Ecosystem Science & Sustainabi | Warner Coll of Natural Resrces |

## Undergraduate

Overall Credit Hours Earned: 137.000
Colorado State University Credit Hours Earned: 73.000
Colorado State University GPA Credit Hours: 68.000
Colorado State University Grade Points: 272.000
Colorado State University Cumulative GPA: 4.000
Transfer Credit Hours Earned: 64.000

### Academic Term Summary

| Term | Term Dates | Class | Major | Term GPA | Quality Points | GPA Hours | Hours Earned | End of Term Standing |
|---|---|---|---|---|---|---|---|---|
| Spring Semester 2026 | 01/20/2026 - 05/15/2026 | Senior | Ecosystem Sci & Sustainability | 0.000 | 0.000 | 0.000 | 0.000 | |
| Fall Semester 2025 | 08/25/2025 - 12/19/2025 | Senior | Ecosystem Sci & Sustainability | 0.000 | 0.000 | 0.000 | 0.000 | |
| Summer Session 2025 | 05/19/2025 - 08/08/2025 | Senior | Ecosystem Sci & Sustainability | 0.000 | 0.000 | 0.000 | 0.000 | |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Spring Semester 2025 | 01/21/2025 - 05/16/2025 | Senior | Ecosystem Sci & Sustainability | 4.000 | 72.000 | 18.000 | 18.000 | Good Standing |
| Fall Semester 2024 | 08/19/2024 - 12/13/2024 | Senior | Ecosystem Sci & Sustainability | 4.000 | 64.000 | 16.000 | 21.000 | Good Standing |
| Summer Session 2024 | 05/13/2024 - 08/02/2024 | Senior | Ecosystem Sci & Sustainability | 4.000 | 20.000 | 5.000 | 5.000 | Good Standing |
| Spring Semester 2024 | 01/16/2024 - 05/10/2024 | Senior | Ecosystem Sci & Sustainability | 4.000 | 60.000 | 15.000 | 15.000 | Good Standing |
| Fall Semester 2023 | 08/21/2023 - 12/15/2023 | Junior | Ecosystem Sci & Sustainability | 4.000 | 56.000 | 14.000 | 14.000 | Good Standing |

## Current Credit Courses

| Term | Course | Title | Credits | Level |
|---|---|---|---|---|
| Fall Semester 2025 | CO-301B-014 | Writing in the Disciplines: Sciences (GT-CO3) | 3 | Undergraduate |
| Fall Semester 2025 | ESS-411-001 | Earth Systems Ecology | 3 | Undergraduate |
| Fall Semester 2025 | NR-400-001 | Public Communication in Natural Resources | 3 | Undergraduate |
| Fall Semester 2025 | NR-400-R02 | Public Communication in Natural Resources | 0 | Undergraduate |

## Completed CSU Courses

| Term | Course | Title | Credits | Grade | Level | Comments |
|---|---|---|---|---|---|---|
| Spring Semester 2025 | BSPM-495-001 | Independent Study | 2 | A | Undergraduate | |
| Spring Semester 2025 | ESS-312-001 | Sustainability Science | 3 | A | Undergraduate | |
| Spring Semester 2025 | ESS-330-L01 | Quantitative Reasoning for Ecosystem Science - Lab | 0 | NGC | Undergraduate | |
| Spring Semester 2025 | ESS-330-001 | Quantitative Reasoning for Ecosystem Science | 3 | A | Undergraduate | |
| Spring Semester 2025 | ESS-400-001 | Global Perspectives on Sustainability | 3 | A | Undergraduate | |

| | | | | | | |
|---|---|---|---|---|---|---|
| Spring Semester 2025 | ESS-440-001 | Practicing Sustainability | 4 | A+ | Undergraduate | |
| Spring Semester 2025 | ESS-440-R02 | Practicing Sustainability - Recitation | 0 | NGC | Undergraduate | |
| Spring Semester 2025 | NR-320-001 | Natural Resources History and Policy | 3 | A | Undergraduate | |
| Fall Semester 2024 | ESS-311-001 | Ecosystem Ecology | 3 | A+ | Undergraduate | |
| Fall Semester 2024 | ESS-487-001 | Internship | 5 | S | Undergraduate | |
| Fall Semester 2024 | NR-319-L02 | Introduction to Geospatial Science | 0 | NGC | Undergraduate | |
| Fall Semester 2024 | NR-319-001 | Introduction to Geospatial Science | 4 | A | Undergraduate | |
| Fall Semester 2024 | POLS-103-001 | State and Local Government and Politics (GT-SS1) | 3 | A | Undergraduate | |
| Fall Semester 2024 | POLS-364-001 | Air, Climate, and Energy Policy Analysis | 3 | A | Undergraduate | |
| Fall Semester 2024 | STAT-307-002 | Introduction to Biostatistics | 3 | A+ | Undergraduate | |
| Summer Session 2024 | PH-121-L02 | General Physics I (GT-SC1)-Lab | 0 | NGC | Undergraduate | |
| Summer Session 2024 | PH-121-001 | General Physics I (GT-SC1) | 5 | A | Undergraduate | |
| Summer Session 2024 | PH-121-R01 | General Physics I (GT-SC1)-Recitation | 0 | NGC | Undergraduate | |
| Spring Semester 2024 | BZ-384-002 | Supervised College Teaching | 1 | A+ | Undergraduate | |
| Spring Semester 2024 | ESS-130-001 | Intro to Systems Theory for Sustainability | 1 | A+ | Undergraduate | |
| Spring Semester 2024 | LIFE-103-002 | Biology of Organisms-Animals and Plants (GT-SC1) | 4 | A+ | Undergraduate | |
| Spring Semester 2024 | LIFE-103-L18 | Biology of Organisms-Animals and Plants (GT-SC1) - Lab | 0 | NGC | Undergraduate | |
| Spring Semester 2024 | LIFE-320-002 | Ecology | 3 | A+ | Undergraduate | |
| Spring Semester 2024 | POLS-101-401 | American Government and Politics (GT-SS1) | 3 | A | Undergraduate | |

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|---|---|---|---|---|---|---|
| Spring Semester 2024 | WR-204-001 | Sustainable Watersheds (GT-SC2) | 3 | A+ | Undergraduate | |
| Fall Semester 2023 | ECON-240-001 | Issues in Environmental Economics (GT-SS1) | 3 | A+ | Undergraduate | |
| Fall Semester 2023 | ESS-210-001 | Physical Geography | 3 | A+ | Undergraduate | |
| Fall Semester 2023 | GES-101-001 | Foundations of Environmental Sustainability | 3 | A | Undergraduate | |
| Fall Semester 2023 | IU-300-102 | Becoming A Scientist | 1 | A+ | Undergraduate | |
| Fall Semester 2023 | LIFE-102-L67 | Attributes of Living Systems (GT-SC1) -Lab | 0 | NGC | Undergraduate | |
| Fall Semester 2023 | LIFE-102-001 | Attributes of Living Systems (GT-SC1) | 4 | A+ | Undergraduate | |

## Transfer Courses

| Term | Institution | Course | Title | Credits | Grade |
|---|---|---|---|---|---|
| Spring Semester 2023 | Front Range Comm Coll-Westmin | ACT-2++ | Accounting Principles I | 1 | TA |
| Spring Semester 2023 | Front Range Comm Coll-Westmin | ACT-210 | Accounting Principles I | 3 | TA |
| Spring Semester 2023 | Front Range Comm Coll-Westmin | CS-165 | Computer Science II: Java | 4 | TA |
| Fall Semester 2022 | Front Range Comm Coll-Westmin | BUS-150 | Intro PC Application:ms Offic | 3 | TA |
| Fall Semester 2022 | Front Range Comm Coll-Westmin | CO-1++ | English Composition Ii:co2 | 3 | TA |
| Fall Semester 2022 | Front Range Comm Coll-Westmin | CS-1++ | Computer Science I: Java | 4 | TA |
| Spring Semester 2022 | Front Range Comm Coll-Westmin | CS-1++ | Intro. To Programming: C++ | 3 | TA |
| Spring Semester 2021 | Front Range Comm Coll-Westmin | FIN-200 | Personal Finance | 3 | TA |
| Spring Semester 2021 | Univ Colo Denver/Hlth Sci Ctr | HIST-150 | United States History to 1876 | 3 | TA |
| Spring Semester 2021 | Univ Colo Denver/Hlth Sci Ctr | HIST-151 | United States History Sn 1876 | 3 | TA |
| Spring Semester 2021 | Advanced Placement Program | CO-130 | Engl Lang Scr 4 & Lit Scr ++ | 3 | TS |
| Spring Semester 2021 | Advanced Placement Program | CO-150 | Engl Lang Scr 4 & Lit Scr ++ | 3 | TS |
| Spring Semester 2021 | Advanced Placement Program | E-140 | Engl Lang Scr 4 & Lit Scr ++ | 3 | TS |
| Fall Semester 2020 | Front Range Comm Coll-Westmin | LSPA-200 | Spanish Language Iii: AH4 | 3 | TA |

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|---|---|---|---|---|---|
| Fall Semester 2020 | Univ Colo Denver/Hlth Sci Ctr | MATH-160 | Calculus I | 4 | TA- |
| Spring Semester 2020 | Advanced Placement Program | CHEM-1++3L | Chemistry Score of 3 | 4 | TS |
| Spring Semester 2020 | Advanced Placement Program | GR-100 | Human Geography Score of 5 | 3 | TS |
| Fall Semester 2019 | Univ Colo Denver/Hlth Sci Ctr | CHEM-111 | General Chemistry I | 3 | TA- |
| Fall Semester 2019 | Univ Colo Denver/Hlth Sci Ctr | CHEM-112 | General Chemistry Lab I | 1 | TA- |
| Fall Semester 2019 | Univ Colo Denver/Hlth Sci Ctr | MATH-1++1B | College Trigonometry | 1 | TA |
| Fall Semester 2019 | Univ Colo Denver/Hlth Sci Ctr | MATH-125 | College Trigonometry | 1 | TA |
| Fall Semester 2019 | Univ Colo Denver/Hlth Sci Ctr | MATH-126 | College Trigonometry | 1 | TA |
| Spring Semester 2019 | Univ Colo Denver/Hlth Sci Ctr | MATH-1++1B | College Algebra | 1 | TA |
| Spring Semester 2019 | Univ Colo Denver/Hlth Sci Ctr | MATH-117 | College Algebra | 1 | TA |
| Spring Semester 2019 | Univ Colo Denver/Hlth Sci Ctr | MATH-118 | College Algebra | 1 | TA |
| Spring Semester 2019 | Univ Colo Denver/Hlth Sci Ctr | MATH-124 | College Algebra | 1 | TA |

## Proposed Field(s) of Study

Major Field of Study: Life Sciences
Sub-field: Ecology

## Proposed Graduate Study and Graduate School Information

Master's program in Ecology and Evolutionary Biology at University of Colorado Boulder. Advisors in this field of study at CU Boulder study a range of areas related to ecology, including microbial and soil ecology, plant ecophysiology, ecosystem ecology, etc.

## Names and Addresses of at least 3 reference letter writers

1) Cynthia Brown, email: cynthia.s.brown@colostate.edu. I worked with a graduate student (Lauren Myers) advised by Cini as an undergraduate research assistant. I worked closely with Cini not only to support Lauren's research, but also to prepare my own sub-project, which I presented at CURC.
2) Lauren Myers, email: laurenmyers7@gmail.com. I worked directly under Lauren as her undergraduate research assistant for her project regarding indaziflam and Boulder County's native seed bank. Lauren also mentored me for my CURC project and helped me navigate using R to create models and graphs. I think out of all references, Lauren would be able to write the most detailed account of my experience in research and capacity to do my own research project.

3) Ed Hall, email: Ed.Hall@colostate.edu. I took ecosystem ecology with Ed Hall and feel that this class is when I not only started to form a passion for ecology, but also began to understand it. While there is much more for me to learn, I gained so much fundamental knowledge in this class, and feel that Ed is an instructor who got to see me grow a lot throughout the semester. I feel that I participated much more actively than usual in this class compared to other courses I've done at CSU, so I think Ed would be an ideal instructor for me to reach out to.
4) James Henriksen, email: jamesrh@rams.colostate.edu. James was one of the key stakeholders that I worked with for my capstone project. I worked with James frequently during this project, as I was very involved with the microscopy aspect of it. James taught me how to do DIC microscopy, and I was able to take some exciting photos and videos of microbial life from samples.

## II. Develop draft paragraphs for your Personal, Relevant Background and Future Goals Statement.

### Personal Background

Being raised in Colorado, I was fortunate to grow up with the great outdoors right in my backyard. I spent my summers as a kid camping in national forests, building terrariums, and learning about the environment through direct exposure. These experiences were the beginning of an exciting curiosity - to understand the inner workings of the environment and its constituents - that has followed me throughout my life, and which motivated me to study ecosystem science and sustainability as an undergraduate student at Colorado State University.

### Intellectual Merit

During my time at Colorado State University, I have taken several courses that have helped to prepare me for future academic endeavors. Of note, the classes that I found most fulfilling were those that focused on ecology. In these courses, I gained fundamental understanding of several key topics, including nutrient cycling, dynamic systems, soil taxonomy, atmospheric composition, plant ecology, and ecosystem production. Outside of the classroom, I had the opportunity to apply my knowledge in a lab setting, working as an undergraduate research assistant in Dr. Cynthia Brown's lab at Colorado State University As a research assistant, I worked alongside graduate student Lauren Myers, whose research project was inspired by the work of Boulder County Parks and Open Spaces (BCPOS), an agency that uses indaziflam as a restoration tool. Indaziflam is a pre-emergence herbicide used to manage Bromus *tectorum*, commonly known as cheatgrass, an invasive annual grass common across the western United States. Indaziflam halts cellulose production, preventing radicle formation and seed emergence. While indaziflam can effectively reduce cheatgrass cover, BCPOS was unsure of the herbicide's impact on the native seedbank. This helped to inform the research question of our study: Does indaziflam inhibit seed

emergence for native species in Colorado? For this study, we used 14 species, 11 of which were native and 3 of which were invasive. Functional groups used included invasive and native grasses and native forbs. For our study, we planted seeds of each species in planting trays using two types of soil: topsoil and sand mix (50% topsoil and 50% sand by volume). We sprayed trays with indaziflam at varying rates, with a control rate of 0 fluid oz/acre and our highest rate, 7 fluid oz/acre, set at 2 times the base label rate. Our study included 3 repetitions, each with 10 trays of each soil type. We observed each set of trays for 6 weeks in a greenhouse and took daily measurements of emergence, height, injury symptoms, and true leaf emergence. We also collected soil and sprout samples from trays at the end of each repetition. After helping with data collection and entry, I took on my own sub-project and used our data to investigate interactions between functional group & rate and seed weight & rate as predictors for emergence. I used R to create generalized linear models and to create plots that demonstrated trends across groups. I had the opportunity to present my project at Colorado State University's Celebrate Undergraduate Research & Creativity event in 2025. My experiences as an undergraduate research assistant allowed me to see the research process go from theory to practice, and I got to participate in several stages, from planning to data collection to analysis. Creating my own sub-project allowed me to navigate these stages a bit more independently, and to practice using tools like R to analyze data and interpret summary statistics. Presenting my project helped me practice communicating to the broader public, and conveying the significance of the research we had done.

**Broader Impacts**

Participating in undergraduate research sparked a passion for me, and while I learned many skills from the opportunity, I also recognize that there is lots left for me to learn. Graduate school will give me the opportunity to practice the research process further, and continue to develop skills that I began to practice during my time in Dr. Cynthia Brown's lab. While I've learned so much as an undergraduate student, it can be difficult to take theoretical knowledge and translate that to a research project and applicable information for informing policy, management decisions, and other broader implications. Graduate school will allow me to practice this skill, learn new skills, and become more confident as a scientist. I hope that the skills that I gain will allow me to produce work that can be used by local, state, and national agencies for land management, restoration, combatting the effects of climate change, and progressing our collective understanding of biogeochemistry.

I also hope that my experiences will allow me to participate in scientific education as my career progresses. During my time as an undergraduate student, I had the opportunity to work as a lab teaching assistant for an introductory biology course. Helping my peers

learn foundational scientific knowledge and practice new skills in a lab setting was so exciting for me, because I got to see the beginning of future scientific careers, and use my knowledge to help people that may one day be my colleagues. Just as important as producing novel research is the passing of the torch to future generations of scientists who will lead the way in combatting the same issues that I hope to address throughout my career. Although I've always had an interest in science, I never thought that research was something that someone like me could pursue. I thought that I didn't come from the right background, and because no one in my family has gone to graduate school, I always thought I wouldn't either. My perspective changed because of the people that I've worked with as an undergraduate student, and the teachers that have inspired me and showed me that science is for everyone. I hope that one day I can be that person for someone too.

## III. Develop a draft Research/Program Plan Statement that includes the start of a literature review/background section. The literature review will include publications that inspired your choice of research or program plan and will serve as background materials that you are basing your Research/Program Plan on.

a. Identify 1-2 papers to start your literature review.

Sebastian, J., Swanson, J.K., Lauer, D. and Jones, L.C. (2025), Indaziflam for Cheatgrass (*Bromus tectorum*) control increased native species richness for up to 8 years in Colorado Front Range (United States) shrub-steppe. Restor Ecol e70163. https://doi.org/10.1111/rec.70163

b. Develop reverse outlines and summaries of the papers.

**Summary:**

Cheatgrass is an invasive annual grass that dominates swaths of land and thrives in the shrub-steppe ecosystems that characterize the Colorado Front Range. Indaziflam is an herbicide commonly used to control cheatgrass, shown to effectively reduce its cover. While previous studies have only considered the effects of indaziflam over a short-term period (2-4 years), Sebastian et al. present data on the long-term effects of indaziflam over a long-term period (6-8 years) across 12 sites in Boulder County. Their research suggests that indaziflam is effective for long-term cheatgrass control, and that native species richness, including rare and short-lived species, increases as a result. This is likely due to both reduced cheatgrass cover from indaziflam application and existing seedbank diversity. Data and analysis provided by this study can assist land managers in making more informed cheatgrass control and indaziflam application decisions.

**Abstract**

1) Provides key points, including the location of the study (12 sites across Boulder County), what cheatgrass is and why it threatens native biodiversity, the time scale (6 to 8 growing seasons), and the effects of indaziflam application (70-98% control of cheatgrass and increased species richness).

**Implications for Practice**

2) Just one application of indaziflam controlled cheatgrass for 6-8 years, allowing native species diversity to increase every year compared to nearby non-treated sites.
3) Cheatgrass control allowed all growth forms and long and short lived species to establish and develop resilient plant communities that were less likely to be reinvaded.
4) Sometimes just one application of indaziflam effectively controlled cheatgrass when the site only exhibited mild degradation.

**Introduction**

5) Indaziflam, an herbicide that kills cheatgrass seedlings by inhibiting cellulose biosynthesis, has been shown to be effective at controlling cheatgrass long-term, which could allow rare and short-lived plant species to reestablish.
6) Using pesticides can come with non-target effects, including negative effects on plant community composition, which should be considered when weighing the pros and cons of using indaziflam.
7) “Table 1. Published non-target abundance and diversity responses after indaziflam application.”
8) Most existing studies only consider short-term effects of indaziflam (2-4 years), while this study looks at the long-term effects (6-8 years), providing data that can help land managers make more informed indaziflam application decisions.

## Methods

9) The study included 12 locations across Boulder County, all exhibiting great biodiversity but also presence of cheatgrass, with a diversity of soil types, aspects, elevations, and land use.
10) “Table 2. Study locations in Boulder County, Colorado. At each location, a non-treated area of the same size and with similar slope and aspect was present adjacent to the treated area.”
11) Herbicide was applied to sites over a 3 year period between 2016-2019 using a tractor, spraying a solution of indaziflam (Rejuvra), glyphosate (Roundup), and non-ionic surfactant, with non-treated plots adjacent to treated plots used as controls.
12) Data on plant coverage was collected 9-12 times annually between March and November in each plot using transects, and species were categorized into

different functional groups using the CNHP Rare Plant Guide, the Flora of Colorado, and the USDA PLANTS database.

**Analysis**

13) Analysis was done using R, and cheatgrass cover was analyzed using a GLMM using the package “glmmTMB”.
14) Species richness was also analyzed, looking at metrics including gains and losses due to herbicide, with special interest on different effects between functional groups and longevity (short-lived species).
15) Species richness was also analyzed using a GLMM using the packages “glmmTMB” and “DHARMa”.
16) Beta diversity was assessed using the Sørenson dissimilarity index, and the temporal beta-diversity indices function in the R package “adespatial”.
17) Dissimilarity was compared between location-treatment plots 6 summers after treatment (SAT) as this was the longest period of time after treatment for all locations, and R packages “vegan” and “pheatmap” were used to produce metrics.

**Results**

18) Cheatgrass cover was significantly lower in treated plots than non-treated plots for all locations and across all SAT, with an 89-99% cheatgrass cover control when comparing treated plots to non-treated control plots.
19) “Table 3. Mean comparison tests for Cheatgrass cover (Chk = non-treated, Trt = treated, and SAT = summer after treatment).”
20) Figure 1: Show comparison of non-treated vs treated plot side by side, with the non-treated plot being covered by senesced cheatgrass with very little native plant coverage in between and the treated plot being covered by native plants.
21) Species richness increased significantly as a result of the variables summer after treatment and herbicide application in treated plots, with GLMs showing a 22-116% increase in species richness compared to non-treated plots and significant increases in short-lived and forb richness.
22) Figure 2: Shows increase in species richness for each functional group for each summer after treatment between non-treated and treated plots.
23) Mean total native species richness over 6 SAT was between 47 (low) -76 (high) in non-treated plots and 69 (low) - 165 (high) in treated plots, with 61% greater species richness of short-lived native species in treated plots vs. non-treated plots.
24) Species gain was much greater than species loss in all treated plots, and paired t-tests showed that proportional differences were significant for every SAT and functional group other than shrubs at 2 SAT.

25) Figure 3: Shows dissimilarity (gain + loss) for all species for each summer after treatment.
26) Figure 4: Shows dissimilarity for all functional groups for each summer after treatment.
27) All native functional groups were more often found in treated plots vs non-treated plots, and although rare species data was limited, 1-4 rare species were found in all treated plots whereas only 1 rare species was found in only one non-treated plot.
28) Dissimilarity was greater across non-treated locations than treated locations.
29) Figure 5: “Bray-Curtis treatment-location dissimilarities six summers after treatment for all 247 species across 12 locations.”

**Discussion**

30) This study suggests that indaziflam treatment is effective long-term (up to 8 years), and this is likely due to depletion of cheatgrass seeds in the seedbank, allowing native species richness to increase and treated plots to remain resistant to future cheatgrass invasion.
31) Richness increases were particularly high for short-lived species, contrasting previous research, therefore this increase was likely due to an existing diverse and resilient seedbank.
32) Non-treated plots exhibited fluctuation over the course of the study in native species richness likely due to precipitation differences, while treated plots exhibited yearly increases in richness likely due to reduced cheatgrass cover that allowed native species greater water resource availability.
33) Non-treated plots were more dissimilar across locations than treated plots, indicating that indaziflam treatment increases richness and decreases dissimilarity across treated sites.
34) Results can be used to exemplify harms of cheatgrass on native species richness, show how invasive species control and biodiversity can prevent cheatgrass reinvasion, demonstrate importance of long-term observation of indaziflam effects, encourage prioritization of land stewardship, and exemplify fast native species recovery in response to reduced cheatgrass cover.

**Acknowledgments**

This short section just recognizes various people who were not listed as authors but who helped with the study.

c. Identify key aspects of the papers for your literature review.

Invasive annual grasses, cheatgrass, native species richness, shrub-steppe ecosystems, land management

d. Update your reference section from Assignment I to include the papers in your literature review.

## References


Brandeis University. Reverse Outlining. (n.d.).

National Science Foundation. (2025, August). NSF 24-591: NSF Graduate Research Fellowship Program (GRFP).

Sebastian, J., Swanson, J.K., Lauer, D. and Jones, L.C. (2025), Indaziflam for Cheatgrass (Bromus tectorum) control increased native species richness for up to 8 years in Colorado Front Range (United States) shrub-steppe. Restor Ecol e70163. https://doi.org/10.1111/rec.70163