Cowboys and Aliens: Cheatgrass Management in Wyoming
A Socio-Environmental Case Study

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Teaching Notes

Abstract

In this case study, students learn socio-environmental synthesis through the lens of a land management dilemma -- creating a management strategy for an alien plant species in Wyoming. Students are first given background on the invasion of cheatgrass (*Bromus tectorum*) on western rangelands, and then introduced to the study area, a large tract of public land at risk of cheatgrass invasion after a severe fire. Students are assigned to one of three teams: residents of a town adjacent to the public land, economists, and ecologists, in order to represent the social, economic, and scientific implications of six different possible management strategies that the state could take on the parcel. After consulting and deciding on priorities and goals within these three groups, mixed groups will be created for students representing these different backgrounds to work toward a solution that satisfies the concerns of all parties. While students will be introduced to technical aspects of invasion ecology and ecosystem management (e.g. ecological concepts such as succession, and management strategies such as targeted grazing and chemical control), the broad goal of the project is to engage students with the sociocultural, economic, and ultimately political dimensions of different management approaches, and what possible communicatory strategies might exist for working with diverse groups of stakeholders. This case study would be most appropriate for an upper-division course in ecology, rangeland or wildlife management, botany, or natural resources and/or environmental studies.

Objectives

- Understand the concept of a socio-environmental system
- Recognize the interactions of political, economic, and sociocultural factors with scientific information and science-based ecosystem management
- Synthesize multiple different kinds of input in ecosystem management decision-making and planning
- Articulate the value in synthesizing different types of knowledge and data in making ecosystem management decisions; further, identify both challenges and successes

Topical areas: Rangeland and wildlife management; Community ecology; Invasion ecology
Level: Mid-level and upper-level undergraduate
Type: Small group, class discussion

Introduction

Invasive plants are of serious concern in the western United States, and one of the most devastating invaders is cheatgrass (*Bromus tectorum*), an invasive annual grass with the ability to decimate native perennial communities. Cheatgrass can quickly become dominant; a C3 grass that greens up early in the season, it can rapidly form monospecific stands in the absence of competition (such as in the early season after a fire). It is particularly devastating in sagebrush

communities because sagebrush does not recover quickly after fire, giving cheatgrass a window in which to establish. Once established, cheatgrass provides a constant, fine fuel load and facilitates frequent high-intensity burns unlike the occasional low-intensity fires common in native sagebrush communities. Therefore cheatgrass perpetuates its own dominance. It is an ongoing management problem in the west and there are no easy solutions once cheatgrass is established on a range.

This case asks students to consider a looming invasion by cheatgrass in a section of newly-burned sagebrush-dominated range, and to ultimately develop a management strategy that will appropriately respond to the threat of invasion. The site considered in the case is a fictional parcel of federally managed land in the Wyoming Basin shrub steppe ecoregion, referred to in the case as "Ram Mountain Area" (RMA). While RMA is not a real parcel, this case is entirely based on reality, and presents cheatgrass management concerns that are alive in well in Wyoming. Specifically, much of this case is based on management decisions and conversations that needed to be made on Forest Service land in the aftermath of the Squirrel Creek Fire in 2012 -- an event that is mentioned in the case study for reference. For the purposes of the case, a very generalized description of RMA is presented. This case is not intended to dig deeply into some of the site-specific nuances of cheatgrass management in the region, but to provide a framework for balancing sociocultural, ecological, and economic concerns when crafting a management approach.

While I would not recommend presenting this to students as simply a fictionalized account of a real fire (as it does amalgamate a few different management challenges), at the conclusion of the case study it may be useful to direct students to the Rocky Mountain Cheatgrass Management Project (a joint effort by the University of Wyoming and Colorado State University) for more information about management recommendations, history, and ongoing monitoring and experimental work.

This case presents students the opportunity to learn socio-environmental synthesis through a management planning process that approximates a real-world representation of different interests. Ecosystem management is an art form as much as a science, and managers must incorporate budgetary concerns, public opinion, historical land use, and regional context into their planning just as much as they incorporate scientific background and best management practices. This case study will give students practice applying different kinds of knowledge and experience to a pressing real-world problem with no single clear solution.

The case study would be most appropriate for a mid- to upper-division course in ecology, rangeland or wildlife management, botany, or natural resources and/or environmental studies. It is designed to fill two full course periods for 1.25-1.5 hour class, but can be adapted for shorter or longer sessions. It is primarily intended to teach students a socioenvironmental synthetic approach to problem-solving in ecological management, but it also develops and/or reinforces ecological and management concepts related to succession, alternative stable ecosystem states, and invasion ecology.

Learning goals

The case study addresses the following SES learning goals:

1. Ability to describe a socio-environmental system, including the ecological and social components and their interactions

2. Ability to identify disciplines and approaches relevant to the socio-environmental problem
3. Value different types of knowledge and understand the value of different knowledge sources
4. Ability to analyze and synthesize existing data
   a. Synthesize data of different types through group activity

Objectives

1) Understand the concept of a socio-environmental system

- *Activity*: Describing Ram Mountain Area in terms of its existence as a socio-environmental system -- identifying the different social and ecological factors involved in making a management decision, as well as how these decisions will ultimately create multiple kinds of impacts

2) Recognize the interactions of political, economic, and sociocultural factors with scientific information and science-based ecosystem management.

- *Activity*: Framing of case study explicitly in SES terms; students are told ahead of time that they will be required to match their knowledge related to certain management strategies with different kinds of knowledge, and must prepare for these interactions in small groups

3) Synthesize multiple different kinds of input in ecosystem management decision-making and planning

- *Activity*: Using "stakeholder group" background in a mixed-stakeholder group to cooperatively decide upon *and justify* a management decision; must acknowledge value of different types of inputs in order to form a persuasive management proposal

4) Articulate the value in synthesizing different types of knowledge and data in making ecosystem management decisions; further, identify both challenges and successes

- *Activity*: Concluding discussion in which students are asked to identify the reasons for accounting for multiple types of input, as well as identify what difficulties they faced and what were their greatest successes

Classroom management

Day 1:

The following two readings are suggested, at a minimum, to be assigned PRIOR TO Day 1, so that students enter with some background knowledge on the Wyoming Basin sagebrush steppe and the introduction of cheatgrass. Further reading related to succession and alternative ecosystem states may be assigned at the instructor's discretion.

1) World Wildlife Fund. Wyoming Basin shrub steppe. http://worldwildlife.org/ecoregions/na1313
2) Ypsilantis, WG. 2003. Risk of Cheatgrass Invasion After Fire in Selected Sagebrush Community Types. Resource Notes (BLM) 63. http://www.blm.gov/nstc/resourcenotes/respdf/RN63.pdf

The first day of the case study exercise is intended to be an "introductory day" in which students are given a basic foundation in the ecological concepts that underly questions of invasive species management, as well as an introduction to cheatgrass and its history in the west. Students with more extensive background in ecological theory may not require as much introduction to concepts of succession and alternative stable states, but a basic primer on invasion ecology is likely necessary. After reviewing these concepts, students will be introduced to the Ram Mountain Area problem and the case study task assigned. From there, they will be broken into their three groups and given instructions on how the following class (in which the case study will be run) will proceed.

A generalized timetable for Day 1(assuming a 1 hour, 25 minute course period) is below. It is written with the assumption that the students have some baseline understanding of community ecology concepts, and should be adjusted according to student background:

40 minutes: conceptual review of succession, alternative states, and invasion

-5 minutes: reviewing the concept of Clementsian"succession"

- But do ecosystems always end up at a single, predetermined "climax" state? Have students think of example ecosystems where this may not be the case

-10 minutes: alternative stable states

- [Modification] May introduce or review "state and transition models" if a range management oriented course
- "Basins of attraction" -- once an ecosystem is shifted to a new state, it may be difficult to move it into its "original" condition
- Example: California Annual Grasslands (now managed as an annual grassland)

-25 minutes: introduction to invasive species

- Elton: the "war" metaphor ("invasion"), concept of "ecological resilience"
- Steps of invasion: 1) Introduction; 2) Establishment; 3) Spread; 4) Impacts
- Have students list invasive species with which they are familiar -- what are some of the impacts they know about from these species? (Can be plants, animals, etc. -- the goal is to brainstorm)
- Review concept of "propagule pressure"
- Connecting invasive species back to succession/alternative states
- Dealing with invasive species is an ECONOMIC problem as well as a biological problem: how do we count the costs of invasive species? There have been many attempts to measure the economic impact of invasive species -- what would you measure?
- There are also sociological components: how do people feel about "invasive" species (try to get students to recognize there is a moral judgement in the name). Are there non-native species in the United States that we feel "good" about? Why? (e.g. horses!)

10 minutes: cheatgrass in the west

- Give context: originally from Eurasia, several ideas about how it was introduced
- Aldo Leopold: "One simply woke up one fine spring to find the range dominated by a new weed...cheatgrass…"
- Ask students: why do we consider cheatgrass an "invasive" species? (e.g. how does it spread and have impacts?) How does cheatgrass get into new areas? Where do you think it might be most prone to spread? (Disturbed areas…) What kinds of impacts does it

have? -- sagebrush evolved with infrequent, low intensity fire, cheatgrass facilitates frequent, high intensity fires -- consequences?
- Transition: the case study is going to ask you to consider cheatgrass and how it can best be managed, taking into account ecological, sociocultural, and economic information.

15 minutes: site description and introduction to SES
- What do students know about the Wyoming Basin sagebrush steppe? What's the climate like? What kinds of species?
- Southeast Wyoming, Snowy Range overview
- "Ram Mountain Area:" federally administered, 15,000 ac, sagebrush transitioning into montane environment
- Scene setting: Ram Mountain Area has very recently burned (summer) -- agency administering it has a few months before spring begins to decide how to manage for cheatgrass, which has been identified in the area but has not yet invaded due to healthy sagebrush community (which is now partially burned and will be slow to recover)
- **What is a socioenvironmental system? How is RMA an example**? Why is it applicable to this particular scenario? What factors besides biological site descriptions might influence how we choose to approach this problem? (use SES as transition point to begin explaining the task) What IMPACTS do management actions have on ecology, economics, and society at large? (can brainstorm broadly here)

<u>***at this point, hand out the Background, Problem Description, and Task handout and the Management Strategies handout***</u>

20 minutes: review task and management approaches; assign groups

-10 minutes: reviewing task
- Using the information given to you in class, in the readings, and in handouts, you will be asked to develop management recommendations to present to the administering federal agency; management proposals will ultimately be justified through ecological, economic, and sociocultural means
- Explain that class will be split into three groups of equal size to represent groups looking at possible management strategies from these three angles
- Students will be assigned a role -- your job will involve taking on a "point of view"
- Homework assignment will be to familiarize yourself with the possible management actions described in the handouts from the point of view of the stakeholder group you are supposed to represent; at the beginning of next class, you will meet with other members of your stakeholder group to discuss and prioritize the options presented
- Students will then meet in "split" groups (all stakeholders represented) to attempt to agree on a management recommendation -- this will be (briefly) shared with the class
- STUDENTS MAY ADVOCATE FOR MULTIPLE MANAGEMENT ACTIONS. However, adopting multiple strategies doesn't happen in a void! Is it cost effective? Risky? How do people feel about it? Must be justified ecologically, economically, socioculturally, whatever position you advocate for. The stronger and better-grounded your case, the more likely the agency will take your advice
- Students may bring prior, extended, or outside knowledge to the conversation, but primarily conversations should be based on info sheets

-10 minutes: review management options
- Hands off (no intervention, continued monitoring)
- Fire suppression

- Targeted grazing
- Competitive seeding
- Mechanical treatments
- Herbicides

[Modification] -- in a management oriented class, it may be desirable to supplement the information given to students with more technical detail; the handouts provided are intended for students with little to no background in weed management/control. **The management actions as presented have been intentionally simplified for ease of discussion by students with varying background knowledge.** During the case study, be aware that students may ask for details -- you may choose to provide them if you so desire, but remind them that they have enough to work off of with the information provided.

-divide into groups and answer questions: students may be assorted due to interests or at random depending on instructor discretion

Day 2: running the case study

Day 2 is more of a "hands off" day while students work through the case study under the direction of the instructor. While instructors should "float" to keep students on task and generally make sure everyone is keeping to the schedule, resist intervention as much as possible!

One note: mechanical treatments are a non-viable (generally) treatment for cheatgrass; this inclusion is intended to get students to articulate the concept of "propagule pressure" and reinforce concepts related to invasion. It also provides an opportunity to see what happens when the "scientists" try to communicate evidence-based management information to other stakeholders. What approach will they take? Might they ultimately insult other stakeholders? This could allow an avenue in the concluding discussion to talk about *how* these conversations unfolded. Communication is key!

The general structure for the day is as follows: students will meet within their stakeholder groups to discuss and justify their management preferences. Afterwards, students will meet in mixed groups to work out a management plan upon which all parties can agree. Each group must explain this plan in 2-4 minutes to the class at the conclusion of discussion time, and the case study will conclude with a full class discussion.

Note: the variable times suggested are related to class size. In a smaller class with few groups, less time is needed for presentations; in a larger class with potentially many groups, it may be necessary to slightly shorten the discussions in order to allow time for presentations.

15-25 minutes: meetings within stakeholder groups

- Emphasize to students that they must thoroughly discuss their priorities -- rank the options, including any combination methods that they have generated
- Rankings must be justified: try to come to a consensus within your stakeholder group so that you can have the best opportunity of communicating your concerns within all the mixed groups -- at the same time, remind students that they must be willing to match their concerns against the concerns of others

- Discuss generalized management concerns within stakeholder groups as well: how do you feel about the risk of a cheatgrass invasion? What's RMA worth to you?

25-30 minutes: meetings with mixed stakeholder groups

- Groups of 3-6 (depending on class size) -- 1-2 representatives from each stakeholder group
- Present your case rationally and straightforwardly, and try to work through any differences
- Come to a consensus about your preferred management strategy, justifying it from ecological, economic, and sociocultural positions
- If time, also elaborate on your LEAST preferred approaches, with similar justification
- A speaker must be selected to present your decision to the class
- Note: this is up to instructor discretion, but it may be advisable to remind students that their goal is to cooperate rather than "win!" Some students tend to want to "battle." A combative group, however, could provide an interesting opportunity to demonstrate the consequences of failure to cohesively and respectfully consider all key points of view.

30-45 minutes: Presentations and discussion

- Each group presents and defends management proposal for 2-4 minutes
- Were there common themes and threads or a diversity of suggestions? Why do you think this happened?
- What were the particular "strong points" observed in different group management approaches?
- Were there management strategies that were generally more popular? Why or why not?
- What were the biggest challenges in coming to a consensus? What worked well in your discussion?
- What did you learn from this exercise? Why is it important to consider multiple kinds of information, input, and points of view when making a decision in a socio-environmental system?
- If desired and/or time is limited, may assign students a short reflection paper homework, for discussion in the next class. This will allow the instructor to assess the success of the activity in communicating SES-related goals.

This case study is not intended to resolve to one clear answer (other than mechanical treatment not being a particularly viable form of management for cheatgrass). There is no "right answer." At the conclusion of the activity, emphasize to students that the importance of the activity lies in the process of decision making using multiple forms of input, and recognizing these forms of input (and generally, the use of a synthetic approach to problem-solving) as crucial in making robust decisions in a socio-environmental system.

<u>Blocks of Analysis</u>

Public lands as socio-environmental systems

Stakeholders have a complicated relationship with public lands, especially in the west. In Wyoming, for example, almost half of the state land-base is public. This means that citizens naturally have opinions, concerns, and values associated with these tracts of land. Additionally,

the economics of public lands are always important to consider when understanding how they function: the BLM often issues grazing or energy leases, the Forest Service manages for timber, and many state lands serve as habitat management areas, seasonal hunting grounds, or sites for recreation. While the RMA example does not include any energy dynamics, it does require that students recognize that there are important factors in understanding any parcel of public land that go beyond simple scientific site descriptions.

Invasion ecology and management

Invasive species are a key threat to ecosystem stability and functionality. Indeed, they are often referred to in terms usually reserved for descriptions of wildfires. Invasive annual grasses are a particular threat in the west due to the ways in which they can potentially alter native perennial communities. This can have habitat implications for sensitive species, hydrologic impacts that affect humans (e.g. alteration of snowpack dynamics), and can also impact rangelands and the extent to which they can be used for grazing. Invasive species are studied biologically, but also by necessity involve economic and other social analyses; the very concept of "invasion" is morally loaded. Elucidating the ways in which understanding and managing invasion is tied to human interests and needs is key to understanding why invasions unfold the way they do and what management practices might be used in the presence of an invasive species.

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