



**teton science schools**  
EDUCATING FOR A VIBRANT WORLD

**Teton Science Schools and Rhodes College  
Maymester Course Offering  
Rocky Mountain Ecology Field Research  
Summer, 2018**

**Course Title:** Rocky Mountain Ecology Field Research

**Instructors:** Kevin Krasnow, Ph.D., Jordan Nobler, M.S., Christina Aragon, B.S.

**Course Dates:** May 27 – June 21, 2018 **Semester Credits:** 4 **Contact Hours:** 165+

**Foundation Credit:** F7 and F11

**Accommodations:**

- 21 nights at Kelly Campus in rustic log cabin setting
- 4 nights/5 days camping in Yellowstone

**COURSE OVERVIEW**

This field-based course is focused on the ecology of the Greater Yellowstone Ecosystem (GYE). Topics include: the influence of large-scale, regional abiotic processes (such as geology, climate and water cycling) on ecological patterns and processes; community composition and interactions among organisms; community dynamics and patterns of succession; natural disturbance regimes (such as fire and disease); trophic interactions among organisms; social-ecological systems; human influence and management; and identification/taxonomy of plants, mammals and birds. Students will become familiar with basic processes of field inquiry, project design, research techniques and data collection, analysis, and presentation. Field examples and manuscripts illustrating regional research concerning topics covered in this course will be presented throughout.

**EDUCATIONAL OBJECTIVES**

1. Engage the discipline of ecology – as defined by the interaction of biotic and abiotic factors across multiple scales in space and time, from geologic, climatic, and disturbance drivers, to floral and faunal interactions and adaptations, to human influence and management.
2. Learn to identify and conceptualize key ecological patterns and processes that define the GYE, such as historical glacial activity, spatial distribution of vegetative communities, disturbance regimes, and trophic cascades.
3. Explore interrelationships between organisms within and among dominant vegetative community types (sagebrush, aspen, conifer and riparian), topics include adaptation, diversity, competition, resource partitioning, predation, herbivory, succession and disturbance.
4. Develop taxonomic and field identification skills in ornithology, mammalogy, and botany.
5. Understand how human influence and management has and will continue to shape the GYE
6. Practice outdoor skills and managing risk in the Rocky Mountains.
7. Practice teamwork, listening, leadership, and cooperation by working in groups and utilizing the aptitudes and experience of all group members to complete projects
8. Engage scientific papers to understand how ongoing regional research add to our understanding of the ecological content of this course.
9. Practice the process of science by asking questions about ecological phenomena in the GYE and then collecting and analyzing data to answer those questions.
10. Develop an understanding of the purpose and limitation of statistics in ecological field research.
11. Present the findings of scientific research to peers and faculty.

12. Develop and apply science and ecological literacy skills to a novel setting.

## READINGS AND EQUIPMENT

There are no required texts for this course. The following field guides are optional:

- *Plants of the Rocky Mountains*: Kershaw, Pojar, and MacKinnon
- *The Sibley Guide to Birds*: David Sibley OR *National Geographic Field Guide to the Birds of North America*
- *A Field Guide to the Hoofed Mammals of Jackson Hole*, by J. Brad Stelfox and Lynne Lawrence

### Assigned Readings

As this course progresses, you will receive digital copies of the assigned readings listed in the course schedule below. We will also be utilizing a recent National Geographic issue that focuses on the GYE (provided).

### Optional Background Reading

The following books are recommended as pre-trip reading:

- *Mountains and Plains: The Ecology of Wyoming Landscapes*, by Dennis H. Knight. An excellent book covering the vegetative communities of WY
- *Creation of the Teton Landscape: A Geological Chronicle of Jackson Hole and the Teton Range*, by David J. Love, John C. Reed, and Kenneth L. Pierce

### Student Equipment Required

Field notebooks, field clothes, binoculars (recommended), hand lens (recommended). You will receive a detailed equipment list related to traveling and living in the Rocky Mountains.

### Expectations and Assessment

This is a letter grade course. Rubrics will be provided for all assignments. Grading is based on the percentile scale below, and grade point credit will be awarded on an 8.0 scale, see table below. Daily attendance is mandatory per policy. Students are expected to complete work in a timely and professional manner. The equivalent of 0.5 points per day will be deducted for late assignments.

Category	Description	Score	Grade
<b>Exceptional</b>	<b>Exceeding expectations</b> ; indicates mastery; in-depth understanding; higher-order thinking; inferences, and extensions of learning objectives that go beyond what was taught; truly superb effort	7.7-8.0	A +
		7.4-7.6	A
		7.0-7.3	A-
<b>Proficient</b>	<b>Meeting expectations</b> ; application of concepts; independently demonstrates understanding and thorough competency of learning objectives explicitly taught	6.4-6.9	B+
		5.8-6.3	B
		5.3-5.7	B-
<b>Developing</b>	<b>Approaching expectations</b> ; demonstration of fundamental, basic understanding without application and understanding of more complex ideas and processes; meets minimum requirements for satisfactory learning	4.8-5.2	C+
		4.4-4.7	C
		4.0-4.3	C-
<b>Insufficient</b>	<b>Below expectations</b> ; partial or no demonstration of understanding and progress toward learning objectives; major errors and omissions present; inadequate for competency	3.0-3.9	D
		0-2.9	F
<b>Incomplete</b>	Student has not completed coursework due to medical or family emergencies. Credit received on course completion.		I

## COURSE SCHEDULE

\*Instructors reserve the right to change course material and schedule to enhance the learning experience for Rhodes students. Please see all activities in this schedule as flexible.

### Week #1

#### **Sunday, May 27 - Arrivals**

- Arrival to Teton Science Schools
- Tour of campus
- Orientation

#### **Monday, May 28 – Intros, TSS Culture, Risk Management, Reading the Landscape**

- Morning-Afternoon: Welcome, TSS culture, and syllabus overview, wilderness 101 and risk management – living and learning in the GYE; wildlife training
- Day: Reading the GYE landscape – intro to ecology, ecological patterns and processes, biotic and abiotic components, dominant vegetative communities, adaptation to a harsh climate, intro to geologic processes of the GYE.
- Evening: Field Journaling

#### Reading:

- Knight, D. et al. (2014). Mountains and Plains. Chpt. 15, The Greater Yellowstone Ecosystem pp. 245-265.

#### **Tuesday, May 29 – Rock and Ice: Abiotic Processes Drive Life in the GYE**

- Morning: Climatic and geological formation processes
- Afternoon: Hydrologic and erosional processes
- Evening: Reading a scientific paper, teambuilding

#### Readings:

- Clark, T.W (1999). *The Natural World of Jackson Hole Ch.2: The Physical Environment*,
- Love, J.D.; J. Reed, and K. Pierce (2003). *Creation of the Teton Landscape: A geological chronicle of Jackson Hole and the Teton Range, Chapter 1: The Story Begins pp. 1-11*

#### **Wednesday, May 30 – Community Ecology I: Sage-Aspen Community Ecology, vegetative adaptations**

- Morning: Exploring communities, ecotones, adaptations, and diversity using flora and fauna as guides
- Midday: Sagebrush ecology, competition, wildflower identification
- Afternoon: Aspen ecology; Aspen-conifer succession
- Evening: Natural history focus

#### Readings:

- Knight, D. et al. (2014). Mountains and Plains. Chpt. 7, Sagebrush pp. 109-130.
- Knight, D. et al. (2014). Mountains and Plains. Pages 166-171 in Chpt. 10, Escarpments and the Foothill Transition.
- Knight, D. et al. (2014). Mountains and Plains. Pages 173-175 and 196-199 in Chpt. 11, Mountain Forests.

#### **Thursday, May 31 – Community Ecology II: Conifer Ecology, Abiotic and Biotic Drivers of Disturbance**

- Morning-early afternoon: Conifer community, tree identification and life history
- Mid-afternoon: biotic disturbance, abiotic disturbance
- Evening: off

#### Readings:

- Knight, D. et al. (2014). *Mountains and Plains*. Chpt. 11 Mountain Forests (pages not read yet)
- Knight, D. et al. (2014). *Mountains and Plains*. Chpt. 12 The Forest Ecosystem, pp 200-229.

- Schoennagel et al. (2004). The Interaction of Fire, Fuels, and Climate across Rocky Mountain Forests. *BioScience* 54(7):661-676.

### **Friday, June 1 – Community Ecology III: Riparian Ecology and Human Dimensions**

- Morning-afternoon: Riparian habitat and species diversity, trophic cascades, the importance of riparian habitat, vegetative structure, keystone species, apex consumers, and human influence
- Evening: Introduction to Social Ecological Systems

#### Readings:

- Wolf et al. 2007. Hydrologic regime and herbivory stabilize an alternative state in Yellowstone National Park. *Ecological Applications* 17(6): 1572-1587
- Knight, D. et al. (2014). *Mountains and Plains*. Chapter 4, Riparian Landscapes, pp 45-65.

### **Saturday, June 2 – Jackson and Yellowstone Prep**

- Morning: Natural boundaries, human boundaries: how have humans shaped and interpreted this ecosystem? (*National Museum of Wildlife Art*)
- Late morning through midday: Lunch and a little free time in Jackson
- Afternoon: Prep and pack for Yellowstone
- Evening: Pack personal gear and final preparation for Yellowstone

## **Week #2**

### **Sunday, June 3 – The Yellowstone Geo-ecosystem**

**Accommodations:** Bridge Bay Campground, Yellowstone National Park

- Early morning: Depart for Yellowstone
- Morning: Introduction to the Yellowstone geo-ecosystem (*West Thumb*)
- Afternoon: The Yellowstone super volcano and caldera (*Elephant's Back*)
- Evening: Intro to front country camping systems

### **Monday, June 4 – The Yellowstone Geo-ecosystem: continued**

- Morning: Hydrothermal geology & bacterial community ecology (*Grand Prismatic Overlook & Old Faithful*)
- Afternoon: Wildlife viewing (*Hayden Valley*)
- Evening: Land ethic, history of YNP, and the preservation movement

#### Readings:

- Leopold. 1949. "The Land Ethic." *Sand County Almanac*. Oxford University Press, London
- Wilson. 2014. America's Public Lands. Ch. 4 National Parks.

### **Tuesday, June 5 – Trophic Cascades in Yellowstone: Apex Consumers Shape Ecosystems**

- Morning-afternoon: Predator-prey ecology, food webs, trophic cascades, the importance of apex consumers for biodiversity and ecosystem health (*Mt. Washburn*)
- Evening: Set up camp at Tower, history of wolves in Yellowstone

#### Readings:

- Smith et al. 2003. Yellowstone after wolves, *Bioscience* 53(4): 330-340
- Ripple and Beschta. 2004. Wolves and the ecology of fear: can predation risk structure ecosystems? *Bioscience* 54(8): 755-766
- Ripple and Beschta. 2012. Trophic cascades in Yellowstone: the first 15 years after wolf reintroduction. *Biological Conservation* 145: 205-213
- Kaufmann et al. 2010. Are wolves saving Yellowstone's aspen? A landscape-level test of a behaviorally mediated trophic cascade. *Ecology* 91(9): 2742-2755

- Brodie et al. 2012. Climate change intensification of herbivore impacts on tree recruitment. *Proceedings of the Royal Society of Biological Sciences* 279: 1366-1370
- Middleton et al. 2013. Animal migration amid shifting patterns of phenology and predation: lessons from a Yellowstone elk herd. *Ecology* 94(6): 1245-1256

### **Wednesday, June 6 – Yellowstone in Context: the History and Future of Conservation on a Changing Planet**

- Morning-afternoon: YNP conservation history, wildlife viewing, discuss history and cultural/political symbolism and challenges of wolves, bears and bison, wilderness, and climate change
- Evening: Wildlife watching (Lamar Valley)

#### Readings:

- Leopold. 1949. "Thinking like a mountain." *Sand County Almanac*. Oxford University Press, London

### **Thursday, June 7 – Fire ecology, Grand Canyon, Postcard moments, Return to KC**

- Morning: Pack camp, head south, fire ecology, succession, fire management
- Afternoon: Grand Canyon of the Yellowstone, Harlequin ducks, Berry Fire
- Evening: return to Teton Science School, unload and clean supplies, sleep in a real bed, whew!

### **Friday, June 8 – Check in & Exam Prep**

- Morning: Individual check-in/feedback
- Afternoon: Exam study session
- Evening: Study Time

### **Saturday, June 9 – Exam and Synthesis**

- Morning: Mid-term exam
- Late morning: Review exam
- Mid-afternoon: Town (laundry, etc)
- Evening program: Free time in town

## Week #3

### **Sunday, June 10 – Explore and Relax in Grand Teton**

- Morning & Evening - TBD (historically a hike)

### **Monday, June 11 – The Scientific Process, Research Design, Research Proposal Development**

- Morning: Review of the scientific method, hypothesis testing, formalizing testable questions, brainstorm project ideas
- Afternoon: Leadership/communication exercise, Introduction to research proposal development, assign research groups, research proposal development – topic, hypothesis, question, research design
- Evening: Music at the Hoot

### **Tuesday, June 12 – Statistical Analyses, Research Proposal Presentations, and Field Preparation**

- Morning: Principles of data collection, intro to statistical analysis – use of Excel, R software
- Mid-Morning Workshop: Research proposal development - research design and statistical analysis
- Lunch: Present research proposals to class, student and instructor feedback
- Afternoon: Research proposal refinement, gather field gear, pilot test methods, and review field logistics
- Evening: Jackson Hole Bird and Nature Club presentation (*Teton County Library*)

#### Reading:

- Chapter 1: Fundamentals (pgs 1-5, through "Statistical Modeling") in Crawley, M.J. (2005). *Statistics, An Introduction using R*. Imperial College London, UK: John Wiley & Sons, Ltd.

### **Wednesday, June 13 –Research Project Implementation**

- Morning and afternoon: Field research project data collection preparation, data organization, set up for analysis
- Evening: Reading/work on research projects and/ or introduce transference project

### **Thursday, June 14 – Research Project Implementation, attend Research Seminar**

- Morning and afternoon: Field research project data collection, data organization, set up for analysis
- Late afternoon - evening: BBQ and research seminar at AMK ranch

### **Friday, June 15 – Research Project Implementation and Data Analysis**

- Morning - afternoon: Field research project data collection, data organization, set up for analysis
- Late afternoon: Begin data analysis

### **Saturday, June 16 – Data Analysis, Research Wrap-up, Presentation Preparation**

- Morning – evening: Data analysis, research wrap-up, presentation prep

### **Sunday, June 17 – Fun Day & Presentations**

- Morning: Final presentation prep
- Afternoon: Presentations: scheduled with group consensus

### **Monday, June 18 – Social-ecological Systems**

- Morning: Introduction to social-ecological systems
- Afternoon: Water quality and testing procedures, example presentation: Nutrient Loading in Fish Creek, Introduction to social-ecological system assignment
- Evening: Music at the Hoot (optional)

### **Tuesday, June 19 – Social-ecological Systems**

- Morning-afternoon: Research and work on social-ecological system project
- Evening: Presentations

### **Wednesday, June 20 – Course Reflection, Synthesis, and Celebration**

- Morning through midday: Group reflection, synthesis discussion, assessments
- Mid-afternoon: Hands to work and course evaluations
- Evening: Campfire celebration

### **Thursday, June 21 – Depart TSS**

- Clean dorms
- Departures

### **ASSESSMENT:**

**Mid-course exam (Sat., June 9)** **20%**

*Goal:* Promote understanding of course material and stimulate critical thinking skills

**Quality of participation in field exercises and discussions** **15%**

*Goal:* Stimulate interest in field studies and provide experience in collecting field data

Assessed after each section of the course.

**Course journal** **15%**

*Goal:* Provide structure for recording field observations throughout the course.

Assessed periodically during the course.

**Research Project** **30%**

---

*Goal:* As a group, students apply and expand their knowledge of the ecology of the GYE and the scientific method through designing, executing, and presenting self-directed research projects.

*Product:* 30 minute oral presentation

**Social Ecological System Presentation** **20%**

---

*Goal:* Examine a natural resource management issue through the Social Ecological System framework

*Product:* 8-10 minute presentation