

# TOBY MAXWELL

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## OVERVIEW

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Career emphasis on climate change, wildfire, and exotic grass affects on native plant resilience and soil processes in rangelands, with a special emphasis on carbon sequestration. Procured \$500,000 as lead PI and >\$250,000 as co-PI in the last 2 years from competitive national and regional science funding programs.

## EDUCATION

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**University of California, Davis**

September 2012-March 2018

*Ph.D. Agricultural and Environmental Chemistry - track in ecosystem ecology and soil biogeochemistry*  
*Adviser: William Horwath*

Dissertation Title: Advancing molecular to regional understanding of carbon-water relations in managed and natural systems across California

**State University of New York, Geneseo**

September 2007-May 2011

*B.S. Chemistry, Magna Cum Laude*

## WORK EXPERIENCE

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**Boise State University**

Apr. 2020 - Present, 40 hours/week, Salary - \$56,000/year

*Title: Research Ecologist*

*Project 1 - Project Director: Developing **scaleable management tools** to ameliorate the negative effects of **wildfire**, exotic plant invasions and soil degradation and improve **restoration success**, **above-ground productivity**, **native plant resilience**, and **soil carbon sequestration** in sagebrush steppe **rangelands**.*

*Project 2 - co-PI: Quantifying the impacts of and interactions between **climate change**, plant community and soil type on sagebrush steppe **rangeland state transitions** by assessing resistance to invasive plants and **resilience to wildfire and ecological drought***

### Responsibilities

- Complete the full research cycle for **comprehensive biological investigations in restoration ecology in sagebrush steppe rangelands across Southern Idaho**.
  - Assessment of gaps in the scientific literature and the **needs of Idaho Fish & Game, and Bureau of Land Management rangeland managers to inform co-production of grant proposals**.
  - Design, implementation and management of multiple field experiments to quantify plant community and soil biogeochemical responses to disturbance (e.g. wildfire, drought, restoration, herbicides).
  - Field sampling (plant community and soils), laboratory (soil Nitrogen and Carbon dynamics) and instrumental (elemental and stable isotope) analysis to assess restoration success, resilience, soil carbon stocks, and invasive plant management in sagebrush steppe rangelands.
  - Development of **multi-scale descriptive and predictive spatial and temporal statistical protocols in R** to analyze results from field and greenhouse experiments in restoration ecology.
  - **Production of manuscripts for submission to peer reviewed journals as the lead author**.
  - Supervision of interns and technicians. Serve as a mentor and **resource to M.S. and Ph.D. students for field, laboratory, and statistical methods in plant biology and soil biogeochemistry**.
- Collaboration with USGS Forest, Rangeland, and Ecosystem Science Center

Lead senior personnel: BromeCast: National research effort to unravel genotype by environment interactions of *Bromus tectorum* (Cheatgrass). Specifically - manipulating micro-climate to quantify the **impacts of climate change on Cheatgrass and improve prediction of its fitness in sagebrush**

**steppe rangelands** across the Western United States.

- Work with an interdisciplinary and inter-agency team of scientists to design field studies that evaluate fundamental biological responses of Cheatgrass to the **effects of environmental perturbations (i.e. soil climate manipulations) across rangelands in the Western United States.**
- Develop, **modify and adapt standard biological field procedures** to experimentally test for the impacts of climate change on plant phenology and demographics of cheatgrass.
- Deploy sensors for continuous monitoring of soil moisture and temperature in the field.
- Prepare manuscripts for publication in peer reviewed scientific journals.

**University of Oregon**

Apr. 2018 - Mar. 2020, 40 hours/week, Salary - \$42,000/year

*Title: Postdoctoral Scholar*

*Supervisor: Dr. Lucas Silva*

*Project 1: Evaluating the impacts of **climate change and invasive plants** on Carbon and Nitrogen cycling in Pacific Northwest **rangelands***

*Project 2: Assessment of **cross-scale biological responses to climate change** in Oregon's sub-alpine forests*

**Responsibilities**

- Independently design field experiments in rangeland and forest biology/ecology. **Adapt and modify standard biological field methods in forest and rangeland biology, and stable isotope ecology.**
- Collect, prepare and analyze tree cores for temporal growth trends (i.e. Basal Area Increment), soils, and plant material for physical (e.g. leaf mass area), chemical (carbon and nitrogen), and biological data (nitrogen mineralization) to inform **cross-scale investigations of climate change impacts on forest and rangeland aboveground productivity.**
- Know the taxonomy and ecology of common plants across Pacific Northwest rangelands.
- Run and maintain lab instrumentation (costech elemental analyzer, automated Soxhlet extractor, UV-Vis spectrophotometer) and maintain detailed records of methodologies and quality control on data collection.
- **Supervise and serve as a technical resource for technicians and undergraduate, M.S., and Ph.D. students in biological field and lab techniques, and statistical analysis.**
- Use Geographic Information Systems and R statistical software to **aggregate and analyze climate, soil, and plant community data for spatial and temporal trends.**
- **Prepare talks and posters to present research findings at regional/national/international scientific meetings and manuscripts for peer reviewed journals.**

**University of California, Davis**

Oct. 2012 - Mar. 2018, 40 hours/week, Salary - \$26,000/Year

*Title: Graduate Student Researcher*

*Supervisor: Dr. William Horwath*

*Project 1: Using soil-plant interactions to predict the impacts of climate change on carbon-water relations in Sierra Nevada Forests*

*Project 2: Identifying the impacts of drought and climate change on common wheat production across California*

## Responsibilities

- **Design experiments and adapt standard soil and vegetation collection methods** to quantify water use and plant productivity across diverse ecological landscapes in the Sierra Nevada, California.
- **Apply advanced statistical software (i.e. R) for descriptive and predictive multi-scale modeling.** Aggregation and analysis of ecological data sets with complex spatial and temporal dynamics.
- **Write manuscripts and reports for submission to peer reviewed scientific journals.**
- Use natural abundance and enriched stable isotope techniques to **study plant productivity and efficiency responses to climate change and land management.**
- Management and oversight of undergraduate interns and technicians.
- Restore, maintain, and generate protocols for gas chromatograph/mass spectrometer, trace gas analyzer, carbon and nitrogen elemental analyzer, HPLC, UV-VIS spectrophotometer.

### **State University of New York, New Paltz**

May 2010 - Sep. 2010, 40 hours/week

*Title: NSF Research Experience for Undergraduates Intern*

*Supervisor: Dr. Megan Ferguson*

*Determining the potential for chlorination to produce harmful disinfection byproducts in New York City's Water Supply*

## Responsibilities

- **Design and implement sample collection, processing, and storage protocols** for water quality samples from across the Ashokan watershed, New York.
- Measure water chemistry in field and lab – pH, conductivity, turbidity, dissolved organic carbon.
- Assess the the potential for chlorination to generate harmful byproducts in drinking water.

## **PUBLICATIONS & REPORTS**

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**Maxwell, T.M.**, Germino, M.J. (In review). The effects of cheatgrass invasion on US Great Basin carbon storage depend on interactions between plant community composition, precipitation seasonality, and soil climate regime. *Journal of Applied Ecology*.

Dawson, H.R., **Maxwell, T.M.**, Reed, P. B., Bridgham, S., and Silva, L.C.R. (In Review) Plant form-function relationships predict water-use efficiency under experimental drought in grasslands. *Journal of Experimental Botany*.

Renwick, L.L.R., Deen, W., Silva, L.C.R., Gilbert, M.E., **Maxwell, T.M.**, Bowles, T.M., Gaudin, A.C.M. (2021). Long-term crop rotation diversification enhances maize drought resistance through soil organic matter. *Environmental Research Letters*.

Broz, A., Retallack, G.J., **Maxwell, T.M.** and Silva, L.C.R, (2021). A record of vapour pressure deficit preserved in wood and soil across biomes. *Nature Scientific Reports*.

**Maxwell, T.M.** and Silva, L.C.R, (2020). A State Factor Model of Ecosystem Carbon-Water Relations. *Trends in Plant Science*

Liles, G.C., **Maxwell T.M.** et al., (2019). Two decades of experimental manipulation reveal potential for enhanced biomass accumulation and water use efficiency in ponderosa pine plantations across climate gradients *J. Geophysical Research Biogeosciences*.

**Maxwell, T.M.**, et al., (2018). Integrating effects of species composition and soil properties to predict shifts in montane forest carbon–water relations. *Proceedings of the National Academy of Sciences*

**Maxwell T.M.**, et al., (2018). Predictable oxygen isotope exchange between plant lipids and environmental water: implications for ecosystem water balance reconstruction. *J. Geophysical Research Biogeosciences*

**Maxwell, T.M.** (2018). Advancing molecular to regional understanding of carbon-water relations in managed and natural systems across California. *PhD Dissertation, University of California, Davis.*

Jeszurki, D., Couvreur, V., **Maxwell T.M.**, et al., (2017). Impact of root growth and hydraulic conductance on canopy carbon-water relations of young walnut trees (*Juglans regia* L.) under drought. *Scientia horticulturae*

**Maxwell, T.M.**, et al., (2014). Using multielemental isotopic analysis to decipher drought impacts and adaptive management in ancient agricultural systems. *Proceedings of the National Academy of Sciences*

Culman, S.W., Haden, V.R., **Maxwell, T.M.**, Waterhouse, H., and William Horwath. (2014). Greenhouse Gas Mitigation Opportunities in California Agriculture: Review of California Cropland Emissions and Mitigation Potential. NI GGMOCA R 3. Durham, NC: Duke University.

## **PUBLICATIONS IN PREPARATION**

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**Maxwell, T.M.**, de Graaff, M.A., Germino, M.J. How and why diversity may not confer community resistance to invasion: experimental evidence for cheatgrass in burned sagebrush steppe Target Journal: *Ecology*.

**Maxwell, T.M.**, Germino, M.J., Adler, P. Using colored gravel to manipulate soil microclimate, and test the impacts of climate change on plant phenology. Target Journal: *Rangeland Ecology and Management*.

**Maxwell, T.M.**, Bridgham, S., and Silva, L.C.R. Biodiversity drives ecological interactions that control native plant resilience to drought. Target Journal: *Nature Climate Change*.

**Maxwell, T.M.**, and Silva, L.C.R. Rising influence of soil properties over the last century explains shifting productivity thresholds in Oregon's sub-alpine forests. Target Journal: *Science Advances*.

## **PRESENTATIONS**

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**Maxwell, T.M.**, de Graaff, M.A., Germino, M.G. Pre-fire hydroclimate and plant-community composition influence post-fire soil resource availability and resistance and resilience in the sagebrush steppe. Abstract 92544, Oral Presentation at 2021 Annual Meeting, Ecological Society of America, Aug. 2-6.

**Maxwell, T.M.** Understanding the role of forests in the global carbon cycle and climate change. University of Oregon, Introductory Environmental Science Course. 23, October, 2019 (Invited).

**Maxwell, T.M.** From molecules to ecosystems: using plant-soil inter-relations to decipher climate change impacts on carbon-water cycles. University of Oregon Department of Geography Seminar Series, 7, March, 2019 (Invited).

**Maxwell, T.M.** Understanding the global carbon cycle: Feedbacks, disturbance, and the role of soils in driving forest responses to climate change. University of Oregon. Introductory Environmental Science Course, 11, February, 2019 (Invited).

**Maxwell, T.M.** Using stable isotopes to investigate forest carbon-water relations. UC Davis Stable Isotope Seminar, 5, Nov. 2018 (Invited).

**Maxwell, T.M.**, et al., Dynamic and inertial controls on forest carbon-water relations. Abstract PP31D-2311, Oral presentation at 2017 Fall Meeting, American Geophysical Union, New Orleans, LA, Dec. 11-15.

**Maxwell, T.M.**, et al., Soil properties drive carbon-water relations across a climate gradient in Sierra Nevada forests. Abstract 60315, Oral Presentation at 2016 Annual Meeting, Ecological Society of America, Ft. Lauderdale, FL, Aug. 7-12.

**Maxwell, T.M.**, et al., Soil properties drive water use efficiency across a climate gradient. Abstract B53G-0641, Poster presentation at 2015 Fall Meeting, American Geophysical Union, San Francisco, CA, Dec. 14-18.

**Maxwell, T.M.**, et al., Expanding lipid proxies to the next dimension. Abstract PP34B-02, Oral presentation at 2014 Fall Meeting, American Geophysical Union, San Francisco, CA, Dec. 15-19.

**Maxwell, T.M.**, et al., Quantifying carbon storage water Balance relationships using oxygen isotope ratios of Plant Lipids. Poster presentation at 2014 European Geochemical Society Goldschmidt Conference, Sacramento, CA, June. 9-12.

**Maxwell, T.M.**, et al., Quantifying carbon storage water Balance relationships using oxygen isotope ratios of Plant Lipids. Poster presentation at 2014 Soil Science Society of America conference: Soil's Role in Restoring Ecosystem Services, Sacramento, CA, March. 7-9.

## GRANTS & AWARDS

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USDA NIFA - Sustainable Agroecosystems, 2020 - Project Director - \$499,935, award: 2020-05120  
Co-Project Directors - Brynne Lazarus, Allison Simler-Williamson, Matthew Germino  
*Impact of diversity in the pool of exotic species invading rangelands: response of soil resources, productivity and restoration potential*

NSF DEB - Ecosystem Sciences Cluster, 2020 - Co-Principle Investigator - \$259,153, award: DEB-2037660

Principle investigator - Marie-Anne de Graaff, Co-Principle Investigator- Matthew Germino  
*RAPID: Opportunistic use of a naturally burned climate-manipulation study to test abiotic drivers of resistance and resilience of sagebrush-steppe landscapes*

National Geographic Exploration and Research, 2018 - \$5000, award: EC-422R-18  
*The climate paradox: mapping resilience and vulnerability of montane forests of Oregon*

Jastro Shields Research Award, 2015 - \$3000

William and Linda Sullivan Fellowship, 2014 - \$1240

## COURSEWORK IN ECOLOGY, BIOLOGY & PHYSICAL SCIENCES

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### Relevant undergraduate and graduate coursework

*See supplemental PDF for full course descriptions*

### Coursework in ecology - 32 quarter credits, 10 semester credits

Soil microbiology, soil genesis, experimental design and analysis, soil plant interrelations, applied multivariate modeling, geomorphology and river management, quantitative geography, conservation and resource management, environmental geology, environmental issues, exploring undergraduate chemistry lab - directed undergraduate research

### Coursework in basic and applied biology - 11 quarter credits, 23 semester credits

Environmental toxicology, soil physics, soil chemistry, biochemistry I/II, biochemistry laboratory, Organic chemistry I/II, lab techniques in organic chemistry, Modern analytical chemistry

### Coursework in physical/mathematical sciences - 3 quarter credits, 39 semester credits

Transition metal chemistry, General chemistry I/II, Calculus I/II/III, Analytical Physics I/II, Physical Chemistry I/II, Inorganic Chemistry

## WORKSHOPS AND TRAINING

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### **NSF Wildfire in the Biosphere Innovation Lab - invited participant - May 2021**

*Collaborative workshop designed to generate creative strategies and new research collaborations aimed at improving understanding of wildfire across temporal and spatial scales, predicting feedbacks between wildfire and living systems, and improving the representation of biological processes in models.*

### **University of Utah short course in stable isotope ecology - June 2014**

*Application of stable isotopes to study plant ecology, feedback mechanisms, and ecosystem dynamics, ranging from plant-ecology, to animal community dynamics and trophic structures.*

### **UC Davis soils field course - plant-soil interactions in California ecosystems - June 2013**

*Field classification of soil taxonomy, topographic features, land use classification, vegetation composition from the Great Basin desert, to Sierra Nevada alpine biomes across agricultural and natural ecosystems. Evaluation of ecosystem ecological interactions between animal-soil-plant-climate systems.*

## MENTORSHIP EXPERIENCE

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- **Kyle Calf-Looking**, *Field Technician*, September 2021–Present, Implementing and monitoring manipulative field experiments in SW Idaho Rangelands.
- **Logan Brauer**, *Field Technician*, May 2021 –December 2021, Monitoring rangeland plant communities after wildfire.
- **Ashley Leavell**, *Undergraduate Student*, May 2020 –May 2021, Determining the role of soil nutrient cycling as a driver of plant community recovery after wildfire
- **Hilary Dawson**, *Lab Technician*, May 2019–June 2020, Identifying the role of biodiversity and plant traits in determining ecological resilience of native plants in Pacific Northwest prairies
- **Adriana Uscanga**, *PhD Student*, August 2019–April 2020, Identifying the role of land use and interactions between soil and vegetation features in determining ecosystem services in Mexican cloud forests.
- **Sydney Katz**, *Undergraduate Student*, August 2019–April 2020, Determining thresholds for the transfer of isotopic signals in decomposing organic matter.
- **Jamie Wright**, *PhD Student*, April 2018–December 2019, Taught protocols and maintenance for lab instrumentation, statistical methods and interpretation of ecological data.
- **Michael Faranacci**, *Masters Student*, August 2018–August 2019, Connecting principles of plant ecology and soil science to understand the impacts of forest management.
- **Monika Ruwaimana**, *PhD Student*, March 2019–June 2019, Preparation of tropical soils for physical and chemical analysis.
- **Hunter Mackin**, *Undergraduate Student*, June 2018–June 2019, Measuring leaf traits and soil properties of forest soils.
- **Tara Seely**, *Masters Student*, August 2015–August 2017, Determining the role of climate change and management on ecophysiology and productivity in Almond Orchards.
- **Laura Emberson**, *Masters Student*, August 2015–August 2017, Identifying long term effects of climate change compared to management in common wheat in California cropping systems.
- **Lynette Williams** *Undergraduate Student*, May 2015–September 2015, Measuring the relationship between soil carbon storage and mineralogy.

## TEACHING EXPERIENCE

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### **Boise State University**

*Instructor of Record*

Global Change Ecology

*Fall 2021*

- Journal club with focus on top down climate change ecology.

- As instructor I provided the first four classes as lectures on background topics, and ways to improve science communication. The remainder of the course was student led discussions of recent impactful work in global change ecology.

**University of Oregon**

Environmental Soil Chemistry

*Lecturer*

*January 2019*

- Taught introductory lectures in the Soil Chemistry course at the covering applications of periodic trends in environmental science.
- Discussed applications of soil science to terrestrial ecosystem ecology and ecosystem restoration and rehabilitation.

**University of California, Davis**

Science and Society - Forests in Society

*Teaching Assistant*

*Spring 2014, 2015, 2016*

- Designed curriculum and taught 3x1 hour discussions per week including field-based labs, discussions, citizen science, and presentation skills workshops.
- Presented lectures and organized discussions on the science and policy of post fire restoration and rehabilitation in the Western United States.
- Gave in class lectures, wrote and graded tests and quizzes, held office hours.

**University of California, Davis**

Stable isotopes in environmental science

*Lecturer/Organizer*

*Fall 2015*

- Organized course, arranged for visiting speakers, lecturer.
- Lecture title: *Integrating carbon-water relations using multielemental and compound specific isotopic measurements*

**SERVICE**

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**Peer Review**

Spring 2017 - Present

- Served as a referee for peer review of the following journals: Agricultural and Forest Meteorology, Ecology, Global Change Biology, Journal of Geophysical Research: Biogeosciences, Plant and Soil, PLOS-ONE, Nature Communications, Nature Scientific Reports, Nutrient Cycling in Agroecosystems, Trees.

**Center for Land Based Learning**

Spring 2013 - Spring 2017

- Assisted high school programs from rural communities to participate in ecological restoration projects at reclaimed wilderness sites in coordination with agricultural land owners.

**Pacific Crest Trail Association**

Winter 2016 - Spring 2018

- Wrote scientific blog post about human-environment interactions along the trail.
- Clerical assistance for database organization and volunteer coordination.

**PROFESSIONAL MEMBERSHIPS**

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Soil Science Society of America

American Geophysical Union

Ecological Society of America

**OTHER SKILLS**

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Expert: R statistical environment; Microsoft office.

Proficient: QGIS; Google earth engine.

Proficient in Spanish conversation.