

Water Resources: Water, Land & Life Research

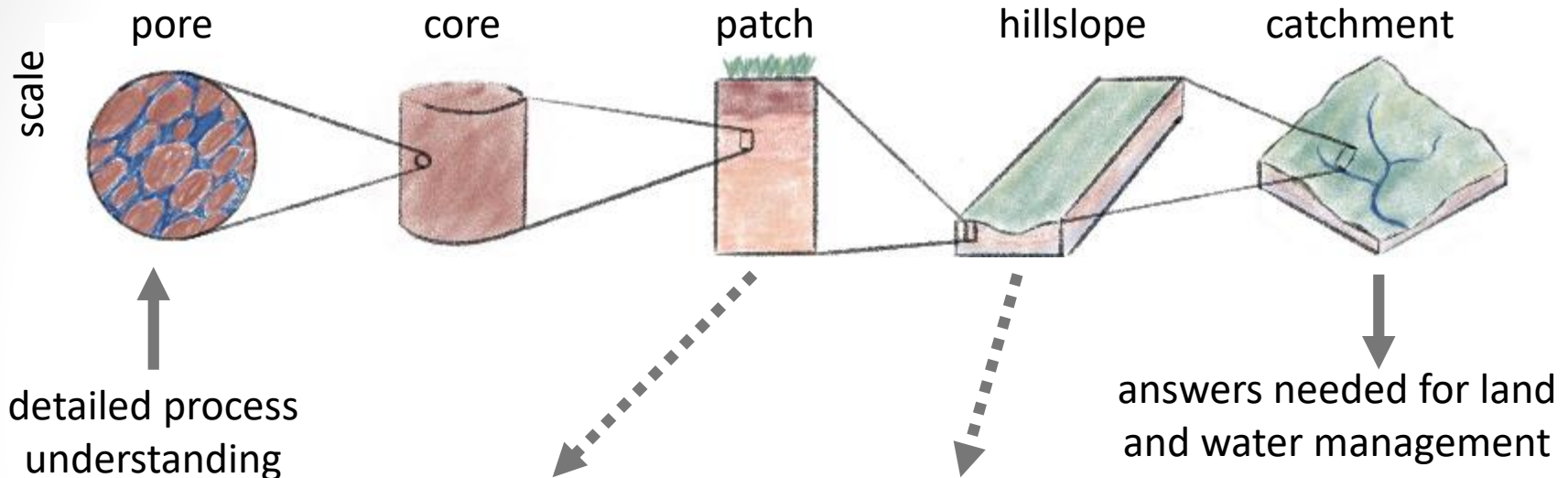
Critical Zone Hydrology

- **Dr. Hannes Bauser**
- Assistant Professor
- Department of Geoscience
- Email: hannes.bauser@unlv.edu
- Website: <https://geoscience.unlv.edu/people/departement-faculty/hannes-bauser/>

Expertise

- Vadose Zone Hydrology and Soil Physics
- Hydrologic Modeling
- Data Assimilation
- Machine Learning

Hydrologic Scaling Challenge



Collaboration with the Desert Research Institute for access to the [SEPHAS Lysimeters](#) in Boulder City.



Collaboration with the University of Arizona for access to the [Landscape Evolution Observatory](#) at Biosphere 2.

How can we use data science (e.g., data assimilation, machine learning) to combine process understanding and data to solve the hydrologic scaling challenge?

Dr. Dale Devitt

Professor

Director - Center for Urban Water Conservation

School of Life Sciences

Phone 702-895-4699

Expertise

Soil Plant Water Relations

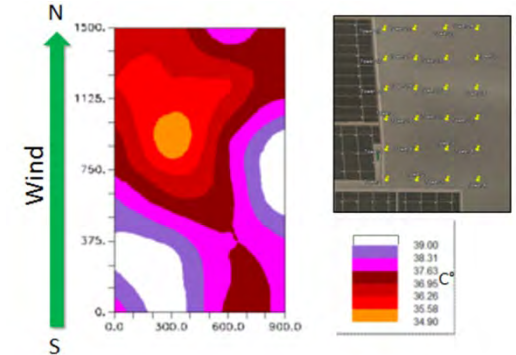
Water Management

Evapotranspiration

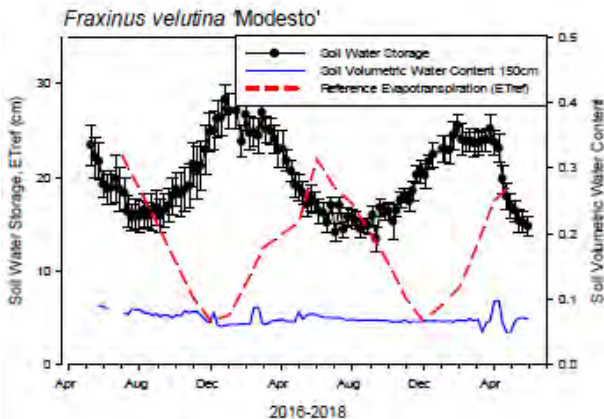
Salinity

Current Research

- Assessing the impact of large scale solar development on desert ecosystems.



- Tree grass water use tradeoffs in urban landscapes



10 acre research facility in North Las Vegas dedicated to conducting applied and basic water related research.



Response (growth, flower and seed production) of desert perennial shrubs to altered precipitation



Aqueous Geochemistry and Astrobiology

- **Dr. Elisabeth (Libby) Hausrath**
- Professor
- Department of Geoscience
- Email: Elisabeth.Hausrath@unlv.edu
- Website: <https://hausrath.faculty.unlv.edu/>

Expertise

- Using laboratory experiments, field work, and modeling to interpret water-rock interactions and soil-forming processes on Earth and Mars
- Interpreting the signatures of past aqueous and biological impacts on minerals
- Participating Scientist on the Mars Science Laboratory Curiosity and the Mars2020 rover Perseverance and member of the Network for Life Detection [\(NFOLD\)](#) Steering Committee..

Holes made by sampling soil on Mars



Image credit: NASA/JPL-Caltech

<https://mars.nasa.gov/news/9311/nasas-perseverance-rover-gets-the-dirt-on-mars/#:~:text=The%20mission's%20first%20two%20samples,prepare%20for%20future%20missions%20there.>

Sedimentary Geology

Dr. Ganqing Jiang

Professor

Department of Geoscience

Phone: (702) 895-2708

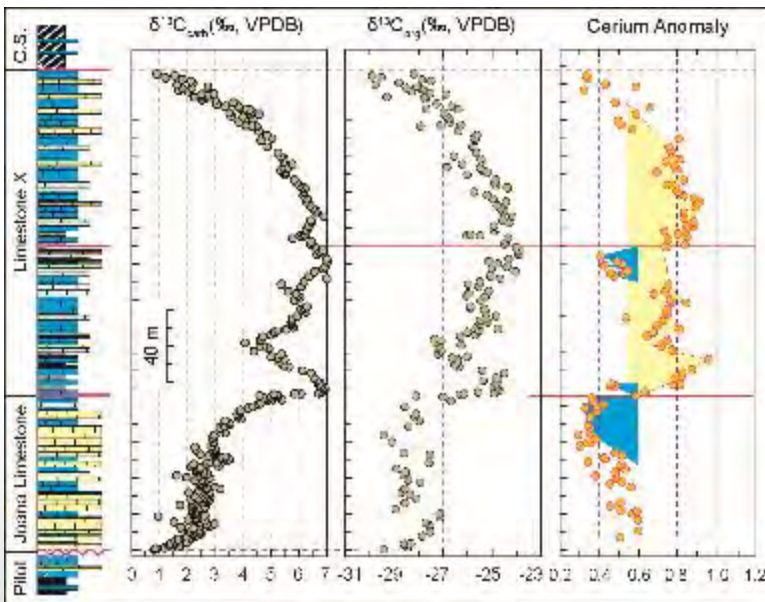
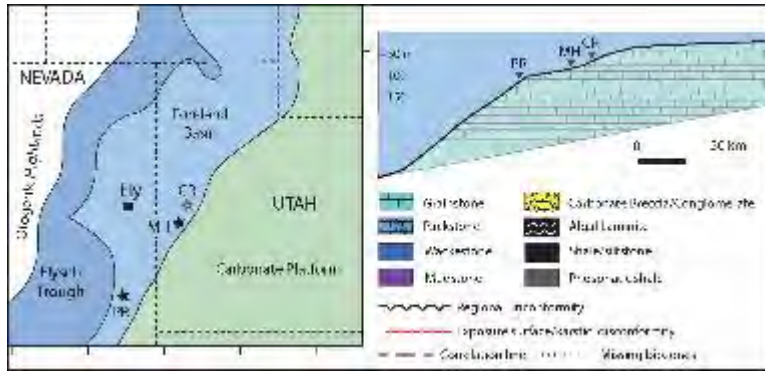
Email: Ganqing.Jiang@unlv.edu

Expertise:

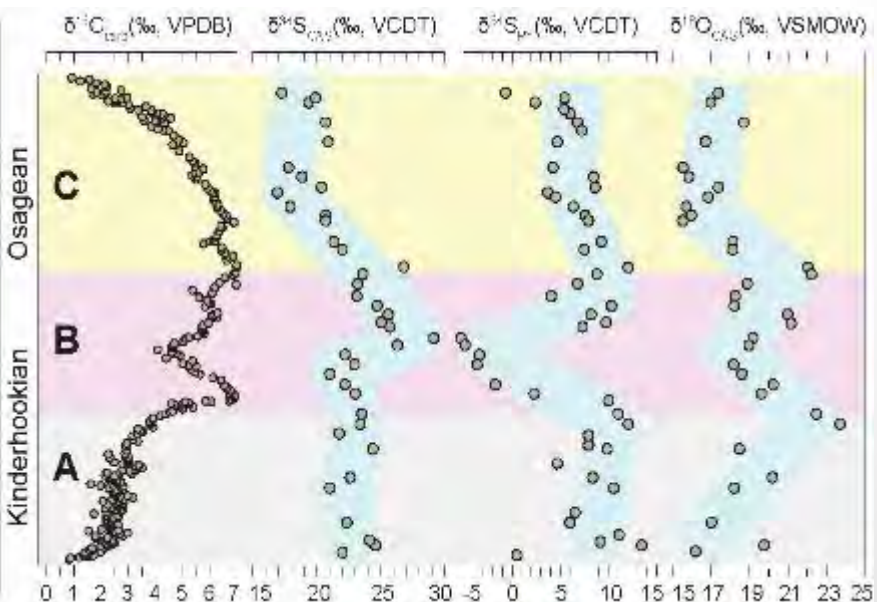
Sequence and chemostratigraphy

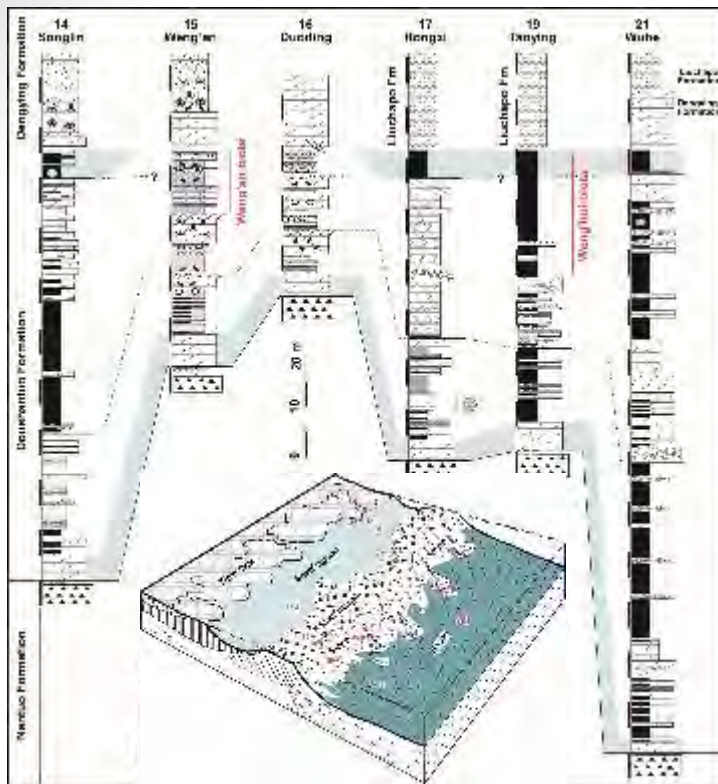
sedimentology

Carbonate diagenesis

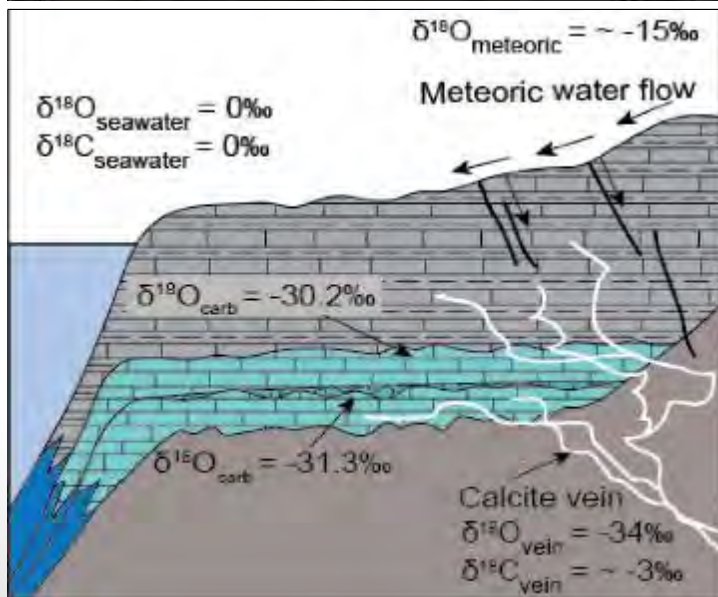


- Sequence and chemostratigraphy
- Paleogeographic reconstruction
- Applications of stable isotopes and rare earth elements
- Paleoenvironmental change across major perturbations of the carbon cycle and mass extinctions





- Basin analyses and paleoceanography
- Fluid migration and carbonate diagenesis
- Tracing fluid migration in sedimentary basins using stable isotopes and trace elements
- Carbonate aquifer



Climate Science and Paleoclimatology

Matthew S. Lachniet

Professor

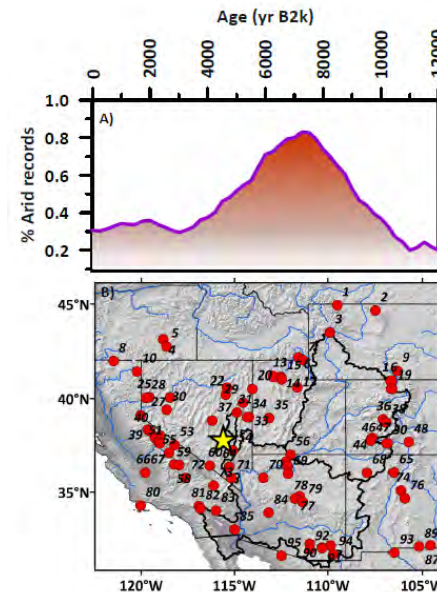
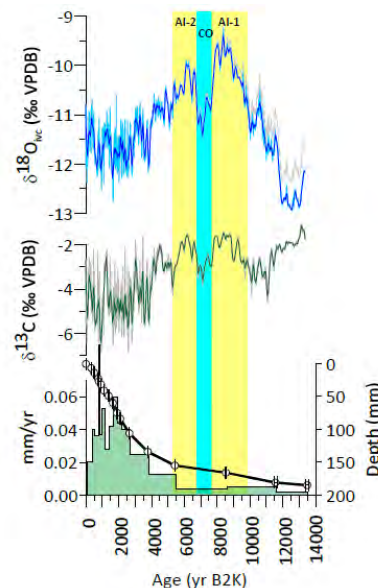
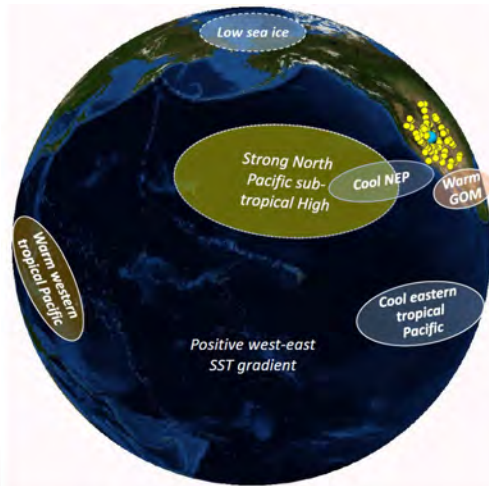
Department of Geoscience

Phone 702-895-4388

Matthew.Lachniet@unlv.edu

Paleoclimatology

- Study of the causes, timing, and consequences of climate change on timescales ranging from decades to millennia
- Cause of aridity in the Great Basin and Western United States
- Influence of ocean temperatures on precipitation in Nevada
- Cave archives of past climate with sites in Nevada, Mexico, Central America, and elsewhere



Hydrology

Dr. Michael Nicholl

Department of Geoscience

Phone: (702) 895-4616

Email: michael.nicholl@unlv.edu

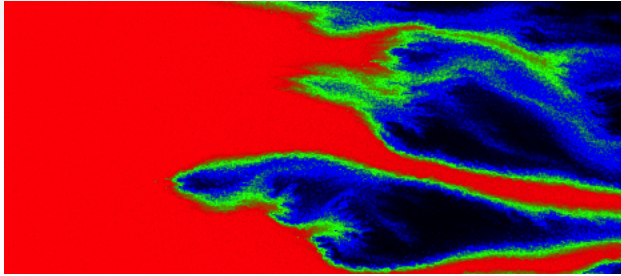
Expertise:

Unsaturated zone hydrology

Fractured rock hydrology

Environmental fluid mechanics

Fractured Rock Hydrology



False color image of a miscible displacement experiment in a single fracture



Water (blue) pooled above a fracture intersection



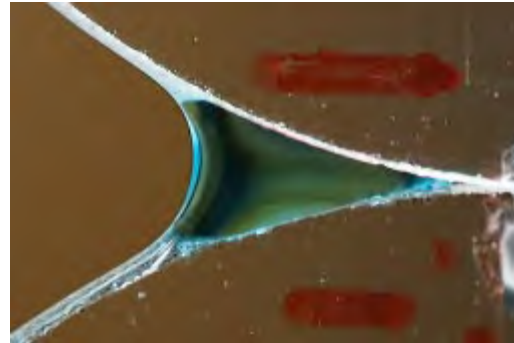
Field mapping of fracture networks
blue dye (right foreground) is from an infiltration test



Isothermal flow across a single rock fracture (matrix-to-matrix flow)

- ❑ Two-phase flow and transport in fractured rock
- ❑ Laboratory experimentation, field mapping, numerical simulations
- ❑ Contaminant transport, geothermal energy, enhanced petroleum recovery

Unsaturated Porous Media



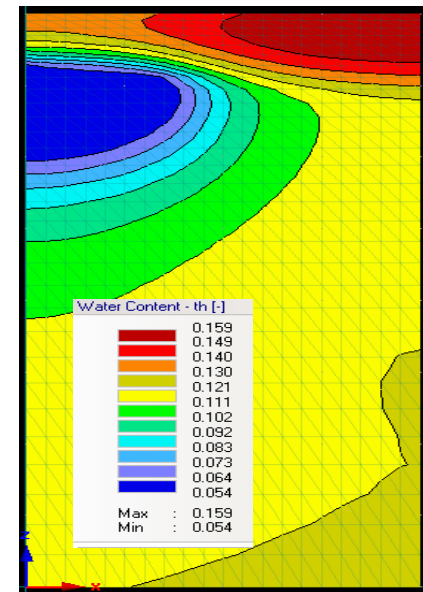
Millimeter-scale transport experiment



Hydraulic conductivity of a rock slab



Sampling Chloride as a proxy for root-driven horizontal flow



2D simulation of root-driven transport

- ❑ Challenging existing conceptual models for unsaturated and two-phase flow
- ❑ Design and execution of critical laboratory/field/numerical experiments

Environmental Geochemistry

Dr. Zach Perzan

- Assistant Professor
- Department of Geoscience
- Email: zach.perzan@unlv.edu
- Website: <https://zperzan.github.io/>

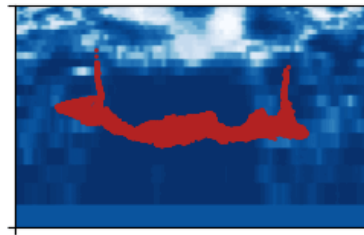
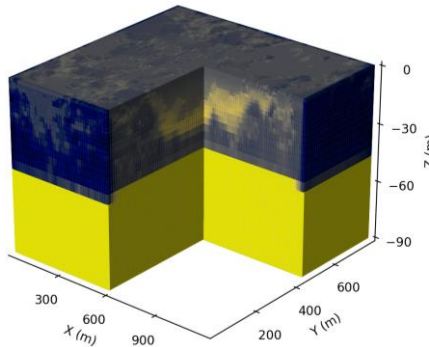
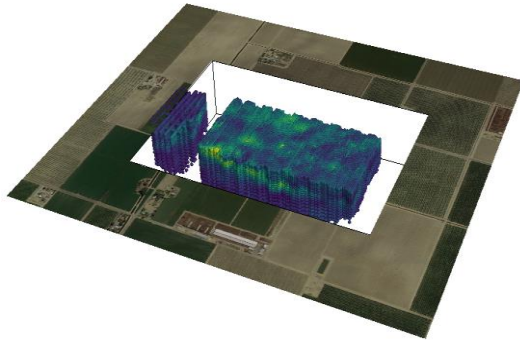
Expertise

- Environmental geochemistry
- Surface water-groundwater hydrology
- Machine learning
- Uncertainty quantification
- Managed aquifer recharge



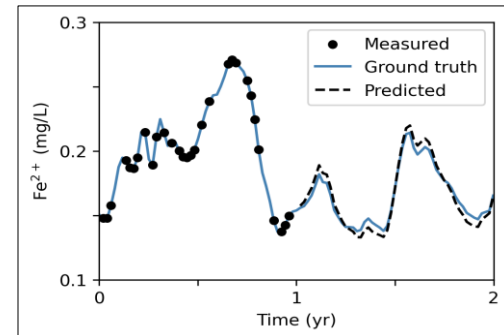
Understanding how hydrologic extremes (droughts and floods) impact water quality

Managed aquifer recharge



Geophysical surveys (top left) give us a 3D image of the distribution of sand, silt and clay within the subsurface (top right). We can then use hydrologic and geochemical models to understand how water (bottom left) and contaminants (bottom right) move through these sediments during a flood.

Floodplain biogeochemistry



Sensor arrays deployed in Colorado (top left) and Wyoming (top right) allow us to monitor sudden changes in water quality during floods. By pairing these with field experiments – such as tracer tests (bottom left) – we can develop data-driven water quality forecasts (bottom right).

Dryland ecology, hydrology and climate dynamics

Dr. Matthew Petrie

Assistant Professor

School of Life Sciences

ph: 702-895-5844

e: matthew.petrie@unlv.edu

Expertise:

Vegetation ecology and near-surface hydrology

Forest regeneration

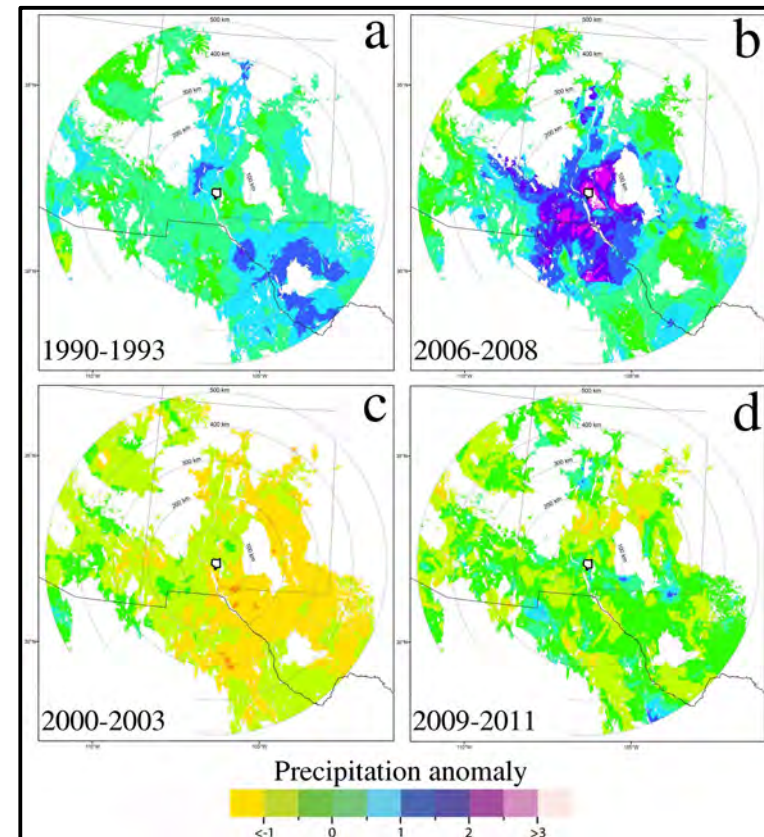
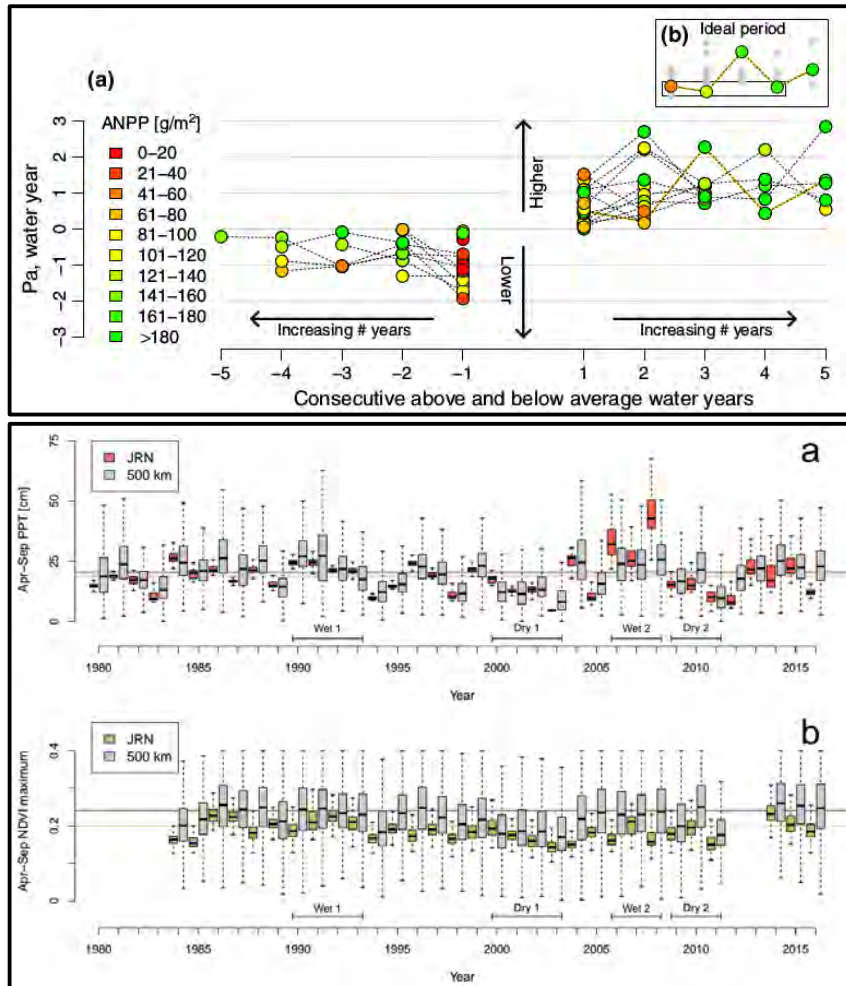
Climate dynamics and climate change forecasting

Extreme events

Landscape ecology

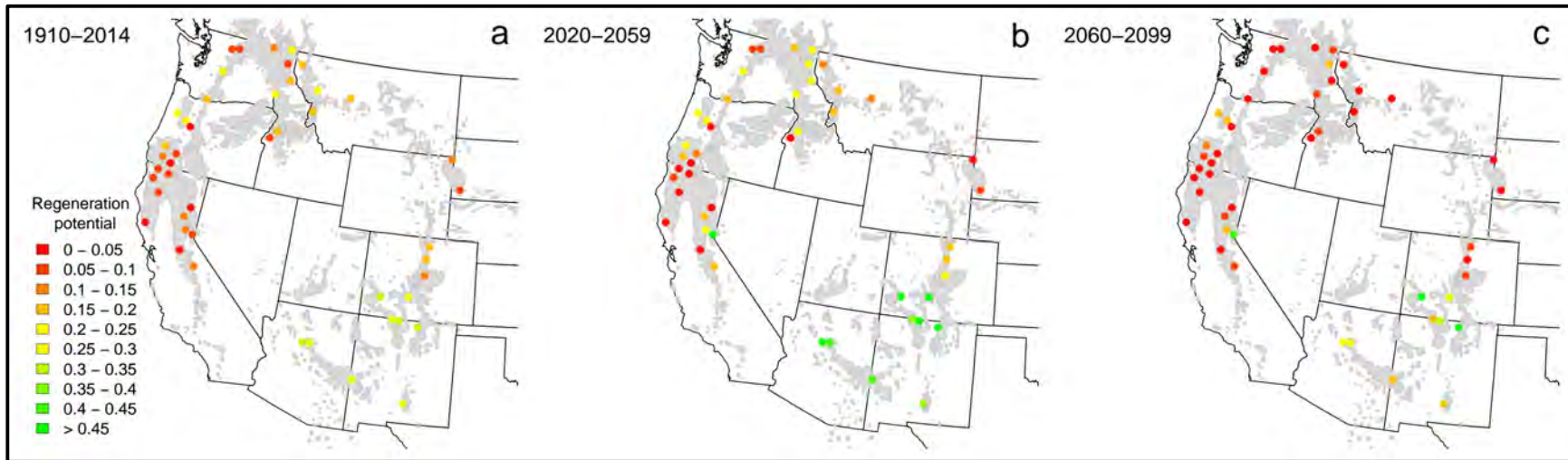
Manipulative field experimentation

Linking extreme climate events and ecological dynamics across space and time



Above: Disentangling locally- and regionally-observed ecological responses to multiyear high and low rainfall periods. Multiyear periods are a key component of understanding climate impacts to arid and semiarid regions. Our research focuses on the physical mechanisms that shape ecological responses, providing a foundation for understanding the effects of local and regional extreme events in a changing climate.

Forecasting climate change impacts



Above: Natural forest regeneration may declinest substantially throughout the western US in the 21st century. We study how climate, landscape properties, and the stress tolerance of tree populations will shape the future of western forests.

Left: Forecasts for increasing belowground extreme temperature events in a changing climate. We use downscaled climate model projections to forecast the increasing occurrence of moderate (0-σ) and very high (2-σ) extreme temperature events throughout multiple depths in the soil profile for ecosystems of the central and western US.

Dryland microbes and soil ecology

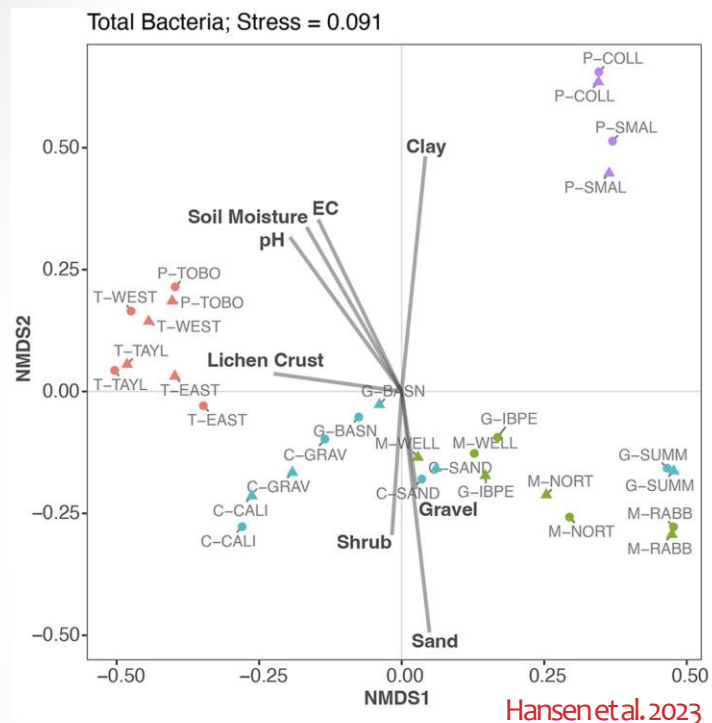
Dr. Nicole Pietrasiak

- Associate Professor of Sustainability in Arid Lands
- School of Life Sciences
- Email: nicole.pietrasiak@unlv.edu

Expertise

- Soil Microbiology and Ecology
- Biological Soil Crusts
- Phycology and Cyanobacteria/Algae Culture Collection
- Soil Science
- Dryland Ecology
- Biogeomorphology

In our lab we investigate what shapes the diversity, abundance, and distribution of desert microbes



Landscape and soil properties select for unique microbiomes



WHEN IS A LINEAGE A SPECIES? A CASE STUDY IN *MYXOCORYS* GEN. NOV. (SYNECHOCOCCALES: CYANOBACTERIA) WITH THE DESCRIPTION OF TWO NEW SPECIES FROM THE AMERICAS¹

Nicole Piatkowski²

Plant and Environmental Sciences Department, New Mexico State University, 945 College Drive, Las Cruces, New Mexico 88003, USA

Karina Osorio-Santol

Department of Comparative Biology, Faculty of Science, Universidad Nacional Autónoma de México, Coyoacán, Distrito Federal 04510, México

Sergei Shalygin

Plant and Environmental Sciences Department, New Mexico State University, 945 College Drive, Las Cruces, New Mexico 88003, USA

Michael P. Martin

Department of Biology, John Carroll University, University Heights, Ohio 44118, USA

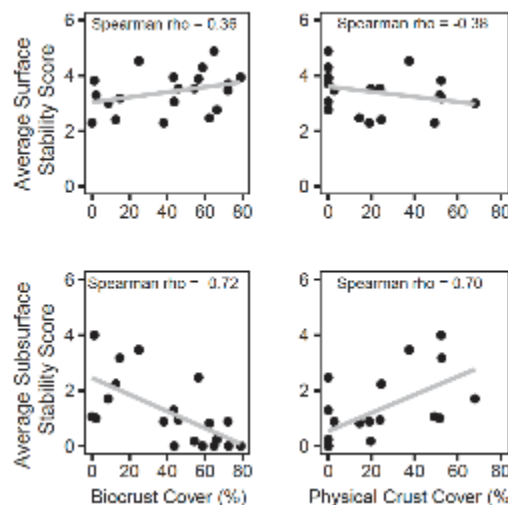
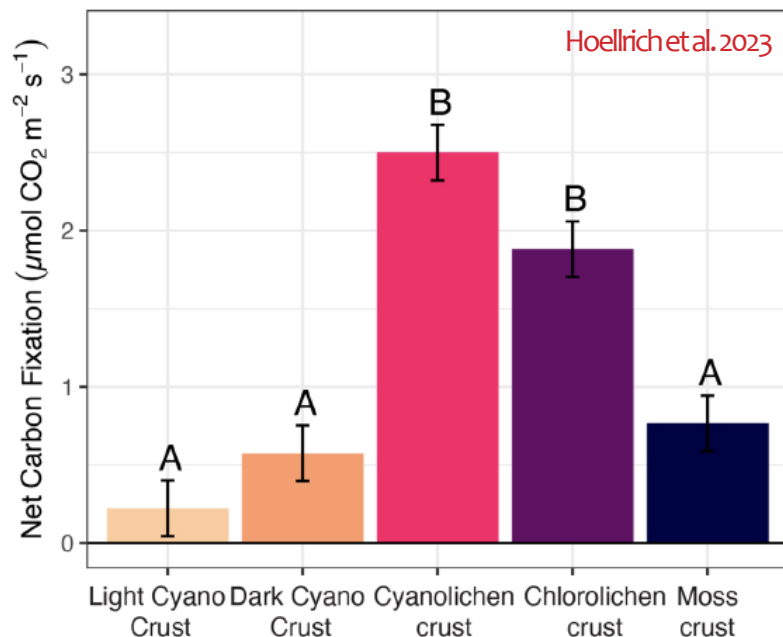
and Jeffrey R. Johansen

Department of Biology, John Carroll University, University Heights, Ohio 44118, USA
Department of Botany, Faculty of Sciences, University of South Bohemia, Branišovská 31, České Budějovice 370 05, Czech Republic



We also describe species and genera new to science and society.

And we identify and quantify the roles microbes play in dryland ecosystem functioning and soil health



Microbes are part of our dryland biodiversity. They prevent soil loss, increase soil fertility, control nutrient cycling, and contribute to carbon sequestration.

Dryland microbes are crucial for maintaining sustainable arid lands.

Stovall et al. 2023

Computational biology and the physiology of plants

Dr. Paul J Schulte

Associate Professor,

School of Life Sciences

Email: paul.Schulte@unlv.edu

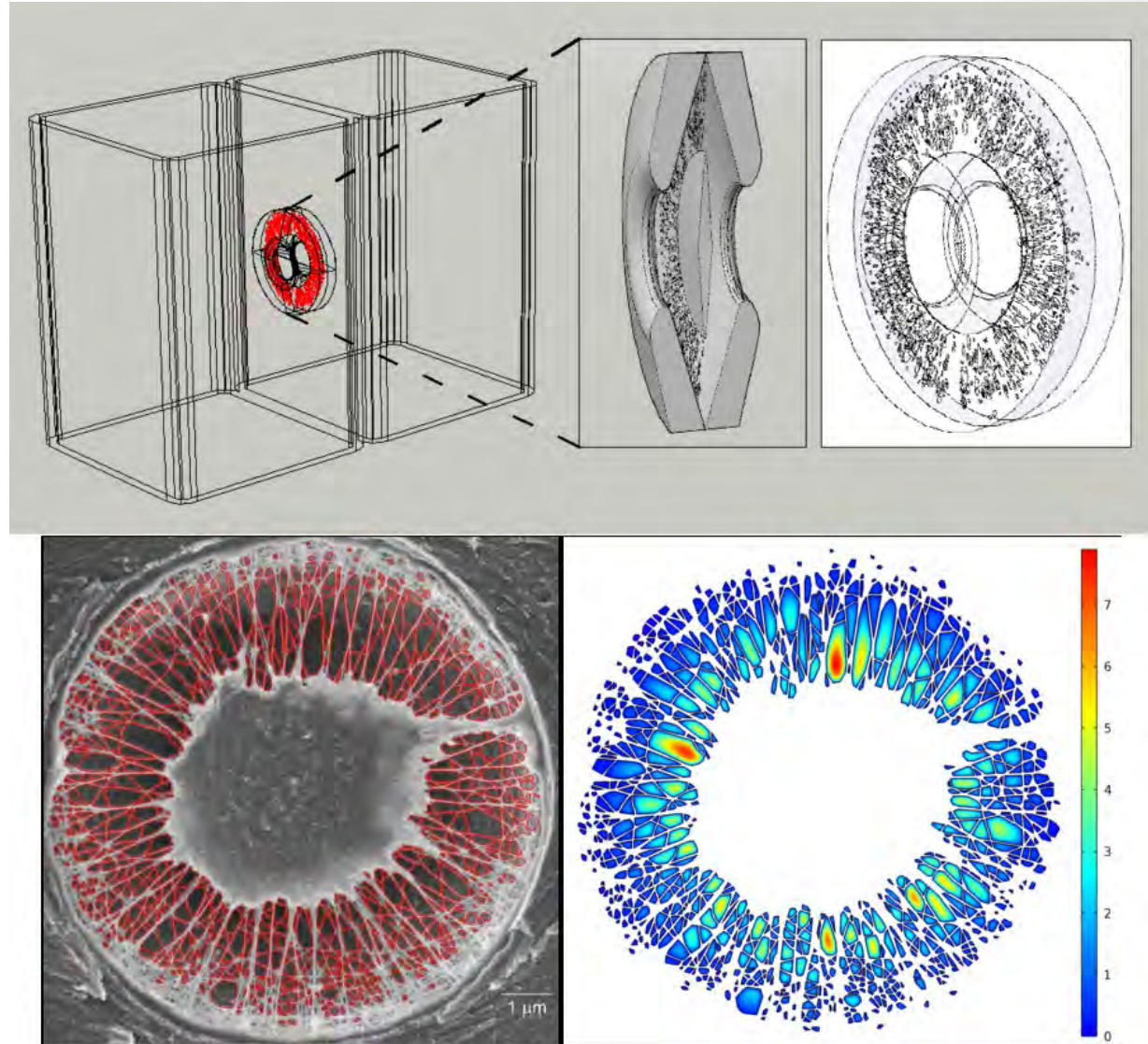
Expertise

- Plant water relations and transport processes
- Computational fluid dynamics
- Anatomy of transport tissues in plants

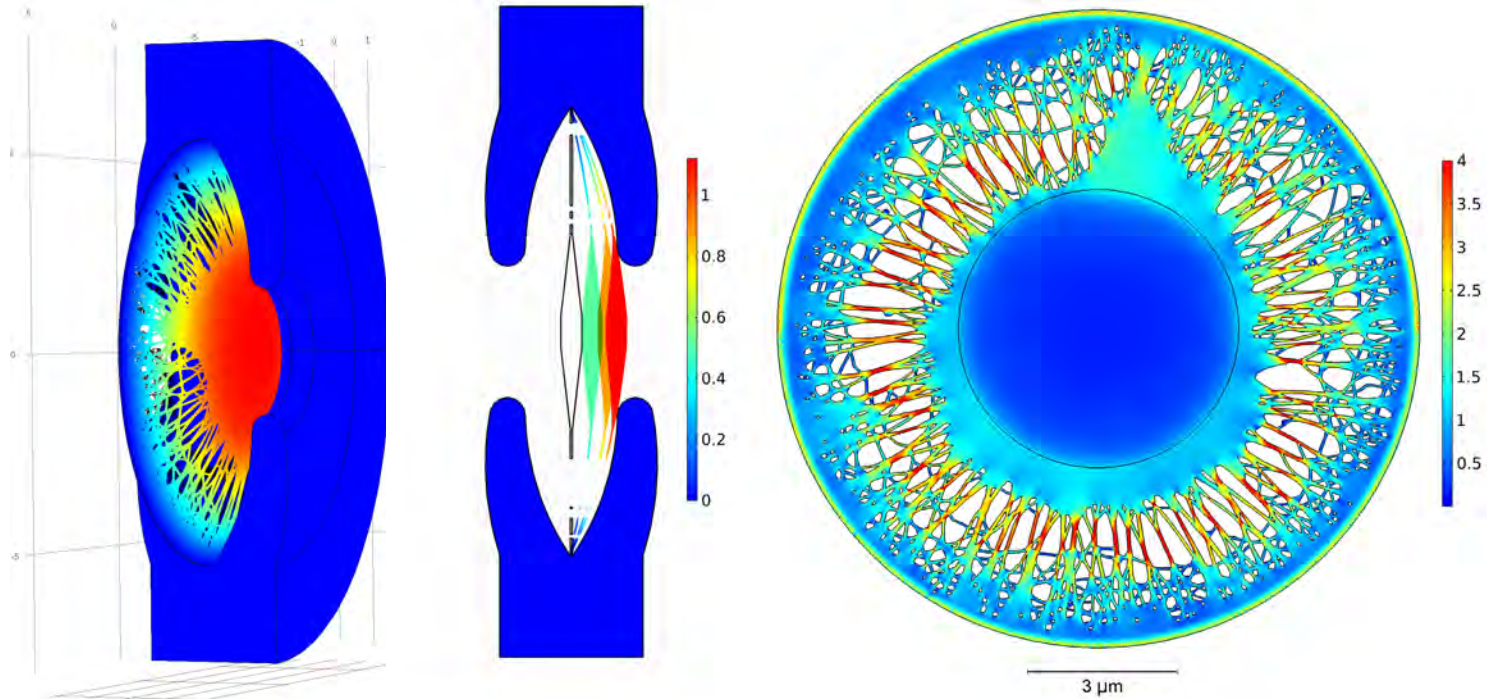
Fluid dynamics of flow between cells

Computer models and mathematical approaches to studying transport processes can help us understand the roles that these structures play in the flow of water from roots to the leaves of tall trees.

These images show work based on a computational fluid dynamics approach to flow through pits in conifer tracheids.



Biomechanics of valves in plant cells



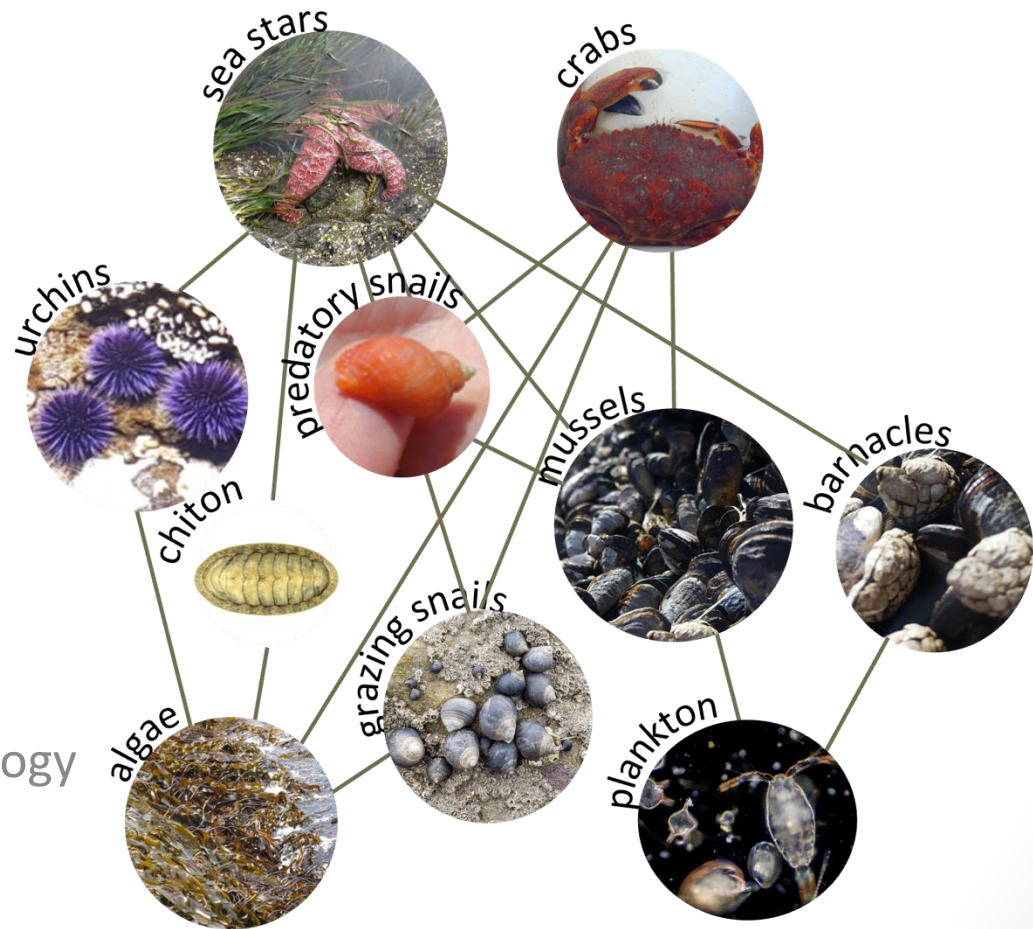
Water flows along the xylem in conifer trees from cell-to-cell through small openings called pits. The pits in many species contain structures that appear to act as valves that prevent air from spreading and blocking the transport system. The above figures show results from solid mechanics modeling of the pressures that are required to deflect the valve and seal the pit.

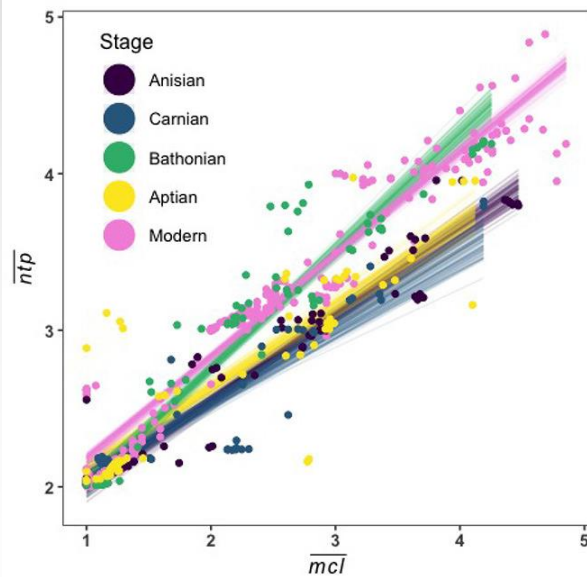
Paleoecology

- **Dr. Carrie L. Tyler, Ph.D.**
- Assistant Professor
- Department of Geoscience
- Email: carrie.tyler@unlv.edu
- Website: www.carrietyler.com

Expertise

- Marine invertebrates
- Taphonomy
- Food webs
- Conservation Paleobiology
- Predation





Marine food web structure from the Bathonian Stage (168 mya) resembles a modern Jamaican reef, but not the ecosystem before or after it.

A better understanding of trophic position is needed for restoration planning, as communities may be so severely altered that restoring species or interactions may no longer be possible.

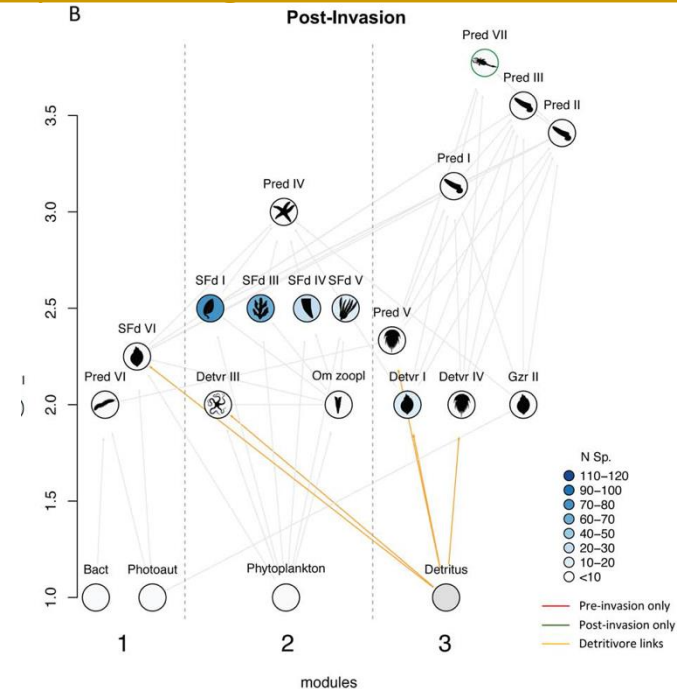
Banker *et al.* 2022 <https://doi.org/10.3389/fevo.2022.983374>

Fossil food webs before and after an invasion show changes in ecosystem dynamics, and invaders destabilized the ecosystem.

Conservation efforts may need to focus on preserving functional diversity if more diverse ecosystems are not inherently more stable.

Kempf *et al.* 2020

<https://doi.org/10.1017/pab.2020.26>



Surface Processes

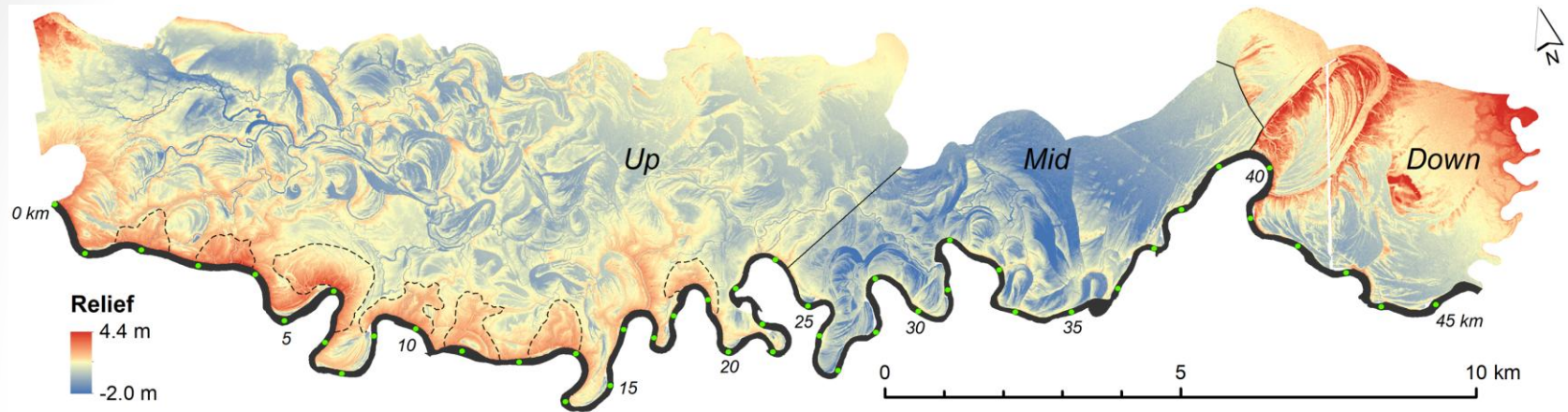
- **Dr. Haiqing Xu**
- Assistant Professor
- Department of Geoscience
- Email: haiqing.xu@unlv.edu

Expertise

- Floodplain Hydrodynamics
- Fluvial Geomorphology
- Remote Sensing



Floodplain topography, characterized by subtle surface channels, oxbow lakes, and natural levees, generates complex flow dynamics with intermittent inundation. Site: Congaree River Floodplain, SC.



Floodplain Channel



Oxbow Lake