Life and Environment

Plants: Ecology, Biology, & Food Source Research
Ecology, Conservation, and Restoration Ecology Research

Dr. Scott Abella
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School of Life Sciences
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Expertise
• Fire ecology
• Restoration ecology
• Plant Ecology
• Statistical and ecological community analysis

Web and link to publications
https://www.unlv.edu/people/scott-abella
https://abellaappliedecologylab.wordpress.com/
We perform fire ecology research that assists local and national wildland fire management efforts in changing environments.

Before-after wildfire in Red Rock Canyon National Conservation Area, just outside Las Vegas. We study fire effects, fuel management, and restoration strategies.
One of several topics in plant ecology we are studying is forest decline and ways to conserve forests, both in western and eastern North America.

Forest decline after a 15-year “perfect storm” of invasion by hemlock woolly adelgid, drought, and hurricanes

Scott R. Abella

Abstract Invasions by introduced pests can interact with other disturbances to alter forests and their functions, particularly when a dominant tree species declines. To identify changes after invasion by the insect hemlock woolly adelgid (Adelges tsugae, HWA), coinciding with severe droughts and hurricanes, this study compared tree species composition of eastern hemlock (Tsuga canadensis) forests on 11 plots before (2001) and 15 years after (2016) invasion in the southern Appalachian Mountains, USA. Losses of hemlock trees after HWA invasion were among the highest reported, with a 90% decline in density, 86% decline in basal area, and 100% mortality for individ- stained winds in 2004; pest-related declines of deciduous tree species otherwise likely benefiting from hemlock’s demise; death of deciduous trees when large hemlocks fell; and competition from aggressive understory plants including doghobble (Leucaena foemina), rosebay rhododendron (Rhododendron maximum), and Rubus spp. Models of forest change and ecosystem function should not assume that deciduous trees always increase during the first decades after HWA invasion.

Keywords Deciduous forest - Introduced forest pest - Jocassee Gorges - Rhododendron - Southern

Forest Inventory and Analysis Information Management

Brenda J. Buck, Ph.D.
Director: Forest Inventory and Analysis Information Management Research Group (UNLV-FIA)
Department of Geoscience
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The Team’s Expertise:
• Inventory, monitoring, and analysis
• Storage and display of forest inventory data
• Computer systems analysis
• Database development
• Application development
• Section 508 compliance
UNLV-FIA Partnership

Since 1998, our research group at UNLV has worked in partnership with the Forest Inventory and Analysis (FIA) Program, which is part of the research and development (R&D) arm of the USDA Forest Service. As the Nation’s forest census, FIA researches and reports forest status and trends in the United States.
UNLV-FIA Partnership

As a university partner to FIA, our work focuses on the agency’s strategic program area of inventory, monitoring and analysis. Our area of emphasis is information management research and development to optimize the storage, delivery, and display of forest inventory data.

The support we provide helps to ensure that information about the health and productivity of our Nation’s forests is both timely and accurate. This enables policy makers, land stewards and non-governmental groups to base decisions and assessments related to the health, diversity, and productivity of U.S. forests and grasslands on scientifically credible information.
Paleohydrology & Extreme Events

Bethany L. Coulthard
Assistant Professor
Department of Geoscience
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Using tree rings to study the influence of climate change on global water cycles relevant to human populations and ecosystems, with an emphasis on freshwater runoff, snowpacks, and forest hydrology.

- Examination of past and future snow droughts across the western North American cordilleras.
- Reconstructing extreme (flood/drought) events in the Fraser Basin, BC, Canada.
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.
Dryland ecology, hydrology and climate dynamics

Dr. Matthew Petrie
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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 decline substantially throughout the western US in the 21 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.
Computational Biology and the Physiology of Plants

Dr. Paul J Schulte
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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.
Dr. Jeffery Shen  
Professor,  
School of Life Sciences  
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Expertise  
• Big Data Analysis to Study Biology, Agriculture and Medicine  
• Molecular Mechanisms Controlling Plant Responses to Drought, Heat, and Salinity  
• Seed Germination, Tissue Culture and Plant Transformation  
• Molecular Basis of Leukemia (in collaboration with Dr. J. Cheng at the University of Chicago Medical School)  
• Nutrition of Cereal Crops (in collaboration with Dr. Christine Bergman, Ph.D. and R.D. at UNLV)
Molecular Basis of Drought Stress Responses and Seed Germination

**BMC Genomics**, 2016, 17:102
**Plant Science**, 2015, 236:214-222
**Front. Plant Science**, 2015, 6: 1145

**Short Read Assembly Algorithm** for Genome and Transcriptome Analysis

http://shenlab.sols.unlv.edu/shenlab/software/Tiling_Assembly/tiling_assembly.html

**DNA Research**, 2015, 22: 319-329
**Genomics**, 2014, 103:122-134

**Promoter and Coding Region Structures**

http://shenlab.sols.unlv.edu/shenlab/software/TSD/transcript_display.html

**Bioinformatics**, 2016, 32:2024-2025

**Molecular Basis of Leukemia** (in collaboration with Medical School, University of Chicago)

Cytogenetically normal refractory cytopenia with multilineage dysplasia (CN-RCMD)

**Nature Communications**, 2018, 9:1163
**Leukemia**, 2013, 27: 1291-1300
Speciation in Trees

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School of Life Sciences
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Expertise
• Local Adaptation & Population Divergence
• Evolution of Reproductive Isolating Barriers
• Phylogeography & Phylogenomics
• Population Genomics
• Hawaiian Evolutionary Biology
Study system: Hawaiian *Metrosideros*

2.5-to-3.9-million-year-old incipient adaptive radiation of woody taxa that dominates Hawaiian forests.
Local Adaptation & Population Divergence

Response to light vs. shade

Leaf micromorphology

Response to 1-hour exposure to 2 m/s current

Survival @ 3.5 years

Daily exposure to 43C

W=330, p=0.03
Evolution of Reproductive Isolating Barriers
**Phylogeography & Phylogenomics**

Phylogenomic analysis of 14 taxa (8.5 million genome-wide SNPs)

Phylogenetic analysis of 11 taxa (8.5 million genome-wide SNPs)

STRUCTURE analysis of 35 populations (9 nuclear SSR loci)
Population Genomics

- STRUCTURE analysis (8.5 million SNPs)
- FST analysis to detect genomic islands of divergence
- Selection analysis
- Divergence time estimation
Water Stress

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Expertise
• Plant desiccation tolerance
• Water stress strategies
• Principal abiotic and biotic factors of desiccation tolerance
• Sex ratios in plants and tradeoffs with stress
• Control of mosses in golf course putting greens
How plants survive without water

- Expertise
- Plant desiccation tolerance
- Water stress strategies
- Principal abiotic and biotic factors of desiccation tolerance
- Sex ratios in plants and tradeoffs with stress
- Control of mosses in golf course putting greens

Exposure to humid conditions (prehydration) improves plant health.

Regeneration of a moss after 20 years without water, a record for adult plants of any kind.
How plants survive without water

golf course mosses (green) are different from natives (blue)

plants dry slowly at 4 humidities

a fully hydrated desert moss