Plenary Speakers

Wednesday March 29th

Student Union Memorial Center
North Ballroom

2:00 PM – 3:30 PM
Full STEAM ahead! Scientific illustration as an avenue for including art in STEM education

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Scientists illustrate to record observations in the lab or field, to diagram and clarify their own ideas, and to explain ideas to others. Illustrating helps hone observational skills, which are at the core of science, by requiring the pencil-holder to pay close attention to the subject. Illustrating is also an integral part of understanding and communicating science, but it is often left out of science education. Encouraging students to think visually about their world could provide a foundation in observation and analysis that enables them to engage more deeply with it. It is also an entryway to science for students who may not think of themselves as “good at science.” Over the course of this year, I have been conducting a NASA Space Grant outreach effort in middle & high school classrooms in Tucson, at K-12 teacher professional development events, and with graduate & undergraduate students at the University of Arizona. Efforts have consisted of scientific illustration workshops intended to build students’ observational skills and engage them in a creative approach to the scientific method. The response from both students and teachers has been positive. Based on these experiences, I have compiled a set of resources & guidelines for both science teachers and researchers on how to use scientific illustration to teach and communicate science.
Fate, transport, and biodegradation of endocrine disrupting compounds, pharmaceuticals, and personal care products from wastewater effluents

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Chemicals of emerging concern (CECs) including pharmaceuticals, personal care products (PPCPs) and endocrine disrupting compounds (EDCs) have been measured in water sources throughout the world. Recently, studies on the concentration, fate and transport of these chemicals have also been linked to negative health effects on human populations. The presence of EDCs can promote a chronic physiological response when organisms are continually exposed at low concentrations. Our new quantitative study will characterize the role of sorption-desorption and biodegradation in the transport and fate of EDCs in soils receiving wastewater effluent and help establish maximum safe limit EDC concentrations for treated discharge. Experiments will use a synthetic wastewater effluent solution, which will infiltrate natural soils with diverse characteristics (texture, organic matter, pH, etc.). Adsorption and biodegradation of EDCs will be determined in abiotic and biotic microcosms. The effect of different substrates and oxygen conditions on the biodegradation of EDCs will also be studied. Furthermore, the microbial community in each soil will be characterized for its diversity and compared amongst all a miscellany of studied microcosms by cloning the 16S bacterial region. Total concentrations of amplified bacteria DNA will be determined by quantitative polymerase chain reaction (Q-PCR). This collaborative project involves scientists from University of Arizona and Universidad de las Américas Puebla in México.
Bottoms up: Deep alteration exposed in dismembered porphyry copper systems of Arizona

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Ore deposits are complex systems, and their geologic features reflect many interacting variables. Porphyry copper systems are found across the Laramide magmatic arc in Arizona. Porphyry systems are magmatic-hydrothermal deposits; they form from the exsolation of fluids from large crystallizing magma bodies that are shallowly intruded into the Earth’s crust (~1-7 km). Porphyry systems develop common varieties of hydrothermal alteration, where hot (~300-500°C) magmatic-hydrothermal fluids add and remove elements from original host rock. These styles of alteration form patterns around porphyry systems and represent evolving conditions of formation. Porphyry copper systems in Arizona have been overprinted by Basin and Range extension, where normal faults have dismembered porphyry systems and brought originally deep portions of the system to the surface. These exposures allow for observation of alteration from shallow to deep, distal to proximal around porphyry copper systems.

Deep, poorly documented forms of alteration include greisen and sodic-calcic alteration. Greisen alteration, characterized by coarse hydrothermal muscovite, forms deep in the roots of porphyry systems, proximal to the ore deposit. Isotopic data, fluid inclusion investigations, and timing relationships suggest that greisen-forming fluids evolve from the magma at late stages, postdating formation of ore-grade mineralization at higher levels. Sodic-calcic alteration is another deep form of alteration that can form proximal or distal to porphyry systems; this form of alteration contains minerals such as plagioclase, actinolite, and epidote and is characterized by the addition of Na and Ca and the loss of K, Fe, Si from host rock. Isotopic data, fluid inclusion study, and timing relationships suggest that these fluids represent the circulation of external, non-magmatic fluids. Development of propylitic alteration, a type of distal alteration that is characterized by volatile addition, as opposed to Na-Ca alteration in part may reflect paleoclimate conditions at time of porphyry emplacement. Na-Ca alteration forms from brines, either connate fluids or deeply circulating surficial fluids formed in arid environments, whereas propylitic alteration represents the circulation of dilute groundwater that is more common in wetter climates.
Plant invasions affect density and reproductive success of birds in arid grasslands

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Arid grasslands are among the most threatened ecological communities in North America. Human activities, including changes in land use, fire suppression, overgrazing, and introductions of nonnative plants have reduced cover of native grasses and facilitated increases in woody shrubs. Presently, only about 14% of grasslands in Arizona remain dominated by native grasses with few shrubs, features that once characterized grasslands throughout this region. These changes have reduced the quantity and quality of habitat for many species, including grassland birds, which have declined more rapidly than any other group of birds. Although evidence for declines in grassland species is strong, linkages between breeding birds and changes in vegetation composition, structure, and floristics associated with plant invasions are not well established. Therefore, identifying those habitat features that govern the status, demography, and distribution of grassland birds is an important first step towards developing effective conservation strategies for populations of grassland birds throughout the region. For the past four years, we studied how territory establishment, density, and nesting success of birds breeding in arid grasslands are affected by encroachment of woody plants and invasions by nonnative grasses. We established 140, 10-ha plots that spanned gradients of invasion at three sites that capture the range of variation in vegetation structure of grasslands in North America. We surveyed birds with distance sampling protocols during 560 point count surveys, found and monitored 577 nests, tracked settlement patterns of birds as they arrived on breeding grounds, and characterized the vegetation community. In addition, we are studying how populations and communities of arthropods—the primary prey of grassland birds during the breeding season—change along these invasion gradients, and we are collaborating with the Arizona Game and Fish Department to develop a protocol and strategy for monitoring grassland birds in Arizona. This research has revealed several interesting findings, including a decoupling of how birds perceive nonnative plants and the resources associated with those plants. For example, as cover of nonnative grasses increase, some grassland birds increase in density, but experience decreased nest survival. This suggests that when novel plants that are structurally similar to the native species they displace invade a community, proximate cues used by animals to gauge habitat quality may cease to indicate the future resource levels with which they were associated over evolutionary timescales. Animals may not have the plasticity to respond to these rapidly-developed disassociations and may become attracted to areas that function as ecological traps, which can have important implications for the persistence of imperiled populations.
Stand structure and composition increases ecosystem stability in eastern U.S. forests

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Currently, forests account for almost half of the carbon captured from the atmosphere, while only covering about 30% of the land area. Increased levels of biodiversity have been thought to buffer the effects of changing climate conditions, but recent studies suggest that species responses to climate are not dissimilar between species of the same forest type. However, structural components of the forest, such as canopy stratigraphy, may further support increased ecosystem stability.

To address this issue, we collected tree cores from six eastern U.S. forests that are influenced by large-scale climate factors as well as small-scale ecological pressures, such as competition among individuals. We analyzed regional groupings of canopy-class tree ring chronologies and assessed their response to site-level climate variables. Two groupings emerged, a synchronous climate response, composed of Midwest sites (Missouri, Indiana, Ohio), and an asynchronous climate response composed of Northeast (Maine and Massachusetts) and Michigan. Midwest sites showed significant negative relationships with growing season mean temperature and precipitation and northern sites were not climate sensitive. Temperature was the primary driver of ring-width variability for dominant and intermediate strata but precipitation correlated strongest with the secondary mode of understory trees. These results identify regions where canopy layers within a forest are responding synchronously, suggesting an increased vulnerability to changing climate conditions.