



4th Annual
St. Louis Ecology, Evolution, and Conservation (SLEEC)
Retreat
Southern Illinois University Edwardsville

September 27, 2014
Schedule

0800 **Bagels and coffee**; signing in; setting up posters and talks

First morning session:

0900 Welcome and Introduction: Bob Marquis (UMSL and the Harris Center)

0905 Greetings from Southern Illinois University Edwardsville: Dr. Aldemaro Romero, Jr.,
Dean College Arts and Sciences, SIUE

0915 DUVERNELL, DAVID (SIUE). Historical phylogeography and contemporary interactions
among members of a topminnow species complex.

0930 CALLEN, STEVEN T., and Allison J. Miller (SLU). Signatures of niche shift following
the introduction of kudzu (*Pueraria montana*) into North America.

0945 GUTIÉRREZ-JIMÉNEZ, LETICIA, and Robert E. Ricklefs (UMSL). Tales of
biodiversity, rodents and pathogens: Can we reduce disease risk?

1000 MERZ, BOB (STL Zoo). American burying beetle conservation.

1015 MILLER, JAMES (MOBOT). Using available plant specimen data for rapid conservation
assessments.

1030 **Coffee and posters**

Second morning session:

1100 SMITH, JEFF, Joan E. Strassmann, and David C. Queller (WashU). Fine-scale spatial
ecology drives relatedness in a cooperative amoeba

1115 ESSNER, RICK (SIUE). Landing in basal frogs: evidence of saltational patterns in the evolution of anuran locomotion.

1130 FOWLER-FINN, KASEY D., and Rafael L. Rodriguez (SLU). Mate choice as a mechanism for local adaptation and ecological divergence.

1145 HART, ROBBIE (UMSL). Climate Impacts on Himalayan plant phenology: insights from ecology, natural history collections, and traditional knowledge.

1200 REED, LEIGHTON (MOBOT). How and where should we restore tropical forests?

1215 **Lunch break and posters**

Afternoon session

1400 SUKHUM, KIMBERLEY, Megan Freiler, Robert Wang, Bruce A. Carlson (WashU). The costs of extreme encephalization: Bigger brains result in increased energetic demand and reduced hypoxia tolerance in weakly electric African fishes.

1415 Lv, Jie, and ZHENGUO LIN (SLU). Highly heterogeneous patterns of genome divergence between different yeast lineages.

1430 TAYLOR, CHARLOTTE and Burgund Bassüner (MOBOT). Diversity patterns in neotropical plants: The Rubiaceae (quinine) family.

1445 QI, XINSHUAI, Cynthia Vigueira, BK Song, Yan Liu, Ana Caicedo, Yulin Jia, and Kenneth M. Olsen (WashU). Comparative QTL mapping, population genetics, and the parallel evolution of weedy rice.

1500 MILLER, ELIOTT (UMSL), Sarah K. Wagner, Mark Westoby, Robert E. Ricklefs. [Habitat and niche relationships across the phylogeny of Australian honeyeaters](#)

1515 **Coffee and posters**

Keynote address

1615 PETERSON, TOWNSEND (The University of Kansas Biodiversity Institute): How complex is biological diversification: What simple virtual species can teach us

1715 Concluding remarks

1830 **Happy Hour and Dinner**

ST. LOUIS SLEEC FALL 2014 RETREAT ORAL PRESENTATIONS

CALLEN, STEVEN T. (scallen@slu.edu); Allison J. Miller (amille75@slu.edu). Department of Biology, Saint Louis University. 3507 Laclede Ave, Saint Louis, MO 63103. Signatures of niche shift following the introduction of kudzu (*Pueraria montana*) into North America.

Climate is an important factor limiting organismal distributions in native and introduced ranges. Some species' introduced ranges retain the climatic characteristics of their native range (stability/conservatism), whereas others undergo a niche shift. Recent advances further partition niche shift into unfilling and expansion components. Kudzu (*Pueraria montana*) is an aggressive, introduced species in the United States. We compare kudzu's introduced and native climatic niches in climate and geographic spaces using ordination analyses, niche hypothesis tests, and GIS modeling. Results suggest kudzu underwent a niche shift following introduction into North America, expanding into both warmer and colder climates and environments with greater precipitation during dry periods. While some areas occupied in the introduced range were climatically similar to those occupied in the native range, others constituted novel environments. Further, large areas exist in the US where kudzu has not been recorded, but which have analogous climates experienced in the native range.

DUVERNELL, DAVID (dduvern@siue.edu) Southern Illinois University Edwardsville, Edwardsville, IL 62025. Historical phylogeography and contemporary interactions among members of a topminnow species complex.

The *Fundulus notatus* species complex includes multiple species of topminnows with similar ecological requirements and broadly overlapping distributions. The blackstripe topminnow (*F. notatus*) and the black spotted topminnow (*F. olivaceus*) co-occur in numerous drainages throughout the central and southern United States. In drainages where they both occur *F. olivaceus* is typically (though not exclusively) found in headwater habitats, and *F. notatus* is usually restricted to large river habitats. Differences in life history characteristics are generally consistent with predictions for headwater and large river specialists, respectively. Contact zones usually occur at river/tributary confluences where ecological gradients are steep. The prevalence of hybridization varies substantially among contact zones and is greatest in habitats where ecological transitions are most abrupt. Phylogeographic studies establish the reciprocal monophyly of both species. The occurrence of substantial geographic population genetic structure in *F. notatus* compared to that found in *F. olivaceus* indicates a relatively older distribution for *F. notatus*. Throughout most drainages where they both occur, contact has occurred secondarily through more recent range expansion of *F. olivaceus*.

ESSNER, RICK (ressner@siue.edu) Department of Biological Sciences, Southern Illinois University Edwardsville, Edwardsville, IL 62026. Landing in basal frogs: evidence of saltational patterns in the evolution of anuran locomotion.

All frogs are assumed to jump in a similar manner by rapidly extending hindlimbs during the propulsive phase and rotating the limbs forward during flight in order to land forelimbs first. However, studies of jumping behavior are lacking in frogs of the family Leiopelmatidae which diverged from all other frogs (*Lalagobatrachia*) over 200 mya. These semi-aquatic or terrestrial anurans retain a suite of plesiomorphic morphological features and are unique in using an asynchronous (trot-like) rather than synchronous "frog-kick" swimming gait of other frogs. We compared jumping behavior in leiopelmatids to more derived frogs and found that leiopelmatids maintain extended hindlimbs throughout flight and landing phases and do not land on adducted forelimbs. These "belly-flop" landings limit the ability for repeated jumps and are consistent with a riparian origin of jumping in frogs. The unique behavior of leiopelmatids shows that frogs evolved jumping before they perfected landing. Moreover, an inability to rapidly cycle the limbs may provide a functional explanation for the absence of synchronous swimming in leiopelmatids.

FOWLER-FINN, KASEY D. (fowlerfinn@slu.edu) Department of Biology, Saint Louis University. 3507 Laclede Ave, Saint Louis, MO 63103; Rafael L. Rodriguez (rafa@uwm.edu) Department of Biological Sciences, University of Wisconsin-Milwaukee, 3209 N. Maryland Ave, Milwaukee WI 53211. Mate choice as a mechanism for local adaptation and ecological divergence.

Adaptation resulting from mate choice provides a mechanism for the rapid creation of ecological differences among populations. We test the hypothesis that adaptation occurs via mate choice using a quantitative genetics breeding design and two species of *Enchenopa binotata* treehoppers (Hemiptera: Membracidae). These plant-feeding insects show a pattern of diversification in female mate preferences and male mating signals that corresponds to shifts in host plant use. If sexual selection leads to adaptation, we expect that (i) male signals indicate ecological performance, and (ii) females prefer signals of the highest performing males. We found that, in one species, male signals indicate ecological performance, but females do not prefer high-performing genotypes. In the second species, male signals do not indicate ecological performance. Thus, the relative importance of ecological and sexual selection appears to vary across species. Our results unify a diverse suite of expectations about how adaptation and divergence proceed.

GUTIÉRREZ-JIMÉNEZ, LETICIA and Robert E. Ricklefs. University of Missouri at Saint Louis, Biology Department, One University Blvd, 63121-4400. Tales of biodiversity, rodents and pathogens: Can we reduce disease risk?

The effect of mammal diversity on human disease risk is poorly known for rodent and tick-borne diseases, especially as relates to their transmission, prevalence, and contagion. The Greater Yellowstone Ecosystem is one of the last remaining locations in the United States which has a high diversity of mammalian species across trophic levels, including top carnivores and large ungulates. This makes the Greater Yellowstone Ecosystem a unique area to explore the dilution effect hypothesis for vector-borne pathogens. Accordingly, areas protected from human disturbance, where top predators and mesocarnivores depress the abundance of rodent species, should exhibit reduced prevalence of vector-borne blood parasites. Controversially, there was a 50% higher rodent density and diversity in the disturbed locations. No significant change was observed in the haemoparasite diversity, although those are more similar in disturbed locations. Understanding how the rodent community moderates disease risk and pathogen transmission emphasizes the public health benefits of rich trophic networks and complex mammalian community assemblages.

HART, ROBBIE (robbiehart@gmail.com) University of Missouri St. Louis. Climate Impacts on Himalayan plant phenology: insights from ecology, natural history collections, and traditional knowledge.

Unsurpassed diversity, endemism, and beauty of rhododendrons in the eastern Himalaya make the genus iconic. Observations by scientists, horticulturalists, and indigenous peoples suggest that temporal patterns (flowering phenology) within and among species are changing with the rapid effects of climate change in the region. Focusing on Yulong Mountain, in the Eastern Himalaya, we investigated change in rhododendron phenology through three lines of evidence: 1) a detailed observational study of rhododendron flowering times among species and elevations on Yulong Mountain; 2) flowering times from more than 10,000 historical specimens of Yulong rhododendron species collected by plant hunters and botanists 1884-2009, now preserved in

natural history collections worldwide and 3) interviews with the indigenous Naxi and Yi residents of the Yulong Mountain area about their traditional ecological knowledge of phenology and their observations of change. Together, these data complement and reinforce each other to paint a picture of an intricate spatial and temporal patterning that is subject to disruption by climate change, and to demonstrate the use of data from disparate domains in inferring past change.

Lv, Jie (jie.lv@rice.edu), Department of Ecology and Evolutionary Biology, Rice University, and LIN, ZHENGUO (zhenguolin@slu.edu), Department of Biology, Saint Louis University, 3507 Laclede Ave, Saint Louis, MO 63103. Highly heterogeneous patterns of genome divergence between different yeast lineages.

The availability of large numbers of complete genomes in many yeast species offers an unprecedented opportunity to examine how genomes have diverged over time and its impacts on the evolution of biodiversity. The budding yeasts and fission yeasts diverged about 500 million years ago, but there is a huge disparity in species richness between the two lineages (~1000 budding yeast species vs. 4 fission yeast species), which is remain unexplained. Here, we employed comparative genomics methods to comprehensively characterize and compare the genome divergence patterns for the two lineages. Our study revealed that the rate of gene order divergence in fission yeasts is about four times slower than that of budding yeasts. In addition, the divergence of gene content in fission yeasts is highly limited. The different evolutionary patterns of genome architecture and gene content between the two lineages may have contributed to the disparity in species richness.

MERZ, BOB (merz@stlzoo.org), Zoological Manager of Invertebrates, Saint Louis Zoo, One Government Drive, St. Louis MO 63110. American burying beetle conservation.

As a bright red-orange insect that embalms carrion with naturally secreted fluid, the American Burying Beetle is a necessary part of our ecosystem. These insects are responsible for recycling decomposing components back into the environment. Unfortunately, the American burying beetle has been on decline for many years now. The Saint Louis Zoo is committed to working with conservation organizations to assist with declining populations of native flora and fauna. The Center has successfully bred thousands of American burying beetles on the Zoo campus. Working with U.S. Fish & Wildlife Service, the Missouri Department of Conservation and The Nature Conservancy, the Zoo is reintroducing captive beetles to Southwest Missouri since 2012.

MILLER, ELIOT (eliot.isaac@gmail.com), Department of Biology, University of Missouri-St. Louis, One University Blvd., St. Louis, MO 63121, Sarah K. Wagner, U. of Colorado, Mark Westoby, Macquarie University, Robert E. Ricklefs, UMSL. [Habitat and niche relationships across the phylogeny of Australian honeyeaters.](#)

Recent evidence strongly supports the notion that, on a continental scale, phylogenetic niche conservatism influences which species occur where. What about that other cherished ecological force, competition? Does it influence species' distributions? Do species partition available niche space? What does available niche space even look like? We detail our approach for quantifying [foraging](#) niche size and partitioning among 75 Australian honeyeater species. We show that species tend to occupy characteristic and somewhat restricted portions of niche space, but that [extensive](#) niche overlap is the overriding signal among co-occurring species. Instead of occupying smaller niches, more finely partitioning available niche space, or occupying larger

total assemblage niche space, species from **species-rich** regions simply overlap more in niche space. We discuss implications for community assembly processes.

MILLER, JAMES (james.miller@mobot.org), Research Division, Missouri Botanical Garden, PO Box 299, St Louis, MO 63166-0299. Using available plant specimen data for rapid conservation assessments.

It has been estimated that more than a quarter and perhaps even close to half of the world's plant species are in some danger of possible extinction in the next 50 years. Several systems for assessing the conservation status of plants have been developed and are in wide use but none have completed assessments for more than a tiny percentage of known plant species. The most widely used method, the IUCN's Red List, which can be used for many kinds of organisms and has been very successful in completing assessments for mammals, birds, and amphibians, has completed assessments for only about 15,000 species. The Red List process is complicated and data demanding. A new method that provides a simple approximation of Red List assessments was developed based on calculated Extent of Occurrence (EOO) from locality data taken from herbarium specimens with data available in databases. Those species with EOO values less than 20,000 km² are considered "At Risk," a term chosen to not overlap with IUCN's terminology but roughly equivalent to the Red List category of Threatened. Analysis of the 2,025 native species of plants from Puerto Rico identifies 570 with EOO values less than 20,000 km², and therefore At Risk. A more complete analysis using procedures for IUCN's Red List produces nearly identical results, indicating that even limited available specimen data provide a reliable predictor of conservation status.

PETERSON, TOWNSEND (town@ku.edu), Department of Ecology & Evolutionary Biology, University of Kansas Biodiversity Institute, 1450 Jayhawk Blvd, Lawrence, KS 66045. How complex is biological diversification: What simple virtual species can tell us.

Biodiversity is assorted unevenly across the surface of the planet. Well-known patterns include greater diversity in lowland tropical areas compared with montane tropical areas, on continents as compared with on islands, and at low latitudes compared with high latitudes, but the processes underlying global patterns remain elusive and poorly understood. Here, I present a series of explorations of real and virtual species, illustrating geographic and ecological processes that have led to diversification. In particular, I analyze a series of simple virtual species (yes, attend this seminar and you will learn about the marvelous "Kansas Species"!), and explore lessons that they can teach regarding biological diversification on regional, continental, and global scales.

QI, XINSHUAI (qxs@wustl.edu), Cynthia Vigueira, BK Song, Yan Liu, Ana Caicedo, Yulin Jia, Kenneth M. Olsen. Department of Biology, Washington University in St. Louis, St. Louis, MO 63130. Comparative QTL mapping, population genetics, and the parallel evolution of weedy rice.

Agricultural weeds related to crops are especially challenging to agriculture. Understanding the origin and evolutionary history of these weeds is not only essential for weed control, but also of great interest to evolutionary biologists. In recent years, a worldwide crop mimic, weedy rice (*Oryza sativa* L., also called red rice), has infested rice fields and caused major reductions in crop yield. In the US, there are two major weedy rice strains, straw hull (SH) and black hull awned (BHA), that have been identified. Genetic surveys have demonstrated that they were derived from two Asian domesticated rice varieties: *indica* and *aus*. However, it is still unclear whether this parallel evolution of weediness has occurred through shared genetic mechanisms or

not. Another question is the extent to which weedy rice populations found in world regions with wild *Oryza* species, such as Southeast Asia, have been influenced by genetic introgression from the wild populations. Here we first used GBS-derived SNPs to construct genetic maps of two F5 recombinant inbred line populations, derived from crosses between each US weed form and *indica* rice. With dense SNPs across the rice genome, we were able to create two fine scale linkage maps, and identified 53 weedy rice QTLs. The mapping results showed that the similar phenotypic traits in the two US weedy rice strains are primarily controlled by different genetic mechanisms. We then did a parallel population genetic study focusing on the comparative weedy rice origins between the US, South Korea and Southeast Asia. *STRUCTURE* and PCoA analyses suggest that weedy rice populations in Cambodia, Thailand, Vietnam and Indonesia has a genetic admixture of crop and wild rice, which is different from the US, South Korea and Malaysian weedy rice. Our studies demonstrate multiple, parallel origins of weedy rice. This knowledge of weed origins is essential for future weedy rice control strategies.

REED, LEIGHTON (j.leighton.reid@gmail.com), Center for Conservation and Sustainable Development, Missouri Botanical Garden, PO Box 299, St Louis, MO 63166-0299. How and where should we restore tropical forests?

The pace and extent of tropical forest regeneration on former agricultural lands will partially determine what proportion of global biodiversity persists into the 22nd century. To this end, I aim to understand how and where we can best expend resources to accelerate forest succession. In a restoration experiment in southern Costa Rica, planting trees attracted fruit-eating birds (but not bats), enriching seed rain and seedling recruitment. Small tree islands accelerated forest development to a similar degree as extensive tree plantations, suggesting that these may be a cost-effective alternative. Whereas tree planting can stimulate recolonization by plants and animals on severely degraded or isolated sites, in many places secondary forests are regenerating on their own. Will these new forests last long enough to become habitat for deep-forest species? If not, are there ways to accelerate development of old-growth forest attributes?

SMITH, JEFF (jeffsmith@wustl.edu); Joan E. Strassmann; David C. Queller. Department of Biology, Washington University in St. Louis, St. Louis, MO 63130. Fine-scale spatial ecology drives relatedness in a cooperative amoeba.

The outcome of social evolution depends critically on the genetic structure of social interactions -- who interacts with whom. Microbes participate in a wide variety of social behaviors, but the determinants of microbial social structure are largely unknown. Here we show that social structure among cooperative *Dictyostelium* amoebae is strongly determined by the spatial population ecology of dispersal at surprisingly small scales. Grazing amoebae do not intermix much, creating substantial genetic relatedness in multicellular fruiting bodies when the cells colonizing a feeding site are separated on average by just a few millimeters. Even adjacent fruiting bodies can consist of substantially different genotypes. Soil populations of amoebae are sparse enough to create substantial relatedness through spatial structure alone. These results account for the otherwise unexplained high relatedness in fruiting bodies from natural habitats and show how microbial social structure is determined by the interaction between spatial population ecology and cellular behavior.

SUKHUM, KIMBERLEY (kvsukhum@gmail.com), Megan Freiler, Robert Wang, Bruce A. Carlson. Department of Biology, Washington University in St. Louis, St. Louis, MO 63130. The

costs of extreme encephalization: Bigger brains result in increased energetic demand and reduced hypoxia tolerance in weakly electric African fishes.

A large brain offers several advantages including an increased ability to adapt to new environments, forage for food, and develop social networks. However, brain tissue is very energetically costly. So how do animals balance the costs of extreme encephalization? Multiple hypotheses have been suggested for how a species could accommodate the costs of an increase in brain tissue, including decreasing the size of other energetically expensive tissues or increasing overall energy consumption. We show that in the mormyrid family of electric fishes, there is not a trade-off in organ size, but instead large-brained fish have increased basal metabolic rates. We also show that an increase in brain size and energy demand comes with decreased hypoxia tolerance in large-brained fish. These findings likely relate to species differences in behavior and ecology, and may have implications for conservation efforts as hypoxic and anoxic environments increase globally as a result of human activities.

TAYLOR, CHARLOTTE (Charlotte.Taylor@mobot.org), Research Department, Missouri Botanical Garden, P.O. Box 299, St. Louis, MO 63166 USA & Burgund Bassüner (MBG).
Diversity patterns in neotropical plants: The Rubiaceae (quinine) family.

Finding patterns in the natural world is basic to scientific inquiry. Herbarium specimen data detail distribution patterns in Neotropical plants, and these patterns can then be studied in the context of geographic and environmental factors; data quality is very important here to seeing a real pattern. Study of the Rubiaceae family in Central and South America using MBG data shows some apparent patterns that give insight into species differences, ecological factors, and regional diversity for this family. This information allows us to formulate and test some hypotheses about evolutionary and biogeographic history. This information also supports work assessing conservation status for Rubiaceae species.