



SICB 2023 Annual Meeting Abstracts

1511 Evelyn Abbott, Mikhail Matz

Gene body methylation and gene expression plasticity do not correlate in a reef-building coral

As coral reefs continue to decline, the relationship between epigenetics and response to environmental change warrants investigation. In invertebrates, epigenetic markers are almost entirely in the form of gene body methylation (GBM). Here, we tested whether environmentally-driven changes in GBM impact gene expression plasticity in a reef-building coral. In our experiment, coral fragments were subjected to either heat or control conditions over four weeks, in addition to daily temperature fluctuations due to the time of day. Near the end of the experiment, some heated corals were switched to the control condition to see if their expression would revert remain in the heated state, indicating reduced plasticity. When taking a transcriptome-wide approach, we found no significant correlation between treatment-driven GBM change and reduced plasticity. In regards to daily expression changes, we found evidence that some genes had reduced plasticity at the end of the experiment. However, this was unrelated to GBM change. Finally, to look for fine-scale signatures of reduced plasticity and GBM change we identified modules of co-regulated genes, one of which showed reduced plasticity following heat treatment. However, there was no significant correlation between gene membership in this module and plasticity in the heat and control groups, and only a negligible correlation in the switched group. We conclude from these results that although GBM can change over time, this has no bearing on gene.

488 David Adams, Michael Deutsch, Lorin Neuman-Lee, Matthew Gifford

Consequences of Anthropogenic Fire Suppression for Lizard Immunity

Maintenance of innate immunity is energetically costly. When resources are limited, organisms might trade-

off between immunity and other important functions like growth and reproduction. Climate change is expected to introduce novel or intensified immune challenges, which may exacerbate life history trade-offs and reduce individual fitness, especially in already vulnerable populations. Eastern Collared Lizards (*Crotaphytus collaris*) are especially vulnerable to the compounded effects of human disturbances, climate change, and life history trade-offs. *Crotaphytus collaris* is a Species of Greatest Conservation Need (SGCN) in the state of Arkansas where naturally occurring populations are concentrated on xeric glade outcroppings. Due to anthropogenic fire suppression, many glades have been overrun by red cedar trees (*Juniperus virginiana*), which dramatically altered the habitat. *Crotaphytus collaris* on cedar-encroached glades have smaller body sizes and lower fecundity than *C. collaris* on non-degraded glades, which current modeling suggests is caused by energy limitations on cedar-encroached glades. We investigated immune function and sex steroid concentrations of *C. collaris* between glades with varying tree densities across the reproductive season. We predicted that immune function would be suppressed during the height of reproductive investment and that the degree of immune suppression would be highest on cedar-encroached glades where energy is thought to be most limited. Results of these analyses and their implications for ecoimmunology and conservation efforts will be discussed.

1292 Danielle Adams, Brad Boyce, Daniel Hooks, Benjamin Klitsner, Samantha Price, Richard Blob

Material properties of Cetartiodactyla skull and jaw bones

Reentering aquatic habitats involved drastic evolutionary changes in the physiology and morphology of whales and dolphins (Cetacea) compared to their terrestrial relatives (Artiodactyla). Bone material properties of the skull and lower jaw, including density and

298 Shana Caro, Rebeca Moreno-Villarreal, Camilla Hinde, Hans Hofmann

Into the wild: How real-world complexity and fitness consequences shape decision-making in birds

Deciding how much to feed offspring is one of the most critical decisions parents make. However, despite knowing much about what choices parents make and why, we know little about how they make those choices. What we do know about the cognitive mechanisms underlying complex decision-making has come from laboratory studies, which may not adequately reflect decisions made in the real world, with real-world complexity, constraints and consequences. To overcome these issues, we conducted a non-invasive, naturalistic experiment on decision-making speed in a wild passerine songbird, using 62 parents of the great tit *Parus major*. Surprisingly, we did not find the canonical speed-accuracy trade-off: instead, we found that parents made slower decisions if they made an error (fed a non-preferred chick). We found that parents valued accuracy over speed especially in situations when offspring starvation was more likely, i.e. when the fitness consequences for making a wrong decision were higher. Finally, we found that parental decision speed was constrained by offspring behavior, their own sex, and prey characteristics. Overall, these results indicate that laboratory studies may overestimate the importance of speed-accuracy trade-offs when individuals are presented with complex evidence varying across multiple parameters; may underestimate the mediating effects of urgency on decision-making; and may underestimate the constraints under which decisions are executed. More broadly, our study demonstrates how crucial evolutionarily relevant experiments are for neuroethology.

915 Katrina Carrier, Daniel Powell, Yasemin Altug, Isabella Kane, Rania Janmohamed, Patsy Dickinson

Combinatorial effects of changes in ion concentration and temperature on the lobster nervous system

Climate change has resulted in altered patterns of rainfall globally. Consequently, sea water is both increasing and decreasing in salinity as a function of decreased and increased rainfall patterns, respectively. This includes changes in both surface and water column salinity. These changes are problematic for the nervous systems of marine osmoconformers as changes to the ionic concentrations in their extracellular environment can fundamentally affect neuron function. Simultaneously, ocean temperatures are rising, which can likewise alter neuron function in marine poikilotherms. Because

changes in the extracellular concentrations of all permeable ion species and changes in temperature will affect the activity of all neurons in a network, the combinatorial effects of such perturbations on neural networks are of interest. Using the stomatogastric and cardiac nervous systems of the American lobster (*H. americanus*), we demonstrate that these circuits, which control movements of the foregut and heart, respectively, are able to maintain physiological function when the extracellular saline concentration is altered to 0.75x and 1.25x the normal concentration. We establish the upper limit of temperatures that the systems can withstand without “crashing” (ceasing function but recovering when returned to normal conditions) in normal (1x) physiological saline. We then determine whether combinatorial changes in temperature and salinity concentrations change the limits for each individual perturbation when they occur together.

73 Amanda Carter, Kimberly Sheldon

Plasticity of dung beetle mothers rescues offspring survival under climate change conditions

By influencing offspring development and survival, parental effects have the potential to aid responses to rapid environmental change. We examined whether *Onthophagus taurus* dung beetles modified breeding behaviors in response to climate change conditions, and as a result, buffered their offspring from increasing temperatures during development. We conducted a breeding experiment under miniature greenhouses in the field and tracked female reproductive behaviors and offspring phenotype and survival. Dung beetles lay eggs inside of brood balls made of dung and bury them underground. Burial depth influences the temperatures offspring experience during development – with deeper depths offering cooler, less variable temperatures – which can have profound effects on development. We put females in ambient or greenhouse treatments and measured brood ball production, mass, and burial depth. We allowed offspring to develop underground at the maternal burial depth until eclosion, and measured offspring survival, mass, and sex. Females in the greenhouse treatment buried brood balls deeper than those in the ambient treatment, such that offspring developed at similar temperatures in both treatments. As a result, offspring survival was similar between treatments, but body size was smaller, and more females were produced in the greenhouse treatment. Our results demonstrate that parental effects can buffer offspring survival from climate change, underscoring the importance of plasticity in climate change responses.

detectability depends on dewlap-versus-background luminance and chromatic contrast. Background luminance is highly variable, so that a wide range of dewlap luminances are equally effective. Chromatic contrast against the largely green background of most habitats is generally greatest for red or orange dewlaps. However, in shaded habitat, the relatively low photon flux emitted by such colors limits their effectiveness. This is because photon-shot noise limits color visibility under low light conditions for small-eyed animals like anoles. Broader-band colors, such as white or yellow, are often more visible in moderate-to-heavy shade because they reflect more photons and, in many cases, diffusely transmit more light, which makes them several times more radiant across the spectrum, and gives them a glowing appearance. Consistent with these observations, most anoles in low shade habitats possess red or orange dewlaps, while those in shaded habitats more often possess white or yellow dewlaps.

649 Caroline Fleming, Randi Rotjan, Justin McAlister, Grace Beery, Itasca Motter, Wendy Heiger-Bernays

Nutrient or pollutant? Disentangling the effects of nitrogen on urbanized corals in a changing ocean

Marine coastal ecosystems that exist downstream from urban centers are subjected to excess dissolved inorganic nitrogen (DIN) in the form of wastewater effluent, industrial waste, and fertilizer runoff that can overwhelm organismal function, turning nitrogen from a nutrient to a pollutant. One group of urban marine organisms that are particularly vulnerable to nitrogen pollution are corals, due to the presence of endosymbiotic algae (zooxanthellae). While nitrogen is critical for the symbiont to photosynthesize and ultimately assimilate photosynthates into workable energy, research suggests excess nitrogen can harm tropical corals: the overactivity of the symbionts generates harmful reactive oxygen species that can lead to coral mortality. In this study, we leveraged the facultative symbiosis of the urban coral *Astrangia poculata* to quantify the physiological tolerance threshold of adult and larval *A. poculata* exposed to two four levels of nitrogen species (ammonium and nitrate) under ambient and increased temperature conditions. Using metabolic, morphological, and physiological outputs, we directly quantified the levels of pollution and temperature that cause distress. Overall, we hypothesized that 1) the impacts of increased DIN will be amplified in elevated temperature conditions 2) larval corals will experience more severe physiological outcomes compared to adults due to their larger surface area to volume ratio, and 3) nitrate, rather than ammo-

nium, will have stronger deleterious effects, given the increased energetic investment needed by the coral to process nitrate.

945 Rachel Fleming, Thomas Roberts

Evidence for a spring-powered mechanism in woodpecker drumming

Almost all woodpecker species perform drumming: a high-speed, sociosexual display that consists of rapidly hammering their bill against a tree. Drilling behavior, by contrast, is less rapid and used for foraging and nest excavation. The acoustic signature of these behaviors vary between species in both length and speed. Though both behaviors are common for woodpeckers, the mechanical basis of woodpecker drumming and drilling are still not well understood. We hypothesize that the very high frequency of drumming (20-30 Hz for many species) requires significant elastic energy storage and recovery to maintain the motion. Since spring-mass systems operate most effectively at the system natural frequency, we predicted that drilling frequencies in a given species would be constrained to a narrow range. Drilling is slower and more likely to be powered by muscle action, thus we predicted drilling frequencies would be less constrained. We analyzed audio recordings of drumming and drilling to measure the rate (beat s⁻¹) for several species and found, as predicted, a relatively narrow range of drumming frequencies within a given individual. Drilling frequencies were slower, and, in all species, there was a substantial gap between drilling and drumming frequencies where no beak behavior occurred. A simple mathematical model of the drilling and drumming motion suggests that this gap represents a frequency regime where neither elastic power or muscle power are sufficient to drive the motion.

1046 J. Morgan Fleming, Katie Marshall, Timothy Meidl, Jorge Celi, Kimberly Sheldon

Metabolic plasticity of tropical and temperate dung beetles to increasing temperature variation

Increasing temperature fluctuations associated with climate change are expected to have profound effects on species performance and fitness, but these effects might vary among organisms that evolved in different thermal environments. For instance, tropical species that have evolved in relatively stable thermal conditions may have limited capacity to cope with increasing temperature fluctuations compared to temperate species that evolved in more variable thermal conditions. We used dung beetles from tropical (Ecuador) and tem-

tion. While biologists agree that understanding cellular mechanical environments is useful for elucidating many of these cellular processes, the methods for proving the mechanical link are often highly customized, or too general to draw useful mechanical conclusions. In this paper, we describe a new method where we analyze microscopy videos to quantify parameters describing eukaryotic adherent cell shape (e.g. area, perimeter, curvature), thereby allowing us to draw conclusions about cell mechanics under various conditions. We include an overview of experimental methods to change cell mechanics, different image analysis tools, and a description of measurements which correlate with mechanical impacts. In particular, we use an ImageJ plug-in, WEKA, and custom MATLAB and Python codes to investigate the possibility that the cytoskeletal protein obscurin is mechanosensing in epithelial cells. A mechanosensing protein monitors if the cell mechanical environment is altered and then produces a biochemical signal. In addition to correlating cell properties with obscurin expression level, we describe a simple mathematical model that builds on the image analysis data to predict cell membrane tension. Our goal is to provide microscopists with quantitative tools that are broadly helpful in delineating whether various proteins or conditions alter a cell's mechanosensing capability in an easy, straight forward manner.

309 Jenny Ouyang, Jennifer Heppner, Justin White

Urbanization, heavy metal pollution, and fitness in house sparrows

Understanding the links between environmental characteristics, phenotypes, and fitness enables researchers to predict the impact of changing landscapes on individuals and populations. Although avian reproductive output is typically lower in urban than natural areas, the underlying reasons for this discrepancy may lie at the intersection of abiotic and biotic environmental and individual differences. In this study, we aimed to identify which abiotic stressors are linked to avian reproductive output in urban areas and whether this link is mediated by individual hormone levels. We used fine-scaled estimates (2m² spatial resolution) of nighttime light, noise, and urban density to assess their impacts on the physiological condition of adult house sparrows (*Passer domesticus*). We measured circulating levels of lead and glucocorticoid concentrations in breeding pairs of free-living house sparrows and related these physiological traits to reproductive success. Using structural equation modeling, we found that increased urban density levels linked directly to increased plasma corticosterone and lead concentrations that subse-

quently led to decreased fledgling mass. Although urban areas may be attractive due to decreased natural predators and available nesting sites, they may act as ecological traps that increase physiological damage and decrease fitness. With fine-scale ecological mapping for a species with small home ranges, we demonstrated the presence and impacts of urban stressors in a small city with high human densities.

56 Julia Padro, Tate Linden, Emily Blackwell, Chris Law
Mandibular sexual dimorphism in mongooses (herpestids) and civets (viverrids)

Rensch's rule suggests that sexual dimorphism increases as body size increases in species where males are larger than females. One hypothesis explaining this pattern is that through sexual selection male-male competition for food, mating partners, and territory increases with body size. Here, we examine whether mandibular sexual dimorphism follows Rensch's rule in two families within the order Carnivora: Herpestidae (mongooses) and Viverridae (civets and genets). Although previous work found that these two families exhibit conflicting patterns concerning Rensch's rule, whether a more consistent signal can be found in a trophic morphology such as the mandible has yet to be investigated. To test the hypothesis that viverrid and herpestid mandibles follow Rensch's rule, we 3D scanned 64 mandibles across 10 viverrids and 94 mandibles across 16 herpestids from museum collections and performed geometric morphometrics to quantify shape and size differences between male and female mandibles. We then used ANOVAs to test for mandibular dimorphism in each species, and linear regressions to test for Rensch's rule. We found that mandibular dimorphism does not increase with mandibular size, indicating that herpestid and viverrid mandibles do not follow Rensch's rule. Our results suggest that the effects of sexual selection and niche divergence on sexual dimorphism cannot be captured by Rensch's rule, and additional analyses are needed to investigate how mating system, social system, and diet affect sexual dimorphism.

727 Anchal Padukone, Kimberly Sheldon

Temperature means and fluctuations interact to impact life-history traits in *Spodoptera frugiperda*

Temperature variability associated with climate change may exacerbate the ecological and economic impacts of insect pests, such as the widespread fall armyworm (*Spodoptera frugiperda*). However, our current understanding of how temperature changes impact insect performance often comes from studies using a series of constant temperature treatments. These may not

range after being moved up to 1000 meters, suggesting advanced navigational abilities. In addition, we piloted ablation studies targeting olfaction and magnetoreception and studied their effect on homing, with our results suggesting multi-modal models of navigation in cane toads. Additionally, we collected brains to compare activity in the medial pallium and other brain regions to determine the neural signature of homing behavior, using phosphorylated ribosomes as a marker of neural activity. Combining field based behavioral studies with laboratory analyses of brain activity allows us to better understand how the amphibian brain governs natural behaviors.

939 Kimberly Sheldon

Behavioral plasticity of dung beetle species in warmer, more variable temperatures impacts fitness

Temperature strongly affects insect development, but plasticity of adult reproductive behaviors can alter the temperatures experienced by earlier life stages. To date, few studies have tested whether adult behavioral plasticity can protect offspring from the warmer, more variable temperatures linked to climate change. Here I discuss laboratory experiments and field manipulations in which my lab has examined whether the adults of three dung beetle species modify their breeding behaviors in response to increases in temperature mean and variance and whether these behavioral shifts can protect dung beetle offspring from temperature changes. Tunneling dung beetles lay their eggs inside brood balls constructed of dung that are buried below the soil surface. The depth of the brood ball affects the temperatures that the offspring experience and, thus, offspring development. Based on lab and field studies, all three species placed brood balls deeper in the soil in response to warmer and more variable temperatures, but for some species, the greater burial depth came at a cost to brood ball size and/or number, which can impact fitness. Despite greater burial depths, offspring in brood balls in the heated treatments still experienced warmer mean temperatures, which had a large, negative effect on offspring survival of the species with the smallest body size. These findings suggest adult behaviors could partially shield developing offspring from temperature changes.

1569 Analisa Shields-Estrada, David Cannatella

Near-infrared reflectance as a thermoregulatory mechanism in *Hyla* tree frogs

Investigating patterns of ecological selection and pinpointing resulting thermoregulatory phenotypes in species most at risk of extinction, is paramount to our

understanding of how species will fare in a rapidly changing climate. One important thermoregulatory phenotype is color (i.e., visible spectral reflectance). Adaptive variation in color reflects a suite of organismal specific traits and behaviors mediated by natural and sexual selection pressures. The role of color in signaling has been studied extensively; however, how color influences thermoregulation, specifically in taxa with color-specific competing selection pressures, and the roles of other reflection spectra (i.e., the near infrared), have been largely ignored. Our work examines the adaptive role of visible and near-infrared spectral reflectance in Nearctic tree frog (Genus *Hyla*) thermoregulation. We measured warming tolerance of four species of hylid inhabiting diverse microclimates across Texas and recorded spectral reflectance measurements and photographs in the visible (400-700nm) and near-infrared spectra (700-1100nm) to assess how spectral reflectance mediates thermoregulatory ability in these frogs. All four species demonstrated significantly increased visible or near-infrared reflectance in response to increased environmental temperature. This is the first evidence to photograph and quantify frogs using real-time changes in visible and near-infrared reflectance to thermoregulate. This work identifies an understudied thermoregulatory mechanism in tree frogs and highlights the importance of identifying how species might persistence in an increasingly changing and unpredictable climate.

1022 Erin Shilling, Ashley Carreiro, Ian Combs, Joshua Voss

Efficacy of stony coral tissue loss disease intervention and impacts on coral microbial communities

Since 2014, stony coral tissue loss disease (SCTLD) has spread from Florida to multiple Caribbean coral reefs. These disease outbreaks have triggered mass mortality events in many regions with some northern sections of Florida's Coral Reef experiencing up to 83% mortality. We investigated the effectiveness of SCTLD intervention treatments in situ and considered the impacts of these treatments on corals' surface mucus microbial communities. SCTLD-affected *Montastraea cavernosa* colonies offshore of Broward County, Florida were tagged and divided into three treatment groups: 1) chlorinated epoxy, 2) CoreRx/Ocean Alchemists Base 2B plus amoxicillin, 3) untreated controls. A fourth set of untreated, healthy colonies were included as well. Results from tracking of both lesion progression and healthy coral tissue surface area remaining over an 11-month period indicated that the amoxicillin treatment is effective for healing individual lesions and preserving coral tissue. However, this treatment does not necessarily prevent the development of new lesions. The chlo-