EGSA Symposium - 2017 Abstracts

Session 1: Science in a Changing Climate

Ice cold & in hot water: Measuring thermal sensitivity of a developing Antarctic fish
Erin Flynn, GGE
Temperature strongly influences the limits and pace of life in ectotherms, shaping the physiology, behavior, ecology, and evolution of organisms within diverse ecosystems. While adult Antarctic fishes that inhabit the Ross Sea, Antarctica, where temperatures range from -1.9 to 0.5°C, exhibit limited acute (12-17°C) and chronic (4-9°C) temperature tolerances, little is known about earlier life stages. To investigate the thermal sensitivity of embryos of the dragonfish (*Gymnodraco acuticeps*), I measured resting metabolic rate performance curves of individual embryos (n=16-17) across a 9°C temperature gradient (-1 to 8°C) from the field and after a two-week acclimation at three temperatures (-1, 2, and 4°C). Time altered the shape and height of the performance curve, while warmer temperature acclimation more modestly increased curve height. These findings, along with ongoing work examining the concurrent effects of temperature and CO2-acidified seawater on gene expression to whole organism performance, inform how these life stages function in their sub-zero environment and provide insight into their capacity to cope with a changing climate.

Drought and plant invasion in salt marshes of the San Francisco Bay
Rachel Wigginton, GGE
Invasion by noxious weeds is a major conservation and management concern in tidal wetlands. When developing management strategies for these invaders, we must consider the impact of extreme climatic events, such as climate change-induced drought. A particularly problematic invader in San Francisco Bay Delta Estuary is *Lepidium latifolium* (white top). We monitored *Ledpidium* populations from 2014-2016. Between 2014 and 2015, near the peak of California's historic drought, we observed a significant decrease in *Lepidium* stem count ($p<0.05$), stem height ($p<0.05$), and percent cover ($p<0.05$). In order to understand the connection between this invasive plant dieback and drought, we established a manipulative experiment in winter 2016 at the Palo Alto Baylands Nature Reserve, where we altered precipitation in invaded salt marsh plots. We applied four precipitation treatments in a randomized block design (N=6/treatment): rain exclusion (rainout shelter), rain exclusion control (rainout shelter with reirrigation), rain addition (2" of additional water added), and unmanipulated control. Plots were assessed after removal of rainout shelters for stem count and height of *Lepidium*, height of native plants, and percent cover of all plant species. *Lepidium* stems were harvested to assess above ground biomass production within plots. Stem measurements differed between treatments, but covaried with the stem measurements in the plots the previous year. As climate continues to shift and become more variable, understanding how invasion interacts with these changes will likely be critical to effectively managing the *L. latifolium* invasion and preserving these important tidal habitats.

Ecological diversity: Alpha, beta… human?
Ash Zemenick, GGE
Ecologists are driven to understand and sustain the vast diversity of organisms on our home planet, Earth. However, the population of humans in STEM fields have historically been a uniform group of humans in terms of various dimensions of identity, the easiest of them to measure being race and ethnicity, sex, and more recently, gender and sexuality. In the past few years, the diversity gap has been brought to the forefront as a major issue in ecology to remedy, as evidenced by requiring Broader Impacts statements in NSF grants, and statements and policies by societies such the Ecological Society of America, among other efforts. Although we have made progress, we have a long way to go. In this talk I will discuss: why human diversity is important, why it has been limited, and how we can work to diversify our wonderful field. Ethically, all humans, no matter their identity, should be able to pursue a career in science/ecology without systemic barriers to their success. Further, human diversity has utility for scientific enterprise: more diverse groups of people are better at solving difficult problems, and are more productive. Although the benefits of human diversity are recognized, and explicit biases against underrepresented groups (i.e. outright discrimination) has waned, underrepresentation is still a problem.
As an endeavor, science requires objectivity. Scientists therefore strive to remove bias and conflicts of interest in their work. However, science was built and exists within human society; Science is inherently biased. Implicit biases ingrained in our subconscious from years of strong, repeated exposure to stereotypes and experiences shape our decisions and actions, and influence the recruitment and retention of underrepresented groups in STEM at every stage of education. Thus the cycle is self-perpetuating: underrepresentation contributes to the stereotype of particular scientist. This stereotype fuels implicit biases that lower recruitment and retention of underrepresented groups in biology, further perpetuating implicit biases, which in turn limits recruitment and retention. To diversify ecology then, we need to identify and confront the biases acting against underrepresented groups and intentionally work to remove them. We need to be willing to adapt our community to reflect the values and interests of everyone, not just of groups that have historically dominated the field.
One research-supported action to dampen implicit biases is to increase the visibility of successful biologists (i.e. role models) from underrepresented groups. Role models are inspiring, critical to intellectual growth and development,

and provide psychological support that increases retention of underrepresented groups. Various efforts have been made to increase the apparency of underrepresented role models in biology. Many are fantastic but are limited in scope, and some tend to tokenize diversity rather than humanize it. I am working to build a repository to increase the visibility of, and to humanize, role models from underrepresented groups in biology courses worldwide. I will briefly present my plans for the project in hopes of getting thoughtful, critical feedback from the attendees at the symposium.

Session 2: Trophic Interactions

Bees benefit from fire due to a lengthened postfire flowering season
John Mola, GGE
Disturbance is a dominant structuring force in many temperate and semi-arid communities. Typically studies focus on the response of the plant community to disturbance by fire, with few studies investigating the effects of fire on multi-trophic interactions. Further, much of fire ecology research is dominated by space-for-time substitutions, lumping fires together based on time since fire and unable to account for differences in the seasonality, intensity, or variation among sites pre-fire. Therefore, investigations into post-fire interactions from a common disturbance event are particularly valuable. Herein, I present results showing that the post-fire response of forb communities and the bumblebee (Bombus vosnesenskii) population changes dramatically over the brief flowering season within burned and unburned grasslands. Data prior to the fire suggest the study sites differ little in terms of their bumblebee abundance. Following fire, burned and unburned sites have equal early spring bumblebee abundance, when flowers are ample in both treatments. Shortly after the initial spring bloom, bumblebee abundance is only sustained in burned sites where plants bloomed in greater abundance and for a longer duration. Further, the inflorescence density of the most commonly visited plant was significantly higher in burned sites, suggesting an increase in patch quality and quantity for bumblebee foragers in post-fire communities. These results suggest a positive effect of fire for bumblebee populations and forb communities in California grassland ecosystems. Future studies should consider how disturbance influences the phenological context of species interactions.

Life in the fast lane: Predator foraging mode influences the effect of antipredator behavior
Jason Sadowski, GGE
Empirical studies have determined that the presence of predators can have strong effects on prey behavior and species interactions. Theoretical models of predator induced changes in prey phenotype have supported the importance of antipredator behavior on community stability. However theoretical studies tend to focus on the general influence of predator presence/absence without considering the mechanism behind induced changes in prey phenotype. To examine how mechanistic changes in prey behavior could influence community structure we incorporated encounter rates dependent on movement through the environment and created an intuitive tradeoff such that prey can hide from predators at the cost of foraging on resources. Overall we find that the velocity of the predator has a major influence on the importance of antipredator behavior. Predators with large movement velocities (mobile predators) override antipredator behavior and are able to effectively forage on prey regardless of prey antipredator response. On the other hand, predators with small movement velocities (sit and wait predators) are greatly influenced by the magnitude of antipredator behavior. These theoretical results agree well with the empirically demonstrated importance of cues from sit-and-wait predators. We posit that sit-and-wait predator cues are not only more reliable, but that responding to these cues is more advantageous to prey density and community stability.

DNA in the Delta: Using genetics to study food webs and fish
Ann Holmes, GGE
Genetics is a useful tool in a conservation and management context, often providing novel ecological data. In aquatic ecosystems, zooplankton are a crucial food source for larval fish. However, the details of food web processes are difficult to characterize in the wild, mostly due to the very small size of plankton. We used high-throughput genetic sequencing (HTS) to study food web process in the habitat of delta smelt, a highly endangered fish in the San Francisco Estuary and Delta. HTS revealed variable and sometimes unexpected feeding patterns. Zooplankton preferred certain phytoplankton species over others, but without respect to presumed nutritional values. The results provide novel data on food web processes, which are an important consideration in conservation and management strategies.

Feeding en route: Are migrating songbirds fueling raptor migration?
Ryan Bourbour, Avian Sciences
Little is known about the foraging ecology of migrating raptors. However, simultaneous peaks of migratory movement between falcons, accipiters, and songbirds suggest that bird-eating raptors may be tracking flocks of migrating songbirds as a plentiful food source. This strategy would allow energetically stressed songbirds to be exploited by predators that continuously hunt throughout their migratory journey. Documenting prey selection of these highly mobile predators has been challenging in the past, and as a result, most of our knowledge is derived from opportunistic observations. We have developed a method to identify trace prey DNA on the exterior of beaks and talons of migrating raptors using DNA metabarcoding. With the advent of modern genetic techniques, molecular

evidence can now be used to study complex trophic interactions within migratory flyways. This study will provide novel insights into the ecology and evolutionary strategies of migrating raptors and has conservation implications in the face of anthropogenic climate change and the potential decoupling of cues.

Session 3: Conservation & Land Management

Creating a species distribution model for the Sacramento Valley red fox
Sophie Preckler-Quisquater, GGE
The Sacramento Valley red fox (*Vulpes vulpes patwin*) is endemic to California, occurring solely within the northern Central Valley. Within this region, a presence-only model based on den sites located during 2007-2009 suggested affiliations to grassland and human development (presumably to avoid coyotes), as well as avoidance of flooded agriculture. This model provided 3 predictive levels: high, moderate, and low probabilities of occurrence. During 2014-2016, we tested this model by surveying 107 sites within 63 randomly selected grid cells. Each site was surveyed for 90 days using baited motion-triggered cameras. We detected red fox at 26 (36%) of 73 high-probability sites, 4 (20%) of 20 moderate-probability sites, and 0 (0%) of 14 low-probability sites, supporting the utility of the model. We also used maximum-likelihood modeling with the presence-absence data from our survey to refine the model, estimate probability of detection, and estimate occupancy throughout the range. The two modeling approaches produced similar distributional predictions, but the occupancy survey, in conjunction with data on home range and group size, additionally enabled us to produce the first range-wide population abundance estimate for the Sacramento Valley red fox.

The effects of waterfowl management on the Salt Marsh harvest mouse
Katie Smith, GGE
The salt marsh harvest mouse (Reithrodontomys raviventris) is an endangered species, endemic to the San Francisco Bay Estuary. Over 90% of the historical tidal marsh habitat for this species has been lost to development and other anthropogenic use. In the Suisun Marsh large areas of habitat has been preserved by waterfowl hunters. Though many managers have regarded waterfowl management as harmful to the salt marsh harvest mouse we show that these habitat types have high value for this species.

Multiple drivers of vegetation change in an urban landscape: Riparian canopy expansion along headwater streams near Sacramento, California
Joanna Solins, GGE
Urbanization is often associated with a decrease in riparian tree canopy cover, but this outcome may vary depending on native ecosystem characteristics and previous land uses. We examined changes in riparian tree canopy along headwater streams in the metropolitan area of Sacramento, California, which has a Mediterranean climate and was heavily impacted by agriculture before urbanization. Using aerial imagery from 1937, 1984, and 2014, we quantified changes in the area, width, and density of riparian tree canopy across the 85-square- km Arcade Creek watershed. To better understand the drivers of canopy change, we mapped watershed land cover from the same aerial imagery, examined stream hydrology using stream gage data and field observations, and conducted field surveys of riparian woody vegetation at nineteen sites across the stream network. Land cover in the Arcade Creek watershed shifted almost entirely from pasture and crops to urban development between 1937 and 2014. During that time, forested area within 50 m of streams increased by 38 percent. The median width of riparian tree canopy more than doubled, and the density of tree cover along first- and second-order streams increased significantly (p < 0.0001). Much of the Arcade Creek stream network now receives dry-season flow subsidies from urban runoff, but these subsidies are spatially and temporally variable. Widespread channel incision in the watershed, likely due to an increase in the magnitude of more frequent floods, may limit the impact of increased dry-season flows on riparian trees. Accordingly, we found few hydrophilic species growing along these streams. Instead we found evidence of robust native oak regeneration and a high density of escaped horticultural species. The observed increase in riparian forest cover was thus likely caused by changes in vegetation management due to urbanization, possibly augmented by increased dry-season water availability. The changes in canopy cover stand in contrast to the accepted pattern of riparian forest decline with urbanization, and are expected to affect stream and terrestrial ecological function.

From microbes to water districts: Linking observations across scales to uncover the implications of riparian and channel management on water quality in an irrigated agricultural landscape
Alex Webster, GGE
Interactions among runoff, riparian and stream ecosystems, and surface water quality remain uncertain in many settings, particularly those heavily impacted by human activities. For example, waterways in the irrigated agricultural landscape of California's Central Valley are seasonally disconnected from groundwater tables and are extensively modified by infrastructure and management. These conditions make the impact of riparian and channel management difficult to predict across scales, which hinders efforts to promote best management practices to improve water quality. We seek to link observations across catchment, reach, and patch scales to understand patterns of nitrate in waterways draining irrigated cropland. Data was collected on 80 reaches spanning two water management districts.

At the catchment scale, water districts implemented waterway and riparian management differently: one water district had a decentralized approach, allowing individual land owners to manage their waterway channels and banks, while the other had a centralized approach, in which land owners defer management to a district-run program. At the reach scale, riparian and waterway vegetation, geomorphic complexity, and flow conditions were quantified. At the patch scale, denitrification potential and organic matter were measured in riparian toeslope soils and channel sediments, along with associated vegetation and geomorphic features. All factors were tested for their ability to predict water quality using generalized linear mixed effects models and the consistency of predictors within and across scales was evaluated. A hierarchy of predictors emerges: catchment-scale management regimes predict reach-scale geomorphic and vegetation complexity, which in turn predicts denitrification potential. These findings suggest that, in the absence of other regulations, a decentralized management approach to riparian zones and waterways allows complexity to arise, which in turn promotes ecosystem function and improved water quality.

Posters

Conservation of the Channel Island spotted skunk (Spilogale gracilis amphiala)
Ellie Bolas, GGE
Two of the northern California Channel Islands, Santa Cruz and Santa Rosa, are unusual in that they support two endemic carnivores, the island fox (*Urocyon littoralis*) and the island spotted skunk (*Spilogale gracilis amphiala*). The relationship between these two sympatric species is not well understood; however long-term population trends indicate the possibility of interference competition with negative impacts on the island spotted skunk. Currently, skunks on both islands appear to be in decline based on incidental captures during annual island fox live-trapping. We report here on on-going research on both islands to examine the cause of this decline. Remote cameras are currently deployed as an independent assessment of skunk presence to determine if incidental captures of skunks during fox live-trapping are an accurate estimate of the relative abundance of skunks. Additionally, previous research on the skunk and fox on Santa Cruz Island indicates an overlap in habitat use, home range, and diet, suggesting the potential for intense interspecific competition. We are performing microhabitat assessments at all live-trapping sites to be compared with past capture histories for both species. These data can identify the extent of niche overlap between the two, as well as possible refugia available to the skunks.

Science-Informed Leadership
Madeline Gottlieb, GGE
Executive branch appointees affect science, energy, the environment, education, and public health but do not necessarily demonstrate scientific or evidence-based decision-making. Threats to defund federal science programs will have far-reaching consequences for the scientific community and its beneficiaries. Science Informed Leadership is a graduate student-led effort to promote the appointment of executive branch leaders with a demonstrated track record of evidence-based governance that is rooted in scientific evidence and consensus, especially with regard to policy and regulatory issues that directly affect science, energy, the environment, education, and public health. We empower scientific advocacy by organizing communication resources to enable science-minded citizens to encourage their senators to consider federal appointments that affirm the importance of non-partisan, evidence-based decision-making. Science Informed Leadership has over 2,000 webapp users across 47 states, 600 volunteers nationwide, and has drafted a consensus statement signed by 17 university graduate student associations, representing ~120,000 students.

Novel presence of Proctophyllodes huitzilopochtlii on Anna's (Calypte anna) and black-chinned (Archilochus alexandri) hummingbirds
Emilie Graves, GGE

Implications for biological pest control: What's on the menu for barn owls in an intensive agricultural region?
Breanna Martinico, GGE
Barn owls (*Tyto alba*) are the most widespread raptor species on Earth, and because they are thought to provide natural vertebrate pest control services, farmers in some agricultural regions have encouraged barn owls to breed and hunt on their farms by installing artificial nest boxes. However, barn owl populations are declining in some agricultural regions, which may be a result of changes in land use and agricultural intensification. We studied barn owl diet and nest box occupancy in an intensive agricultural landscape in the Central Valley of California to measure whether agricultural land use affected barn owl diet. We collected 415 viable pellets from 25 active nest boxes over two breeding seasons and compared these results with agricultural land use types within a 1-km radius of each nest. Mice (*Mus musculus* and *Reithrodontomys megalotis*) were the most numerous prey and the most important by biomass, but their importance in barn owl diet declined with higher proportions of perennial crops in the surrounding landscape. California voles (*Microtus californicus*) were less important by number, but still represented a significant proportion of the biomass consumed by owls in our study area. Pocket gophers (*Thomomys* spp.) were consumed less often but were also an important source of biomass. Furthermore, barn owls nesting in areas with higher proportions of perennial crops consumed more gophers and fewer voles, many of which were juveniles, suggesting

that gophers are more abundant and a more important part of barn owl diet in perennial crop areas. Over 99.5% of prey items in barn owl diet were agricultural pests and owls are therefore likely to provide valuable pest control services for growers in our area, although the species consumed may vary with crop types with implications for pest-control.

Genomic techniques enhance biodiversity monitoring in the Yolo Bypass
Sarah Stinson, GGE
One of California's biodiversity hotspots is the floodplain habitat of the Yolo Bypass in Yolo county. It safeguards many threatened and endangered species that primarily consume invertebrates. Traditional invertebrate biodiversity monitoring relies on time intensive taxonomic identification, and excludes many larval stages and cryptic species. Genetic techniques can greatly enhance traditional biodiversity monitoring, increasing the coverage of species presence-absence data and providing a rapid assessment of biodiversity without destructive sampling. Species identification resulting from genetically identified samples are taxonomically comprehensive, efficient, and auditable by third parties. We are developing environmental DNA (eDNA) tools to assess aquatic invertebrate biodiversity, and to enhance biomonitoring and restoration efforts within the Yolo Bypass Wildlife Area (YBWA). This study will improve the coverage of species presence-absence data and provide a rapid assessment of biodiversity without destructive sampling. Once validated on individual taxa of known biomass, an eDNA microcosm validation will be performed. Microcosms comprising a 'mock community' of invertebrate species will be cultured in the laboratory. We will validate the eDNA technique using invertebrates commonly detected in the YBWA, of known life stage and biomass. DNA from microcosm water samples will ensure all taxa can be detected with this method. Finally, field sampling of taxonomic specimens and water samples (eDNA) will be conducted concurrently to compare the total biodiversity obtained by each method. Characterization of seasonal, site-specific invertebrate (YWBA food web) composition after a ten-year flood event will be enhanced by using genomic techniques in conjunction with traditional biomonitoring.

Distribution and connectivity of Sierra Nevada red fox in the Oregon Cascades
Cate Quinn, GGE
The Sierra Nevada red fox (SNRF; *Vulpes vulpes necator*) is a montane subspecies of red fox that historically occurred throughout the Sierra Nevada and Southern Cascade ranges in California and Oregon. Over the last century SNRF have declined precipitously; in California, where only 2 isolated populations each numbering <50 individuals occur, it is clear SNRF are imperiled. In contrast, almost no information on the status and distribution of SNRF in Oregon exists to guide conservation strategy. Scattered camera detections suggest as many as 5 potential populations between Crater Lake to the south and Mt. Hood to the north, with no insight into site abundance or connectivity. Here we summarize new camera and genetic detections carried out by a collaboration of state, federal, and non-profit organizations from 2012-2016. We apply habitat correlates to confirmed presences and predict the potential range of SNRF in Oregon in a preliminary species distribution model, as well as use microsatellite genotypes to determine minimum number of individuals and characterize their genetic connectivity. We discuss implications of our results to SNRF conservation and make preliminary recommendations for next research steps.

Accounting for spatially heterogeneous preferences while managing invasive species: A choice experiment
Joakim Weill, Agricultural and Resource Economics
Invasive species are causing tremendous impacts to ecosystems, economic activities and human welfare. Efficient management of a biological invasion requires the quantitative valuation of their impacts, for instance by measuring the population's preferences regarding these impacts. Although several studies emphasize the spatial nature of invasions and its implications in terms of management strategies, there is to our knowledge no study measuring spatially differentiated preferences with regards to invasive species. Our work is a first attempt to fill this gap. We use a spatially explicit discrete choice experiment to value the willingness to pay to reduce the invasion of an amphibious plant, the Primrose willow, in the park of Briere in France. Our results show that this willingness to pay is significant and spatially differentiated.