Abstracts for the 13th Annual Graduate Student Symposium in Ecology
3001 PES, UC Davis
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Session 1:

Max Odland, Graduate Group in Ecology
Understory Plant Communities after Thinning and RxFire in a Sierra Nevada Mixed-Conifer Forest

Forest management treatments aimed at reducing wildfire risk also affect forest understory plant communities. I use understory plant community data from a long-term field experiment at the Teakettle Experimental Forest in the southern Sierra Nevada to examine patterns of biodiversity and plant community composition following a full-factorial experiment of thinning and prescribed fire treatments in old-growth mixed-conifer forest that took place in 2001. I expected diversity to increase most in combined burn-thin plots after initial treatment and after a second application of prescribed fire. After initial treatments, combined burn-thin treatments had greater increases in α richness and evenness than control, thin-only, and burn-only treatments. However, the burn-thin treatments show decreased β diversity over time. Following a second application of fire in the burn treatments, burn-only plots show an increase in α and γ richness, but retain low evenness and β diversity, indicating that those plant communities are dominated by fewer, consistently occurring species. Different functional groups of understory plants responded differently to the treatments, with herbaceous plant cover increasing immediately after burn-thin treatments, but shrubs increasing shortly after, and persisting over time. These changes in the understory plant community may be driven by changes in environmental conditions following the treatments, as well as biotic interactions between different functional groups.

Lauren Hennelly, Graduate Group in Ecology
Genomic insights into the distinctiveness and local adaptation of South Asian wolves

Widely distributed and vagile species can exhibit and sometimes maintain local adaptations despite high gene flow. The gray wolf is distributed across Eurasia and North America, providing a good model to investigate these and other evolutionary processes. Only recently, distinct and divergent maternal lineages of gray wolves have been found within the Indian Subcontinent and the Tibetan plateau, diverging ~400,000 and ~800,000 from each other and the gray wolf clade, respectively. However, their genomic distinctiveness remains unknown, especially for the Indian wolf, which has only been sequenced at the mitochondria. We sequenced the whole genomes from Tibetan and Indian wolves and combined these with previously sequenced Holarctic and Arabian wolves to evaluate (1) the overall genome-wide distinctiveness of Tibetan and Indian wolves, (2) the genomic distinctiveness of each population across the genome, and (3) genomic regions that are candidates for potential signatures of local selection and reproductive isolating genes within South Asian wolves. Our research will provide insight into the processes that influence population differentiation in highly mobile species and inform conservation priorities of these south Asian wolves.

Sarah Gaffney, Graduate Group in Ecology
Long-term resistance of native grasses to noxious weed invasion

A central challenge to restoration is providing long-term suppression of invasive species. Planting native species that are functionally similar to invaders can be an effective approach. In California, established native perennial grasses can suppress invasion of the noxious weeds goatgrass (*Aegliops triuncialis*) and medusahead (*Elymus caput-medusae*), as they can successfully compete for late-season soil moisture. However, dynamics at patch edges are unknown and may allow goatgrass and medusahead persistence in restored native patch edges; therefore to fully understand long-term native suppression of noxious weeds, we must explicitly study patch edges.

In this study, we investigated a) the importance of priority effects for native grass establishment and suppression of noxious weeds, b) the spatial patterns of noxious weeds in these native-planted communities and c) how long-term precipitation treatments affect these outcomes. We performed a spatially explicit composition sampling (centers vs edge) of eleven-year-old experimental grassland plots. These plots were originally seeded with various mixtures of native, naturalized, and noxious weed plants and later placed under normal, wet, and drought conditions. Plots were allowed to be naturally invaded by species included in the study.

In native-only-planted plots, natives had high cover 11 years after seeding, as well as low noxious weed cover in the edge and the core. These results were similar across precipitation treatments. Our study shows that seeding natives in the absence of noxious weeds results in priority effects that allow long-term persistence and invasion resistance across precipitation patterns, and patch spatial dynamics do not create spatial refuges for invaders.

Session 2:

Manon Hess, Avignon University
Talk: Exploring the challenges of translating ecological theory into the practicalities of managing invasive species: the case of limiting similarity

The establishment of a native resistant plant cover after a disturbance (e.g. after restoration activities implying vegetation clearing) is increasingly recommended to impair invasive plant species colonization and local spread. One of the ecological theories explored by applied ecologists seeking to improve the invasion resistance of plant communities is limiting similarity. The limiting similarity theory, deriving from the classical niche theory, states that coexistence between species is more limited by competitive exclusion when species share niche properties. In practical terms, attempts to apply limiting similarity involve reassembling plant communities so that the dominant species' ecological niche is similar to that of a target invader. We pointed out several theoretical and practical limits to the application of this theory to limit the installation of invasive plants.

The demonstration and application of limiting similarity appears particularly complex due to the difficulty of (1) measuring ecological niche overlap between species, and (2) disentangling niche from fitness processes. Likewise, limiting similarity appears to operate at a time-scale that is too long for efficient impact on invasive species' early establishment. It may also be ineffective against invasions in the long term, due to environmental changes and community instability. Finally, limiting similarity is not applicable to the most common situations, where there are multiple co-occurring invasive species or no prior identification of potential invasives.

Aure Durbecq, Avignon University

Identifying reference communities in ecological restoration: the use of abiotic conditions driving vegetation structure

In restoration ecology, the reference ecosystem represents a key concept which is well defined from a theoretical point of view. In practice, however, selecting reference systems, such as reference plant communities, often lacks clear methodology. In order to facilitate this selection, we provide a framework based on ecological theory and more precisely on relationships between vegetation and environmental factors to identify reference plant communities. The four major steps are: 1) the delimitation of a geographical zone in which habitat types similar to restoration sites occur; 2) the identification of environmental factors structuring non-degraded plant communities within this geographical zone; 3) the comparison of the environmental factors between non-degraded and degraded sites; 4) the selection of the non-degraded sites most similar to restoration sites in terms of environmental factors to use them as references. We concept-proved our approach by identifying reference communities using abiotic factor combinations for five mountain grassland sites degraded by the construction of a high-voltage line. In a multivariate analysis of eighteen non-degraded sites, we identified six major environmental factors explaining plant species compositions. A second multivariate analysis including degraded sites provided environmental distances of the eighteen non-degraded to each of the degraded sites. The results demonstrated that the environmentally most similar sites were not necessarily the geographically closest ones. In conclusion, the analysis of regional plant-environment interactions provides an important tool to identify reference communities or source sites for seed transfer if not available adjacent to degraded habitats.

Clara Stuligross, Graduate Group in Ecology
Combined pesticide and resource stressors impair bee reproduction

Global insect declines are linked to agricultural intensification, which represents the largest land use worldwide. Insects like bees experience multiple stressors simultaneously with agricultural landscapes which act together to impact insect health, diminishing their ability to deliver the ecosystem serices on which human food supplies depend. Disentangling the effects of coupled stressors is a primary challenge for understanding how to promote their populations and ensure robust pollination and other ecosystem services. We quantified the individual and combined effects of resource limitation and pesticide exposure on the survival, nesting, and reproduction of the blue orchard bee *Osmia lignaria*. We established nesting females in 16 large flight cages using a crossed resource x pesticide design; cages contained spring wildflowers at high or low densities, treated with or without the common insecticide, imidacloprid. Pesticides and resource limitation combined additively to dramatically reduce reproduction in free-flying bees. Our results emphasize the importance of considering multiple drivers when investigating population persistence, management, and risk assessment for the long-term sustainability of food production and natural ecosystems.

Amelia Munson, Animal Behavior Graduate Group
You Make Me, Me: The Social Niche Hypothesis and Behavioral Consistency

Although consistent individual differences in behavior are common across the animal kingdom, it remains unclear why this is the case. Theoretically, individuals would benefit from being flexible in response to the current context. The social niche hypothesis is one theory that has been used to explain behavioral consistency. It posits that competition between individuals in a

social group can lead to character displacement. Positive feedback then keeps individuals in that role due to the benefits of specialization, including learning, and the costs of switching strategies. Social experience should thus generate increased behavioral consistency, however, previous evidence of the social niche hypothesis is mixed. This may be because many studies focus on short term exposure to social groups. We investigated how social experience affects consistent individual variation in shoaling behaviour in three-spine sticklebacks (*Gasterosteus aceleatus*). We tested shoaling behavior and then housed fish in either groups or alone and re-tested shoaling behavior. In line with the social niche hypothesis, we observed a substantial increase in the repeatability of shoaling behaviour of sticklebacks that were housed in a stable social group for 1 month.

Session 3:

Adam Pepi, Graduate Group in Ecology
Changing precipitation dynamics and changing herbivore dynamical regimes

The complex interaction between endogenous dynamics and exogenous environmental variation is at the core of population dynamics, and has been the focus of long-running debates in ecology. Global climate change has only increased the relevance of unravelling this complexity, as the changing climate leads in shifts in patterns of environmental variation that affect population fluctuations. In the present study, we document a shift in population dynamics of a univoltine native caterpillar, *Arctia virginalis* (Lepidoptera: Erebidae) from shorter period oscillations characterized by direct density dependence, to longer period oscillations characterized by delayed density dependence, concurrent with a shift in regional precipitation dynamics. Wavelet and time series analyses suggest that the shift in precipitation dynamics likely drove the change in caterpillar population dynamics. The change in precipitation dynamics itself was likely caused by shifts in large-scale oceanic climate oscillations. Shifts in population dynamics induced by changing patterns of environmental noise as found in the present study mean that forecasting population dynamics using model based on historical climate regimes may be difficult or impossible with changing climates, and illustrate the importance of understanding the complex manner in which endogenous and exogenous drivers interact to generate dynamics in ecological populations.

Mandy Frazier, Graduate Group in Ecology
Could it be good to eat your brother?! Examining differential metabolic performance in cannibal burbot, Lota lota

The practice of mitigating cannibalism in aquaculture is an important focus for hatcheries seeking to maximize yield and has been maintained in hatcheries focusing on wild stock restoration. We hypothesize, however, that a cannibal feeding strategy may confer performance advantages over a non-cannibal feeding strategy. This study examined metabolic performance differences between cannibal and non-cannibal burbot, Lota lota, at the Twin River's Hatchery in Bonner's Ferry, Idaho, USA. After habitat alteration led to a functional extinction of burbot in the region, the Kootenai Tribe of Idaho's Twin River's Hatchery has played a leading role in the reestablishment and conservation of burbot in the Kootenai River, Idaho. We examined morphometric data (weight, length, and condition factor), whole animal resting metabolic rate (RMR), and the enzyme activity of lactate dehydrogenase (LDH), citrate synthase (CS), and 3-hydroxyacyl-CoA dehydrogenase (HOAD) to describe the baseline metabolic performance of

cannibal and non-cannibal burbot. Taken together, our results demonstrated significant differences in the metabolic strategies of the feeding strategies, where cannibal burbot relied more heavily on carbohydrate metabolism and non-cannibal burbot relied more heavily on glycolytic and lipid metabolism. This study demonstrates the need to reevaluate the traditional practice of removing cannibal fish in conservation hatcheries, as it may not be the ideal strategy of raising the most robust individuals for release. When natural habitat conditions cannot be restored due to permanent habitat alteration, prioritizing release of higher performing individuals could help achieve conservation goals.

Ann Holmes, Graduate Group in Ecology
eDNA in Estuaries: Enclosure experiment shows capabilities and limitations of eDNA detection of delta smelt (talk)

The dynamic and heterogeneous natural of tidal estuaries presents a challenge for eDNA sampling and interpretation, particularly for rare target species. Enclosure studies can improve understanding how environmental conditions affect eDNA detection and guiding best practices for eDNA monitoring of wild fish. Here we describe results of an enclosure experiment with endangered delta smelt (*Hypomesus transpacificus*) in the San Francisco Estuary. We sampled water from 1m to 100m upstream and downstream of enclosures at two sites. We assayed samples for delta smelt eDNA using a species-specific quantitative PCR (qPCR) assay. Our results characterize how distance, tide direction, and site characteristics influence eDNA detection. Delta smelt eDNA detection was most consistent at distances less than 10m from the enclosures. On a flood tide, positive detections were more frequent upstream from the enclosures. On an ebb tide, positive detections were more frequent downstream from the enclosures. We saw some variation in eDNA detection rates between the two sites, perhaps due to shore morphology and differences in vessel traffic. The estimated eDNA concentration of all samples was below the Limit of Quantification (LOQ). The numerous factors influencing detection and consistent low eDNA concentrations across all detections suggest that eDNA sampling of wild delta smelt using qPCR is best suited for determining presence/absence, rather than quantitative estimates. This work helps to establish capabilities and limitations for eDNA monitoring of delta smelt in the San Francisco Estuary, and may inform eDNA methods applied to any rare, estuarine species.

Eliza Oldach, Graduate Group in Ecology
Talk: Globalization as an adaptive response to climate change impacts in Maine's lobster industry

Climate change is catalyzing shifts in the marine environment and, in turn, necessitating adaptation by marine resource users. In the Gulf of Maine, one of the observed changes is a decline in fishing quotas for Atlantic herring, as fishery managers seek to protect the stock from harm caused by declining populations of its primary food source, the copepod *Calanus finmarchicus*. However, Maine's iconic lobster industry has been heavily reliant on herring for bait, and the reduced quota forced the industry to adapt to a "bait crisis" in 2019. In this study, we analyzed individual- and group-level efforts as the industry adapted to changing bait supply. Ultimately, we observed that: (1) fishers escaped a cultural attachment to herring: (2) suppliers built capacity to source alternative bait options; and (3) policymakers institutionalized pathways to support bait trade. These findings highlight the role of globalization as climate change

adaptation, contrary to its primary treatment in the literature as an exogenous stress decoupled from local actors, and intrinsically linked to climate change.

Chris Adlam, Graduate Group in Ecology
Keepers of the Flame: Supporting the Revitalization of Indigenous Cultural Burning (talk)

Since time immemorial, California Indian tribes have used fire to maintain ecosystems that sustain their economic, cultural, and spiritual wellbeing. Keepers of the Flame is a partnership between cultural fire practitioners and UC Davis students and researchers seeking to support the revitalization of this practice. Initially an undergraduate course, the project grew into series of Indigenous Fire Workshops involving multiple tribes, policymakers and agencies. The interest in cultural burning grows with each conflagration, yet understanding its implications requires new teaching approaches, questioning cross-cultural dynamics, and a willingness to embrace the interconnectedness of culture and ecology. This presentation tells the story of the Keepers of the Flame project as it seeks to harness a different model of community-engaged research that supports the empowerment of Tribal fire experts.

Rob Blenk, Graduate Group in Ecology
An agent-based model of wintering foraging and energetics of North American waterfowl: Applications of a decision-support tool

For many wintering populations, the amount of energy available on a landscape is a limiting factor. This is held to be true for wintering waterfowl across much of North America. However, current dominant methods of evaluating energetic carrying capacity for waterfowl are not spatially explicit and are unable to take into account the considerable costs and limitations associated with acquiring food-- namely the costs of traveling to and from foraging patches, actively finding and acquiring food, and metabolizing that food. We present the Spatially-explicit Waterbird Agent-based Modeling Program (SWAMP), a spatially-explicit decision-support tool for conservation researchers and managers, and present an application of this program in California's Butte Basin, critical winter habitat for the conservation of North American waterfowl. By running parallel simulations representing different possible future conditions for waterfowl, we provide insight as to the relative importance of factors such as continuing drought, urban expansion, changes in rice agricultural practices, and further restoration of natural wetlands. SWAMP is also currently in the process of undergoing expansion into other landscapes, as well as adaptations for application to the conservation of other species such as the endangered Siberian Crane.

Poster Session:

Cody Aylward, Graduate Group in Ecology
Using DNA from Museum Specimens to Compare Historical and Modern Genetic Diversity of Salt Marsh Harvest Mouse

Salt marsh harvest mouse (SMHM; *Reithrodontomys raviventris*) is a federally endangerd species endemic to coastal marshes of the San Francisco Estuary. Approximately 90% of historical SMHM habitat has been lost to land development in the past century. Understanding the impact of habitat loss on genetic diversity is important to aiding the recovery and long term

persistence of SMHM. Furthermore, SMHM have not been recently detected in several locations near the putative subspecies boundary in the mid-bay. We used modern (2010-2019) and museum (1908-1960) specimens to estimate changes in genetic diversity and evaluate the subspecies status of SMHM museum specimens collected in the mid-bay. We first optimized a sample collection and DNA extraction protocol. Next, we collected 50 SMHM toe samples from the Museum of Vertebrate Zoology and Natural History Museum of LA County. We amplified the D-loop region of mtDNA and constructed haplotype networks of modern and museum specimens. Our preliminary results suggest there may be more genetic diversity in the historical specimens than the modern specimens. Furthermore, mid-bay specimens on both sides of the putative subspecies boundary were genetically grouped with the northern subspecies. Sampling is ongoing; our preliminary results suggest potential genetic consequences of habitat loss and potential revision of subspecies boundaries.

Taylor Davis, Graduate Group in Ecology
Optimizing tissue sampling and extraction protocols for next-generation genomic sequencing

The application of genomic tools in wildlife studies allows researchers to characterize and monitor populations, as well as understand mechanisms affecting genetic variation, adaptation, and evolution. However, these tools depend on high-quality genomic DNA sources, which typically come from tissues rather than noninvasive sources. Opportunistically collected samples (e.g., road-killed carcasses) may be an important genomic source for some species, but can result in highly variable DNA quality depending on freshness and environmental conditions. The primary objective of this study was to determine optimal guidelines for sampling and extracting field specimens to maximize DNA quality for genomic sequencing. Using red fox (*Vulpes vulpes*) carcasses in various stages of decay, we extracted DNA from multiple tissue types using two common extraction methods: silica membrane binding (DNeasy®) and salting out precipitation (Gentra® Puregene®). We found no significant difference between extraction method across all decay levels and tissue types, however we found that Gentra® Puregene® is both more costly and more time consuming. We found that in fresh samples muscle, gonads, and skin, produced the highest quality of DNA. However, in more degraded specimens, nose and tongue yielded the highest quality of DNA.

Annelise Del Rio, Graduate Group in Ecology
Critical Windows in Chinook Salmon Development: Differential Sensitivity to Warming and Hypoxia During Early Development

Conditions within salmon redds, or nests, can be highly variable. With the progression of global climate change high temperatures and hypoxia, low dissolved oxygen, may occur more frequently within the gravel rearing environment. Management strategies for salmon embryo survival in the Sacramento River largely focus on releases of cold water from the Shasta Dam during the incubation period. During drought or warming events, the supply of cold water can become limited and water releases may have to be more carefully timed. We examined how elevated temperature and hypoxia as single and combined stressors affected developing Chinook salmon. Exposures lasted either from fertilization through hatching or for short periods during embryonic development to test the effect of exposure timing. We measured growth, hatching success, developmental time, and metabolic performance at two embryonic stages. Hatching success was lowest in the chronic warm hypoxia exposure and the late warming and hypoxia exposure, suggesting the combination of stressors is most detrimental to survival, with greater

sensitivity during later stages in embryonic development. Embryos reared in hypoxia also developed more slowly and took longer to hatch compared to normoxic treatments. Determining developmental windows of increased sensitivity to stressors can inform effective and efficient water management policies to support salmon embryo survival.

Nick Framsted, Graduate Group in Ecology
Nutrients from the deep: internal phosphorus loading in hyper-eutrophic Clear Lake

Eutrophication is a large problem globally that results from excessive nutrients, such as nitrogen and phosphorus, in aquatic systems. In the case of phosphorus, sources can be external (i.e. runoff) or from within the lake (internal loading). Internal loading is a phenomenon where chemically reduced conditions at the sediment-water interface of lake bottoms (usually induced by anoxic conditions) facilitate the diffusion of metal-bound forms of phosphorus from sediments into the overlying water. Quantifying internal loading of phosphorus is often overlooked due to the complex logistics involved with sampling benthic environments at depth. Efforts to restore Clear Lake, a hyper-eutrophic lake located in Lake County, CA, have largely focused on external nutrient inputs as the cause of excessive phosphorus concentrations. This project provides the first direct measure of phosphorus flux rates from the nutrient-rich lake-bottom sediments to the overlying water column. Using laboratory incubations of intact sediment cores, we measured the flux of soluble reactive phosphorus (SRP) into the overlying water over a 30-day period in both anoxic and oxic core treatments. We monitored pH and redox over the course of the incubation to confirm oxidative differences between treatments. Among the six sites we sampled, rates of SRP flux in anoxic treatments ranged from 8.8 to 26.7 mg m-2 d-1. Fluxes in oxygenated treatments from the same sites ranged from -0.14 to 1.16 mg m-2 d-1.These results indicate large spatial variability in phosphorus flux as demonstrated by the 3-fold difference in the anoxic rates previously mentioned. Estimated annual internal loads can contribute 25.6 MT P yr-1—comparable to annual external loads. Our results show that internal loads likely account for 33-41% of SRP and 17-22% of TP to the lake. The extent to which internal loading contributes to harmful algal blooms depends on the duration of anoxia and the size of the anoxic zone in the lake. To understand these processes we are measuring dissolved oxygen concentrations near the sediments and developing a hydrodynamic model of lake mixing. Due to the high rates of sediment phosphorus flux, managers should take internal loading into consideration when examining current total maximum daily load (TMDLs) allocations of phosphorus to the lake.

Helen Killeen, Graduate Group in Ecology
Inter-annual variation in the distribution of marine fish larvae of the central California Current

Annual cohort strength for many marine fisheries is thought to depend strongly on the survival rates of larvae. In the California Current System, low larval survival has often been attributed to strong upwelling, which may advect tiny, weakly swimming larvae away from suitable nearshore settlement sites. Other taxa have been found to avoid advection by swimming vertically in a stratified water column, but whether such behaviors are common for fish larvae is unclear. During the spring and summer of 2017 and 2018, we conducted a series of cross-shelf surveys to examine how larval distributions responded to varying upwelling conditions. All cruises were conducted from within one kilometer of shore to the edge of the continental shelf where ichthyoplankton are most abundant. Nearly three-quarters of all ichthyoplankton were collected within ten kilometers of shore, even during strong upwelling. Moreover, species-specific

distributions revealed that ichthyoplankton frequently exhibit depth preferences that may allow them to either avoid or promote offshore advection depending on ontogenetic changes in habitat requirements. These findings suggest that, for many species, offshore advection may not be the most important source of larval mortality and that depth preferences are key to understanding larval dispersal and survival in coastal environments.

Sean Luis, Graduate Group in Ecology
Investigating Physical Drivers of Straying Behavior in Hatchery Origin Adult Chinook Salmon (Oncorhynchus tshawytscha) through Ecohydraulic Analysis

"Straying" is a behavioral phenomenon in which adult salmon migrate to non-natal freshwater habitats. In some cases, stray rates have been shown to increase dramatically in hatchery-origin populations because juvenile release strategies can limit olfactory imprinting at early life cycle stages. This study examines the confluence of the tributary Yuba River with the larger, mainstem Feather River in northeastern California to investigate non olfactory migratory cues and migratory microhabitat (1 m^2 scale) preference at a river junction. River junctions are hotspots of biological activity and important in network scale connectivity for flows of water, sediment, biomass, and energy. Monitoring data from 2004 to 2011 show that straying of adult Feather River hatchery origin Chinook salmon into the Yuba River increased with greater discharge and lower temperatures contributed by the Yuba, suggesting strong hydraulic influences on navigational cues. To characterize responses to confluence hydraulics, duel-frequency identification sonars (DIDSON, commonly referred to as "imaging sonars") will be utilized to observe and quantify physical habitat selection and swimming behavior of adult fall run Chinook salmon at the confluence. In a fall 2018 pilot study, 794 geo-referenced fish detections were recorded using similar methods in the project area. These data informed a more robust 2019 sampling campaign that includes more detailed habitat characterization. This behavioral data will then be compared with 2-D hydrodynamic model outputs to characterize migratory responses to microhabitat conditions and identify an actively selected migratory corridor based on observed patterns in habitat selection.

Breanna Martinico, Graduate Group in Ecology
Sublethal anticoagulant rodenticide exposure in Red-tailed Hawks (Buteo jamaicensis) wintering in the agricultural landscape of the Sacramento Valley, California

The vast agricultural landscape of California's Central Valley supports a wintering raptor population among the most abundant and diverse in the United States and Canada, and provides some of the last remaining compatible habitat for birds of prey in the region. On industrial farms, anticoagulant rodenticides (ARs) are an important component of integrated pest management strategies for controlling rodent pests that have populations inflated by food production, leaving raptors that commonly hunt pest rodents at an elevated risk of AR exposure in these systems. We have little understanding of sublethal exposure rates in wild raptor populations, as most of our knowledge is based on data collected from sick or injured birds brought into rehabilitation centers and carcasses; a knowledge gap that is mainly due to the logistically challenging nature of sampling wild raptors on the landscape. Therefore, it is important to begin to document and quantify the level at which non-target AR exposure is occurring in raptors, the impacts on the health of individuals, and the consequences at the population level. Our objective is to quantify the prevalence of sublethal exposure to ARs in wild Red-tailed Hawks (*Buteo jamaicensis*) hunting in the agricultural landscape of the Sacramento Valley using blood samples. In winter

2019, we sampled 14 Red-tailed Hawks of which 5 (35.7%) were positive for trace (<5 ppb) AR exposure for one or two of the following compounds: Bromadiolone, Brodifacoum, and Difethialone. We plan to sample hawks again in winter 2020 and to investigate how AR exposure may be related to immune stress and blood parasite load.

Lisa Rosenthal, Graduate Group in Ecology
Sporulation potential of Phytophthora ramorum differs among California plant species

Gathering information on host susceptibility and infectiousness (i.e. host competency) is a step in the right direction for obtaining targeted strategies for disease management. Sudden oak death (SOD) is a prominent forest disease, caused by the generalist invasive pathogen *Phytophthora ramorum* that has profoundly impacted California coastal ecosystems. SOD has largely been treated as a two-host system, with bay laurel being the most transmissive host, tanoak less so, and all remaining species as epidemiologically unimportant. However, this conventional understanding of host competencies primarily stems from observational field studies rather than direct measurements on the diverse assemblage of plant species. While much has been learned in its absence, the goal of this study is to formally quantify the sporulation potential of common plant species inhabiting SOD-endemic ecosystems on the California coast. This study will allow us to fill in gaps of the pathogen's basic biology, understand more about the trajectory of SOD in a changing environment, and finally, generate a more nuanced perspective of how the entire host community contributes to disease risk. We use a network of long-term monitoring plots located in the Big Sur region to identify the top 10 most common plant species in both redwood and mixed evergreen forests. Leaf tissue from each species was inoculated in a controlled laboratory environment and assessed for production of its two spore types, sporangia and chlamydospores, the infectious and resistant propagules, respectively. Our results showed that once challenged by *P. ramorum*, almost all plant species were infected and produced spores to some extent. We found sporangia production was greatest in tanoak and bay laurel and the difference was insignificant, and even though other species produced much less, quantities were non-zero. Thus, additional species may play a previously unrecognized role in local transmission. Chlamydospore production was highest in bigleaf maple and ceanothus, which raises questions about the role they play in pathogen persistence. Additionally, lesion size does not reliably correlate with the production of either sporangia or chlamydospores. Overall, we achieved an empirical foundation to better understand how community composition affects transmission. Future work must assess the ecological relevance of laboratory-based findings by corroborating them with field-collected data.