The California Botanical Society's
28th Annual Graduate Student Symposium

Friday – April 30

9:00 - 9:15 am	Welcome and Schedule overview
9:15 - 10:00 am	**Session 1 : Pathogens and Invasives**

Eduardo Luis Cruz

Attack of the Clones: Using transcriptomics to investigate the invasion success of *Carpobrotus edulis*

Transcriptomics utilizes RNA sequences to get a snapshot of genetic expression. This is a powerful tool in non-model species lacking a reference genome. Thus, the application of comparative transcriptomics has the potential to help us elucidate the evolutionary mechanisms that facilitate species invasion. *Carpobrotus edulis* is an invasive stoloniferous succulent plant belonging to the Aizoaceae family native to South Africa. We leveraged the use of RNAseq to investigate evolutionary changes in the highly invasive species, constructing a de novo transcriptome and performing a differential expression analysis between native and invasive populations. Our goal was to determine what evolutionary changes have occurred between invasive and native populations that might help us explain its highly invasive behavior. RNA-seq data was gathered from experimental native and invasive populations tested under stress conditions and used to assemble a de novo transcriptome. Altogether, we provide the first annotated transcriptome for the plant genus *Carpobrotus* and the Aizoaceae family. A preliminary differential expression analysis identified several differentially expressed transcripts between native and invasive populations. GO enrichment revealed five categories significantly enriched in the native group; two categories were involved in flower development and three were involved in stress-related metabolic functions. Invasive populations showed no increases in these stress response categories and showed decreased expression in genes relating to protection and defense. Thus, supporting the hypothesis that invasive populations have undergone significant genetic modification. These results are expected under the Evolution of Increased Competitive Ability hypothesis, wherein novel metabolic processes evolve when introduced ecologies.

Greg Huffman

Fungi associated with herbaceous native and non-native plants in Coastal Northern California

The presence of fungal species, potentially pathogens, associated with herbaceous plants was monitored at Golden Gate National Recreation Area in coastal Marin County (Marin Headlands and Tennessee Valley), which is characterized by varying degrees of human caused disturbance and topographic variety (e.g., distance to the coast). The research involved a combination of field sampling surveys and data collection using a stratified random design, pathogen identification through microbiological and molecular analysis, and multivariant analysis and ordination of results. A total of two years of repeated sampling (four times a year) was organized to allow for the detection of seasonal differences in pathogen presence on aerial plant parts. Throughout March of 2018 to March of 2020 a total of 843 samples were collected from five different sample transects. From those 843 plant samples, 34 microbial isolates were grown into pure cultures, which were identified as 16 different species using sequencing of the ITS1 region. Additionally, 10 hitherto unknown species were isolated and compared with GenBank data. *Phytophthora ramorum*, a well-known pathogen of forest trees, was isolated for the first time in the USA from the native herbaceous species *Marah fabacea* (Cucurbitaceae).

	Franki Crites Distribution and Frequency of Aquatic Oomycetes Throughout Marin County in Relation to Physical Chemical Water Parameters Oomycetes, also known as water molds, belong to the kingdom Stramenopila and are a well known group of plant pathogens and saprophytes. Important species include *Phytophthora ramorum* (causal agent of sudden oak death), *Pythium aphanidermatum* (root rot), and *Phytophthora infestans* (late potato blight), all major threats to the environment, agriculture, and the economy. Although many oomycete species have been found in various water sources, little is known about the correlation between the distribution and frequency of oomycetes in aquatic environments and physical chemical water parameters. The objective of this study was to detect and identify aquatic oomycetes from Marin Co. using repeated seasonal sampling and DNA sequencing and to analyze relevant physical chemical water characteristics such as temperature, pH, conductivity, turbidity, total suspended solids, biochemical oxygen demand, and bacteriological contamination. Throughout June of 2019 to April of 2020 a total of 180 different samples were collected from nine different sampling locations throughout Marin Country. From those 180, 67 isolates (37%) grew into colonies, which were identified as 16 different species. Water quality characteristics varied across seasons and locations, and the correlation to microbial diversity has yet to be determined. Although these are preliminary results, at least two of the species (*Phytophthora undulata* and *Nothophytophthora caduca*) identified in this study have not been found in the United States thus far, suggesting global transmission of new species.
10:00 - 10:30 am	Coffee Break
10:30 - 12:00 pm	**Session 2 : Phylogenetics and Hybridization** Niveditha Ramadoss The Phylogenetic Relationships of the Subfamily Arbutoideae (Ericaceae). Implications for the Origin of *Arbutus* Arbutoideae is a subfamily in Ericaceae that comprises taxa mostly adapted to dry climates and diverse in their morphological traits. Six genera are commonly recognized - *Arbutus*, *Arctostaphylos*, *Arctous*, *Comarostaphylis*, *Ornithostaphylos*, and *Xylococcus* but their phylogenetic relationships have long been unclear. Moreover, in a previous study Arbutus was found to be paraphyletic with the North American taxa forming a clade separate from the European taxa. But this paraphyletic phylogeny was based on unreliable markers, low bootstrap values and polytomy. Thus, the goals of our project are to reconstruct the phylogenetic relationships of subfamily Arbutoideae and use it to understand the morphological diversity among the genera and test the monophyly of genus *Arbutus*. Phylogenetic relationships will be estimated using maximum likelihood (ML) and Bayesian analyses of SNPs (Single Nucleotide Polymorphisms) data from the nuclear genome. The SNP data is generated by a next generation sequencing technique called DartSeq which allows the detection of a high number of informative SNPs across the genome. Preliminary results based on DAPC (Discriminant Analysis of Principal Components) show that the North American *Arbutus* is genetically distinct from European *Arbutus*. In addition, preliminary ML tree did not support the monophyly of *Arbutus*. This study will help resolve the taxonomic uncertainty of this subfamily thereby providing a better understanding of the evolutionary processes of these species. Ioana Anghel Close relatives in sympatry: is there evidence of contemporary or historical gene flow between species of *Linanthus*?

The majority of the 25 species in the genus *Linanthus* occur in a geographically diverse area characterized by exceptional plant endemism. Half of the putative sister species overlap in range and seven species pairs co-flower and co-occur at a locally sympatric scale. Most species have a short life cycle, flowering and seeding in a span of a few weeks, before the hot dry summers characterizing the California desert climate. These geographic, phenological, and life cycle traits make it likely that co-occurring species interact ecologically, potentially competing for resources and pollinators, with ample opportunities for interspecific gene flow. With much of the diversification estimated at less than 7 Myo, it is plausible that reproductive isolation between species is incomplete. Indeed, previous phylogenetic work has shown that clades of species are poorly resolved, and several species are not monophyletic (Bell et al. 1999; Landis et al. 2018). These inconsistencies in previous phylogenetic analyses may indicate misidentification due to error, limitations of traditional taxonomic methods (Zapata and Jiménez 2012; Cadena et al. 2018), or a reticulated pattern of divergence (Mallet et al. 2016). To determine whether there is evidence of gene flow between any of the lineages or between populations that occur in sympatry, I am using RAD to sequence an average of 7 individuals per species, with a fourth of the individuals from populations with another co-occurring species of *Linanthus*. I will then use SNAQ and the D-statistic to determine potential cases of historical and contemporary gene flow across species.

Glen Morrison

Genomic data show genetic distinction among some, but not all species, in the historically puzzling genus *Arctostaphylos*.

The manzanitas (*Arctostaphylos* Adans., Ericaceae) are evergreen shrubs and small trees known for their distinctive colorful bark, twisting branches, and urn-shaped flowers. Arctostaphylos is the most species-diverse woody genus in the California Floristic Province (CFP) and shows a high degree of endemism there, with all but a few of the sixty species occurring only in the CFP. Species boundaries in the manzanitas have long been a subject of debate among taxonomists of the group, due to great morphological similarity among many species, interspecific hybridization, and introgression. However, previous genetic analyses were unable to distinguish within- versus among-species variability due to limitations of the sequencing data used and a lack of multiple samples within species. In this study, we used double digest restriction site-associated DNA sequencing to generate thousands of single nucleotide polymorphisms for approximately half of all manzanita species, including multiple individuals per species. We used distance-based and tree-based methods to assess genetic differentiation among sampled species. Preliminary results from this study demonstrate that many species are genetically coherent and distinct, while others appear genetically intermixed with one or more other species. However, these data are still preliminary, and additional sampling and inclusion of other lines of evidence are needed to assess whether these species are distinct.

Ryan Buck

Pinyon Pine Syngameonic Hybridization

The two-needled pinyon pine (*Pinus edulis*) experiences some of the highest mortality rates among forest species after prolonged periods of drought, which are expected to increase in intensity with climate change. A close relative, *Pinus monophylla*, has one needle-per-fascicle, a trait thought to be adapted to more arid environments. Both species are dominant in the Southwestern US and Baja California and play important ecological roles in supporting biodiversity. Despite occupying different ecological niches, they have overlapping distributions, facilitating potential hybridization. Two additional needle types have been observed near contact zones: *fallax*-type and *californiarum*-type. Both have one needle-per-fascicle but have varying numbers of resin canals and stomatal rows. Additionally, *californiarum*-type overlaps in distribution with *Pinus quadrifolia*, which has four needles-per-fascicle and is sister to *P. monophylla*. Individuals with intermediate morphology have been observed in their contact zones, leading some to believe they also hybridize. In this study, we used morphological and next-generation sequencing data to test for

hybridization, detect the direction of gene flow, and determine the extent of the hybrid zones in this complex. We examined the entire range of these five pinyon pine taxa to determine the evolutionary patterns of gene flow among species and discover the extent of hybridization. We hypothesize that the three previously described taxa, *P. edulis*, *P. monophylla*, and *P. quadrifolia* will be independent species that hybridize and are parent lineages of *californiarum*-type and *fallax*-type, which both result from that hybridization. Genetic population structure was determined using the software fastSTRUCTURE, a Discriminant Analysis of Principal Components (DAPC), and a Principal Coordinates Analysis (PCoA) in R. Lamarc and fastsimcoal2 were used to examine the magnitude and direction of gene flow as well as possible hybrid speciation events. Our results support *P. edulis*, *P. monophylla*, and *P. quadrifolia* being independent species, with *fallax*-type resulting from hybridization between *P. edulis* and *californiarum*-type, and *californiarum*-type possibly being its own species. Additionally, hybridization events among all species pairs were detected, suggesting the presence of a rare multidirectional multispecies network called a syngameon. These hybridization events could have profound impacts on species' abilities to survive in future drought conditions.

Alexandra McElwee-Adame

Multidirectional Hybridization Challenges Species Boundaries Within the Plant Genus *Arbutus* of Mexico

It is estimated that somewhere between 30-70% of extant flowering plants have experienced a hybridization event at some point in their evolutionary history. Species in the genus *Arbutus* are suspected to hybridize based on morphology, however, no studies have applied genomic approaches to the species distributed throughout mainland Mexico (*A. arizonica*, *A. bicolor*, *A. madrensis*, *A. mollis*, *A. occidentalis*, *A. tessellata*, *A. xalapensis*), leaving a gap in our understanding of the species boundaries within this system. Additionally, field observations have noted high levels of overlapping distribution, with as many as five species found in the same locality, possibly allowing hybridization to occur. Field observations further note that many suspected hybrid combinations may occur, many between *A. bicolor*, *A. madrensis*, *A. tessellata* and *A. occidentalis*, blurring our understanding of where species boundaries may be drawn in this genus. Therefore, our study aims to apply a genomic approach to 1) understand the effect of overlapping distribution on species boundaries within *Arbutus* with respect to *A. menziesii*, the only allopatrically occurring species 2) identify hybrid individuals and parental species and 3) determine if hybrid crosses persist for several generations. We hypothesize that all species that occur sympatrically will exhibit varying levels of hybridization. Using DArT genomic data, we applied both a model based, and non-model based hierarchical population genetics approach to determine species boundaries between the overlapping *Arbutus* species as well identifying hybrid individuals. Our study was able to correctly identify five observed hybrid crosses as well as a novel cross between A. arizonica and A. occidentalis. With many of these species residing within the Madrean Pine-Oak Woodlands biodiversity hotspot, we hope that results of this study inform important conservation decisions within this critical region as well as further our understanding of how species behave under varying levels of overlapping distribution.

Reece Riley

A Phylogeny of the Genus *Helianthella*

This project aims to establish a phylogeny of the genus *Helianthella* (little sunflowers) and place it within its taxonomic subtribe in the family Asteraceae. *Helianthella* are all wildflowers of varying sizes, with perennial taproots and annual flowers with basal rosettes of leaves. They are distributed along the mountains of Western North America, from Southern Canada to Northern Mexico, with some highly geographically restricted species in California and Mexico. This genus has gone understudied for many decades, with its last major taxonomic treatment being a monograph

	in 1952. Since then it has received a few scattered additional species descriptions and seen occasional use as an outgroup in other studies, but the relationships among the 10-11 species within *Helianthella*, and the relationship of the genus to the four other genera in the subtribe *Enceliinae*, are unknown. The genetic and technological tools and methods available today, such as PCR and modern computers, were not yet invented when last this genus was directly studied, so applying them now could provide a wealth of new information about the spread and diversification of these species. A combination of genetic and morphological methods will be used to resolve a phylogeny of *Helianthella* and infer the evolutionary and biogeographical history of the genus. Preserved herbarium specimens and new field collections will be examined morphologically and sampled for genetic sequencing, and the gathered data will be run through multiple phylogeny-building programs. The resulting trees will give insights into the diversification of montane plants and their movement patterns.
12:00 - 1:45 pm	**Lunch Seminar : Talk to a Botanist 1** Daniel Winkler Research Ecologist at the *United States Geological Survey* Josie Lesage Applied Ecologist at *Santa Barbara Botanic Garden* Nick Jensen Conservation Program Director at *California Native Plant Society* Stephanie Freed Assistant Director of Operations at *Ecosystem Investment Partners* Steven Serkanic Terrestrial Biologist at *Pacific Gas and Electric*
1:45 - 2:30 pm	**Session 3 : Lightning 1 + Physiology** Anjum Kaur Gujral (LT) Investigating leaf trait coordination and its role in determining habitat suitability under current and future climate Leaf hydraulic conductance (K_{leaf} ; the efficiency of water transport) constrains photosynthesis and plant growth as it directly influences the magnitude of stomatal conductance that can be supported while avoiding desiccation. The sensitivity of K_{leaf} and photosynthesis to water stress has long been investigated in terrestrial plants. However, to date, the leaf traits that control K_{leaf} and susceptibility to hydraulic dysfunction, as measured by water potential that induces 50% hydraulic failure (P50), are not well resolved. Most work in hydraulic efficiency and safety has been conducted on woody stems with relatively little attention given to leaves of herbaceous species. Plant water-use strategies are important for whole-plant carbon gain; therefore, a better understanding of coordination between K_{leaf}, P50, and leaf economic traits that influence relative growth rate, is necessary. Relying on a synthesis of previously published data on woody plants and newly gathered data on herbaceous species, this study aims to elucidate leaf trait coordination between K_{leaf} per unit mass (K_{leaf} mass), leaf hydraulic vulnerability ($P50_{leaf}$), turgor loss point ($\dot{I}^{TLP}$), leaf mass per area (LMA), leaf size (LA), and vein density (VD). The California Floristic Province is an excellent study system to elucidate leaf trait coordination in herbaceous plants due to the rich functional and taxonomic diversity in herbaceous species that grow in vastly different climates between bioregions. This study will also assess whether leaf trait coordination can inform species bioclimatic limits in current and future climates, as leaf traits may be under strong selective pressure with climate change.

Emma Fryer (LT)

Community Assembly of Vertic Clay Endemic Annual Plants of the San Joaquin Desert

The San Joaquin Desert (SJD) hosts a high diversity of rare, endemic annual plants notable for their massive floral displays following high-precipitation winters. In such years, the blooms on the vertic (smectite) clay soils of the SJD form a distinctive patchwork pattern that are associated with the heterogeneous pattern of soil texture and salinity. These soils are physically extreme due to high clay content, high shrink-swell, and sodicity, which render them inhospitable to most plant life. Like species endemic to other extreme substrates (e.g., serpentine) in California, vertic clay endemic species appear highly adapted to these harsh soils. The non-native annual grass, *Bromus madritensis*, has invaded the vertic clay ecosystems in some areas and begun to displace the native vertic clay endemic species. The combination of a diverse suite of native vertic clay endemic species (species pool), extreme abiotic and heterogeneous factors (habitat filter) and the invasion of *B. madritensis* (competition filter) makes this an ideal community to study the model community assembly. This study will quantify edaphic factors determining fundamental niche for these species through a transplant study of twelve SJD native annuals across three soils (non-sodic, sodic, and extremely sodic vertic clay) and soil texture studies of five congener pairs reciprocally transplanted over contrasting soil textures. The role of *B. madritensis* as a possible biotic factor acting on these species will be addressed by a duplicate soil chemistry study with added *B. madritensis* plants in each native species' pot, and thereby determine the realized niche of these species.

Alec Chiono (LT)

Testing the Climatic Variability Hypothesis with coastal and inland populations of *Mimulus guttatus*

The Climatic Variability Hypothesis (CVH) states that organisms in more climatically variable environments should be adapted to a wider range of climatic conditions than organisms in less variable environments. Due to marine influence, coastal areas typically experience smaller temperature fluctuations relative to inland areas. According to the CVH, we expect coastal organisms to have more narrow thermal niches because they experience a smaller range of temperatures. We tested the CVH in a novel setting by comparing the thermal niches of coastal and inland populations of *Mimulus guttatus* using a growth chamber experiment. We measured relative growth rate of individuals from three coastal and three inland populations under eight temperature treatments. We then used relative growth rate to build thermal performance curves for each population and measured thermal niche breadth as the width of these curves. Coastal and inland populations do not differ in thermal niche breadth, with coastal populations having wider thermal niches than expected. In fact, we only found differentiation in thermal niche traits between inland populations, not between coastal and inland populations. Therefore, we do not find support for the CVH, but new questions arise about thermal niche evolution in *Mimulus guttatus*.

Carlos Anthony Portillo

Experimental crosses reveal seedless fruits in the functionally dioecious *Cylindropuntia wolfii*

Cylindropuntia wolfii is a rare, native and endemic cactus that is narrowly distributed across the US/Mexican border particularly in the Jacumba area where it is dominant and well adapted. Histological studies have shown that this species has a functionally dioecious sexual system, with individuals having either male or female flowers, however many fruits carry aborted seeds which affects the sexual reproduction and therefore perpetuation of this species. Thus in this study we aimed to understand the reproductive biology of *C. wolfii*. We carried out experimental crosses to

	determine if aborted seeds are due to a lack of pollen and ovule viability. We compared natural crosses (e.g. bee-pollinated) against manual crosses, either self pollinated or outcrossed. A negative control was used as reference, in which flowers were covered during the whole experiment to prevent pollination. Crosses were performed in May and fruit development was tracked during the entire season. Mature fruits were collected from August to September. The fruits were opened and the aborted ovules and mature seeds were counted using a microscope. The seed set was estimated as total mature seeds per total number of ovules. We observed seeds in outcrossed females but no seeds in males in any crosses, corroborating that the sexual system is functional dioecious. We found the seed set in general was low and that of the outcrosses were significantly higher than the seed set of bee pollinated flowers, indicating there is a problem in the pollinator efficiency or abundance. This study is part of our first steps toward analysis of the fruits of *C. wolfii* which has been afflicted by reduced seed production. Beverlie Gomez Solving Controversies: A Case Study of Plant Hydraulics Resolving controversies in science is a practice that allows for progression in our knowledge of nature. Therefore, understanding how controversies are resolved is illustrative of the scientific process. In plants, the water transport system known as xylem, is difficult to study. Those that do, disagree on what basic principles constitute plant hydraulics; thus, efforts to move forward in this area of study have been impeded. The main controversies studied here are: (1) acceptance of the cohesion tension theory; (2) problems with measuring vulnerability of long vesseled species; (3) the mechanism for embolism refilling. To evaluate the origin and dialogue surrounding these controversies, I analyzed published research that pertained to any of these 3 topics. I then, documented how the controversy was resolved and commented on its effect in the field. For controversy 1, the cohesion tension theory is well established and has various references to deem accurate. For controversy 2, measuring vulnerability of long vesseled species can be done using various methods if performed correctly. For controversy 3, the mechanism of embolism refilling is still elusive, but data suggests plant anatomy and root pressure are involved. This matter is still to be explored. The debating and conflicting evidence in the study of plant hydraulics has allowed for the establishment of basic principles, in some cases. Our newly and widely agreed upon concepts of water transport, can now be taken further to resolve problems regarding hydraulics to protect vegetation.
2:30 - 3:30 pm	**Poster Session (Gathertown)** Adriana Hernandez Identifying ecological drivers of diversity in the highly polymorphic California endemic lily, *Calochortus venustus* Polymorphic taxa represent instances in which rules of natural selection have seemingly been broken. While selection often homogenizes variation of traits, many questions remain regarding the mechanisms that shape and maintain gene flow given a diversity of phenotypes. The California endemic butterfly mariposa lily, *Calochortus venustus*, displays striking variation in floral pigmentation and patterning: individuals within a population can range in petal color from a spectrum of red, purple, pink, white, and yellow, with variation in other floral traits as well. This hypervariability is only observed at the southern range, while northern populations are almost exclusively white. Population genetics data show gene flow between morphotypes, affirming that phenotypic variation is not due to reproductive isolation (Hernández et al., in prep). Phylogeography suggests a south to north migration along bifurcating mountain ranges indicating

parallel evolution toward the white morphotype in the northern range. Concordance of population dynamics, evolutionary history, and spatial phenotypic distribution provides evidence that phenotypic diversity is locally adaptive. Climatic niche modeling was implemented for each morphotype in order to identify potential niche differences using Maxent. Preliminary data suggest that while each morphotype occupies a different fundamental climatic niche, some may be limited in part by dispersal while others are likely limited by habitat suitability strongly associated with temperature and precipitation. Ongoing studies will test across hypotheses of pollinator preference and constancy, flowering phenology, and a heterogeneous landscape of physical environmental variables, in order to identify the ecological mechanisms that maintain phenotypic diversity and drive local adaptation.

Aneetta V.J

Eco-friendly Fabric Dyeing using *Anchusa capensis* Flower

Anchusa capensis is a biennial plant growing up to 60cm tall. It is usually grown in ornamental gardens, where it is treated as a self-seeding annual. The are several named varieties like Blue angel, Cape Forget-Me Not, Summer Forget-Me Not. The genus Anchusa is a group of approximately 35 species found mostly in Europe, North Africa and West Asia. The plant has many flowering stems and leaves are hairy/ rough. From the Ethnobotany of the plant it was understood that flowers can be added to salads, pasta, puddings, custards and leaves are also edible. The plant name *Anchusa* is derived from the Greek word anchousa, which imply its use as a dye base for cosmetic paint obtained from Anchusa tinctoria root. The specific epithet capensis means "from the Cape". The textile dye industry produces hazardous waste which constitutes 95% of waste water from colouring process and 5% from rinsing. Research studies are still very wide to replace synthetic dyes with natural colourants. Natural dyes not only function to provide colour but have anti-microbial, anti-bacterial, UV protection and are skin friendly. The sources for natural blue dye is limited, indigo is a natural blue dye extracted from the leaves of some plants of the Indigofera genus. Hence the intensive blue colour of this flower is the factor why it is chosen for fabric dyeing. In this concern a research is planned to be carried out to extract blue colour from these plants and study its dye ability and properties change on silk.

Desiree Hale

Testing the predictive utility of breeding system and other trait combinations on island colonization

Establishing a new population is critically dependent on finding mates. In plants, self-compatible (SC) breeding systems may be more advantageous for facilitating establishment relative to a self-incompatible (SI) breeding system, especially in isolated locales such as remote islands. Despite the empirical support for this idea, its many exceptions suggest multiple ecological processes are at play. Upon arrival of an individual to an island, a specific combination of breeding system and traits may be optimal for maximizing reproduction and establishment of a new population despite low mate availability. Few studies have investigated how breeding system and other phenotypic or ecological traits interact to influence the strength of mate limitation as a colonization filter. While breeding system may still be the strongest predictor for successful island colonization, other traits could either weaken or strengthen its predictive utility. The goal of this project is to test whether SC species are enriched on islands across 9 plant families, and to investigate whether plant lifespan, woodiness, floral symmetry and pollinator specialization directly or indirectly influence our findings. Using a dataset of breeding system, geographic and phenotypic data we ask three main questions: 1.) Are self-compatible species enriched on islands? 2.) What traits correlate with the index of self-compatibility? 3.) How might traits indirectly or directly influence the presence or

absence of species on remote islands? Answering these questions will help us understand the strength of mate limitation as a colonization filter on islands.

Diana Verónica López Silva

A comparison of the thermal performance of two extensive green roofs covered with plants differing in carbon metabolism

Urbanization and climate change can have negative effects on human welfare. Therefore, it is necessary to implement sustainable technologies, such as green roofs (GRs) to diminish the ecological footprint and improve the quality of life within cities. However, there are no quantifications of the thermal efficiency of this technology for the climatic conditions of Northwest Mexico, nor research on the use of regional materials and native plants in GRs. To quantify how GRs mitigate thermal variability, six experimental modules were built with different roof cover: concrete, reflective coating, dry soil, wet soil, *Sedum acre* (traditional green roof), and *Salicornia pacifica* (blue green roof). These last two have different carbon assimilation metabolism: *S. pacifica* is a wetland C3 species, with diurnal transpiration that grows at flooded soils, and *S. acre* is a CAM species, with night-time transpiration and is commonly used in GRs. Temperature data was monitored during the Winter of 2020 in Ensenada, B.C., a city with semiarid Mediterranean climate. We found that vegetated covers were able to reduce the temperatures of the inner layers of roofs by up to 12.07 Â°C and inner air temperature by 9.3 Â°C compared to the concrete roof, working as efficient thermal regulators potentially reducing building cooling and heating demand. The use of native species is recommended to improve GR thermal performance and provide ecosystem services. Further GR research is needed to maximize their benefits and promote their use.

Gustavo Velázquez Martínez

Effect of the glandular and stellate trichomes of *Datura wrightii* (Solanaceae) on the specialist's survival and development beetle *Lema daturaphila*

The plant-herbivory interaction has been one of the most used models in the study of antagonistic interactions and adaptive evolution. The theory states that, as a result of reciprocal selection, plants and herbivores have evolved a set of defensive and counter-defensive traits, respectively. Being this coevolutionary process, the main responsible for the great diversity of chemical and physical attributes present in plants. Physical barriers are the first line of defense against herbivorous insect attacks, playing a fundamental role in resistance. The trichomes are within this group of barriers, and they are structures of epidermal origin located on the surface of the aerial part of the plants, and which are mainly divided into glandular and non-glandular forms. From what has been documented, the behavior of insects can be drastically influenced by these structures, as well as having profound effects on their performance and the selection of host plants. In this work, the effect of dimorphic trichomes of the *Datura wrightii* species on the survival and development of its specialist beetle *Lema daturaphila*, is being assessed. Since these dimorphic characteristics give them a different defensive value, they are expected to affect the performance of the specialist beetle differently as well.

Myriam Serrano

Tracking Leaf Trait Differentiation of Newly Diverging Subspecies of *Chenopodium oahuense* on the Hawaiian Islands

A single native *Chenopodium* species, *Chenopodium oahuense*, can be found throughout the Hawaiian archipelago. Subpopulations of this species can be found in a wide range of habitats that differ greatly in temperature, humidity and elevation. Field observations and experiments in common gardens suggest that large climate differences across the population range are driving

distinct morphologies. These morphological differences are likely associated with physiological adaptations to the local climates of the subpopulations, however, physiological comparisons have not been done. Our main objective is to document *Chenopodium oahuense* leaf traits (e.g. leaf size, stomatal density, leaf hydraulic conductance, osmotic potential at full turgor and leaf level capacitance) for the different sub-populations and between juvenile and adult growth forms. We also intend to elucidate how variation in each sub population's home environment has led to adaptive shifts in plant water use strategies. Preliminary results suggest that the environmental niche differences such as elevation, rainfall, and annual temperature experienced by each subpopulation are strongly coupled to differences in water use strategy. Pressure volume curve analyses of the different subpopulations are showing differences in osmotic potential at full turgor and turgor loss point. Preliminary stomatal conductance and leaf size measurements also indicate differences between juveniles and adults within populations. In conclusion our preliminary data suggest differences in plant water use strategy are linked to the population's distinct environmental conditions. Increasing our understanding of diversification and evolutionary adaptations within a specific lineage has broad implications for understanding other ecological systems with diverging sub populations.

Paris Krause

Using terrestrial laser scanning to evaluate non-destructive aboveground biomass allometries in diverse northern California forests

With increasing wildfire severity and frequency in California, accurate quantification of greenhouse gas emissions and carbon sequestration of forests is more important than ever. A crucial part of carbon accounting is to quantify a tree's aboveground biomass (AGB) using allometric equations. Unfortunately, species-specific equations are limited because data to inform these equations, which requires many trees to be destructively harvested, are difficult and time-consuming to collect. As such, our objective was to use terrestrial laser scanning (TLS) to non-destructively estimate AGB of six native tree species in California (300 individuals), and develop new allometric equations for each species using volumes obtained from quantitative structure models (QSMs). We hypothesized that TLS volume-based AGB estimates would differ from traditional allometric AGB estimates due to the ability of TLS to accurately quantify whole tree structure. We collected TLS data on species of interest at Latour Demonstration State Forest (Shasta County), Pepperwood Preserve and Saddle Mountain Preserve (Sonoma County) using a Riegl VZ-400i scanner. 3D point clouds of trees were extracted from TLS scans and AGB was calculated using QSMs, where parameters were optimized to the height of the tree. In general, across all species, AGB calculated from TLS and QSM volume were approximately 35% greater compared to traditional allometric equations, in preliminary data. As AGB impacts both carbon sequestration and fire risk, these data can provide land managers with updated data to inform decisions regarding management of these species in the face of climate change.

Nora Bales

Investigating the relationship between biological soil crusts and purple amole (*Hooveria purpurea* var. *purpurea*), a rare plant on California's Central Coast

Purple amole, *Hooveria purpurea* var. *purpurea* is a threatened Californian endemic plant known from only four populations, all on Department of Defense lands. The largest of these four populations occurs at Camp Roberts, a California Army National Guard Training Site. Prior field studies of purple amole have observed greater purple amole plant density in populations associated with biological soil crusts. Biological soil crusts perform important ecological functions in arid ecosystems worldwide, including soil stabilization, water retention, and nitrogen fixation. The objective of this study is to understand the relationship between purple amole density and biocrust presence, level of development, and diversity. In 2020, we found a significant positive correlation between purple amole density and biocrust presence ($R^2=0.45$, $p<0.05$). Further data

	on purple amole density and biocrust percent cover collected in spring 2021 will help clarify if this trend persists despite interannual variation in climate and disturbance regime. Further, we will identify crust component organisms using microscopy and DNA sequencing, and measure a suite of biotic and abiotic purple amole habitat parameters. We expect to find greater purple amole density in areas with more developed biological soil crusts. Previous management efforts have focused on strategies to increase purple amole reproductive output without considering other habitat parameters. If purple amole density is truly correlated with biological soil crust presence, then any future management, conservation, or restoration efforts for this plant must also consider biological soil crusts.
3:30 - 4:30 pm	**Social Hour (Gathertown)**

Saturday – May 1

9:00 - 9:15 am	Welcome and Schedule overview
9:15 - 10:15 am	**Session 4 : Fire and Diversity** Nina House A Vascular Flora of the Manter and Salmon Creek Watersheds in the Southern Sierra Nevada, Tulare County, CA My study aims to document the flora of the Manter and Salmon Creek watersheds in the southern Sierra Nevada, Tulare County, CA, a 51 sq. mi. area of the Kern Plateau. There are several aspects of this area that make it worthy of botanical exploration. The Kern Plateau is an ecologically unique area in the southern Sierra Nevada that is home to numerous endemic species. Additionally, the Domeland Wilderness makes up 25 sq. mi. of the study site and represents an area that has seen little in the way of botanical exploration. These qualities provide an opportunity to document important botanical discoveries, including new county records, species at the edge of their range, and disjunct plant populations. This study is being performed at a crucial time, as there are many projected impacts from land use and climate change in this remote region. Disturbance from cattle grazing, off-highway vehicular use, and drought have been documented at the site and will all have lasting impacts on the flora. To date, I have completed a total of 13 field trips, totaling 46 days in the field and resulting in the collection of 917 plant vouchers. My primary goal is to produce an annotated checklist of the regional flora. With an additional twelve trips planned for summer 2021, I anticipate contributing much more to our botanical understanding of this region. Christina Varnava Exploring botanical diversity in the ashes of the Thomas Fire: A vascular flora of the upper Sespe Creek watershed Ventura County is a hotspot of plant biodiversity in California, with several endemic species and many rare taxa. It is an ideal location for floristic studies, which form the basis of many other types of botanical and ecological research. Sespe Creek is a 61-mile-long stream within Los Padres National Forest (Ventura County, CA). Many taxa are known from Sespe Creek watershed, however, nearly all herbarium specimens from the area were collected over 20 years ago and immediately along Hwy 33. Tremendous diversity in this area is threatened by numerous anthropogenic activities, highlighting the importance of thorough documentation and study. Additionally, part of the watershed was affected by the Thomas Fire, one of the largest fires in California history. Many areas in the burn scar have not been resurveyed.

A voucher-based floristic inventory was completed across the upper portion of the watershed (93 sq mi) over two full field seasons. New collections were made across the watershed, with special focus on areas lacking documentation, the Thomas Fire burn area, and Pine Mountain Ridge, where a logging project was proposed. Previous localities of rare taxa were visited to determine if documented populations persist. Collections were accompanied by photographs and detailed field notes including locality and associated species.

This study has documented ca. 900 minimum-rank taxa in the upper Sespe Creek watershed, including previously undocumented occurrences of invasive and rare taxa. For this study, ca.1100 collections were made and combined with data from 3000 previous collections to analyze patterns of floristic diversity.

Brianne Palmer

Biocrusts and Vegetation Differ in Fire Recovery in a Coastal Grassland

Biological soil crusts (biocrusts) communities of algae, cyanobacteria, lichens, and mosses that co-occur with vascular plant species. However, these communities are often overlooked in fire ecology studies. Using field surveys, microbial sequencing, and laboratory analyses, we assessed how biocrust recovery differs from the vegetation recovery in a coastal grassland on San Clemente Island after a wildfire in 2012 and a prescribed fire in 2017. During our annual sampling from 2018-2020, we found greater biocrust cover in the burned plots compared to the unburned plots and a similar microbial community across all treatments and sites. Furthermore, functional genes and empirical measurements of biocrust functions were similar across treatments. However, the plant community composition varied by treatment, site, and year. Native grass and nonnative forb cover was greater in the burned plots while nonnative grasses dominated the control plots. Soil nutrients and texture were also important in the structuring of plant communities. Biocrust cover declined over the sampling period and plant cover increased, suggesting that after a fire biocrusts may be competing with plants for space or facilitating their subsequent growth. These data suggest that biocrust and plant communities differ in their recovery trajectory after a fire. To further understand the connection between these two communities, we used random forest modeling and identified plant species that were correlated with biocrust cover and biocrust microbes that were correlated with plant cover. Future work will focus on understanding the mechanisms of biocrust survival and explore the potential of biocrust establishment to facilitate restoration.

Rachael L. Olliff Yang

Population differentiation in flowering time in *Lasthenia gracilis*, a widespread annual forb

The timing of cyclical life history events (phenology) is dynamic, and phenological traits can vary across a species ecological and/or geographical range. Differences in phenology among populations can be a result of genetic differentiation, variation in environment, or some combination of the two. In this study, we examine the drivers of phenological differences across a species range, focusing on common goldfields (*Lasthenia gracilis*, Asteraceae). To test for population differentiation in phenology, we collected seed from 21 populations across the range and examined variation in flowering time under common growth conditions in a greenhouse. We recorded the germination date, the number of days from germination to flowering, and the total number of inflorescences across the growing season. We determine that populations of *L. gracilis* exhibit differentiation in flowering time, with earlier flowering in populations from warmer and drier locations. We then compared population flowering response in the common environment to field flowering records sourced from herbarium specimens. Population differences in flowering time in the common environment growth conditions were similar to field flowering records in response to site conditions, and were associated with climate variables in the same direction but with a shallower slope. This pattern of response reveals that both environmental and genetic differences influence flowering time, and that these influences are aligned (i.e. co-gradient variation). Due to the existence of population differentiation in flowering traits, phenology may be

	important to consider in the design of conservation and land management plans, especially when sourcing *L. gracilis* seeds for restoration plantings.
10:15 - 10:45 am	**Coffee Break**
10:45 - 12:00 pm	**Session 5 : Climate and Drought** Denise Mitchell Coordination of drought tolerance and heat tolerance in woody species across ecosystems Widespread drought-induced mortality has been observed in woody plants across ecosystems in recent years. Extreme heat events often accompany drought, but whether heat and drought tolerance are coordinated in leaves is unknown. The objective of this research is to characterize the coordination of drought tolerance and heat tolerance in deciduous and evergreen woody species from three distinct ecosystems (Mediterranean-type shrublands, mixed evergreen forest, and desert), that differ vastly in both mean annual precipitation (MAP) and mean annual temperature (MAT). We characterized drought tolerance as leaf turgor loss point (π^{TLP}) using the rapid assessment method, and heat tolerance using chlorophyll a fluorescence to determine photochemical efficiency decline with increasing temperature on 6-8 species from each ecosystem. Measurements were conducted during the wet and dry seasons to account for plasticity and intra-specific trait variation. Dry season measurements showed stronger relationships than wet season measurements, and demonstrated that leaf heat and drought tolerance were statistically related across all species (R-squared = 0.26, p=0.02). There was also a strong relationship between leaf heat and drought tolerance among evergreen species (R-squared 0.82, p=0.03), but this relationship was not significant among deciduous species. This is likely because deciduous species lose their leaves during the unfavorable season, mitigating their exposure to stress. We attest that the described research will promote a deeper understanding of the physiological, morphological, and biochemical traits that enable the plant to sustain respectable water potentials and minimize heat damage to ultimately gain enough carbon to survive stressful periods of drought and extreme heat. Justin Luong Drought responses and recovery of coastal prairie species experiencing non-native competition Abiotic filters often require species to have similar trait to survive, while biotic filters often cause divergences in traits to facilitate species coexistence. Determining tradeoffs in traits with abiotic and biotic filtering will uncover mechanisms of community assembly and improve coastal prairie restoration. Droughts and species invasions are predicted to increase due to anthropogenic influences and will likely influence the ecophysiology of native prairie species. To better understand these effects, I set up a two-way factorial study manipulating drought and non-native species competition in research greenhouses. I grew five native species (*Bromus carinatus*, *Diplacus aurantiacus*, *Lupinus nanus*, *Sidalcea malviflora*, and *Stipa pulchra*) in winter 2020 for six weeks prior to any treatment then sowed five non-native species (*Carduus pycnocephalus*, *Festuca bromoides*, *Geranium dissectum*, *Medicago polymorpha*, and *Raphanus sativus*) in half of all pots for the competition treatment. Soon after, I applied an episodic drought, where plants did not receive water until they became drought stressed (measured via stomatal conductance). We found that certain coastal prairie species (*Stipa pulchra* and *Sidalcea malviflora*) were well adapted to drought and had little change in productivity or photosynthesis. Others were more sensitive to drought (*Lupinus nanus* and *Diplacus aurantiacus*) and had interactive effects with competition. Non-native species have reduced above and belowground productivity in response to drought.

Samantha Spurlin

Rapid responses to drought in a California rare annual wildflower, San Francisco Collinsia (*Collinsia multicolor*)

Annual wildflowers make up about a third of all California native plants and are a critical resource for pollinators and the ecosystem. However, due to their one-year life cycle, annuals are particularly sensitive to drought which is increasing due to climate change. From 2011 to 2015, the state of California experienced one of its most severe droughts, and by 2014 and 2015 much of California was in a state of "exceptional drought". The year 2014 was in fact recorded as the worst drought in the past 1,200 years. Annual wildflowers are difficult to monitor in the wild, and there is currently a limited understanding of how rare annual wildflowers are coping during periods of precipitation crisis. The objective of this study was to compare the effects of water availability on the flowering time, stomatal density, and chlorophyll fluorescence of *Collinsia multicolor* in pre- and post-drought generations. I hypothesize that plants exposed to drought will show evolution and plasticity toward earlier flowering time to mature before the period of anticipated drought, reduced stomatal density to conserve water transpiration, and reduced chlorophyll fluorescence by using absorbed light energy more efficiently instead of taking in excess absorbed light and re-emitting. Research on annual wildflowers populations, particularly rare and endangered annual wildflowers populations, is a critical step in understanding the broad effects of how years of severely low precipitation may impact these populations, and hopefully the results will show California wildflowers will continue to thrive and live on.

Brooke Wainwright

What does the future look like? Exploring plant community change at the recruitment life stage

Climate change is accelerating globally, causing some species ranges to expand poleward. Plant recruitment is essential for range shifts to occur. In the Southwestern US, climate variability and aridity are increasing, potentially affecting species range shifts. In central New Mexico, creosotebush (*Larrea tridentata*) shrubland is expanding into Chihuahuan Desert grassland, and Chihuahuan Desert grassland dominated by *Bouteloua eriopoda* is expanding into Great Plains grassland dominated by blue grama (*Bouteloua gracilis*). We used two field experiments at the Sevilleta LTER to test the effects of possible future changes in precipitation on recruitment of dominant plant species. In 2019 and 2020, we added blue and black grama seeds in Great Plains grassland (MVE-blue). In 2020, we added black grama and creosote seeds to a second experiment in Chihuahuan Desert grassland (MVE-black). We monitored seeds biweekly for germination and survival. In 2019, recruitment only occurred in plots with ambient or added precipitation (5.5 % germination). In 2020, seeds from 2019 recruited in plots with -75% precipitation (8.1%), suggesting competitive release from drought. In 2020, black grama had the highest germination across ecosystems and years (12.2 %) but creosote had the highest survival among species and years. Germination patterns in 2020 seed additions at MVE-black mirrored patterns in 2019 at MVE-blue. No treatment effects occurred in year 2 at MVE-blue. Precipitation mattered for the first year of seed additions for all species at both sites, but not for the second year of seed additions for either blue or black grama at MVE-blue.

Lacey Benson

A morphometric analysis of western sword fern (*Polystichum munitum*) pinnae and pinnae scales across the coast redwood forest ecological gradient

Ferns are an integral component of biodiversity and productivity in the coast redwood understory and canopy. Given that summer fog is expected to decrease, and winter precipitation patterns are predicted to change it is vital to understand the role of microclimates and adaptation strategies utilized by ferns in the coast redwood ecosystem to gauge how the distribution, community

	dynamics, and reproductive success of ferns will be affected in the coming decades. Researchers have found ferns display signs of shifting climate patterns through leaf traits such as number of fronds, size of fronds, foliar uptake capacity and leaf water retention. By studying morphological and physiological changes to ferns scientists can get a more rapid understanding of how community dynamics and slower growing species such as the coast redwood will be affected by future changes to climate. The aims of this study are (1) to compare western sword fern (Polystichum munitum or POMU) pinnae size traits (length, width, and length:width ratio) to environmental variables such as precipitation, fog frequency, and temperature; (2) to quantify pinnae scale density to compare with in situ and historical climate data; and lastly (3) to collect, mount, and enter POMU specimens and redwood associate species into the Carl W. Sharsmith Herbarium at SJSU. To achieve these objectives, we will utilize digitized herbarium accessions as well as personal collections to measure pinnae in ImageJ as well as count scales on both pinna surfaces. Data will then be compared to latitude and in situ environmental variables. The results of this study will greatly inform our understanding of the landscape scale variety of morphological and physiological traits within POMU and add to previous research on POMU foliar water uptake capacity and leaf water retention abilities.
12:00 - 1:45 pm	**Lunch Seminar : Talk to a Botanist 2** Carlos A. de la Rosa Natural Lands Manager at *San Diego Zoo Wildlife Alliance* Clare Loughran Assistant Curator at *UC Botanical Garden at Berkeley* Laura Klein Head Curator and Director of Herbal Research at *LeafWorks Inc* Lorena Villanueva Almanza Editor at *Botany One*, *Freelance* Science Writer and Editor Lusetta Sims Botanist at *Shasta-Trinity National Forest*
1:45 - 2:45 pm	**Session 6 : Lightning 2 + Ecology** Adriana Hernandez (LT) Identifying ecological drivers of diversity in the highly polymorphic California endemic lily, *Calochortus venustus* Polymorphic taxa represent instances in which rules of natural selection have seemingly been broken. While selection often homogenizes variation of traits, many questions remain regarding the mechanisms that shape and maintain gene flow given a diversity of phenotypes. The California endemic butterfly mariposa lily, *Calochortus venustus*, displays striking variation in floral pigmentation and patterning: individuals within a population can range in petal color from a spectrum of red, purple, pink, white, and yellow, with variation in other floral traits as well. This hypervariability is only observed at the southern range, while northern populations are almost exclusively white. Population genetics data show gene flow between morphotypes, affirming that phenotypic variation is not due to reproductive isolation (Hernández et al., in prep). Phylogeography suggests a south to north migration along bifurcating mountain ranges indicating parallel evolution toward the white morphotype in the northern range. Concordance of population dynamics, evolutionary history, and spatial phenotypic distribution provides evidence that

phenotypic diversity is locally adaptive. Climatic niche modeling was implemented for each morphotype in order to identify potential niche differences using Maxent. Preliminary data suggest that while each morphotype occupies a different fundamental climatic niche, some may be limited in part by dispersal while others are likely limited by habitat suitability strongly associated with temperature and precipitation. Ongoing studies will test across hypotheses of pollinator preference and constancy, flowering phenology, and a heterogeneous landscape of physical environmental variables, in order to identify the ecological mechanisms that maintain phenotypic diversity and drive local adaptation.

Rosie Deak (LT)

Fire influences on meadow vegetation composition

The response of montane forested ecosystems in California to fire is well understood. There is far less known about the role of fire in montane meadows that are often embedded within these forested ecosystems. Given the scale and intensity of wildfires in 2020 it is important to understand the affects of wildfire on these habitats. Meadows are the interface between vegetation and the water table, they provide a disproportionate amount of ecosystem services relative to their size, which is estimated to be less than 0.1% of the land area in the Sierra Nevada. Since montane meadows are nestled within well established fire-adapted forest types and comprise the forest-mosaic, we set out to explore whether meadow systems benefit from wildfires that burn in a particular meadows catchment. Using long term meadow monitoring data from across California, vegetation composition will be compared from before and after wildfire events to evaluate how the severity and extent of a wildfire in an upland catchment influences the downslope meadow. Our analysis focuses on changes in the functional group composition, relative to fire extent and severity, meadow types (moist, wet, dry), hydrogeomorphic type, post fire relative precipitation, and topographic characteristics. We hypothesize that meadows in catchments that burned completely with high tree mortality and had above average post fire precipitation will display increases in abundance of obligate wetland species. This trend will be more evident in mesic types compared to wet or dry meadow types.

Jacob Spriester (LT)

Plumbing the depths: plant rooting patterns are linked to drought resistance in chaparral shrubs

Chaparral shrublands are the most extensive vegetation type in California and are dominated by diverse evergreen shrubs adapted to periodic fire. Climate change has increased the risk of drought and recent ones have triggered widespread dieoff and dieback of some species but not others. Studying traits of species and drought resistance strategies should clarify how some survive better. I hypothesized that rooting patterns of chaparral shrubs are associated with drought resistance. I predicted that species with deeper and more extensive roots have greater access to soil water that prevents vascular failure and promotes drought resistance. To test my hypothesis, I measured the water potential at dawn of six species to estimate plant water access when they are in contact and equilibrated with the soil water. I also used stable isotopes in water as tracers to assess rooting patterns. Vascular resistance to failure was measured on stems using a standard centrifuge technique. I reviewed literature to compile species survival of drought. I found that species dramatically differ in estimated rooting depth. Species were also different in resistance to failure of their vascular systems. Vascular resistance and estimated rooting depth were not correlated. Some species inferred to have shallower roots are the ones that have experienced high

mortality and dieback during recent droughts. My results are important for identifying species vulnerable to future droughts.

Nelly Rodriguez (LT)

Assessing drought tolerance in the tribal oak *Quercus agrifolia*

Quercus agrifolia (Coast Live Oak) is not only of ecological and archaeological importance but also cultural. Distributed throughout California and northern Baja California, this species provides housing and food sources for many animals, restores and improves watersheds through its root system, and is culturally significant to many Tribal communities, providing abundant harvests of acorns to their families. Unfortunately, multiple threats, including several diseases, are affecting these trees and are exacerbated by droughts and high temperatures, which diminish the plants' natural defenses. Previous studies have found that *Quercus agrifolia* has two varieties (var. *agrifolia* and var. *oxyadenia*). These varieties differ in the amount of trichomes on their leaves, with the var. *oxyadenia* having more trichomes and a lighter color as a result, both of which may confer some resistance to extreme temperatures and aridity. The presence of trichomes could increase water retention and be an adaptation to drought conditions. In this study, we hypothesize that the var. *oxyadenia* exhibits higher drought tolerance than the var. *agrifolia*. We are conducting a greenhouse experiment to test if individuals of var. *oxyadenia* perform better when subjected to drought conditions. We have partnered with Tribal groups and have collected seeds from Tribal lands and other areas where these two varieties are distributed. We have planted the seeds and will be measuring their performance (e.g., height, mortality, photosynthesis). Our end goals are to see which variety has higher natural defenses and return the surviving plants to their Tribal lands for further growth and expansion.

Naveena Shri C (LT)

Canna indica Plant Fibres- A Potential Source for Technical Textile Application

With the pandemic around, the demand for the usage Ethnobotanical and Traditional plant sources are gaining enormous importance almost in all the fields, Textiles in particular. Plants with abundant medicinal values are of great demand as they are proved non-toxic to the human use. The splendid properties of the medicinal plants when combined with the textile material give a shielded textile product which would protect the human from microscopic invasions. *Canna indica* is a tropical herb belonging to the family Cannaceae. The plant is native to tropical and sub tropical regions. The pharmacological investigation of Canna indica plant extract shows various medicinal properties such as AIDS/HIV1-RT inhibition, antibacterial, antioxidant, anticancer/cytotoxicity, antidiarrheal, antidiabetic and anti-inflammatory properties. The aim of the research is to use the extract fibres from the plant and check for the above mentioned properties and to positively use in the production of Technical textile products(PPE) such as face masks, face wipes, etc,. The researcher has also planned to use the extracts from the plant to give value added finish to the produced fabric. After successful production and finishing of the textile material from the *Canna indica* plant fibres, it will be subjected to physical, chemical and mechanical testing. Performance study will also be carried out for the developed product.

Eli Balderas (LT)

An Ecological Assessment of a Rare and Endangered Lichen from Central California: *Sulcaria isidiifera*, the Splitting Yarn Lichen

The Splitting Yarn Lichen (*Sulcaria isidiifera*) is an epiphytic fruticose lichen that is endemic to a small pocket of maritime chaparral on the central coast of California. This habitat is becoming increasingly fragmented and is likely diminishing as it faces threats from housing development, climate change, and invasive species. A recent assessment on the status of *S. isidiifera* found a decline in its abundance and distribution, leading to its placement on the International Union for Conservation of Nature Red List as Critically Endangered B2ab(i,ii,iii,iv,v). The assessment

recommended listing of this species under the Federal Endangered Species Act. Listing of *S. isidiifera* would make it only the third lichen in the United States to obtain this designation. To support a future listing petition to the U.S. Fish and Wildlife Service for Endangered Species Act protections, I will conduct an ecological assessment of *S. isidiifera*. I will gather data on the abundance and distribution of *S. isidiifera* throughout its known range and will survey additional stands of maritime chaparral that could potentially support this lichen. In addition, I will further characterize the ecological niche that *S. isidiifera* occupies. I will gather biotic data including preferred shrub substrate and associated plant and lichen species. I will also gather abiotic data including microclimate (temperature and humidity), light intensity, slope, and aspect. This dataset will be used to provide conservation recommendations for *S. isidiifera* and support listing status for this rare and endangered species.

Michael Mulroy

Lichen biotas of ultramafic and sandstone outcrops along a maritime gradient

Saxicolous (i.e., rock-dwelling) lichen communities are highly diverse, ecologically important, and often eye-catching. Yet, these communities are under-studied, and the effects of environmental factors on community composition are not well understood. Descriptive and quantitative ecological studies of these communities are particularly scant in North America. Our research is designed to better understand how lichen community composition responds to variation in rock elemental chemistry as well as climate factors related to maritime influence (e.g., seasonal fog patterns, temperature and precipitation gradients). To do this, we are conducting quantitative sampling of saxicolous communities on eight ultramafic and eight sandstone outcrops along a 70 km coast-inland gradient of decreasing maritime influence. Here, I briefly outline the state of knowledge of lichens of ultramafic substrates in North America, as well as present some preliminary findings from our sampling to date. These include range extensions of several notable lichen species, as well as over a dozen additions to the list of lichens recorded on ultramafic substrates in North America.

Mitchell Coleman

Riparian and Wetland Enhancement Projects at Tejon Ranch: Past, Present, Future

Riparian and wetland vegetation communities are critical biological resources that support disproportionately high ecosystem services and biodiversity relative to the land area they occupy. However, many riparian habitats and wetlands on Tejon Ranch, California, USA, have historically been adversely affected by cattle grazing, particularly during summer months. This disturbance regime has degraded the native density, biodiversity, structure, and habitat use of riparian habitats. Starting in 2014, we started implementing livestock management practices which target dry season exclusion from select riparian pastures (generally May-October), when livestock use of the creeks is highest and when riparian tree seedlings/ herbaceous understory taxa generally emerge and are most sensitive to disturbance. We predicted that excluding cattle during the summer would increase native species richness and cover relative to pastures that are grazed year-round. The response to our management actions was measured with a combination of permanent plots and vegetation transects, monitored annually. Six years on, data analysis suggests that the new grazing regimen has been effective, with an increased native plant species richness and cover, comprised of both understory and canopy taxa. Our data also suggest that grazing exclusion is not universally beneficial for maintaining or increasing native species richness at the landscape scale, with habitat type, pre-existing non-native species presence, and plant life history traits also being important factors. Going forward, we aim to continue the current level of data collection to help inform our adaptive management strategy, as well as work to monument new riparian enhancement pastures.

2:45 - 3:00 pm	**Break**

3:00 - 4:00 pm	**Keynote Address** Dr. Ivalu Cacho Evolutionary ecology of Californian Jewelflowers, an integrative approach
4:00 - 4:15 pm	**Thank you and Awards**
4:15 - 5:00 pm	**Open socialization**