44TH ANNUAL SCB SYMPOSIUM

Botany in the Hot Seat: Vegetation, Fires, and Climate Change

8:00-9:00 am **Registration**

9:00-9:10 am **Annual SCB Business Meeting**

9:10-9:15 am **Opening Remarks**

9:15-10:00 am **Responses of Chaparral to Southern California's Changing Climate.**

Stephen Davis, Professor, Pepperdine University.

California experienced the lowest rainfall in recorded history in 2002, which was soon replaced by even lower rainfall totals in 2007. These annual events represented acute droughts but were superseded by chronic drought between 2012-2016, now extending into 2018. Acute droughts differed from chronic droughts in their cause of chaparral shrub mortality in southern California. Acute drought primarily impacted shallow rooted non-sprouting (obligate seeding chaparral after wildfire, such as *Ceanothus* and *Arctostaphylos* species) whereas chronic drought impacted deep rooted chaparral shrubs that sprout after fire and other disturbance, such as *Malosma laurina*. Whole-plant mortality in the latter was caused by fungal-induced dieback and exceeded 50% at some sites in the Santa Monica Mountains. We hypothesized that the mechanism of mortality for *Malosma laurina* was a naturally occurring endophytic fungus (*Botryosphaeria dothidea*) that invaded xylem and phloem tissue, greatly reducing water and sugar transport, leading to protracted water stress and carbon starvation. We tested these possibilities in controlled pot experiments that compared irrigated controls inoculated with the fungus to inoculated non-irrigated plants and inoculated carbon-starved plants. Fungal elongation rates in pot experiments were over two-fold greater in water stressed plants than irrigated controls, leading to increased incidence of whole branch dieback. Carbon starved plants showed an intermediate pattern relative to controls. Gas-exchange data indicated that potted plants undergoing water stress also experience significant carbon starvation, due to stomatal closure and reduced photosynthesis. Taken together, these results were consistent with field observations in California of acute drought impacting shallow rooted species of chaparral through water stress-induced xylem dysfunction whereas chronic drought preferentially impacts deep rooted species via fungal blockage in water transport of xylem.

10:00-10:45 am **Chaparral Vulnerability and the Challenges of Restoration.**

Carla D'Antonio, Professor, University of California, Santa Barbara. Co-authors: Shane Dewees, Stephanie Ma and Nicole Molinari

We conducted a regional analysis of chaparral vegetation change between 1934 and 2009 to understand the environmental factors that correlate with the loss of chaparral in southern California and provide insight into the conditions where restoration is going to be most needed. We also conducted a more local scale analysis to assess the role of short interval fire in driving chaparral conversion to other vegetation types. Overall, we found that chaparral was relatively stable in terms of total area of two counties (Ventura and Los Angeles) covered across this 75-yr interval but some conversion from chaparral to sage scrub or grassland did occur (Areas converting to urban or agriculture were left out of the analyses.) The best predictors of loss to sage scrub or grassland were elevation and precipitation with low elevation sites and lower precipitation areas being more vulnerable to conversion. These sites also had higher maximum January and August temperatures than areas that did not convert again suggesting that chaparral is more vulnerable in more droughty areas. Our regional analysis showed little role of fire in driving chaparral loss. Our local (Piru area of Los Padres NF) analysis, however, showed that fire was instrumental in driving conversion of sage scrub to grassland but not chaparral to grassland. Thus, fire-driven conversion of chaparral to grassland may be a multi-step process involving sage scrub as a dynamic intermediate vegetation type. We are also conducting restoration out-plantings in low elevation chaparral habitats that have converted to sage scrub or grassland to identify methods for establishing greater woody plant diversity in degraded sites. Because these degraded sites are at low elevation and are hot and dry, their restoration presents a substantial management challenge. We have had no success with broadcast seeding of sage scrub or chaparral species, and limited success with container planting. With the USFS, we are designing new approaches to restoration and these will be discussed.

10:45-11:00 am **BREAK**

11:00-11:45 am **The Challenges of Chaparral Restoration.**

Jan Beyers, Research Ecologist, Emeritus; USDA Forest Service

Chaparral is the characteristic evergreen shrub vegetation that clothes middle elevations throughout southwestern California and, indeed, much of the rest of the state. Resilient to fire at the proper return interval, chaparral for most of its history with humans has been subject to efforts to replace it with something else rather than being regarded as desirable vegetation. But chaparral provides important ecosystem services, such as slope stability and watershed protection, that are often appreciated only in their absence. In the face of increasing fire frequency, invasive species spread, and climate change, chaparral restoration has become a subject of interest and, it turns out, frustration as practitioners discover that although it may be difficult to get rid of chaparral, it can be even harder to get it back. This talk will summarize some efforts and experiments in chaparral restoration, exploring the challenges and opportunities inherent in maintaining this iconic vegetation community.

11:45-12:15 pm ***Ex Situ*** **Seed Production for Conservation and Restoration.**

Josué Campos, Botanist, RECON Native Plants, Inc.

Restoration project face challenges due to the lack of collections available for restoration in long-term seed storage and on-site. fThis issue has lead a native plant nursery in San Diego to implement a set of seed production techniques to satisfy demand on multiple habitat restoration and conservation projects in Southern California and northwest Baja California.

12:15-1:45 pm **LUNCH**

1:45-2:30 pm, **Long-Term Recovery from Wildfire Across a Regional Set of 32 Fires in the Mojave Desert**

Scott Abella, University of Nevada, Las Vegas. Co-author: Dominic Gentilcore

Burned areas are an expanding feature of the Mojave Desert, a region not thought to have historically incurred expansive areas of wildfire. In recent decades, increased fuel loads and connectivity provided by non-native grass invasion has coincided with increased wildfire severity and extent. These wildfires likely represent a novel disturbance with uncertain long-term effects on native desert plants. Improving understanding of these effects could have wide-ranging implications, such as for conserving priority native plant species, habitat for the federally listed desert tortoise, aesthetics of public landscapes, and carbon storage. Since 2008, we have been studying the recovery of vegetation after wildfires within a 1.8-million-hectare landscape in the eastern Mojave Desert. We have measured plant communities on 32 wildfires, now ranging in time since fire from 10-40 years, in a repeatedly measured chronosquence where each burn is also paired with an unburned area to identify influences of climatic and land-use fluctuations on post-burn recovery. Perennial vegetation on over 200 plots was most recently characterized in 2016. This unique data set has provided insights into broad concepts of succession in arid lands, the role of novel disturbances in structuring ecosystem properties, and specific patterns of community and species recovery in creosote and blackbrush communities inhabiting much of the Mojave Desert. In this presentation, major findings thus far will be synthesized, including new data collected in 2016 that revealed unexpected trajectories of change.

2:30-3:15 pm **Responses of Southern California Black Walnut (*Juglans californica*) to Fire and Extreme Drought: Survival in a Changing Climate**

Edward G. Bobich, Professor, California State Polytechnic University, Pomona.

Climatologists have predicted that California will experience shifts between extreme wet and dry periods along with, as predicted globally, increases in temperature. An example of an extreme dry period with elevated temperatures in Southern California is the current drought, which has been associated with increases in the intensity and frequency of fires. In response to drought and fire, Southern California black walnut (*Juglans californica*) sprouts new stems (resprouts) from existing aboveground shoots and/or lignotubers after losing some or all of its aboveground biomass. However, unlike after fire, when resprouts productivity is high and resprouts have higher water potentials than do stems of unburned trees, resprouts produced in response to drought grow slowly and have similar water potentials to older stems, suggesting that the trees are minimizing the shoot biomass that needs to be supported. These responses to drought and fire have led to changes in the population structure of *J. californica* in woodland communities throughout our local valleys and may give insight into the future success of this Southern California endemic tree.

3:15-3:30 pm **BREAK**

3:30-4:15 pm **Resistance and Resilience: Ten Years of Monitoring Shrub and Prairie Communities in Orange County.**

Sarah Kimball, University of California, Irvine. Co-authors: Zachary Principe, Douglas Deutschman, Spring Strahm, Travis E. Huxman, Megan Lulow, and Kathleen Balazs

Mediterranean−climate natural systems have high ecological value, yet the extent of their cover has diminished greatly due to changes in land use. Other stressors, ranging from intense short−term disturbances such as wildfire to more gradual events such as extended drought and continuous pressures including competition with invasive species, test the resistance and resilience of community composition and structure. Data from long−term monitoring provided an opportunity to evaluate the

responses of three Southern California plant communities (chaparral, coastal sage scrub, and grassland) to disturbances. We analyzed ten years of point intercept and quadrat data from Orange County to describe trends through time and assess community resistance and resilience. We found that grassland communities, which were more degraded from the start of our study, were generally resistant to change. Chaparral was also fairly resistant to disturbance, while coastal sage scrub exhibited more variation, with some transects exhibiting more resilience than others. Transects with fewer native shrubs experienced less of a decline in shrub cover during drought than those with dense shrubs. Grasslands had the lowest native diversity. There were increases in native diversity in years with more precipitation that were preceded by dry years. There was a decline in native perennial bunchgrasses during our monitoring. Our analyses demonstrated the resilience of native shrub cover to fire and the susceptibility (low resistance) of dense native shrubs and native grasses to drought and increases in non−native species. We encourage academic ecologists to embrace diverse data sources available for hypothesis testing, especially monitoring efforts associated with regulatory purposes, to advance the goal of understanding long−term dynamics.

4:15-4:45 pm. **Tree Mortality, Drought, and Early Detection of Stress in the Southern Sierra Nevada and Southern California.**

Michèle Slaton, U.S. Forest Service, Pacific Southwest Region Remote Sensing Lab

Land managers seek to increase the pace and scale of forest restoration to enhance forest resilience and support economic sustainability in the face of recent global-scale decline in forest health. Monitoring has traditionally relied upon airborne campaigns and limited site inspection to assess forest health status and vulnerability to disease and drought, often overlooking the very early stages of physiological stress, especially when drought-related, and when evidence of biological disease or pathogens is absent. I describe the capability of remote sensing systems to detect early manifestations of forest health impairment in California, and the importance of field sampling for calibration and validation. Combining recently developed methods to detect disturbance at sub-annual and annual scales allows us to explore the following questions: What magnitude of change has occurred in forests over the last decade? What levels of early stress can be detected consistently? Connecting broad-scale change to physiological status creates the opportunity for near real-time monitoring sufficient to meet an ever-increasing demand for forest health risk assessment.

4:45-4:50 pm **Closing Remarks**

5:30-6:30 pm **Poster Session at Rancho Santa Ana Botanic Garden**

5:15-8:00 pm **Mixer at Rancho Santa Ana Botanic Garden**

Poster Session Abstracts

San Diego Zoo's Native Plant Seed Bank: A tool for conservation of native plant species and regional habitat management.

Stacy Anderson[1], Joe Davitt[1], Joyce Maschinski[1,2], Tobin Weatherson[1]

[1] San Diego Zoo Global, San Diego, CA

[2] Center for Plant Conservation, Escondido, CA

In 2001, the San Diego Zoo Institute for Conservation Research (SDZICR) established a Native Plant Seed Bank (NPSB) with the goal of conserving the diversity from many of San Diego's indigenous plants population by drying and freezing orthodox seed for long-term storage. The NPSB provides protection against catastrophic loss in the wild and safeguards against genetic degradation caused by habitat fragmentation. In addition to the conserving seeds, the NPSB develops dormancy-breaking protocols that ensure seeds can be grown as needed. The NPSB utilized banked seed for propagation and restoration of coastal cactus wren habitat and declining coastal sage scrub as well as to establish a field gene bank of Tecate cypress trees to protect against increased wildfire frequency. The NSGB collected seed to propagate for bulking very rare species to provide additional seed for reintroduction projects and banking. Since 2004, NPSB has worked in partnership with Kew Royal Botanic Gardens, the Bureau of Land Management's Seeds of Success Program and other local government agencies including the San Diego Association of Governments (SANDAG). The NPSB's current efforts focus on San Diego County's rare, threatened and endangered plants as recognized by the California Native Plant Society's rare plant inventory. As a regional partner in the California Plant Rescue project, the NPSB strives to conserve the most at-risk plant species. The Center for Plant Conservation is also headquartered at the SDZICR and advises best practices of collecting and curating seeds. To date, the NPSB has collected over 752 accessions including 57 rare high priority species.

Post-fire vegetation mapping for restoration planning in the Angeles National Forest

Marlee Antill[1], Taylor Edwards[1], Sharon Estrada[1], Jeffrey Martinez[1], Michael Martinez[1], Anna Ongjoco[1], Erin Questad[1], David Schimel[2], and Susan Bonfield[3]

[1]California Polytechnic University Pomona, Department of Biology

[2] NASA JPL

[3] Environment for the Americas

Across Southern California, the coupled effects of fire, drought, and invasive species are reducing native plant populations and increasing destructive wildfires through type conversion of native shrublands to non-native, annual grassland ecosystems. Information on points of entry for invasive species, and on areas where ecosystem stability is higher following fire is important to land managers yet difficult to assess over vast spatial and temporal ranges. The use of imaging spectroscopy data has been proposed to distinguish patterns in post-fire succession efficiently over large areas. A joint project involving researchers at Cal Poly Pomona (CPP), the NASA Jet Propulsion Lab, and Environment for the Americas is utilizing a map created from hyperspectral data collected by NASA's Airborne Visible/Infrared Imaging Spectrometer (AVIRIS) sensor within the Copper and Sayre fires of the Angeles National Forest (ANF). AVIRIS can detect a wide range of spectral reflectance signals used to map plant communities and species across the entire forest from an airborne platform. In order to verify the accuracy of these maps, CPP students collected quantitative vegetation data from 100 field sites in 2018. Rugged terrain necessitated the use of a novel approach for efficient ground data collection, combining field identification, quasi-aerial images, and an image analysis program to estimate cover within $45m^2$ plots. The resulting data will be used to calculate the degree of correspondence between the remote sensing and field data, and to perform community composition and resilience analyses based on topography, timing of fire, and other factors important to restoration ecologists.

Seed LA: Building a Regional Seed Bank in Los Angeles, California.

Genevieve Arnold[1], Cheryl Birker[2], Cindy Castañeda[3], Naomi Fraga[2], Cris Sarabia[4], Kat Superfisky[5], Aaron Thomas[6], Justin Yee[7]

[1]Theodore Payne Foundation, Sun Valley, CA, USA, [2]Rancho Santa Ana Botanic Garden, Claremont, CA, USA, [3]Audubon Center at Debs Park, Los Angeles, CA, USA, [4]Palos Verdes Land Conservancy, Rolling Hills Estates, CA, USA, [5]Grown in LA, Los Angeles, CA, USA, [6]North East Trees, Los Angeles, CA, USA, [7]Urban Waters Federal Partnership, Los Angeles, CA, USA

Seed LA was established to increase the availability of genetically appropriate native seed in the Greater Los Angeles Area with a goal to protect and enhance the ecological health of plant communities and sustain resilient ecosystems. With over nine million people, Los Angeles County is the most populous county in the United States, and the Greater Los Angeles Area is the second-largest metropolitan region in the United States. Urbanization and habitat fragmentation are major causes

of biodiversity loss, and continued urban expansion in an already considerably urbanized region provides significant challenges to habitat restoration. Urban greening efforts that will steward and protect the precious and threatened biodiversity of Greater Los Angeles (e.g. the LA River) are underway, and Seed LA will be a critical component of these initiatives. Improving open spaces in urban areas is critical to supporting wildlife, opportunities for recreation, clean air, carbon sequestration, and local water supplies, making habitat restoration imperative to the health and well-being of the Greater Los Angeles Area. Locally-sourced seed is urgently needed to address this demand by providing material that is essential to grow plants that are well adapted and historically present within our watersheds. Securing locally adapted and genetically appropriate native seed will support relationships with wildlife populations, contribute to a healthy environment for residents, and connect our local community with nature. In this presentation Seed LA will provide an overview of our challenges, goals, and our accomplishments thus far.

Shedding light on the botanical black holes of Santa Barbara and Ventura counties.

Lucie Gimmel, Calvin Davison, Kristen Klitgaard, Stephanie Calloway, Matt Guilliams, Kristen Hasenstab-Lehman, Heather Schneider, Peter Schuyler, Adam Searcy, Sarah Termondt, Dieter Wilken, Denise Knapp.

Santa Barbara Botanic Garden, Department of Conservation and Research, 1200 Mission Canyon Road, Santa Barbara, CA 93105, United States.

The Santa Barbara County backcountry has been underexplored by botanists, with most collection efforts outside of populated areas restricted to major highways and roadsides. Rugged terrain, remoteness, and a National Wilderness designation have long been impediments to exploring this region, many parts of which have few or even lack botanical collections. As a result, we know relatively little about plant biodiversity in these “botanical black holes”. In cooperation with the Los Padres National Forest, and with funding from the National Fish and Wildlife Foundation, the Santa Barbara Botanic Garden initiated a project in 2017 to survey nearly 250,000 acres within the Zaca (2007) and Jesusita (2009) burn scars, mapping both invasive and rare plant species and collecting herbarium specimens. We used mules and horses to get us deep into the forest and carry our gear, and high-tech mapping tools with aerial imagery. In addition to our research and conservation staff, 6 regional institutions and organizations have collaborated in this effort, with an anticipated 2,500 volunteer hours by the project’s end. Survey crews have spent 80 days in the backcountry, exploring over 300 hundred miles of trails and collecting over 3000 plant specimens. Herbarium specimens are processed and digitized into the Garden’s Symbiota database, where all entries are instantly visible to the public. These specimens will serve as an important resource for researchers for decades to come. Data collected during this project will further serve to protect rare plants, control invasive species, and help with fire management in this remote area.

Investigating the origins of the California Island mallows (*Malva*; Malvaceae) using phylogenetic tools

Kristen Hasenstab-Lehman[1], Silas Kok[1,2], C. Matt Guilliams[1]

[1] Santa Barbara Botanic Garden, Department of Conservation and Research, 1200 Mission Canyon Road, Santa Barbara, CA 93105, United States.

[2] Westmont College, 955 La Paz Road, Santa Barbara, CA 93108

The islands off the Pacific Coast of Alta and Baja California represent a diverse range of ecosystems across a wide latitudinal gradient, and are well known for their endemic flora. *Malva* L. is a genus of 25-30 taxa with a cosmopolitan distribution. All Western North America taxa are island endemics, with no naturally occurring populations on the adjacent mainland. Species include *Malva pacifica* and *M. assurgentiflora* which are present on several islands off the coast of Baja and Alta California respectively. *M. lindsayi* is a Guadalupe Island endemic, and *M. occidentalis* is present on Guadalupe Island with a disjunct population on the Coronado Islands. *Malva assurgentiflora* is prized for its beauty and used in the horticulture trade; however, the evolutionary history and biogeographic origins of this species and its local congeners are poorly understood. Ray’s early phylogenetic work suggests that these taxa represent a clade, but each taxon was represented by a single exemplar, and did not include a recently circumscribed taxon endemic to the Southern Channel Islands.

Here, we generate new nrITS and matK sequences for 1-4 individuals of each of the recognized taxa, and use published sequences from across the genus to assess the origins of our island endemics, and timing of invasion of the California islands. Our analyses suggest that the local *Malva* taxa represent an island radiation with a single invasion from the Old World, and a subsequent long distance dispersal to Australia.

Testing the effect of relative humidity on the storage tolerance of *Eriogonum fasciculatum var. foliolosum* [Polygonaceae] seeds

Nina House*, Janneth Rivera, and Cheryl Birker
Rancho Santa Ana Botanic Garden

Seeds banks offer a low-cost means of conserving plant diversity through the preservation of seeds in long-term freezer storage. When maintained at the right temperature and humidity, seeds can be stored for many years with little loss in viability. Debate has risen over the ideal relative humidity threshold for maintaining long-term seed viability in storage. Some studies have found that decreasing the relative humidity beyond a certain point can negatively affect long-term seed viability. These studies primarily focus on agricultural species, however, and very little is known about the ideal humidity level for California native seeds. A long-term viability study was established using seeds of *Eriogonum fasciculatum* var. *foliolosum* to begin to understand the effects of relative humidity on long-term seed viability of California natives. Seeds were cleaned and dried to different relative humidity levels (15%-50% at room temperature) using silica gel. Seeds were then stored in heat-sealed foil packets at -23°C in the California Seed Bank at Rancho Santa Ana Botanic Garden. Germination tests were performed on agar before storage, two weeks after storage, and one year after storage. Initial results suggest that seeds of *Eriogonum fasciculatum* var. *foliolosum* are able to maintain their viability in short-term freezer storage at a wide range of relative humidity levels, but this is the beginning of a longer-term study. This preliminary test serves as a model in determining the ideal storage conditions for other California native species.

Investigating interspecific hybridization and introgression in *Ceanothus ophiochilus*, an endangered southern California endemic shrub

Daniel Jaques, Nathan Vega, Joshua Der
California State University, Fullerton

Ceanothus ophiochilus, Vail Lake ceanothus, is a Federally-threatened California native shrub endemic to southwestern Riverside County. It has a CNPS rare plant rank of 1B.1 (rare, threatened, or endangered in California and elsewhere) and is listed as endangered by the state. *C. ophiochilus* is an edaphic species restricted to pyroxenite-rich outcroppings in a 10 square mile region east of Temecula. *C. ophiochilus* lacks the ability to crown sprout after a fire and relies on germination from the seedbank following fire. As fire intensity increases in Southern California, this poses an increased threat to persistence of this species. *Ceanothus* are known for their ability to hybridize and putative hybrids between *C. ophiochilus* and the more widespread *Ceanothus crassifolius* have been documented. This threat has increased with the construction of fire breaks which have blurred soil boundaries, and has brought these two species into closer contact. In this study we aim to use population genetics to document the extent of hybridization between *C. ophiochilus* and *C. crassifolius* and quantify the level of gene flow and introgression in *C. ophiochilus*. We have used low-coverage whole genome shotgun DNA sequencing (4.7 million read pairs; 2.39 Gb) to identify nearly 600 candidate microsatellite loci. We are currently testing 39 of these candidate loci to evaluate cross-species amplification and determine levels of polymorphism in *C. ophiochilus* and other *Ceanothus* species occurring in the region. Here we present our progress and plans to complete genetic analyses to inform conservation management of this rare species.

ERTH Census 2018: Status of the *Eriogonum thornei* Population in the East Mojave Desert

Andrew Kaiser
Mojave National Preserve

Thorne's buckwheat (*Eriogonum thornei* [Reveal & Hendrickson] L.M. Shultz) is a plant endemic to the New York Mountains within Mojave National Preserve. It is restricted to a single ridge and only occurs in 3 slightly separated concentrations. Not much is known about the physiology of this species, but it has experienced a number of fairly catastrophic recent events that could have extirpated the plant. In 2005, the Hackberry Complex Fire burned over a third of the population. The species seems to have an affinity to copper-rich soils, which have attracted miners. A decommissioned road which runs through the densest part of the largest concentration offers illegal offroaders easier access into Wilderness areas. Throughout all these events, the plant persists; however, no quantifiable data had been collected until 2011 to determine the status of the population. When possible, a complete census is the preferred monitoring method because no statistics are required to analyze the results. In 2011, a census was collected for the population and 12,734 individuals were counted. The population was resurveyed in 2018 using the same methods and 11,417 individuals were counted, indicating a 10% decline over 7 years.

Assessing San Clemente Island Endemic Seed Collections and Germination Tests

My-Lan Le, Cheryl Birker
Rancho Santa Ana Botanic Garden

The California Seed Bank at Rancho Santa Ana Botanic Garden currently houses 48 seed collections of rare plants endemic to San Clemente Island. These collections represent 14 different plant taxa, many of which have not been collected since 1996. When seeds are processed and stored correctly, they can remain viable in storage for many years, however, this storage lifespan varies from species to species. The germination testing program at the California Seed Bank allows staff to monitor the viability of seed collections in storage, as well as develop seed germination protocols for California native plants. Pretreatments for breaking seed dormancy are tailored to the ecology of the species and the morphology of the seed. Germination tests on the San Clemente Island endemic seed collections have yielded variable results. In general, follow-up germination tests have resulted in increased germination rates, most likely due to more informed pretreatments. The species and collections whose germination rates have decreased over time may need to be recollected in the future to maintain their ex-situ conservation status. The results of these germination tests will be presented, and their implications for future *ex-situ* conservation efforts of San Clemente Island's unique and rare flora will be discussed.

A phylogenetic and morphological analysis of biogeography and dispersal mechanism evolution in Channel Islands endemic *Malacothrix* (Asteraceae)

Theresa Lujan[1,2], Kristen Hasenstab-Lehman[1], Bruce G. Baldwin[3], Joongku Lee[4], C. Matt Guilliams[1]

[1] Santa Barbara Botanic Garden, Department of Conservation and Research, 1200 Mission Canyon Road, Santa Barbara, CA 93105, United States.

[2] California State University, Channel Islands, MS Biotechnology Program, One University Drive, Camarillo CA 93012, United States.

[3] University of California, Berkeley, Jepson Herbarium and Department of Integrative Biology, 1000 Valley Life Sciences Building, Berkeley, CA 94720, United States.

[4] Korea Research Institute of Bioscience and Biotechnology (KRIBB), Daejeon, Korea.

Malacothrix DC is a genus of Asteraceae comprising twenty species. Nine minimum-rank taxa are endemic to the California Channel Islands, rendering the genus one of the best examples of diversification across this fringing archipelago. Despite this, inferring the evolutionary history of these island endemic *Malacothrix* has never been the focus of a phylogenetic study. We therefore know little about the number and timing of colonization events in the genus, or morphological features associated with colonization. In this study, we use molecular sequence data to infer phylogenetic relationships so that the history of colonization can be examined. Additionally, we tested if Channel Island *Malacothrix* have lost features commonly associated with dispersal, a phenomenon noted in other island systems. DNA extractions and sequencing of ETS and ITS were conducted for nine island endemic taxa and three mainland--island taxa. These new sequences were added to existing sequences from GenBank. Maximum likelihood and Bayesian inference analyses were performed using the ITS dataset. The inferred trees were strongly supported in general. Biogeographic reconstruction suggested four *Malacothrix* dispersals between the mainland and islands, at approximately 10, 4, 1.5, and 1 MYA. To examine the relationship between presence on an island and loss of traits potentially associated with dispersal, we performed comparative phylogenetic analyses of 5 cypsela and pappus features using our best maximum likelihood tree. We obtained images of these fruit features using both SEM and light microscopy, from which these features were measured using the program ImageJ. Preliminary results will be discussed.

Restoring degraded chaparral and the impact of exotic species on native shrub establishment

Stephanie Ma[1]*, Michala Phillips[2], Katherine Nigro[1], Sameer Saroa[2], Shane Dewees[1], Edith Allen[2], and Carla D'Antonio[1].

[1]University of California, Santa Barbara.

[2]University of California, Riverside.

Chaparral is one of the dominant vegetation types in southern California. It is characterized by evergreen, sclerophyllous shrubs adapted to a Mediterranean climate and has long been considered highly resilient to wildfire disturbances and tolerant of climate stressors (e.g., drought). However, these ecosystems can be degraded or lost due to anthropogenic stressors such as an expanding wildland-urban interface, invasive species, and an increase in fire frequency. As communities become degraded, the need for restoration arises. In this study, we aimed to take early steps to determine how feasible chaparral restoration is, keeping the goals of land managers in mind, and what steps can be taken to promote recovery. Our study focused on establishing *Salvia leucophylla, Salvia apiana, Hesperoyucca whipplei, Eriodictyon crassifolium,* and *Malacothamnus fasciculatus* in degraded chaparral sites in Piru, California. Treatments included: planting 3-4

month old seedlings, sowing seeds, and scarifying the topsoil 5 or 12 cm before sowing seeds. Competition with exotic annuals, including *Avena* and *Bromus* species, was controlled within each treatment at: no removal, half removal or full removal. We observed the greatest seedling establishment with outplanting into plots with full exotic removal. There was almost no shrub establishment from seed. *Salvia apiana* seeds and seedlings had the highest rate of establishment. Scarifying the topsoil led to greater native annual cover in the spring compared with un-scarified treatments. Future work includes seed germination trials in native soil and seed predation studies in the field.

Assessing the structure of genetic variation of Eastwood manzanita, *Arctostaphylos glandulosa*: a preliminary study in Southern California.

Glen Morrison[1], Yi Huang[1], Andrew Sanders[1], Natalie Saavedra[1], Thomas Stoughton[2] and Amy Litt[1]

[1]University of California, Riverside

[2] Plymouth State University

Eastwoood's manzanita, *A. glandulosa* Eastw., is a complex of ten subspecies, distributed throughout the California Floristic Province, that are distinguished by morphological traits (mainly hair and fruit traits), though variation in these traits commonly overlaps among subspecies. Additionally, while some subspecies have clear geographic distributions, the distributions of other subspecies are intermingled, with frequent occurrence of intermediate individuals, meaning there is likely ongoing gene flow among these taxa. Because of this potential for gene flow, these subspecies may not be evolutionarily distinct (i.e. incipient species). Thus, our goal was to assess the structure of genetic variation within *A. glandulosa* and to test the genetic distinctiveness of the subspecies. We generated single nucleotide polymorphism data for 81 *A. glandulosa* individuals collected across Southern California and sequenced using double-digest RAD-seq. We analyzed this data using a Structure analysis, a splits network analysis and ordination techniques. Across analyses we see evidence for a North-South axis of genetic differentiation, with some signal of local differentiation among mountain ranges. This geographic structure of genetic variation does not correlate neatly with current taxonomy, suggesting that these subspecies do not represent incipient species.

Diversification of the genus *Suaeda* (Amaranthaceae s.l.): Use of genome skimming to evaluate a putative species radiation in northwestern Mexico

Carina Motta[1], C. Matt Guilliams[1,2], Katja Seltmann[1], Wayne Ferren [3], Susan Mazer [4], Kristen Hasenstab-Lehman[1,2]

[1] University of California, Santa Barbara, The Cheadle Center for Biodiversity and Ecological Restoration, Harder South Building 578, Santa Barbara, CA, 93106, US.

[2] Santa Barbara Botanic Garden, 1212 Mission Canyon Road, Santa Barbara, CA, 93105, United States

[3] Channel Islands Restoration, 928 Carpinteria Street, Suite 3, Santa Barbara, CA, 93103, US

[4] University Of California, Santa Barbara, Department Of Ecology & Marine Biology, 4119 Life Sciences Building, Santa Barbara, CA, 93106, United States

Nearly 100 estuaries exist along the coast of Baja California and Sonora, Mexico, forming a series of unique wetland habitats isolated from each other by the surrounding arid landscape. The genus *Suaeda* Forssk. ex J.F. Gmel. (Amaranthaceae, formerly Chenopodiaceae) is common in these estuaries and has been hypothesized to be in the process of diversification. Nine putative new species of *Suaeda* were detected by Wayne Ferren during fieldwork in this region in the 1980s, but additional taxonomic study was needed to before describing these as new to science. Nearly 350 specimens of both currently accepted and potentially new species of *Suaeda* were collected by Ferren from 1980-2000 and housed at the UCSB Natural History Museum at the Cheadle Center for Biodiversity and Ecological Restoration (CCBER) for curation and research. Here we aim to evaluate Ferren's hypotheses using phylogenetic analysis of DNA sequence data. Genomic DNA was extracted from four exemplars of each putative species, along with four outgroup species. Genome skim libraries were constructed, and sequenced on an Illumina HiSeq 2500. The nuclear ribosomal cistron and chloroplast genome of each sample were assembled. We inferred evolutionary history with these resulting datasets, and compared the results against Ferren's taxonomic hypotheses to assess support for circumscription of new species. Beyond the implications for taxonomy, there is an urgent conservation need to ensure that biodiversity is adequately described, as these wetlands are threatened by development.

Capturing flowering time data from herbarium specimens: The California Phenology TCN

Katie D. Pearson, Jenn M. Yost

California Polytechnic State University, San Luis Obispo

The timing of flowering is important to science, society, and biodiversity, and herbarium specimens—dried, pressed plants collected across the globe and preserved in

herbaria—can provide rich data on how flowering times vary across time and space and with changes in climate. The California Phenology Thematic Collections Network (CAP TCN) is an NSF-funded project that aims to image nearly one millions herbarium specimens and capture flowering (i.e., phenological) data from these images. The CAP TCN is composed of 22 herbaria at California institutions including universities, botanic gardens, natural history museums, and research stations, and all are working together to achieve this ambitious goal. This poster will describe the current and future activities of the CAP TCN including specimen imaging, development of a new data portal and phenological data standards, and education and outreach opportunities associated with the project. The project manager of the CAP TCN will be present to engage interested persons and answer questions. This project will generate data that will increase our understanding of flowering time shifts—a critical need for agriculturalists, conservation biologists, plant taxonomists, land managers, and wildlife biologists.

Effects of Fire on a Blackbrush and Joshua Tree Woodland in the Mojave Desert

Kassandra M. Rodriguez, Ariana M. Sanchez, Syndee R. Dunn, Andrew M. Jaramillo, M. Kim Koval, Jennifer L. Burnaford, Darren R. Sandquist

California State University, Fullerton

Desert organisms are often highly adapted to extreme conditions, however, native desert communities can be slow to recover after major disturbances (e.g., wildfire) and are prone to invasion by non-native grasses. We examined plant community composition of a Mojave Desert Joshua tree woodland recovering from a 2005 fire by comparing adjacent burned and unburned areas in 2018. We hypothesized that fire disturbance would increase abundance of grasses and annuals relative to an unburned area, but decrease perennial species richness and diversity. We quantified the plant community using line transects, 50 m^2 belt transects, and 0.25 m^2 quadrats. Cover of non-native grasses did not differ between burned and unburned areas, but percent cover of native grasses was approximately ten times higher in the burned area than the unburned area. There was an average of 5.7 ± 0.6 (mean ± SE) perennial species in the burned area and 9.0 ± 0.7 in the unburned area. The diversity of perennial plants was higher in the unburned area (mean H' = 1.742) than in the burned area (mean H' = 1.075). We found an average density of 1.94 ± 0.1 individuals per m 2 for annual plants in the burned area but none were found in the unburned area. Despite 13 years of recovery, we found that the burned area community composition and cover remained very different from the unburned area, but that active management may not be necessary to prevent conversion to a non-native grass system.

Comparison of *Arctostaphylos glandulosa* populations and subspecies using leaf morphology and environmental data

Natalie Saavedra, Yi Huang, Glen Morrison, Andrew Sanders, Amy Litt

University of California, Riverside

The genus *Arctostaphylos*, also known as manzanitas, are a group of evergreen shrubs, almost all occurring within the California Floristic Province. As part of a larger project looking at genetic, morphological, and environmental diversity across the genus, we are studying *A. glandulosa*, optimizing methods to assess taxon boundaries that can be applied to other *Arctostaphylos* taxa across California. In the current taxonomic system, subspecies of *A. glandulosa* are identified on the basis of leaf color, fruit shape, and length and density of glandular hairs. The objective of this study is to see if leaf shape or environment can distinguish populations and subspecies. We sampled *A. glandulosa* from ten populations in Southern California and collected 30 leaves from ten individuals per population. We performed Elliptical Fourier Analysis to quantify leaf shape and did a Principal Component Analysis. The analysis showed no separation among the populations, and found that that within-individual variation is large compared to among-population and among-subspecies variation. As a result, leaf shape is unable to distinguish subspecies or populations. We are using online bioclimate data, and specimens from our herbarium and recent collections, to evaluate whether the environmental factors of annual precipitation, and the temperature of the coldest and warmest months, can distinguish populations and subspecies.

Drought, Fungi, and Death in *Arctostaphylos glauca*

Laura Drake Schultheis

University of California, Santa Barbara

In winter 2016-2017, a full factorial greenhouse experiment was conducted over 90 days using the fungal species *Neofusicoccum australe* to test the specific influences of drought and fungal infection on *Arctostaphylos glauca* performance and mortality. Results show a significant difference between the four treatment groups (drought + inoculation; drought – inoculation; watering + inoculation; and control: watering – inoculation). Compared to all other treatment groups, drought + inoculation yielded the fastest decline in photosynthesis, onset of symptoms, and subsequent

mortality of individuals. These results indicate a possible synergy between drought and fungal infection in influencing the rate of *A. glauca* mortality. The data further suggest that *N. australe* is itself highly virulent and can cause mortality quickly, at least in small individuals, even in non-drought stressed plants. These findings have important implications for similar systems that can be exposed to members of the Botryosphaeriaceae family, especially during periods of extreme drought.

Bringing a new light to an old nightshade (*Solanum clokeyi*)

Tim Sisneros[1,2], Kristen Hasenstab-Lehman[1], C. Matt Guilliams[1]

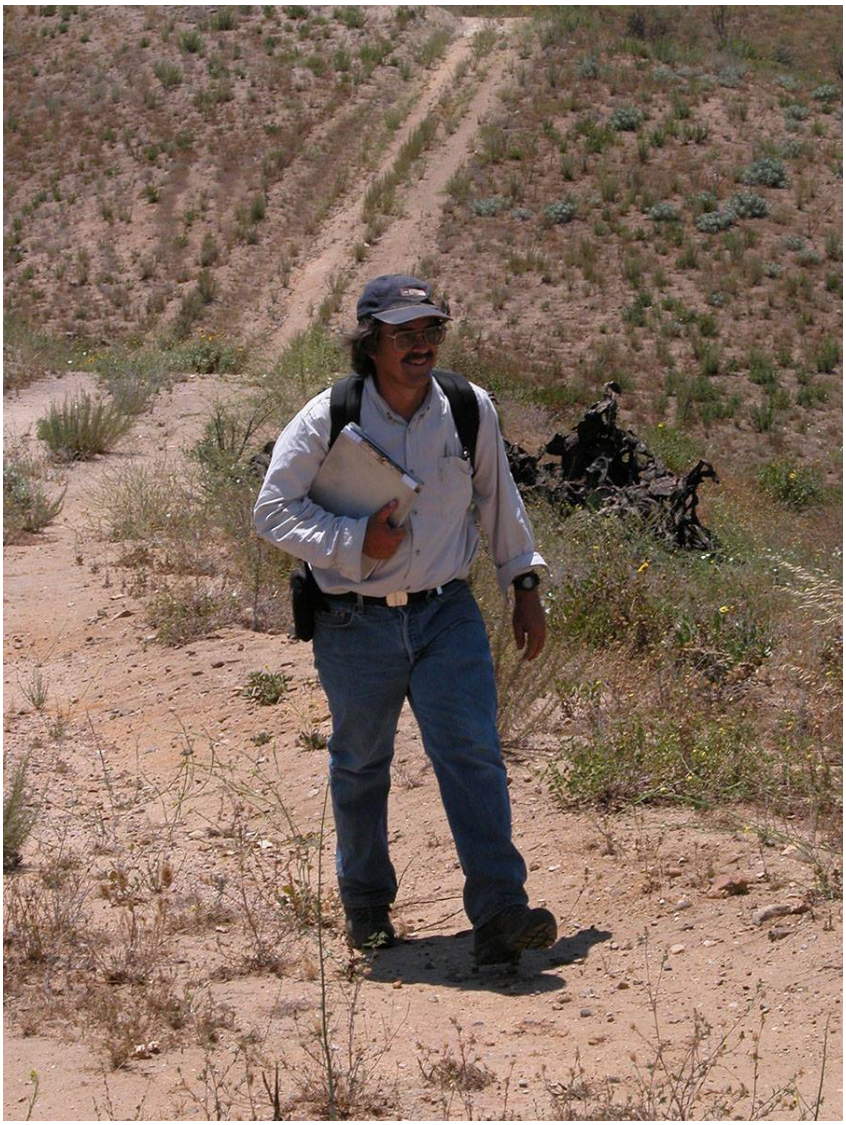
[1]Santa Barbara Botanic Garden, Department of Conservation and Research, 1200 Mission Canyon Road, Santa Barbara, CA 93105, United States.

[2]Santa Barbara City College, AS Program for Biological Sciences, 721 Cliff Drive, Santa Barbara CA 93109, United States

The California Channel Islands are a world-renowned center of plant biodiversity, with ca. 100 plant taxa endemic to the archipelago. Despite active botanical work spanning the islands for over a century, there are still taxonomic mysteries to be solved. The Channel Islands currently support one recognized endemic plant in the genus *Solanum*, *S. wallacei* (A. +Gray) Parish (Solanaceae), but an early taxonomic hypothesis recognizes northern populations of *S. wallacei* as *S. clokeyi* Munz. Since its early description, no further taxonomic studies have been performed to assess support for this taxon, and recent floristic treatments place it in synonymy. With historical and current threats to biodiversity such as introduced herbivores, invasive plants, and climate change affecting these island systems, it is imperative to reevaluate these older taxonomic hypotheses so that native biodiversity is adequately described and conserved. In this study, we performed a morphometric analysis of *S. wallacei* s.l. In total, we examined 116 herbarium specimens of three species of *Solanum*: *S. umbelliferum* Eschsch., *S. wallacei* s.l., and *S. xanti* A. Gray, collected from the Channel Islands and California mainland. We measured 11 leaf, 7 flower, and 3 stem characters to examine if plants from Santa Cruz Island are morphologically different from plants on Santa Catalina Island, which would support the resurrection of the name *S. clokeyi* for the northern plants. Here we discuss our preliminary findings and place them in light of current conditions on Santa Cruz and Santa Catalina islands.

In Memorial

SCB mourns the passing of two incredible botanists, friends, and board members. We would like to dedicate the 44th Annual SCB Symposium in their honor.



Dave Bramlet

15 September 1954 – 3 August 2018

Dave served on the SCB board from 1985-1986, 1989, 2004-2010. He was 1st Vice-President in 1987-1988. He was also an issue editor for Crossosoma for 1984 and 1986

Jessica Orozco

1 February 1987 – 27 October 2018

Jessica served on the SCB board from 2013-2017. She presented at the SCB Annual Symposium in 2015 and she was awarded an SCB annual grant for her research on the flora of the South Fork of the Tule River in 2013.