NORTHERN CALIFORNIA BOTANISTS

BOTANICAL LEAFLETS

ISSUE 20 FALL 2017

PRESIDENT'S MESSAGE

It is fall and hopefully everyone has finished their summer field work. This has been quite an unbelievable year with fires. Unfortunately, a couple of close friends of mine lost their homes in the foothills outside of Oroville due to fire this summer. I'm sure we all know people who were affected by the fires in every part of California. It would be wonderful if we got some rain soon!

Many of us are planning to attend the California Native Plant Society Conference in Los Angeles in February 2018. Northern California Botanists plan to have a booth at the conference so please stop by our booth!

We have added a new board member, Jason Sexton. Welcome to the Northern California Botanist Board! And I would like to thank Matt Guilliams for all of his work on the Board these past years.

We are beginning to plan our next Symposium which will be in January, 2019 at California State University, Chico. So, there is something to look forward to!

Have a great fall with your many vast botanical adventures.

Linnea Hanson

WELCOME JASON SEXTON TO THE NCB BOARD!

Northern California Botanists is pleased to announce the appointment of Jason "Jay" Sexton to the Board. Jay is an Assistant Professor in the Life and Environmental Sciences Unit, University of California, Merced. He studies plant climate adaptation and the determinants of plant distribution limits. He currently works on understanding the distributions of monkeyflowers, giant sequoias, and meadow plant ecosystems of the Sierra Nevada and plant conservation in vernal pool systems of the Central Valley. Jay serves as an advisor to the University of California Natural Reserve System and has presented at past NCB Symposia. Welcome Jay!

MYSTERY PLANT

This plant illustrates a rather unusual feature in northern California flowering plants. The dried seed capsules are held high on stipes, which have grown the maturing pistils up out of the corollas (which are now brown and dried). This "added height" may be advantageous for dispersal of the dust-like seeds in the dense herbaceous vegetation. This species is one of the very last of the summer to flower in subalpine and alpine meadows of northern California. When in flower the large, striped corollas are showy, and tend to be bluer in the Cascades and to the northwest, and whiter in the Sierra Nevada (and everywhere, a favorite of bumblebees). Photo by Rob Schlising

Answer (and view of the plant in flower, with no sign of the stipes) on page 6

INSIDE THIS ISSUE:

NORTHERN CALIFORNIA BOTANISTS IN ACTION

A continuing series that highlights well-known to possibly less-well-known botanists, with photographs from the present to several decades back. Please share unpublished pictures of northern California botanists: send jpegs and information to rschlising@csuchico.edu

Genevieve Walden is the Senior Plant Taxonomist at the Plant Pest Diagnostics Center for the California Department of Food and Agriculture, and Curator of the Herbarium (CDA). She is shown here in the Botany Lab after collection of the federal and state noxious weed *Cuscuta japonica* Choisy (japanese dodder) on *Olea europaea* L. (olive). Genevieve worked as a seasonal employee at CDFA for Fred Hrusa (now Plant Taxonomist emeritus), and then studied hydrophylls for her research, and is excited to work at CDFA and for California again.

Jim Shevock, shown collecting rheophytic mosses in China, is a Research Associate and Fellow at CAS. He "retired" in 2009 after a 32 year public service career with the U.S. Forest Service and National Park Service. In the late 1990s his research focus shifted from flowers to mosses. His herbarium collections exceed 50,000 numbers with many bryophyte duplicates housed in major herbaria worldwide. International collecting expeditions are his passion. He has discovered and named many species as new to science. Among his honors are the various *shevockii* epithets (12) including the moss genus *Shevockia*.

Tom Carlberg is shown during a lichen walk at Manila Dunes. He has a degree in Botany from Humboldt State University, and has worked for the U.S. Forest Service as well as private contractors and non-profits. He has been a cryptogamic botanist for 15 years and has grown from being a macro-lichen specialist to being one of Northern California's top micro-lichenologists. Tom is currently president of the California Lichen Society. He has held many lichen workshops in the state, including workshops for 9 years at Chico State University.

Belinda Lo received her degree in Botany at UC Davis in 2004 and has worked as a field botanist for 11 years in dramatically different localities across the country. She is shown (left, in this photo by Stephany Davis in 2015) at work at California's Manzanar National Historic Site. She enjoys surveying for rare plants, mainly for the U.S. Forest Service but also for non-profits such as The Nature Conservancy and CNPS. Belinda also enjoys learning new floras, and is presently working in the Klamath Ranges. She admits that one of her hobbies is looking for Botrychiums.

NEW! NCB Budding Botanists Program

Northern California Botanists is starting a Budding Botanists program to include early career botanists in the professional community. Members of the Northern California Budding Botanists will be added to our NCB listserv and will receive notifications about classes and workshops. Members can also contact experienced botanists for career advice. Members are also invited to careers sessions during the Northern California Botanists Symposia. To join, ask career questions, or volunteer to answer career questions as an experienced botanist and mentor, please contact us at buddingbotanists@norcalbotanists.org

2017-2018 Student Research Scholarship Awards

Northern California Botanists is pleased to announce the recipients of this year's research scholarship awards. As in the past, we received many worthy applications. This year we awarded 10 scholarships of $1,000 each. The Sacramento Valley and Shasta chapters of the California Native Plant Society have teamed up with NCB and are each funding one of the scholarships.

Kate Miller and Drew Burke are Undergraduate students at Cal Poly, San Luis Obispo.

The title of their research is **"Floristic survey of Yosemite's sky islands."**

Scattered along the crest of the Sierra Nevada are high elevation, unglaciated plateaus containing specialized alpine plant species. With climate change impacting many aspects of life on Earth, we are interested in researching the changes occurring in these remote environments. Plants found on these high elevation plateaus, known commonly as Sky Islands, face a high risk of extinction due to their specialization to small and isolated environments, as well as their lack of an "escape route." Upward migration to higher elevations is not possible for plant populations that are already inhabiting the highest elevation sky islands. Possible shifts in community population is concerning because the Sierra Nevada harbors the vast majority of California's alpine plant diversity.
To our knowledge, this will be the first large scale assessment of potential recent shifts in alpine plant communities in California, and will be used to establish a baseline for monitoring the rate of future change. Community assemblage analyses will assess whether there have been systematic shifts in alpine vegetation between the 2010 and 2017 sampling periods. We propose to resample the unglaciated plateau of Mt. Conness. Because of accelerated recent warming and drought, we expect shifts upward in mean, minimum and maximum elevation.

Carmen Tubbesing is a Ph.D. student at the University of California, Berkeley.

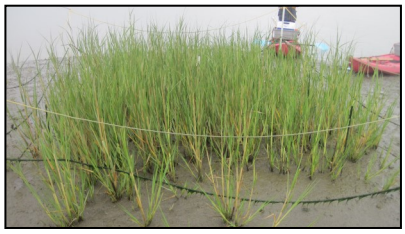
The title of her research is **"Predicting forest recovery following high-severity fire."**

Climatic change and other human influences have altered fire regimes. Predicting successional patterns in such altered regimes is difficult, particularly for long-living, slow-growing organisms. In Sierra Nevada mixed-conifer forests, high-severity fire (with total or near-total tree mortality) is forming unprecedented patch sizes. Native conifer species, such as *Pinus ponderosa, P. lambertiana, Abies concolor, A. magnifica, Calocedrus decurrens,* and *Pseudotsuga menziesii* are adapted to regenerate in mixed-severity, mosaicked forests but lack reproductive traits suited for reoccupation of large high-severity fire patches. However, several native shrub species, including species in the genera *Arctostaphylos* and *Ceanothus*, resprout vigorously after fire or germinate from seed banks, potentially outcompeting the later arriving and slower growing tree seedlings. Recent evidence shows variable long-term tree recovery across burned patches, suggesting that tree recruitment may be governed by site-specific and temporally variable factors such as mast seeding and weather in the first few post-fire years. My study will further this research by modeling shifts from chaparral to tree dominance under variable initial conditions. Using a combination of data synthesis, field measurements, and forest growth simulations, I will identify the demographic process(es) that most limit tree recruitment post-fire.

2017-2018 Student Research Scholarship Awards (Cont.)

Margot Buchbinder is an M.S. student at San Francisco State University.

The title of her research is **"Facilitating physical and biological recovery with planted vegetation at a salt marsh restoration site."**



The San Francisco Bay estuary has lost over 90% of its historic salt marshes due to conversion to agriculture, urbanization and other purposes. Large-scale restoration of marshes in the estuary is underway, but is hindered by high subsidence in former marshes that has caused land elevations to drop over 2 meters in many parts of the Bay. Restoration efforts must therefore strategically build sediment before marsh vegetation can become established. At the Sears Point restoration site in the San Pablo Bay National Wildlife Refuge, over 500 earthen mounds were built to marsh vegetation elevations across a 955-acre site. The mounds are intended to slow wave action at the site, allowing Bay waters to deposit sediment and to reduce erosion. The mounds were also intended to act as nuclei for the colonization of marsh vegetation, but were not planted initially. This project seeks to determine whether actively planting native marsh species can accelerate the ecological and physical development of the site.

I established experimental treatments on 36 mounds in the spring of 2016 including planted *Spartina foliosa*, native Pacific cordgrass, alone and coupled with coir erosion logs intended to protect plantings from wave action. I monitored the experimental mounds quarterly during the growing season for erosion, sediment and vegetation qualities, belowground invertebrates and benthic invertebrates. Preliminary findings through spring of 2017 show that planting *S. foliosa* does not result in improved soil conditions, but that mounds with higher *S. foliosa* densities experience lower erosion. Additionally, I found an immediate trend in benthic invertebrate populations, with higher crab densities found on *S. foliosa* mounds. I am continuing to process and analyze summer 2017 samples and data, and will use my findings to advise future planting actions at Sears Point and to inform planning for future sites utilizing this restoration technique.

Mitchell Bamford is an M.S. student at California State University, Chico.

The title of his research is **"Comparing Restoration Methods in Invaded California Grasslands."**

Biological invasion is one example of an ecological degradation. *Centaurea solstitialis* (Yellow Starthistle) in the Sacramento Valley is one example of this kind of invasion. The field of restoration ecology focuses on repairing these degraded ecosystems. This study is to compare the success rates and overall value of two different restoration methods in areas treated for *C. solstitialis* by planting the native bunchgrass *Stipa pulchra* (Purple Needlegrass) over a range of densities using two different methods (pre-grown plugs and drill seeding). This research will test the hypotheses that plugs are not a better value restoration method than seeds, that restoration success will not increase continuously without limit as planting density increases, and that the effect of intraspecific competition on *S. pulchra* is not greater than the effect of interspecific competition on *S. pulchra* from *C. solstitialis* during the establishment of *Stipa pulchra*.

The methods used in my study are planting pre-grown plugs and drill seeding. The former of which can be expensive and labor intensive but may offer better establishment results, while the latter may expose germinating seeds to higher rates of competition but is generally cheaper and less labor intensive. After efforts to control the *C. solstitialis* during the summer of 2016 by mowing before seed set and tillage to kill any germinating seedlings, plugs and seed were planted at a range of 5 different densities for both methods in the fall of 2016. This was replicated at 3 different sites in the Sacramento Valley. In addition, there is a concurrent greenhouse experiment where 3 overall combined densities of both species are planted in pots at 5 different proportions in an additive design experiment to test the competitive effect the two species exhibit on each other in a more simplified system.

2017-2018 Student Research Scholarship Awards (Cont.)

Amanda Carr is an M.S. student at Western Washington University.

The title of her research is **"Invader success and species coexistence in a California serpentine grassland."**

The rate of biological invasions has increased dramatically in recent decades. Although most invasions fail, some are remarkably successful, sometimes causing large-scale changes to community composition and ecosystem services. These changes are of critical concern for refugia of native diversity, such as the serpentine grasslands of California. The resistance of diverse communities to invasion appears to vary in space and time, in a phenomenon called the "invasion paradox." My research project seeks to address three hypotheses related to this paradox: (1) differences in resource-use strategies (i.e., functional traits) promote species coexistence; (2) functionally diverse communities are initially more resistant to invasion; and (3) an interaction between disturbance and propagule pressure disrupts the effectiveness of diversity in repelling invasion over time. To accomplish my research goals, I am utilizing a long-term dataset of species abundance, disturbance, and seed input for experimental, serpentine plant assemblages. Following eight years (1991-1999) of controlled composition, our plots experienced almost two decades of invasion and disturbance events. After supplementing these data with functional traits related to complementary resource-use, I will evaluate the success of a high impact invader, *Centaurea solstitialis* (yellow starthistle), in response to functional diversity, disturbance, and propagule pressure through time. The combination of manipulated community composition followed by natural invasion and disturbance events offers a unique opportunity to elucidate long-term mechanisms of invader success. Results from this study should help improve our ability to predict successful plant invasions, inform prevention efforts, and design restoration projects and management strategies to optimize resistance to invasion.

Nick Jensen is a Ph.D. student at Claremont Graduate University.

The title of his research is **"Systematics of the *Strepthanthus howellii* alliance."**

Streptanthus (jewelflowers, Brassicaceae) is almost entirely restricted to western North America and has served as a model system for understanding rarity and edaphic specialization. Thirty of 35 recognized *Streptanthus* in California are listed as rare by the California Native Plant Society. Recent phylogenetic research has shed light on evolutionary relationships in the genus, but the *Streptanthus howellii* Alliance (SH), a clade of 10 perennial taxa, is not well understood phylogenetically. The SH includes rare, geographically-limited species in both Southern and Northern California, and the most common taxon in the genus, *S. cordatus* var. *cordatus,* which is widely distributed across the western US. The high rate of rarity in *Streptanthus* is unusual, such that understanding the SH alliance from a phylogenetic perspective will shed light on the evolutionary processes that have shaped the flora of California.

Over the course of the past three years I have traveled in California and the western U.S. collecting tissue samples and morphological data on species in the SH alliance. Using genome-wide sequencing (RADseq), I produced a well-resolved phylogeny of the lineage, utilizing these collected tissues and samples obtained from my collaborator, Dr. Ivalu Cacho. This phylogeny will allow us to analyze historical biogeographic patterns and the evolution of morphological traits in the lineage. In addition to shedding light on evolutionary processes, this research will result in taxonomic clarification in the SH. Taxonomic changes and data collected in the field on threats will help to identify species that are in need of increased conservation attention. In the process of this research, I have found two new species in Southern California, one was hiding in plain sight in the San Bernardino Mountains; the other was waiting to be discovered on the unexplored land of Tejon Ranch in the Tehachapi Mountains. As I continue my dissertation research, I will analyze existing data and incorporate recently collected samples into my existing phylogenetic framework.

2017-2018 STUDENT RESEARCH SCHOLARSHIP AWARDS (CONT.)

Chris Adlam is a Ph.D. student at the University of California, Davis.

The title of his research is **"Climatic controls on conifer encroachment in oak habitats."** *Shasta Chapter CNPS, Award Winner*

Predicting the net effect of climate change on vegetation communities is challenging. One problem is that changes in interspecific interactions complicate forecasts of shifts in individual species distributions. For example, ecologically and culturally valuable oak habitats have been predicted to expand in response to climate. However, this prediction does not consider competition from encroaching conifers, particularly in fire suppressed areas. Yet, the viability of oak populations, their wildlife value, and potential for recreational or tribal use purposes are all reduced when conifers come to dominate the understory and eventually overtop the oaks. To better predict changes in oak habitat quality and extent, this study will evaluate the links between climate and conifer encroachment in Oregon white oak and black oak habitats. Research sites will span the latitudinal and altitudinal range of these two species to look for patterns in the response of encroachment to climate. I will use tree-ring analysis to determine establishment dates and growth rates of conifers that have become established in oak-dominated habitats. I will determine whether historical climatic data can be correlated with these measurements. With this information, I will then build a model to predict where the pressure of conifer encroachment will increase or decrease in response to predicted climate changes over the next century. This information can be used to more efficiently prioritize conservation or restoration of oak habitats.

Cody Rice is an M.S. student at California State University, Chico.

The title of his research is **"Understanding the genetic diversity of *Darlingtonia californica* population clusters."**

The California pitcherplant, *Darlingtonia californica* (Sarraceniaceae), is a perennial herb endemic to a handful of regions in northern California and western Oregon. While *D. californica* is best known for its highly modified leaves and carnivory, an understanding of genetic variation within and among populations remains minimal. Often found in seeps and bogs, *D. californica* thrives in low nutrient, hydric soils in which most other plants cannot survive, thereby reducing competition. However, as many regions begin to warm from a changing climate, these ecosystems risk drying that could result in the significant reduction of population sizes. This project seeks to gain a greater understanding of the genetic diversity of *D. californica* populations and provide knowledge regarding conservation principles. Leaf clippings from twenty individuals were collected from fifteen populations in the four geographic clusters it occurs: Siskiyou, Klamath, northern Sierra Nevada, and Mendocino. Twelve microsatellite loci will then be used to determine genetic variation within and between the population clusters. Significant inter-cluster genotypic differences would be important in indicating which population clusters need increased conservation efforts as compared to other population regions. With the risk of significant loss of habitat due to climate change and other factors, these genetic data are vital to the conservation of this rare and unique species.

ANSWER TO MYSTERY PLANT

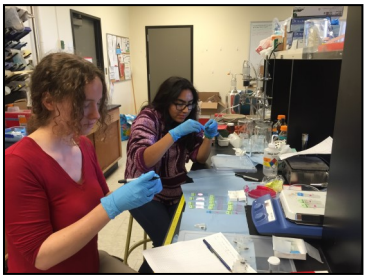
Answer: *Gentiana newberryi* A. Gray var. *tiogana* (A. Heller) J. S. Pringle (Gentianaceae)

A paler version of the alpine gentian from south of the Cascades. Photo by Robert Fischer.

2017-2018 Student Research Scholarship Awards (Cont.)

Maureen Page is a Ph.D. student at the University of California, Davis.

The title of her research is **"Impacts of honey bee abundance on the pollination of native plants."**



Many studies support the claim that introduced honey bees compete with native pollinators. However, little is known about how honey bee introductions will affect native plant communities and plant species' persistence. Recent network analyses have suggested that introduced pollinators can affect native plant community dynamics through increasing connectance and decreasing modularity in pollination networks. However, it is difficult to infer how changes in connectance and network modularity will affect plant reproduction. To bridge this gap, I integrate network approaches with more traditional methods for measuring pollination function to investigate how honey bee abundance alters pollen transport networks as well as the pollination and reproduction of California native plants.

I conducted this work in the California Central Valley at 5 replicated study sites. I collected pollinators and surveyed visitation patterns over four sample rounds from late April – late June. In the lab, I counted and identified pollen grains carried on insect bodies. I also measured daily pollen removal, stigmatic pollen deposition, and seed set for *Eschscholzia californica*. While I am still processing specimens and data, preliminary analyses suggest that there was a slightly negative, though not statistically significant ($p=0.08$) affect of honey bee abundance on *Eschscholzia californica* seed set.

Later this year, I will use insect pollen loads and visitation frequencies to construct pollen transport networks. I will use these networks to select multiple target plant taxa whose interactions with pollinators vary widely across the gradient of honey bee abundance. Next year, in addition to repeating pollinator sampling and seed collection protocols, I will quantify single-visit pollen removal and stigmatic pollen deposition by different pollinator taxa to these target plants.

Prahlada Papper is a Ph.D. student at the University of California, Berkeley.

The title of his research is **"Ecological and phylogenetic relationships of *Quercus garryana* var. *breweri* in the context of the Western white oak clade."**

Brewer's oak (*Quercus garryana* var. *breweri*) is a deciduous shrub form of the more well-known and widespread Oregon white oak tree (*Quercus garryana* var. *garryana*). The large geographic range of Brewer's oak, from the Klamath-Siskiyou south to the Tehachapis, obscures a surprisingly limited ecological range. The species is found mostly in sites with relatively poor soil and only within a narrow mid-elevation montane band. Studies of other oaks in California have generally found that they harbor exceptionally high diversity within local populations, reflected both in molecular genetic diversity and functional or morphological diversity. High diversity can help to buffer oak populations against environmental fluctuations, including the historic variability common in California as well as directional variation now resulting from ongoing climate change.

As part of my broader dissertation involving California white oaks, my Brewer's oak research funded by the Northern California Botanists will characterize within and among population diversity in Brewer's oak compared to the closely related trees *Q. garryana* var. *garryana* and *Q. douglasii* as well as the scrub oaks *Q. john-tuckeri* and *Q. berberidifolia*. In the field, variation in leaf-out and flowering time will be surveyed throughout the spring as a measure of phenological (functional) diversity, while leaves will be scanned to capture morphological diversity. Targeted sequencing will directly characterize genetic diversity and also allow comparisons to the functional and morphological diversity. Preliminary field observation together with its relatively narrow environmental tolerance suggest that Brewer's oak harbors less diversity than other California oaks. If this proves to be the case, then conservation efforts should be focused on preserving populations of this little-appreciated endemic oak.

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