NEW HERBARIUM ON-LINE RESOURCES

We have two virtual herbaria on our website at herbarium.ucdavis.edu. They are both accessed from our homepage by clicking on the “taxonomic resources/virtual herbaria” tab at the top of the page.

One virtual herbarium is for Euphorbiaceae specimens, part of our National Science Foundation grant focusing on the research of Dr. Grady Webster.

The second is a virtual herbarium with images of specimens from Stebbins Cold Canyon, McLaughlin and Quail Ridge Reserves, funded by the UC Natural Reserve System. It is a great resource for identifying the plants of the Inner North Coast Ranges west of Davis. We are still working to make the page more user-friendly. In the mean time, try using it!
JUNE’S AND LOU’S GREEK BOTANY ADVENTURE

Somewhat ruefully, botanists “joke” about the similarity between “geologic time” and “herbarium time.” Due to insufficient curation funding, the number of years between the date when a plant is collected (and pressed) and the date when it is finally labeled and mounted can be decades, sometimes more than a hundred years. The average time between when a new species is deposited in a herbarium and when it is described as a new species is 50 years. In the spirit of “herbarium time,” on Wednesday, January 21, 2015, our herbarium tea will honor work done by June McCaskill and Louis Grivetti thirty years ago — work that generated specimens that are only now being curated.

In 1985, Louis Grivetti, then a professor of nutrition with a strong interest in exotic foods, invited June McCaskill, Curator of the Botany Department herbarium, to join him on a plant collecting trip to Greece. June told me that she said “You have the wrong person, Lou. I don’t know anything about Greek plants.” However Lou was persistent and insisted that June was the only botanist whom he would consider. “I told her that she would know many of the plants,” Lou told me recently. And as soon as she arrived in Greece, June saw that Lou was right – she did know many of the genera, if not the species, because many Mediterranean-region plants have been introduced into California, and they now grow spontaneously in disturbed areas along roadsides. Since June was so skilled at identifying California plants, she had no problem helping Lou identify the plants of Greece.

Lou had received funding to lead two volunteer research teams on a plant-collecting expedition that would retrace the path of the Greek king, Theseus. Their trip took them from Athens to Corinth and back, a route that they called “in the footsteps of Theseus.”

CONSERVATORY MAKES PROGRESS ON THE BOG

In the Summer 2013 issue of Lasthenia, the Conservatory published a Wish List of items needing funding. One item on the list was money for supplies to create the Biological Orchard and Gardens (BOG) near the Mann Laboratory and close to the Conservatory. In response, the Conservatory received a $20,000 donation that has helped the BOG move toward reality by augmenting $10,000 of funding that had been assembled from various sources: BIS 2B funds ($6,000), Dining Services Go Green Grant ($2,500), The California Horticultural Society ($1,500), and a variety of other donations.

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The half-acre plot of water-conserving gardens (including rainwater catchment features) will be used by a variety of UC Davis classes, the Conservatory’s burgeoning internship program, and students interested in edible landscapes (as a result of a small orchard planned for the site).

Ernesto Sandoval and Kelly Torres from The Information Center for the Environment have partnered to coordinate this ambitious project. Funds received so far have allowed for the installation of needed night lighting, the addition of non-compactible soil amendment to mitigate the future uses of the site, and the installation of the main manifold of the irrigation system. Ernesto has also spent many hours shaping the site’s topography with a tractor. Other grant applications are in progress. This winter the remaining portions of the irrigation will be installed; planting should occur in 2015.

Everyone keeps asking when the planting will occur, and Ernesto must keep reminding curious minds that planting is but the last 10% of a successful garden here in California’s Central Valley! The other 90% is soil preparation and proper irrigation. Soil preparation in this case involves inorganic lava fines amendment to improve drainage and minimize soil compaction. This allows for a greater diversity of plants to be grown together. By laying the groundwork so carefully, the final drought-tolerant landscape should thrive long into the future.

We will keep you posted on this ambitious project!

E. Sandoval & K. Mawdsley

ERNESTO’S CONSERVATORY PHOTO UPDATE!

Amborella trichopoda, a member of the earliest lineage of flowering plants, is back at the Conservatory. Its preferred habitat is in the “cool” semi-temperate room.

Summer intern Linnea Whitney completed a cactus grafting project with the species Epithelantha micromeris (above) and she grafted five more cacti onto a previous intern grafting project. The final cactus “tree” has 10 cacti grafted together. What will the future bring?

The conservatory’s Plant Lady, Marlene Simon, tries to warm up at the fall plant sale on October 23.

Visiting scholars in the Japanese Agricultural Training Program visit the Conservatory.

Extending the Conservatory’s collections to the planting beds adjacent to Storer Hall has had multiple benefits. Pictured above are the first-ever fruits from accession number B69.063, Acacia hindsii, collected by Bryce Christman in 1969 on a collecting trip to Mexico with Grady Webster.
K. Mawdsley
JUNE’S AND LOU’S GREEK ADVENTURE (CONT. FROM PAGE 1)

Curated specimen of Heliotropium hirsutissimum collected by June and Lou in 1985. Specimen scan by A. Ayalon.

The aim of the project was to investigate what plants grew at the following archeological sites: Athens (Marathon, Agora, Acropolis), Troezen (Byzantine Church), Nauplion (Xenia's Palace, Palamedes Fortress), Heraeon (Cistern), Epidaurus (Theatre site, Athlete's guest house), Tyrins (Palace area), Mycenae (Lion's gate, Royal Grave Circle, Palace area), Corinth Canal (Poseidon's Temple), Dolkos (Taverna), Ancient Corinth (Temple of Apollo, Theatre), Sikion (Theatre), Kenchereon, Isthmia (Stadium, Temple of Poseidon, Theatre), and Eleusis (Cave, Telesterion). With the help of their volunteers, June and Lou collected close to 2,000 specimens, half of which were left at their collaborating institution, the Goulandris Museum in Kifassia.

Fast forward to 2013, and these valuable specimens, which record the flora of important Greek archeological sites, were still sitting in Greek newspapers awaiting curation. Lou decided that it was time to get things rolling and provided a generous gift to the herbarium to hire curatorial help to label and mount the collection. Allyson Ayalon, UC Davis alumna and herbarium intern from 2011 to 2012, was available, and she was hired to work with Lou to label the specimens, which are now being mounted.

Allyson, who is now a graduate student with Dr. Dan Potter, our herbarium director, is completing a Master's degree that focuses on museum and botanical garden curation. She is working with both the Center for Plant Diversity and the Arboretum to further her already considerable curatorial skills. As part of this, she is developing outreach materials that interpret Lou's and June's Greek specimens. This Greek specimen exhibit will be shown to visitors at our herbarium tea in January, as well as at Picnic Day, Biodiversity Museum Day and at the American Public Gardens Association meeting in Washington, D.C.

A big thank you to Lou and Allyson for helping this project move forward, even if it was in “herbarium time!”

E. Dean

OUR SUMMER INTERN FROM THE EAST

The Center for Plant Diversity has had hundreds of interns and student employees. Usually interns come in to the herbarium three to six hours per week. Therefore, it was a wonderful surprise when a junior at Connecticut College emailed me last spring to ask about the possibility of interning FULL TIME for eight weeks in the summer.

Victoria Stewart (Tori) arrived mid-June and worked nearly full-time, paid by her college's internship program. Although she did not have a lot of plant identification experience, she was game for field work up in the Tahoe Basin (see accompanying article) and anything else that we needed done. She went through our usual intern training, along with several other students, learning about plant name synonyms, type specimens, specimen preparation, label-making, filing, and plant identification/synonymy resources. Tori also had high-level GIS skills and taught me all sorts of new tricks about how to use ArcGIS and ArcMap.

By the end of the summer, Tori had prepared all the rare plant maps for both Washoe Meadows State Park and Sugar Pine Point State Park, helped us finish a number of curatorial projects, learned how to georeference specimens, and made most of my specimen labels for the summer's field work. She made me realize how much we can accomplish when we have full-time, rather than part-time, help. It was a wonderful, productive summer.

E. Dean
This past summer, I spent a lot of time near Lake Tahoe. The Center for Plant Diversity was fortunate to receive two contracts from California State Parks to do surveys at Washoe Meadows and Sugar Pine Point State Parks. The contract at Washoe Meadows concentrated on the distribution and abundance of a number of rare plants that occur in the park. The Sugar Pine Point contract was a survey of the flora and rare plant occurrences in wetland areas, including General Creek and Lily Pond. We have traveled to Sugar Pine Point to collect plants a number of times over the past few years, starting in the summer of 2011 and concluding with six days this past summer between June and August. We began studying the flora of Washoe Meadows State Park in 2007, and we completed the contract work this past summer during nine days of field work between May and August.

I involved a number of UC Davis students in the two projects, mostly undergraduates, but two graduate students also helped. Undergraduate Plant Sciences major Ninh Khuu wins the award for most field excursions to both Washoe Meadows and Sugar Pine Point, but other UC Davis undergraduates who participated were Kelsey Craig, Kasia Izdebska, Hanning Lin, and Wendy Camacho. Incoming Master’s graduate student Allyson Ayalon and current PhD candidate Sarah Doehle both assisted as well.

A number of volunteers came on an early moss field trip to Washoe Meadows. Stephen Rae, Deborah and Shad Canington, Lori Allessio and Cheryl Beyer all helped me find and map rare mosses at the beginning of June; once educated, I could continue to map them on my own during the rest of the summer. Colombe Tresan and Kate Mawdsley also came on one trip each. I am very grateful for the assistance these people provided.

Washoe Meadows State Park is a little-known State Parks property near the town of Meyers (see also *Lasthenia* Fall 2007, which is available on the herbarium website (http://herbarium.ucdavis.edu)). Habitats at Washoe include fens, wet to dry meadows, wet to dry forest, riparian scrub, and vernal pools. For the size of the property (600 acres), Washoe is extremely diverse and has a number of interesting rare mosses and vascular plants. It also has a somewhat unusual occurrence of sand lily (*Leucocrinum montanum*) which mostly grows in northeastern California in Lassen and Modoc counties. This species does occur even further south in Mono County, and there are some occurrences between northeastern California and the Tahoe Basin. Still, when one finds these isolated populations of interesting species, it makes one wonder how they got there and why they have persisted in a particular place.

Sugar Pine Point State Park, located near the town of Tahoma, is well-known to tourists who have camped in one of its many campgrounds or swam at the park’s beach on Lake Tahoe. It is also known for its dirt-bike trails. Fewer people have walked the entire length of its major drainage, General Creek, which starts at the park’s westernmost end and flows all the way to Lake Tahoe. General Creek is an alder-lined drainage that can widen into large expanses of gravel and then narrow to a deep channel with no bank. Traversing this drainage required scaling large piles of downed logs and wading through dense thickets of alder. There were some lovely surprises, a county species record, as well as rare mosses and vascular plants, and I really enjoyed the challenges of the work. We are grateful to State Parks for providing this funding which pays for basic herbarium needs.

Ellen Dean (right) with undergraduate Kasia Izdebska along Angora Creek in Washoe Meadows State Park. Photo: V. Stewart

Undergraduates Ninh Khuu and Wendy Camacho collect a sedge at Washoe Meadows. Photo: E. Dean

I involved a number of UC Davis students in the two projects, mostly undergraduates, but two graduate students also helped. Undergraduate Plant Sciences major Ninh Khuu wins the
UNTANGLING THE ORIGINS OF INVASIVE PLANTS

Biological invasions of nonnative plants have caused environmental and economic losses in both natural and managed ecosystems. Human activities often promote invasions by dispersing species outside their native ranges. In California, the majority of intentionally introduced invasive plants are derived from ornamentals sold by the horticultural trade.

Invasive populations of horticultural species often have complex origins as a result of multiple introductions of genotypes and interspecific and intraspecific hybridizations in introduced ranges. Molecular tools (such as DNA sequencing) are used to assess the origins and introduction histories of invasives and determine whether invasive populations originate from single or multiple cultivated sources. These tools can also identify the cultivated sources (e.g., cultivars) from which invasive populations originated, reveal routes of invasive spread, indicate whether invasive plants are suitable for biological control, and point to geographical locations where searches for potential biocontrol agents might begin. In my lab, we use a diversity of tools to address these questions in some of the most aggressive invasive plants in California. Here are some examples.

Invasive French broom: The Cytisus–Genista broom complex includes several invasive species introduced as ornamental shrubs. “French broom” was introduced as an ornamental into the San Francisco Bay area in the mid-1800s but is now listed as a noxious weed and is no longer available commercially. However, “sweet broom” is presumed to be noninvasive and is sold by nurseries and nursery outlets. French broom is hypothesized to be either Genista monspessulana or a hybrid, potentially between G. stenopetala and G. canariensis. Ornamental sweet broom is currently sold under a variety of names, including Cytisus spachianus, Teline stenopetala ssp. spachiana, C. racemosus ‘Nana’, C. praecox ‘Nana’ and G. racemosa. Morphologically, sweet broom and French broom look very similar. A major difference is that sweet broom flowers are in racemes whereas French broom flowers are arranged in head-like clusters, although intermediates are seen.

Ph.D. student (and past Davis Botanical Society board member) Annabelle Kleist set out to determine the identities and origins of invasive French broom populations in California; she also assessed whether hybridization with sweet broom species is occurring. To determine this, Annabelle sampled leaves of 703 invasive French broom plants from 29 populations throughout California, 282 G. monspessulana plants from the native Mediterranean range of Europe, 14 ornamental sweet broom plants, and 12 plants of named Genista species from the monspessulana clade. Then she extracted DNA from the leaves of each plant and used microsatellite markers and sequence data from chloroplast and nuclear regions to characterize the genetic diversity and signatures of the sampled plants.

Annabelle’s results showed that the origins and identities of invasive French broom populations in California are complex, consisting of multiple closely-related species that have been sold as ornamental plants throughout the state, often under incorrect species names. Invasive “French broom” populations in California are comprised of (1) Genista monspessulana, (2) an unidentified species closely related to G. canariensis, G. stenopetala, and the ornamental sweet brooms, and (3) hybrids between these two groups. Although her research could not determine with certainty whether a currently marketed but unsampled, or previously marketed, sweet broom species contributes to invasive populations, it did suggest that sweet broom should be removed from the marketplace. She also found that the multiple origins, high genetic variation, and hybridization within invasive broom populations predicts that host-specific and damaging natural enemies are unlikely to be identified in the native range. Thus, biological control may have limited success against invasive French broom in California.

Invasive pampas and jubata grasses: Pampas grass (Cortaderia selloana) is a popular ornamental grass used for landscaping. In California the species has escaped cultivation and become invasive. Native to non-mountainous regions of Argentina, Brazil, and Uruguay, it was first introduced into Europe as a horticultural plant in the early 1800s and into California from Europe around 1848. In California, pampas grass was grown commercially for its plumes used in dried flower arrangements until the end of the century. It then came to be cultivated as a landscape ornamental. For a brief period from the mid-1940s through the 1950s, pampas grass was planted for erosion control and forage trials. Based on an analysis of herbarium specimens, the first record of its naturalization in California was 1929. Rapid spread of invasive populations began in the 1950s and continues today.

To gain insight into the horticultural origins and sources of invasive pampas grass in California, postdoctoral research associate Miki Okada and several graduate and undergraduate students travelled across the state and obtained leaf samples from 698 invasive individuals from 33 populations in four geographical regions. They also sampled cultivated plants from California landscape plantings and botanical gardens, all cultivars and selections sold by California nurseries and nursery outlets, all available cultivars and selections from retail vendors in other states, botanical gardens in Europe, and an agricultural research farm in New Zealand. DNA was extracted from the leaf tissue and all plants were genotyped at multiple microsatellite marker loci. Miki then analyzed the pattern of genetic variation across the invaded range of California and tested three alternative hypotheses of escape from cultivation and invasive spread: (1) escape of a single cultivated source at a single location, (2) escape at multiple locations of a single cultivated source, and (3) escape at multiple locations of multiple cultivated sources. The spatial patterning of genetic variation across California indicated that dispersal through landscape plantings has contributed to the invasive spread of pampas grass in California, and that multiple cultivars and selections are contributing to the invasion. Eradication of ornamental pampas grass landscape plantings may be highly effective in controlling existing invasive populations within a reasonable timeframe and prevent further invasion.

Invasive jubata grass (Cortaderia jubata) is closely related to pampas grass, and the two are often confused. How-
ever, jubata grass and pampas grass are quite different biologically. Jubata grass is an asexual apomictic grass, whereas pampas grass reproduces sexually. Jubata grass is native to the Andes Mountains of northern Argentina, Bolivia, Ecuador and Peru. Since its introduction into California, jubata grass has displaced native species and altered natural habitats all along the Pacific coast, where it often forms huge monocultures of plants.

Jubata grass is not currently sold as a horticultural ornamental in California, but early botanical records indicate that the species was once cultivated in Europe and the United States. These early horticultural writings state that jubata grass seed collected in the province of Chimborazo, Ecuador was first brought into cultivation by a nursery in Nancy, France, and thought to have been introduced into California and elsewhere from Europe, possibly as a misidentified variant of pampas grass with pinkish plumes. To shed light on the invasion history and origins of jubata grass in California, we compared the genotypic and clonal variation of jubata grass from the invaded regions of California, Maui, and New Zealand with that from plants of the native range, including the province of Chimborazo in native Ecuador where horticultural material is believed to have originated. We found that invasive jubata grass in California, Maui, and New Zealand consisted of the same single clone that probably originated from a single clone that was introduced into all these areas. Moreover, the invasive clone matched the clone most commonly identified in herbarium specimens from southern Ecuador where the plant material brought into horticulture is believed to have originated. Based on the results of our study, it appears that biological control efforts may be effective in managing invasive jubata grass since invasive populations consist of a single clone and thus there is little variation for resistance to herbicides and pathogens among plants. Moreover, our analyses point to the probable geographical source of invasive jubata grass, which substantially narrows the regions to be searched for a potential biological control agent.

M. Jasieniuk

Our new Davis Botanical Society board president is Dr. Brenda Grewell, a UC Davis PhD and currently a Research Ecologist and Lead Scientist with the USDA Agricultural Research Service’s Exotic and Invasive Weeds Research Unit. She is a faculty affiliate in the UC Davis Department of Plant Sciences, where she is a member of the Weed Science group. Her specialties are plant ecology, wetland ecology, aquatic botany and invasive aquatic plants.

Brenda was drawn to wetlands at an early age, when she often went canoe camping with her family in Ohio. During her early undergraduate years Brenda fully intended to pursue a career in ornithology. During a summer internship observing nesting behavior of Common Loons in lakes of northern Minnesota, she noticed that certain plants grew in some lakes but not in others. Her curiosity regarding the ecology and environmental tolerances of wetland plants became a passion. To this day Brenda can most often be found in her preferred habitat at the water’s edge. Her research includes studies of the ecology of plants in riverine wetlands, shallow lakes and salt marshes.

Her current research focuses on the water primroses (genus *Ludwigia* in the family Onagraceae). She contributed the taxonomic treatment for the genus for the second edition of the Jepson Manual, 2012, and she is currently completing one for the Oregon Flora Project. Her taxonomic and ecological study of water primroses takes her to wetlands throughout the Pacific western states, as well as Florida, Uruguay, Argentina, and France. To facilitate the taxonomic research, Brenda became a Research Associate of the Center for Plant Diversity Herbarium. Brenda has a long association with UC Davis and with the Davis Botanical Society; she and her husband Steve Kidner are currently Life Members of the society as well as annual donors to our herbarium endowment and student grants program.

Brenda received her PhD from the Graduate Group in Ecology in 2004 working with wetland ecologist Eliška Rejmánkova. Her dissertation research focused on the effect of parasitic interactions on species diversity in northern California salt marshes. In 2003 she had a Fulbright fellowship in Botany to study *Lythrum salicaria* (purple loosestrife) in the Czech Republic.

Her dissertation was an outgrowth of her long-time interest in the Federally-endangered plant *Chloropyron molle* ssp. *mole* (soft bird’s beak in the family Orobanchaceae, previously in the genus *Convolvulus*). This interesting hemiparasite is endemic to tidal wetlands of the Suisun and North Bay in the San Francisco Estuary, and Brenda has surveyed for the plant and conducted ecological studies over many years. She contributed information on the plant’s habitat needs to the U.S. Fish and Wildlife Service and was involved in the listing of soft bird’s beak in 1997. Most recently, Brenda has developed management methods for invasive *Lepidium latifolium* (perennial pepperweed) in sensitive tidal wetlands for recovery of soft bird’s beak.

Brenda also conducts research on invasive *Spartina* species (cordgrasses), restoration of *Spartina*-invaded wetlands, and the effect of rising sea level on cordgrasses in Pacific coastal wetlands and in Spain with collaborator Jesús Castillo.

Prior to her PhD research Brenda had a long career as a botanist/ecologist with the California Department of Water Resources, where she worked extensively on plant community responses to changing salinity regimes and other Bay-Delta issues, especially in Suisun Marsh in Solano County. She contributed a chapter on the vegetation of Suisun Marsh in *Suisun Marsh: Ecological History and Possible Futures* (Peter Moyle et al., editors) published this year by UC Press.

We are very fortunate that Brenda has stepped forward to lead the Davis Botanical Society this year. She would like to increase the membership of the society and plans a membership drive. So if you are not yet a member, don’t be surprised if she comes knocking on your door!

K Mawdsley and B. Grewell