

Hidden Treasures

Flattened flora help solve mysteries large and small

Dead, dried, pressed and mounted, the 300,000 plant specimens inside the UC Davis Center for Plant Diversity lack a certain, shall we say, panache.

They don't wave in the breeze like the plants in the Arboretum, inviting visitors to admire their fragrance and grace. They don't provide living tissue from which new plants can be grown. But the specimens stored in this clean, well-lighted herbarium inside the Sciences Laboratory Building are a treasure for scientists, students, farmers, gardeners and wild-flower enthusiasts alike.

Why? Here's a short list of the solutions the specimens (and the people who care for them) provide:

They help poison-control centers save the lives of curious plant-eating toddlers.

They help farmers identify what weeds look like in their seedling and flowering stages, the better to catch them before they take over their fields.

They help researchers document and classify endangered and extinct species, which aids everyone from gardeners to ecologists to better protect the planet.

And that's just the beginning. Thanks to recent advances in DNA technology, scientists can extract and sequence DNA from herbarium specimens – some of them up to 100 years old – and trace a plant's lineage,



Laura Vann is dwarfed by a beloved Joshua.

for example, and learn any number of things about its relationship to other plant groups. The vast majority of the specimens come with notes on where and when it was collected, what type of habitat it was found in, what other plants surrounded it, etc., so scientists can analyze not just the plant but the environment and ecosystem in which it lived.

And how's this for advancing technology? Scientists can even extract DNA from pathogens that once grew on the dead plant. A recent study on plant virus ecology published in the *Journal of Ecology* was based, in part, on DNA extracted from a virus on a leaf of a California native grass specimen collected in 1917 obtained from the Center for Plant Diversity. It was the oldest-ever virus recovered from a plant.

"This study demonstrates that it is possible to develop a historical understanding of plant virus ecology in nature," wrote Carolyn Malmstrom, plant biologist from Michigan State who headed the research published in 2007. "Such work will allow us to examine how plant communities respond to shifts in

virus pressures that arise from environmental changes, invasions or human activities.”

Where are all the Joshua trees?

Laura Vann, a graduate student working with Assistant Professor Jeffery Ross-Ibarra, is passionate about the Joshua tree (*Yucca brevifolia*). She, like so many others, is troubled that this iconic species is disappearing from southern locations, including Joshua Tree National Park.

“Its distribution is moving north and upward in elevation due to global warming and overall reduction of habitable land,” Vann says from her lab in Robbins Hall. “Recruitment and survival of seedlings has been observed to be zero percent, so the outlook for Joshua tree survival does not look good.”

Vann, with assistance from the Center for Plant Diversity, is trying to alter that trend. She has conducted several scouting expeditions to learn more about the dwindling number of Joshua trees. But the dead specimens, with their historical data, is invaluable, as well.

“I use the herbarium’s *Yucca brevifolia* specimens and descriptions of their locale to assess changes in things like population density, evidence of flowering/fruitletting, etc.,” she explains. “I’m also able to use tissue from specimens for DNA extraction and sequencing that will be helpful in exploring genetic variation and demographic history of the

The folders at the Center for Plant Diversity are placed within metal cases (above) and arranged alphabetically by scientific name.



species.”

And why does that matter?

“One of the main questions I hope to answer is whether there are any genetic differences between varieties of Joshua tree (*jaegeriana* and *brevifolia*),” Vann says. “Varietal distinction is currently based only on differences in morphology and distribution within the species range, but lacks any genetic basis. I’m also interested in understanding diversity and patterns of gene flow between populations from a conservation genetics point of view. I think having an idea of which populations harbor the most diversity will be helpful in planning future conservation efforts. Understanding relationships between proposed varieties will also be essential - Are they really genetically distinct and are we attempting to conserve one or two things?”

Vann’s research will no doubt advance *Yucca brevifolia* restoration work already under way at Joshua Tree National Park and beyond.

“I understand they’re hoping to incorporate

genetics into restoring and conserving, so I really hope that my research will be helpful,” Vann says. “I’m not sure people realize the full consequences of climate change. Joshua trees are such amazing and iconic plants, and the thought of them not being in places such as the National Park breaks my heart.”

Climate change and plant species distribution is also central to a project Assistant Professor Andrew Latimer has launched. He, too, will turn to the Center for Plant Diversity for help.

“The herbarium has some particular strengths that make it unique,” Latimer explains. “It has extensive collections from the northern Coast Range, which is projected to be one of the central refugia for California plant species as the climate warms. Also, its history of association with agricultural research has given it the strongest collection of weed species of any herbarium in the state. This information should help us better understand where and when these species were introduced, and how they spread.”

Save it and they will come

The Center for Plant Diversity exists because a long line of scientists and staff took the time and effort to properly save their specimens. And what an amazing array of specimens! Labeled and stored in phylogenetic order in metal cases, the center holds algae, lichens, bryophytes, ferns, gymnosperms, and angiosperms from all over the world. The herbarium is known for its collections of California weeds, vernal pool plants and

grasses. And thanks to the research interest of two of its past directors, the center also holds world-class collections of *Quercus* (Oaks) and *Euphorbiaceae* (the spurge family).

The herbarium began as a small collection of weeds and poisonous plants on what was then the University Farm in 1922, the year W.W. Robbins founded the botany department. Renowned botanist Katherine Esau was hired to teach plant taxonomy in 1928 and added native plants from the Sacramento Valley and nearby coastal ranges to the collection. The first true steward of the herbarium was the late John M. Tucker, a specialist in oak trees who essentially directed the herbarium as a volunteer from 1949 to 1986 in addition to his duties as a botany professor. Tucker conducted his first research in the 1940s while a student at UC Berkeley. He inherited a collection of about 9,400 specimens in wooden cases and during his tenure built the herbarium through exchange programs, creating what is considered one of the world’s largest collections of New World oaks.

In the early years, Tucker was a one-man show. In 1953, a young Mills College graduate, June McCaskill, was hired to assist him. McCaskill built a reputation over her next 38 years of service as an expert on weeds and poisonous plants and was a co-author of the *Growers Weed Identification Handbook*.

In the early 1970s, McCaskill was credited with helping solve the Juan Corona mass-murder case in Yuba County. By studying the different weeds in the grave of 25 slain farmworkers, she determined the order



in which they had been buried. (Detectives still come to call at the herbarium, bringing plant samples from crime scenes they hope will help solve their case.) McCaskill passed away in May of 2001.

Tucker died July 8, 2008, at the age of 92. He stayed active in the herbarium, as well as the UC Davis Arboretum which he also directed, until shortly before his death.

When Tucker officially retired in 1986 he was replaced by Grady Webster, who had been a taxonomist in charge of the herbarium since 1967. Webster was a specialist in the *Euphorbiaceae* and his and his students' collections dramatically increased the numbers of herbarium specimens. Webster technically retired in 1993, but he spent most of his emeritus days in the corner of the herbarium, cataloging his life's work, including the flora of Ecuador's Maquipucuna region.

Between 1999 and 2000, the UC Davis Environmental Horticulture Herbarium was curated and incorporated into the herbarium, adding thousands of California garden plants. In 2001, the UC Davis Viticulture Herbarium was saved from disintegration and added to the collection, documenting what grape cultivars have been grown in California since 1885.

The herbarium also includes the former Beecher Crampton Herbarium Collection which was started in 1913 on the Berkeley campus by Patrick B. Kennedy, a teacher in range science and a specialist in the clover genus *Trifolium*.

Under the radar

Until 2005, the herbarium's 300,000 specimens

Gathering specimens at Bear Creek Ranch in Colusa County is rewarding for Ellen Dean and volunteers Kate Mawdsley and Gordon Harrington.



Dean gathers specimens at Donner State Park with Mark Bibbo and Michael Bower.

were tucked away in Robbins Hall, many in cardboard boxes, kept viable by dedicated staff, faculty and volunteers. When the herbarium moved to its spacious, climate-controlled rooms in the Science Laboratory Building in 2005, its name was changed to the Center for Plant Diversity. Curator Ellen Dean, Collection Manager Jean Shepard, students and volunteers completed the heroic effort of making sure all 300,000 specimens were catalogued and preserved while still helping identify hundreds of envelopes, boxes and cartons of plants that cross their desks from people all over the state. Professor Dan Potter became the current Director in 2006.

Joe DiTomaso, specialist in Cooperative Extension and director of the Weed Research and Information Center, says the herbarium is a tremendous resource. DiTomaso co-authored *Weeds of California* and *Aquatic Weeds of the West* with Evelyn Healy and says they couldn't have written it without Ellen Dean and the herbarium.

“And Ellen provides numerous plant identifications from around the state on new or expanding weed species that help Farm Advisors and Specialists develop effective management programs,” DiTomaso says.

Ellen appreciates the praise but knows that – even while the center's accommodations have come up in the world - it still stays somewhat under the radar.

“It's hard for people to get too excited about squashed dead plants,” she says, replacing a specimen in a folder in a metal case in the stacks. “But that's OK. The herbarium is the hub in the wheel of everything going on in plant sciences at UC Davis.”