



California
Native
Grasslands
Association

GRASSLANDS

Published quarterly by the California Native Grasslands Association

Vol. 32, No. 4 Fall 2022





Mission Statement

The mission of the California Native Grasslands Association is to promote, preserve, and restore the diversity of California's native grasses and grassland ecosystems through education, advocacy, research, and stewardship.

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Grasslands is published quarterly by CNGA.

©2022 CNGA ISSN No. 1540-6857

Layout design: Julie St. John

From the President's Keyboard

Dear members, sponsors, and donors,

As I was visiting family in the southwest of France in October — enjoying the local native ecosystems with few non-native species invasions, and large areas protected as county, state, or national parks — I was reminded of how much work there is still yet to do in California to protect our existing grassland ecosystems and to restore or implement new ones.

CNGA is dedicated to advocating for the state's grasslands ecosystems and open spaces and your contribution is greatly appreciated, whether by being a donor, a sponsor, or a member. Thank you.

Please join or renew for next year, upgrade your membership if you can, and think about making a tax-deductible donation before the end of the year. Your participation will also help us with offering new and more workshops that are so important for educating members of the public about the importance of restoring and protecting our fragile yet crucial and necessary wildlife habitat, including habitat for pollinators and birds that are in decline.

Lastly, although I have previously indicated that I would not run for President again, the board of directors felt like I was the best candidate for the position, and so I will be running again for President next year. I want to assure you that I will keep working on promoting CNGA throughout our beautiful state of California.

Thank you for your support,

JP Marié, Board President



CNGA 2022 Board of Directors Elections Online Voting Open from December 1–20

Members — Your Vote Counts!

On December 1, we will send out an email announcement to all members with links to the candidate statements and directions on how to access to your ballot.

Consider Donating your Time and Expertise by joining the CNGA Board of Directors

For more information, visit us online at cnga.org, contact us at admin@cnga.org, by phone at (530) 902-6009.



G.R.A.S.S. Grassland Research Awards for Student Scholarship
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STUDENTS! Call for Applications:

Submit your application now through January 31, 2023: <https://cnga.org/GRASSgrants>

CNGA is again offering competitive research funds to promote undergraduate and graduate student research focused on understanding, preserving, and restoring California's native grassland ecosystems in accordance with the CNGA Mission and Goals.

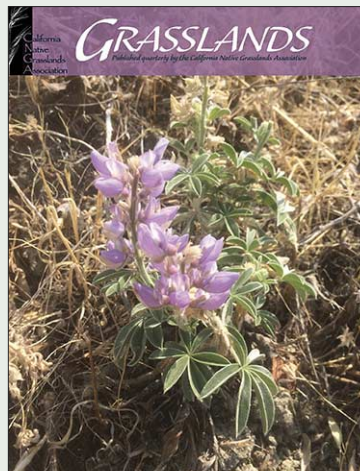
Eligibility: Students from an accredited college or university doing research within California may apply (home institution may be outside California).

Awards: CNGA will fund four or more \$500 awards per year. These awards are designed to support basic undergraduate and graduate research in native grassland ecosystems. Funds can be used for fieldwork, small equipment purchases, visits to herbaria, materials and/or books. Students may re-apply and receive a scholarship award for a maximum of two years.

Grasslands Submission Guidelines

Send written submissions, as email attachments, to grasslands@cnga.org. All submissions are reviewed by the Grasslands Editorial Committee for suitability for publication. Written submissions include peer-reviewed research reports and non-refereed articles, such as progress reports, observations, field notes, interviews, book reviews, and opinions.

Also considered for publication are high-resolution color photographs. For each issue, the Editorial Committee votes on photos that will be featured on our full-color covers. Send photo submissions (at least 300 dpi resolution), as email attachments, to the Editor at grasslands@cnga.org. Include a caption and credited photographer's name.



Submission deadlines for articles:

- * **Spring 2023:** 15 Feb 2023
- * **Summer 2023:** 15 May 2023
- * **Fall 2023:** 15 Aug 2023
- * **Winter 2023:** 15 Nov 2023

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CNGA Events

SAVE THE DATE!

CNGA's 15th Annual Field Day at Hedgerow Farms March 31, 2023

After two years of virtual Field Days, we will meet again in person at Hedgerow Farms in Winters for a day of hay ride tours through the beautiful fields, presentations, food and fun!

Registration will open in early 2023.

For updates and event information, visit <https://cnga.org/Events/>

PRESENTATIONS NOW AVAILABLE:

Grassland Research Awards for Student Scholarship (GRASS) Speaker Seminar

Recordings of our first GRASS Speaker Seminar are available for members to view online at <https://cnga.org/GRASS-Speaker-Series-2022>. Hosted by Justin Luong, CNGA Director and previous GRASS recipient, the series showcases research by some of our 2021 GRASS scholarship winners. Prepare to be impressed!

Joanna Tang, UC Santa Barbara: *Vernal Pool Restoration in South Coast Grasslands* * **Suzanne Ou**, Stanford: *Temporal Changes in Microbially-mediated Plant-soil Feedback on Californian Serpentine Annuals* * **Raphaella Floreani Buzbee**, UC Berkeley: *Compositional Shifts in Coastal Plant Communities and Microclimates in Response to Tule Elk Herbivory* * **Robert Fitch**, UCSB: *Simulated Grazing and Prescribed Fire to Control Common Weeds* * **Roisin (Rosie) Murphy-Deák**, Cal Poly, San Luis Obispo: *Fire Effects in Montane Meadows* * **Leila Wahab**, UC Merced: *Aridification of California Grasslands: Implications for Soil C, soil N, and Plant Diversity* * **Nora Bales**, Cal Poly SLO: *Abundance of a Rare Plant Increases with Biocrust Cover* * **Rebecca Nelson**, UC Davis: *The Effects of Invasion on California Grassland Plant-Pollinator Mutualisms* * **Ernesto Chavez-Velasco**, Point Blue: *Effects of Fog and Drought on Leaf Traits, Growth Rates, and Relative Plasticity of Native California Coastal Grassland Species* * **Landin Noland**, UC Davis: *Resilience of Northern California Chaparral: Will it Persist with More Frequent Fires?*



Grasslands Provide Resilience in a Changing World

Please Join Our End-of-Year Fundraiser

Purple needlegrass (*Stipa pulchra*) plants at Pepperwood Preserve in March 2015. Photo: Michelle Halbur, CNGA Board Member

The mission of the California Native Grasslands Association is to promote, preserve, and restore the diversity of California's native grasses and grassland ecosystems through education, advocacy, research, and stewardship.

YOUR DONATION MAKES A DIFFERENCE!

Our end-of-year donation drive kicks off on **Giving Tuesday**, November 29th. **We thank for your support and invite you to join us** and millions around the world in showing how together we can be a force for good on **#GivingTuesday!**

There are 3 ways to make your tax-deductible donation:

1. **Donate Online** — cnga.org/donations
2. **Donate by Mail** — send your check or credit card information to: CNGA, PO Box 485, Davis CA 95617
3. **Donate by Phone** — call us at (530) 902-6009 with your credit card number and expiration date

Any amount is welcome!

CNGA is a 501(c)(3) non-profit organization. Dues and contributions are tax deductible.

MEET A GRASSLAND RESEARCHER **Robert Fitch**

Robert is a PhD candidate at the University of California Santa Barbara where he studies how to reduce the ecological impacts of fuel modification in the wildland-urban interface. He can be reached at robertfitch@ucsb.edu.

What is your study system?

Throughout my career, I have found myself focused on grassy ecosystems. My study locations include grasslands, oak savannahs, and fuel breaks across southern California.

What are your primary research goals?

My primary interests involve understanding how we can mitigate our ecological impacts from fire suppression activities and increase the resilience of our wildlands to anthropogenic fire. For my dissertation work, I am conducting an experiment looking at how native herbaceous species can be used in fuel breaks to meet fire management goals while supporting native ecosystem services. We measure the characteristics that make plants flammable and then try to understand how different plant communities contribute to wildfire risk across the landscape. I am passionate about wildfire ecology because we are able to take theoretical principles and apply them to solve real-world problems. Most of my projects involve asking questions about restoring degraded landscapes, creating invasion resistance, and testing the effectiveness of management actions.



Robert pauses for a photo in the Elfin Forest Preserve.

Who is your audience?

I try to reach a variety of groups with my research—state agencies, federal agencies, NGOs, and other land managers. My goal is for my research to provide a direct benefit to those implementing work across the state, from invasive species control, to restoration, to managing wildfire. Therefore, I ask scientifically rigorous questions with important applications to current ecological issues.

Who has inspired you, including your mentors?

I can easily say that my experiences in the master's program at Cal Poly Pomona started me on this journey. Erin Questad

brought me into her restoration ecology lab where my first research experience was studying the restoration success of purple needlegrass (*Stipa pulchra*). From that point forward, I was sold on terrestrial plant ecology. Throughout my current PhD program at UCSB, many people have greatly inspired me. Carla D'Antonio (my current advisor), Nicole Molinari (USFS ecologist), and numerous interactions with others (Frank Davis, Matthew Shapero, Max Moritz) have all been remarkable, and fuel my passion for science, research, and teaching.

How has or will your research align with the mission of CNGA “to promote, preserve, and restore the diversity of California’s native grasses and grassland ecosystems through education, advocacy, research, and stewardship”?

Prescribed burning is used as an eradication and restoration tool to address numerous non-native species invading California grasslands. We can increase the effectiveness of prescribed burning to promote California native grassland communities by better understanding the ecological effects of burning on native and invasive weed species dynamics. Thanks to a generous CNGA student research grant, I have been able to conduct a project examining how fuel load

interacts with prescribed fire temperature and the resulting effects on target weed species. Since then, I have been invited to present this work at the California Department of Fish and Wildlife Integrated Pest Management Seminar and the California Weed Science Society Symposium, where land managers are very excited to learn more about grassland prescribed burning. I will continue to promote this work and its large benefits to California grasslands to other agencies and the scientific community.

Why do you love grasslands?

Grasslands are my first love. My project restoring a California native bunchgrass during my master's program left a lasting

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Digitized Herbarium Specimens as keystones of Grassland Research

by Katelin D. Pearson and Jennifer M. Yost¹

Grasslands in California are critical for ecosystem functioning (Bengtsson et al. 2019) and the flourishing of plant and animal species, including around 90% of California's rare plant species (Barry, Larson, and George 2006). The botanical richness of native grasslands is stunning and urges an immediate need for conservation, so how do we know where to start? How can we understand diversity, ecology, and change in grassland ecosystems to precipitate conservation and restoration? One important botanical data source that links the past, present, and future of grassland research and conservation is often underestimated: dried, pressed herbarium specimens and the herbaria that preserve them.

Herbarium specimens form the foundation of our understanding of California's grassland flora. Thousands of botanists and naturalists have documented their botanical research by collecting voucher specimens and depositing them in universities and museums. From John and Sara Lemmon's first forays on the Central Coast in the 1870s (see CAS 123632: <https://cch2.org/portal/collections/individual/index.php?occid=2347380>) to Alice Eastwood's explorations in the late 1800s to early 1900s (see DAV321532: <https://cch2.org/portal/collections/individual/index.php?occid=1373144>), these specimens provide physical evidence of where and when plant species and their habitats have occurred for hundreds of years. These specimens not only provide vital spatiotemporal data, but also tissue for DNA sequencing (Drábková 2014), eDNA sequencing (Kreherwinkel et al. 2022), extraction of endosymbionts (Heberling and Burke 2019), and potentially even propagation from preserved seeds (Bowles et al. 1993, Wolkis et al. 2021). Furthermore, because they are physical samples of plants, the taxonomic identification of herbarium specimens can be verified, which is especially important for difficult-to-identify or frequently hybridizing taxa such as graminoids and oaks. Continued collection efforts over time enable research into how the flora is changing. Researchers have used specimens to determine how and when invasive species have been introduced (Heise and Merenlender 2002), which species have been extirpated (Williams and Crouch 2017), how species distributions have shifted with changes in climate and land use (Martin et al. 2014, Wolf et al. 2016), and how traits such as morphology (McAllister et al. 2018) and phenology (Franks et al. 2007, Pearson et al. 2021) differ

between and within species and populations over time. Each of these areas of research is important to understanding, conserving, and restoring California grasslands, and each is empowered by the spatially and temporally rich record established by specimen data.

The depth and breadth of botanical research that can be conducted is now rapidly growing thanks to increased herbarium digitization: digital cataloging and imaging of physical specimens. Digitization efforts in California have been underway since the early 2000s and have recently been accelerated by the funding of the California Phenology (CAP) Network in 2018 by the National Science Foundation's Advancing Digitization of Biodiversity Specimens program (Yost et al. 2020). This collaboration of 28 West Coast herbaria has coordinated the digitization of over 1 million herbarium specimens. As a result, these specimens' images and label data are available to the public through the California Consortium of Herbaria's "CCH2" data portal (<https://cch2.org/portal/>). The CCH2 portal includes data from over 70 collections and 4.5 million specimen

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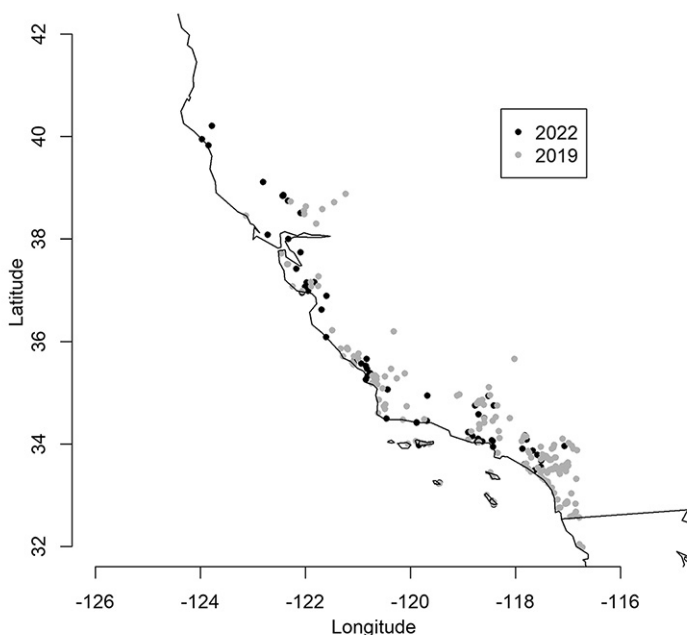


Figure 1. Locations of georeferenced purple needlegrass (*Stipa pulchra* Hitchc.) specimens from California herbaria in CCH2 (a) prior to most digitization work (queried in January 2019), and (b) after a four-year digitization effort by the CAP Network (queried in August 2022) (CCH2 Portal 2022). With increased digitization and continued collection of herbarium specimens, the documented distribution of plant species increases, and we are better able to understand changes in species over time. Specimens shown here are from 19 digitizing herbaria: BSCA, CSUSB, DAV, FSC, HSC, IRVC, LA, LOB, MACF, OBI, RSA, SBBG, SDSU, SFSU, SFV, SJSU, UCR, UCSB, UCSC.

¹California Polytechnic State University, San Luis Obispo. Katie Pearson is a botanist and project manager for the California Phenology Collections Network. She is also the project and data manager for the Symbiota Support Hub, which supports the CCH2 data portal managed by the Consortium of California Herbaria. Dr. Jenn Yost is a botanist and faculty member at Cal Poly State University in the Biology Department. She is the Lead-PI of the California Phenology Collections Network and Co-Chair of the Consortium of California Herbaria.



Figure 2. A specimen of *Stipa pulchra* Hitchc. collected in 1965 by Dieter Wilken (California State University, Los Angeles CC BY-NC). This specimen belongs to the Cal State Los Angeles Herbarium, which was 0% digitized prior to the CAP Network. This herbarium now hosts over 26,000 imaged herbarium specimen records in the CCH2 portal.

Digitized Herbarium Specimens as Keystones of Grassland Research *continued*

records, 1.7 million of which include images and 2.5 million of which include geocoordinates. Since the beginning of the CAP Network, the number of accessible specimen records from California herbaria has nearly doubled. The number of specimens labeled as occurring in “grassland” habitat has increased by upwards of 52% since 2019 for a current total of 42,202 specimens, 86% of which are georeferenced and 52% of which are imaged. CCH2 contains 128,000 specimen vouchers of rare or threatened taxa (CNPS rank 1B or 2B, CNPS 2022; CCH2 Portal 2022) and over 302,000 specimens of grasses from as early as 1802. As digitization and collection continue, so does our botanical knowledge (see Figures).

At this scale, the potential for research, educational, and public use of these data is enormous. Indeed, educators across the state have developed modules that utilize these data to teach spatial mapping of plants, the creation and use of identification keys, and other critical botanical concepts (<https://www.capturingcaliforniasflowers.org/educational-materials.html>). Researchers are using specimen data to analyze trends in phenology (e.g., Park et al. 2018), physiology (e.g., DeLeo et al. 2020), herbivory (Meineke and Davies 2019, Moore et al. 2021), and other important ecological and evolutionary processes (Heberling 2022). Because herbarium specimens are collected for diverse purposes and using multiple methods — often extemporaneously — biases and limitations to using specimen-based data are well-known (see Willis et al. 2017 and Daru et al. 2018 for useful discussions). Evaluation of what, if any, spatiotemporal or taxonomic biases exist and how such biases could impact the interpretation of results are both necessary when using herbarium-derived data. Many such impacts can be minimized by carefully selecting well-sampled or otherwise representative species, increasing

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Digitized Herbarium Specimens as Keystones of Grassland Research *continued*

the size of the dataset, or using statistical methods that account for inconsistent sampling (Willis et al. 2017). The research potential of this dataset only grows — with digitization, data quality improvement efforts, and data augmentation — by recording and linking other types of data. For example, the California Phenology Network also recorded the phenological status (i.e., presence or absence of reproductive features) of over 1.6 million angiosperm specimens in CCH2, building a diverse dataset for phenological analyses and creating a framework for gathering other trait data in the future (Yost et al. 2020, Pearson et al. 2021). These spatiotemporally linked trait data could be vital tools for conservation and restoration research (Gallagher et al. 2021).

Grasslands in California have a dynamic history of floristic change (Barry et al. 2006) documented in part by specimens. To understand how to affect lasting, positive change for these diverse ecosystems, we need to examine the environmental, ecological, and evolutionary drivers of stability and change in grassland flora. Specimen-based research also underpins our understanding of rare taxa (e.g., Rivers et al. 2011) and therefore enables evidence-based conservation planning. The multifaceted dataset provided by herbarium specimens is invaluable to growing our botanical and ecological knowledge, and it is imperative that we continue to preserve and advance these resources for the scientific community and the public (James et al. 2018). Researchers of grasslands — and all ecosystems — must continue to collect specimens to document change over time, and the botanical community must continue to digitize our herbaria to build a more comprehensive historical dataset and preserve the legacy of our native flora.



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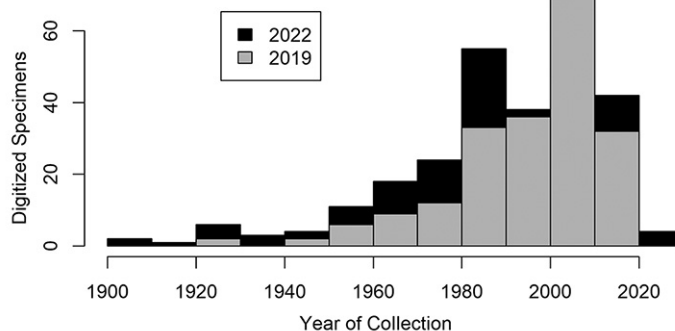


Figure 3. Distribution of herbarium specimen collection dates for *Stipa pulchra* Hitchc. prior to most digitization work shown in gray (queried from CCH2 in January 2019) and after a four-year digitization effort by the CAP Network shown in black (queried in August 2022) (CCH2 Portal 2022). Digitization activities not only increased the number of specimens available per year, but also extended the temporal scale of collections—the earliest specimen in the dataset in 2019 was 1920, whereas the earliest specimen in the dataset in 2022 is 1903—and filled in temporal gaps (e.g., specimens from 1903–1920 and 1930–1940 are now available). As in Figure 1, the specimens shown here are from 19 actively digitizing herbaria in CCH2: BSCA, CSUSB, DAV, FSC, HSC, IRVC, LA, LOB, MACF, OBI, RSA, SBBG, SDSU, SFSU, SFV, SJSU, UCR, UCSB, UCSC.

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CNGA's GRASS Program: Grassland Research Awards for Student Scholarship

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Rosie wearing her favorite hat while examining a meadow in the Mendocino National Forest. Photo: Callie Zender

CNGA's GRASS Program:

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For more information or to make a tax-deductible donation visit <https://cnga.org/GRASSgrants>.

“No other organization has been more supportive of my budding career than CNGA. CNGA Grassland scholarships eliminated the financial burden of research enabling me to pursue my dream study. The CNGA framework has also challenged me to continue to put my research out into the public sphere by inviting me to present and to share what I know in their journal.” —Roisin (Rosie) Murphy-Deak, Six Rivers National Forest Botanist

Digitized Herbarium Specimens as keystones of Grassland Research *continued*

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MEET A GRASSLAND RESEARCHER **Joanna Tang**

Joanna is a PhD Candidate studying urban restoration ecology. Her goal is to bridge the gap between academics and practitioners so that best management practices are informed by innovative research. She can be reached at joannatang@ucsb.edu.

What is your study system?

I study urban vernal pool wetlands, which often exist within a grassland matrix. These seasonal wetlands are threatened with invasion by the surrounding nonnative annual grasses and urbanization; less than 10% of historical vernal pools exist today. My current research investigates the plant communities in the remnant and restored vernal pools surrounding UC Santa Barbara's campus.

What are your primary research goals?

Vernal pools are model systems to study the effects of urbanization, climate change, invasion, and restoration on plant communities because they have experienced widespread degradation and restoration. I study the long-term effects of past restoration actions to ask, "Are we restoring resilient, resistant, self-sustaining native ecosystems?" My goal as a graduate student is to increase our understanding of ecological mechanisms governing resilience and resistance, and my goal as a restoration practitioner is to improve the communication and implementation of research in on-the-ground management. Currently, I am developing a long-term weeding and seeding treatment to decrease nonnative annual grass thatch and increase endemic vernal pool species in restored vernal pools around UC Santa Barbara's campus.

Who is your audience?

I value collaboration with restoration practitioners and ecologists. My goal as a researcher and practitioner is to bridge the gap between academia and the restoration industry so that researchers are investigating real-world problems and practitioners are incorporating cutting-edge research into best management practices.

Who has inspired you, including your mentors?

My advisor, Dr. Carla D'Antonio, inspired me to pursue a PhD because she also values the connection between research and practice. Her love of her work and ecosystems, her inquisitive and keen insight, and her dedicated involvement in community

stewardship has been a guiding light to me throughout my graduate career. I am also inspired by nonprofit restoration leaders, including Grassroots Ecology and Latino Outdoors, who are committed to involving students and a greater diversity of people in ecosystem stewardship, as well as all the wonderful, hard-working colleagues I have met by going to California Society for

Ecological Restoration and California Invasive Plant Council conferences. Mother Nature is my continual source of inspiration — growing up in the Bay Area and biking along wetlands planted the seeds of my love of nature, and I am constantly amazed by the wonders of the world, from the wonderful shade provided by a tree on a hot day, to the intricate compound inflorescences of *Castilleja densiflora*, to the powerful renewal of life after catastrophic wildfires.

How has or will your research align with the mission of CNGA "to promote, preserve, and restore the diversity of California's native grasses and grassland ecosystems through education, advocacy, research, and stewardship"?

The goal of my dissertation research is to improve the restoration of California's grassland vernal pools. I love collaborating with practitioners to figure out what barriers to success need to be addressed in research, and I am dedicated to ensuring that relevant research is being openly communicated to practitioners. Currently, I collaborate with UC Santa Barbara's Cheadle Center for Biodiversity & Ecological Restoration to help manage restoration sites around campus. I enjoy presenting my research at restoration and management conferences. I am also passionate about K-12 education and enjoy involving the local community in stewardship.

Why do you love grasslands?

I love grasslands because they are one of the amazing ecosystems in the California Floristic Province. I am so impressed by how beautifully native grasses and wildflowers grow even during historic drought years. I also love working in grasslands because they have logistically friendly working conditions, compared to snaggy chaparral, icy alpine, and arid desert ecosystems!





Figure 1. Heritage Growers Operations Manager Michele Ranieri and her dog Lucy calibrating application rates for sowing Heritage Growers' native seed production fields.

Introducing Heritage Growers *by Pat Reynolds¹*

Introduction

Heritage Growers (heritagegrowers.com), a venture of River Partners, is a new native seed and plant supply business providing source-identified native seed and plugs for habitat restoration. Our goal is to improve habitat restoration outcomes by making more species and ecotypes available. All profits generated by Heritage Growers will be used to fund River Partners' state-wide habitat restoration efforts.

River Partners has been effectively using native seed for their habitat restoration projects for more than two decades. The seed they use has been a combination of wildland seed and seed produced by commercial sources. The long-term goal of River Partners has been to produce much of their own seed, for their own projects, so they can better control the species and ecotypes used and thus improve restoration success. The source-identified native seed produced by Heritage Growers will be used to support River Partners' projects with excess seed made available to the public to improve habitat restoration outcomes in California.

¹Pat Reynolds is the General Manager of Heritage Growers. He has more than 30 years of professional experience in habitat restoration and serves on the board of the California Native Grasslands Association. preynolds@heritagegrowers.com.

The use of seeds and plants of known genetic origin is an essential component of most habitat restoration efforts. Seeds and plants that originate from known wildland source locations provide restoration practitioners with valuable information regarding the environmental conditions in which the parent stock evolved and how those conditions compare to the conditions present within the restoration site. If the conditions are similar, the plant material used in the restoration site should be well-adapted to site conditions and help to create a healthy and resilient restoration site. Locally sourced plant material (ecotypes) used in restoration projects also ensures the conservation of undiscovered cryptic diversity and preserves native plant evolutionary lineages (Silveira 2021). Seeds of unknown origin, commonly referred to as "variety not stated" (VNS), have not been shaped by the evolutionary pressures that make local ecotypes well-suited for restoration site conditions and can result in less successful establishment or even cause maladaptation of local germplasm from hybridization with non-local plant material (McKay et al. 2005). Maladaptation may occur because the introduced seed hybridizes with existing native stands, altering the genetics of natural populations in the vicinity. Widespread plantings of cultivars, such as what happened with the large-scale planting of the iconic Texas bluebonnet (*Lupinus*

continued next page

Introducing Heritage Growers *continued*

texensis) can potentially swamp native germplasm and change the evolutionary history of species (Turner et.al. 2017). Thus, when implementing habitat restoration projects, it is important to not only use native species but to also use locally source plant material.

There are currently limited tools available to help choose the most appropriate ecotypes for projects when multiple ecotypes are available. The U.S. Forest Service has developed Provisional Seed Transfer Zones (PSTZ) based on areas of similar environmental conditions using climatic data that relies primarily on the minimum winter temperature and an aridity index that uses mean annual temperatures and precipitation. These maps in some cases can be the best information that is available when selecting the best-fit ecotypes for a restoration project. However, when strong environmental influencers, including the presence of unique soil types, such as serpentine soils, are known, this may be of greater importance to the suitability of a given ecotype for a project than climatic conditions. In many cases, because of limitations in the ecotypes that are available, geographic proximity may be the best or only factor that can be used in the selection of a given ecotype for a project.

Native Seed Production

At Heritage Growers, we are concentrating our efforts on producing source-identified California native seed for use in habitat restoration projects. We are producing “workhorse” species (species with a proven record of performing well in habitat restoration projects) whose origins are within regions of active and proposed habitat restoration projects along with many other species to add diversity and improve habitat values. For example, we produce native milkweed (*Asclepias* spp.) to support the monarch butterfly (*Danaus plexippus*), an iconic species that has suffered significant declines in recent years. Heritage Growers will have moderate quantities of source-identified native seeds available by fall 2022 and significant quantities available by fall 2023.

Native Plug Production

Heritage Growers’ native plant nursery is currently up and running. We have many different species and ecotypes and thousands of plants that are available for use right now. We specialize in the production of plugs (1.25” x 2.5”) that are grown out in 200-plant trays. We generally cater to habitat restoration projects, so our minimum plant order is 600 plants. Part of our service includes

providing our customers with advice on how to best use the plants that we produce.

Native Grass Straw

Native grass straw is an excellent restoration tool. It provides good erosion control and often includes native grass seed that can enhance revegetation efforts. We provide recommendations on how to best utilize our native grass straw on projects. The straw that we produce will be certified as noxious-weed-free and will be first available in fall 2023. The straw provided will not necessarily be tracked by ecotype or species because of the logistical issues associated with tracking large quantities of native straw coming off of multiple fields.

Seed and Nursery Amplification Contract Grows

For projects requiring large quantities or site-specific seed or plants, we set up seed amplification and nursery contract grows. We utilize the wildland stock seed provided by partners and clients and amplify that in our fields or grow it out in our nursery. If the seed is not sufficiently clean for amplification purposes, we clean the seeds further and have it tested by our seed lab partners. Based on

the number of live seeds available, as determined by the laboratory analysis, we either directly seed into our fields, or grow the seed into plugs that are then installed into our production plots. We grow, maintain, harvest, test, bag, and tag the seed, returning it to the client for their projects. We set up similar contract grows with our nursery operation to ensure the desired plant material is available when needed.

Restoration Design Consultations

At Heritage Growers, our primary interest is in the successful establishment of native vegetation from locally sourced native plant material. Thus, for most projects, we provide free consultation services to restoration practitioners with the goal of producing the best possible outcomes for the seed and plants that we provide. We consider ourselves partners on restoration projects and enjoy helping develop strategies to maximize success. In cases involving more in-depth consultations that include written products or site visits, we can set up small consulting contracts.

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Figure 2 (inset). Aerial photograph of Heritage Growers’ first-year native seed production fields.

Introducing Heritage Growers *continued*

Seed and Plant Research

One of our goals is to advance the practice and science of seed- and plug-based habitat restoration. We are doing so by growing out new species and new ecotypes, implementing germination trials, and utilizing new farming methods to produce native seed. For example, we are currently collaborating with the Xerces Society to trial seed treatments to improve germination of California milkweed (*Asclepias californica*), an early emerging species of milkweed with a high level of seed dormancy that could play a key role in saving the Monarch butterfly. Since Monarch butterflies are migrating earlier from their overwintering grounds on the California coast than in the past, they are now out of sync with the emergence of many milkweed species. California milkweed, one of the earliest milkweed species to emerge, has the potential to provide early breeding habitat for Monarchs when other milkweed species have not yet emerged. However, research is needed to determine the best means to break seed dormancy so container plants can be cost-effectively produced and out-planted to establish potential breeding habitats in the initial stages of their long migrations.

Restoration Implementation

Since Heritage Growers is a program of River Partners, we can call upon River Partners' operations group to implement habitat restoration projects that utilize the source-identified native seed and plants that we produce. River Partners has more than two decades of experience implementing hundreds of large-scale restoration projects covering more than 18,000 acres statewide. This breadth of experience, and the many lessons learned in implementing complex habitat restoration projects, helps to ensure that the native seed and plants that we produce are used effectively.

Partnerships and Collaborators

At Heritage Growers, we think that partnerships and collaborations are the keys to improving restoration outcomes. Native seed and plant production is a resource-intensive, complex endeavor that is not easily accomplished without working closely with like-minded organizations and individuals. We enjoy working with federal, state, and local agencies, other non-profit organizations, restoration contractors, and any group or entity that shares our interest in improving habitat restoration. We are constantly seeking new



Figure 3. Source identified California poppy (*Eschscholzia californica*) being harvested at Heritage Growers' production fields.

partners and collaborators — if you want a partner on your restoration project, we encourage you to contact us at info@heritagegrowers.com so we can work together to successfully restore high-value, ecologically appropriate, resilient habitat.



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Figure 1. Tracy's partner, Ryan Imbach (left), and their son Colton (right), in the corral to check on the herd.

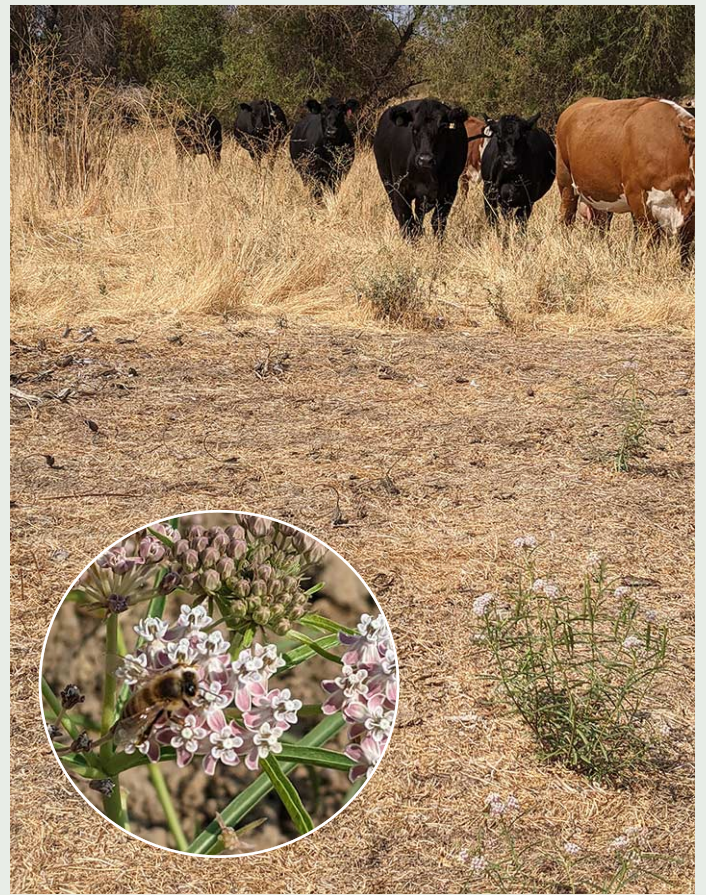


Figure 2. Narrow-leaf milkweed (*Asclepias fascicularis*) with cows in the background. Figure 3 (inset). Milkweed close up.

MEET A RANCHER **Tracy Schohr**

Tracy Schohr is a partner in Schohr Ranch and is a Livestock and Natural Resources Advisor with UCCE for Plumas, Sierra, and Butte Counties. She can be reached at tk schohr@ucanr.edu.

Describe your operation and ecosystem

The Schohr Family has over 150 years of farming tradition in California — our family farming and ranching heritage originated in Yolo County, beginning in 1861. In 1910, the operation expanded to southwestern Butte County and today, continues to farm the property J.W. Browning purchased over a century ago. Today, the family operation raises rice, walnuts, registered Hereford cattle, and commercial cattle.

For the past decade, the grazing operation had been migratory — in the summer our cattle were on irrigated pasture in Gridley, and spent the winter on annual grasslands at Beale Air Force Base near Marysville. At Beale, the cattle grazing had multiple objectives, including controlling weeds, supporting vernal pools, maintaining a purple needlegrass restoration site, reducing fire fuel loads, and more. While at our home ranch, the cattle are on irrigated pasture but will also be found grazing around the rice fields after harvest and in a floodplain helping reduce vegetation and fuel loads.

What are your primary goals as a steward of the land?

As a land steward, my primary goal is to leave the land better for next year and the future, including for my son Colton. When I am in the middle of the pasture considering moving cows to the next field, and weaning early to reduce mouths eating grass, I am worried about the next few weeks — the actions I take now (or don't take) to manage the land can often have impacts for years.

What tools do you use to manage the land? What tools do you wish you could use, but can't (if any)?

I am quick to respond “cows” as our tool to manage the land... but it is so much more! Other tools that are essential to our family ranching operation are permanent fencings, electric fencing, salt, protein supplements, water development, hauling water, 4-wheelers, herding, time, docile cattle genetics.... plus patience, humor, and love. It is difficult to expand our operation and we wish we could use our tools and passion on more land to enhance the ecological values through managed cattle grazing!

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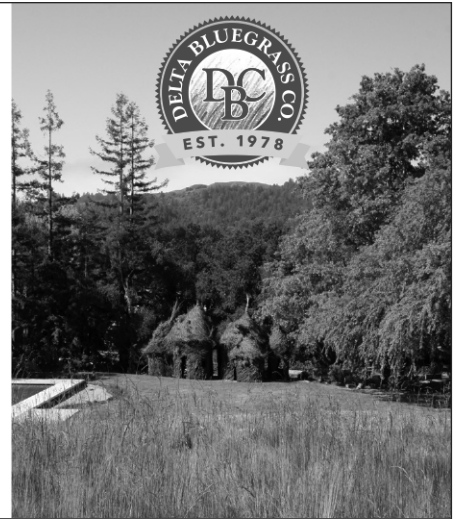
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MEET A RANCHER **Tracy Schohr** *continued*

What partners do you work with?

Our family has a long history of working with the Natural Resources Conservation Service and University of California Cooperative Extension on our home ranch. When grazing at Beale, it brought forward several new partners on the Base that we worked with to improve the management and infrastructure, and to share the role of managed cattle grazing to improve the ecological values of the land.

Who has inspired you, and how?

My biggest inspiration for grazing management and the ecological values of livestock comes from Bruce Hafenfeld. Nearly 20 years ago, when I was fresh out of college, Bruce invested hours teaching me about grazing management to promote wildlife habitat. He encouraged me to build bridges with the environmental community, to learn the science, and to look on the ground. His passion for grazing management and love of the land continues to guide me as a rancher and in my professional career. I am blessed to have had ranchers like Bruce and my grandpa, along with Tim Koopmann and many others who have taught me, inspired me, and challenged me to be a good grazer, grassland manager, animal caretaker, and researcher!

How does the work you do on the land relate to the mission of CNGA “to promote, preserve, and restore the diversity of California’s native grasses and grassland ecosystems through education, advocacy, research, and stewardship”?

When we grazed at Beale Air Force Base, it was directly related to the mission of CNGA, by using science to guide the use of cattle to enhance native grassland species, minimize fire risks, and reduce invasive plant pressures through grazing. The grazing program in our home place is in conjunction with an abundance of wildlife and plant diversity, including milkweed. In my professional career as the University of California Cooperative Extension Livestock and Natural Resources Advisor for Plumas, Sierra, and Butte Counties, I get to work with ranchers and land managers to enhance



Figure 4. Ryan, Colton, and Tracy wrapping up setting up a research monitoring plot in Plumas County.

grasslands, conduct applied research, and share with the public the value of grazing management on grasslands in our state.

Why do you love grasslands? (assuming you do)

I reflect on my grandpa spending hours watching cows grazing, and wondering why he was taking so long! Now, I would have to say I love the sense of peace that comes when you are in the middle of grasslands. Plus, the wonderment and excitement grasslands can bring to a 4-year-old looking at the flowers, birds, bugs, and “super fancy rocks” that quickly fill a pocket.

Any final/closing take-home nuggets, advice, quotes, etc., you would like to include or share?

Two thoughts... One: Ranchers are cattle producers, but we are really grass farmers. If you mismanage your grass then your business and cattle won't survive.

Two: The challenges farmers, ranchers, and researchers are facing now are not in any textbooks, as those have yet to be written. Keep your mind open to understanding the core problems and have a sustainable approach to solutions – environmental, social, and economic.



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Purple needlegrass (*Stipa pulchra*) shines at a grassland restoration site near Hedgerow Farms, Yolo County. Photo: Andrew Rayburn

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Front cover: Late-season *Lupinus* sp. at Elisa Dowd's property on Las Trampas Ridge in San Ramon, Contra Costa County. *Photo by Elisa Dowd, September 2020.*

Back cover: Bodega Bay walk at workshop given by CNGA led by board member Richard King. *Photo by Saxon Holt, December 2016.*

