



California Society for Ecological Restoration Quarterly Newsletter *Summer 2018 Volume 28, Issue 2*

A Message from SERCAL's Incoming President, Gregory Andrew

I have been on the Board of SERCAL since 2013 and I have been so impressed with the high level of restoration work SERCAL's members are conducting in California. Each conference I attend has impressed upon me how extensive restoration work in California is, in all manner of habitat, and how advanced the work is. The SERCAL Board has repeatedly stressed the importance for SERCAL serving you, our members, through the outreach and education we can provide as an organization. The Board has been discussing what the priorities for SERCAL should be and here is a general summary of the direction we want to take:

- * We want to increase and diversify SERCAL's membership to include people in public agencies, non-profits, and schools, as well as consulting companies;

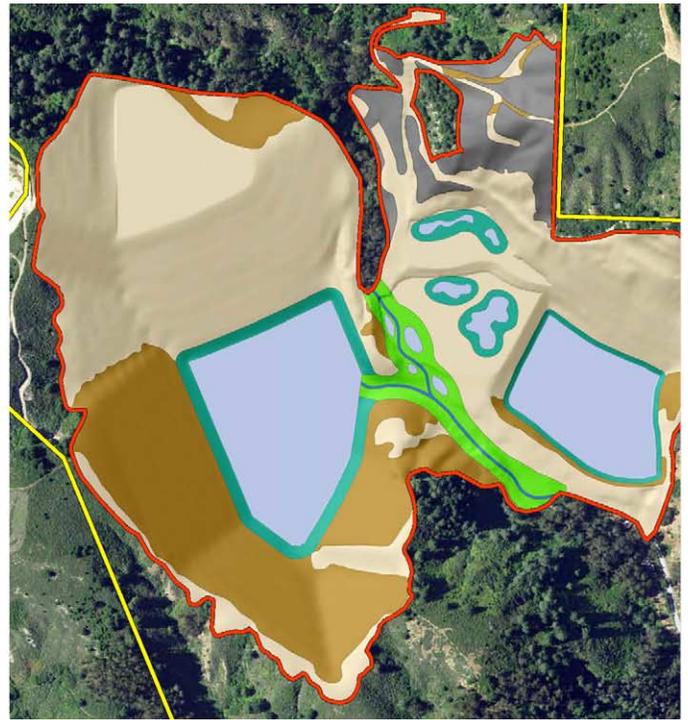
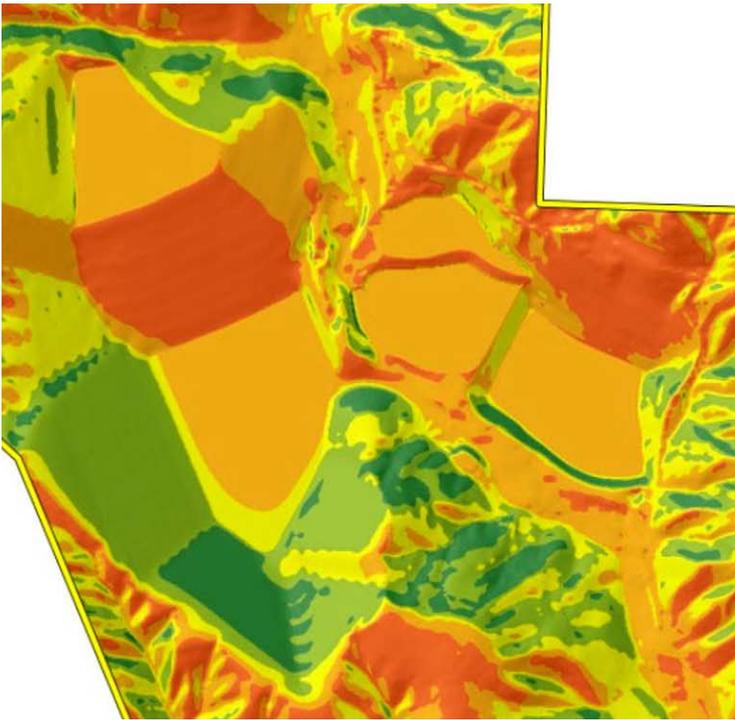


- * We want to make SERCAL more accessible to students as they are the next generation of restorationists;
- * We want to strengthen and advance our methods of communication to members;
- * We want to reinvigorate and expand collaborations with other organizations to promote restoration and SERCAL's services; and
- * We hope to organize more field trips, workshops, and other events to provide more opportunities for members to learn about and enjoy the reason we are all involved in this work.

If you know someone whom you think might benefit from joining SERCAL, please be sure to mention us to them and encourage them to consider becoming a member. There is no lack of need to help California's natural systems remain as special as they truly are. Feel free to contact me too and let's have a chat.

Ecesis is published quarterly by the California Society for Ecological Restoration, a nonprofit corporation, as a service to its members. Newsletter contributions of all types are welcome and may be submitted to any of the regional directors (see page 15).

- 2... **Restoration of Disturbed Lands**
- 6... **Botanical Discoveries at the Cosumnes River Preserve After 2017 Floods**
- 8... **An Outstanding Celebration in San Diego**
- 12... **Ecological Impacts of Changing Conditions**
- Plus...** SERCAL Supporting Members, News, and Contacts (p. 14–15)



The site's revegetation plan is designed based on solar radiation zones. Cool areas (greens in left image) support Doug fir forest (brown in right image); reds and oranges show warm areas (left image) which support grassland and scrub communities (tan in right image).

Restoration of Disturbed Lands:

Using solar radiation zones as a restoration resource

by Geoff Smick¹

Restoration practitioners revel in the glory of returning spawning steelhead to natal streams, replacing long-tilled under vernal pools to their proper shape and size, and lowering filled tidal marshes so they once-again receive twice-daily tidal inundation that springs them back to life. But another equally important but much less reveled-in side of restoration science is restoring disturbed landscapes — long forgotten natural habitats that were replaced by mountains of rock, holes in the ground, that would engulf a large stadium, or toxic brews of cast-aside chemicals that contaminate the ground. How do you even begin to turn these barren landscapes, devoid of any resemblance of a natural community, back into thriving habitats?

To the uninitiated it may seem like a daunting proposition. To be sure there are important resources to help guide the newcomer through this process, but many are dated or focus on revegetation — not natural habitat restoration. Not surprisingly there is a dearth of primary research in this field that may be applicable to the restoration practitioner. Of what resources do exist, most don't address more recent technological advances that can greatly improve restoration success. This article outlines a few approaches and techniques that the restoration ecologist may utilize to

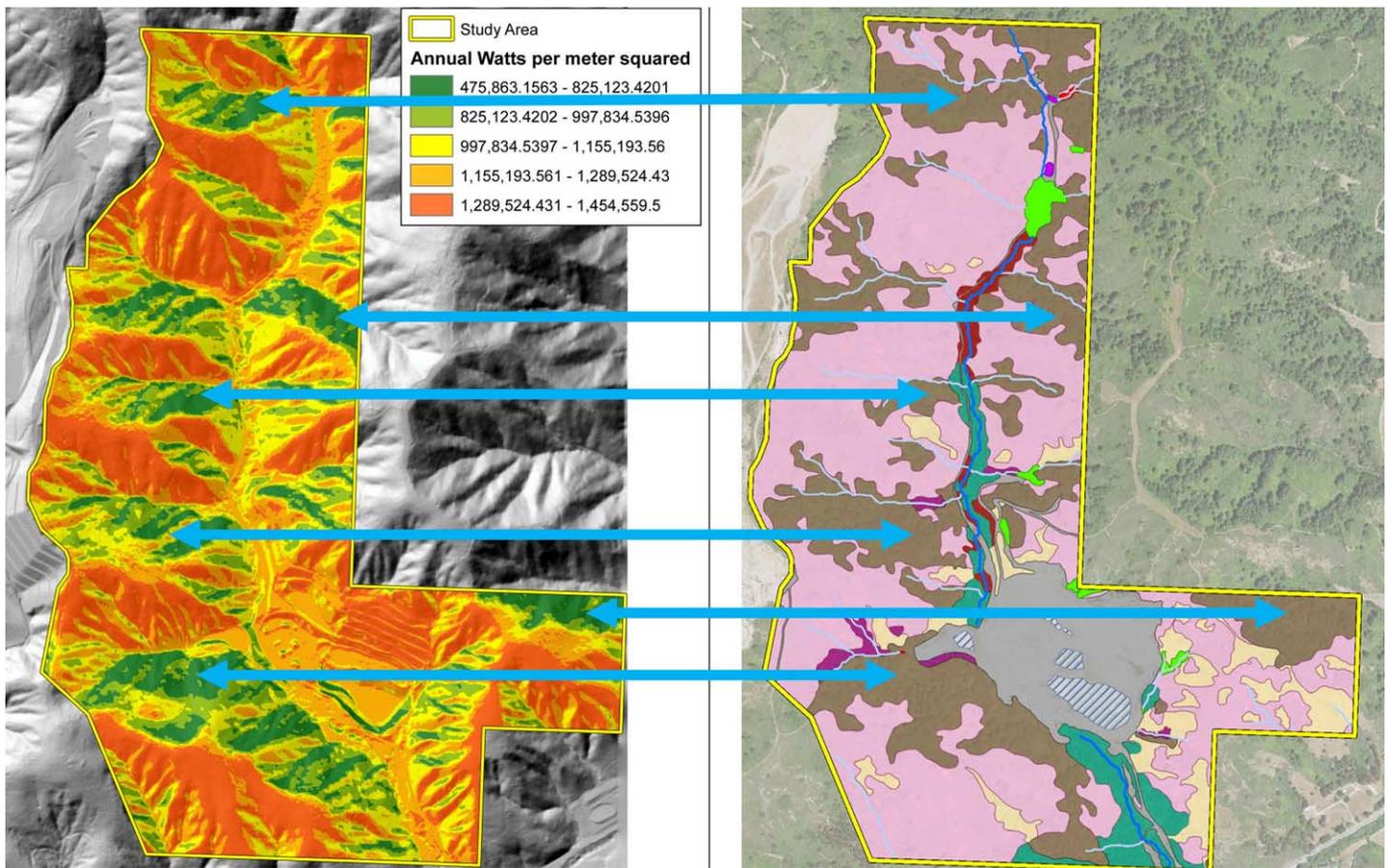
facilitate a more streamlined planning process in addition to increasing success of their restoration project.

So you have a disturbed site you want to restore — where do you even begin? How do you determine what used to grow there? What were the soils like? Some sites are so altered from their natural state that the answers to some of these most basic questions may not be apparent. How do you even begin to approach a situation like this? Some of the answers might be apparent: historical aerial imagery can be obtained with a few clicks of a mouse these days and NRCS soil surveys are great resources for many sites.

But what about older sites that have been disturbed for so long they predate these records? Often one must rely on using the surrounding landscape to infer what habitats used to be present, what their species assemblages were, and if possible what types of soils supported those plant communities. This sounds simple enough but in most parts of California, a large site of several hundred acres may have supported a dozen different plant communities. Sure, you can look around the surrounding undisturbed areas and approximate what habitats and species are present, but how do you understand the placement of the communities across your site?

¹President, WRA, Inc. smick@wra-ca.com

continued next page



Solar radiation zones are correlated to existing vegetation communities to determine their preferred zone. Deep green indicates the coolest zone (left image) and that lines up with the Doug fir forest vegetation community (brown in right image).

Restoration of Disturbed Lands *continued*

Luckily for us, most of California's vegetation communities are shaped largely by our Mediterranean climate regime: cool, moist winters and hot, dry summers. This drives certain patterns at the landscape level that can be predicted to some extent. South-facing slopes experience greater solar radiation and have more xeric plant communities like scrub, chaparral, and grasslands. North-facing slopes are cooler and moister and support more woodland and forest communities. These patterns are strong enough in many portions of our state that vegetation communities can be predicted by the solar radiation that the specific location receives, which is largely a function of slope aspect. This provides a great resource for restoration planning.

First, one maps nearby intact vegetation communities using GIS. Then, using the Area Solar Radiation tool in ESRI's ArcMap, one can determine the average annual solar radiation values (insolation) for the area where the vegetation communities were just mapped. The insolation values can be grouped into several bins to create ranges of values that represent cooler to warmer insolation values (I find that 3-5 groups are typically sufficient). These sets of values are then correlated to the previously mapped vegetation communities. Finally, one runs the Area Solar Radiation tool on the subject restoration area and groups the insolation values into the same bins as the reference site and the correlated

vegetation communities can be approximately laid out based on these results.

We have completed this process on half a dozen project sites in both northern and central California, and the correlation of many of the dominant vegetation communities to solar radiation zones is striking. Of course not all communities follow this same rule — in particular, those responding to increases in hydrology that have nothing to do with the corresponding slope aspect. For example, seep wetlands on hillsides are there because water is expressing itself from the ground in those locations. Similarly, wooded areas often begin to form in drainages of larger watersheds farther downslope due to the increasing hydrology, despite being on south-facing slopes. But by and large many communities correlate very well, making this a great tool to quickly identify where primary vegetation communities should be located based on the existing topographic conditions.

Species composition

Once the primary vegetation communities have been identified, one needs to determine what species are most appropriate to plant. There are great resources on California ecology that list dominant species in many of California's vegetation communities. Two of the

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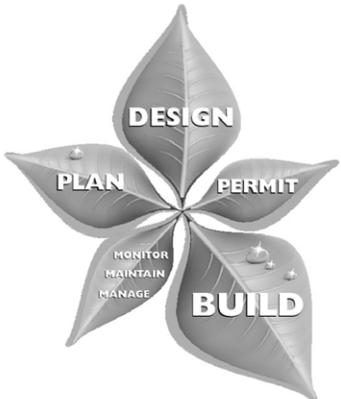
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Test plots are a great way to test soil blends and seed mixes at the restoration site. Deeper soils support grasses (left) while shallower/rocky soils are better suited for shrubs than herbaceous material (right).

Restoration of Disturbed Lands continued from page 3

most comprehensive are: *The Manual of California Vegetation* and *Terrestrial Vegetation of California*. While great reference books for the state, local conditions may vary and drive species competition and abundance at your specific site in a manner that is atypical to the norm. Therefore, it is ideal to capture data from nearby reference sites when possible. Vegetation plots geared towards identifying the diversity and dominance of species in the herbaceous, shrub, and tree layer is one of the best ways to determine species composition for a community. The results of the vegetation plot study should be cross-checked with nurseries/seed suppliers (or conduct a contract-grow operation) to ensure sufficient stock is available.

Test plots

If you have the time and resources, one of the best ways to determine what will be successful in a restoration project is to use a test plot program. A well-designed test plot program can assess the performance of various plant species, soil blends, and other treatments/additives. Assessing vegetative cover, diversity, and

density (stems counts for trees/shrubs) over time in a few different types of soil treatment can provide valuable insight on what will grow best in those conditions. It is especially useful to monitor the response over several years as certain species may start strong but then be outcompeted by other species. This is common in the succession of community establishment: pioneering species may be very abundant early on but are replaced over time as the community progresses to being dominated by climax species. The goal of the test plots is to help determine which conditions support the most successful establishment of those climax species. Obviously this takes time, but by starting with the most informed restoration program you can early on, the chances of success are much greater. While a test plot program bears a cost, the increased survivorship, reduced maintenance, and reduced plant replacement should pay for itself many times over in the long run. In addition, if the project has success criteria and associated monitoring, you may be more likely to reach that success criteria sooner, resulting in even more savings through reduced monitoring.

Restoration of disturbed habitats is an important role for the restoration ecologist. Recent advances in ArcGis tools can help identify the best location for appropriate vegetation communities. In addition, straightforward tools like test plots can hone the restoration planting palette. Together these tools will lead to a more successful restoration program in a shorter amount of time resulting in less maintenance and saved resources.

For more information about these or other techniques related to restoration of disturbed lands, please contact Geoff Smick (smick@wra-ca.com) at WRA, Inc.



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Cosumnes River floodplain restoration where The Nature Conservancy removed portions of a levee system to enhance flood processes. Photo courtesy of The Nature Conservancy, Judah Grossman.

Botanical Discoveries at the Cosumnes River Preserve After 2017 Floods

by Sara Sweet¹

The heavy rains of 2017 caused a lot of excitement for low-lying areas in the California's Central Valley, not all of it good. After the headline-capturing lakes of water drained away — indeed months after the floodwaters receded — a calmer, happier excitement took place on the floodplains at the Cosumnes River Preserve in Sacramento County, California. This was the excitement of botanists finding plants never seen before on the Preserve. Some of these species were not even documented as growing in the Central Valley. The discoveries on the floodplain underscore the importance of large, infrequent flood events in not only renewing ecological sites for disturbance-loving species, but also in the long-distance dispersal necessary to allow genetic mixing and range expansions.

First, there were certain species observed that were already known to occur at the Preserve, but which I had not yet seen in my ten years working here. These included a non-native dock (*Rumex*

acetosella) and garden tomatillo (*Physalis philadelphica*). The other two plants qualify easily for miniature status. The tiny bearded flatsedge (*Cyperus squarrosus*) did not reach over 3 or 4 cm in height on our site, but the outcurved and bristle-like tip of each floral bract created a unique appearance that we spotted easily. It was almost towered over by the false pimpernel (*Lindernia dubia*), which exceeded all of 15 cm at times. On occasion, in a particularly wet microsite in the beginning of the season, we found this plant alive, with small but beautiful white flowers accented with lavender spots. More often, we found false pimpernel in what we formally call the senescent state, but in more colloquial situations refer to as “crunchy”.

Second, and more exciting, we found plants that had never yet been recorded at the Preserve, even though they have been documented as occurring in the Central Valley. Four were native and five introduced, but only one of the introduced plants is listed by Cal-IPC as being invasive. This was false brome (*Brachypodium distachyon*), which is distinguished from the true bromes by having

¹Project Ecologist, Cosumnes River Preserve, The Nature Conservancy. ssweet@tnc.org

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Photo 1: The tiny glandular hairs of *Bergia texana* caught some of the plant's own seeds from the dehiscent fruits. Photo 2: The fruit of *Eleocharis engelmannii* has a miniscule hat (academically called a tubercle) with a high point in the middle that curves gracefully down to each side. The ruler at the bottom shows an increment of one millimeter. Photo 3: This individual of *Calyptidium monospermum* must have swum quite a few miles as a seed from the stable populations at 1,000 ft elevation or above.

Botanical Discoveries at the Cosumnes River Preserve *continued*

a spike-like inflorescence, and a palea that is keeled and ciliate. Magnification is definitely needed to see the palea. Another of the introduced plants was a sedge called bog bulrush (*Schoenoplectus mucronatus*). It is closely related to the much larger bulrushes that are also called tules. We also found a new kind of spurge. Although many people are conditioned to immediately hate spurges, this kind (petty spurge, or *Euphorbia peplus*) has an unexpected grace hiding in its tiny, petal-less flowers. Each of the four glands surrounding the central flower has a pair of appendages that make the structure look like a barn swallow's tail. The other two introduced plants were four-leaved allseed (*Polycarpon tetraphyllum*) and water speedwell (*Veronica anagallis-aquatica*). Both of these species have flowers with petals, although in allseed the petals are quite small enough to accidentally overlook. Speedwell has very charismatic little white flowers tinged with violet.

We found four native Central Valley species that had not yet been documented as occurring on the Preserve. Except for the evening primrose (*Oenothera elata*), which grows along the roadsides a few miles away, we were not familiar with these species. This means that in addition to the fun of discovery, we had the added fun of keying them out, too. Vying for inclusion among the miniatures was smallflower halfchaff (*Lipocarpha micrantha*) at a maximum height of 5 cm. The slender buckwheat (*Eriogonum gracile*) was found growing in sand, which according to *The Jepson Manual* is its usual preference. Lastly, the Texas bergia (*Bergia texana*) bristled with tiny glandular hairs, often glueing its own seeds to its sepals and leaves (Photo 1).

Now for the most exciting discoveries: plants that not only haven't been documented at the Preserve before, but which are not supposed to occur in the Great Valley at all. The first, Englemann's spikerush (*Eleocharis engelmannii*) might not be quite such an outlier, given that *The Jepson Manual* notes the distribution needs study. The tiny hats found on top of spikerush fruits were very useful in keying, but difficult to see without the 40x magnification of the dissecting scope. The hat of Englemann's spikerush is flattened side-to-side, pointy in the middle but curving down gracefully to each side (Photo 2). Second, imagine our surprise when we saw a little wildflower typically not seen below about 1,000 ft elevation. This was the one-seeded pussypaws (*Calyptidium monospermum*) (Photo 3). It has a basal rosette and several stalks, each around 15–20 cm long, that bear tightly clustered flowers. Although Shakespeare wrote a famous speech for Juliet claiming that names don't matter, I confess that I like this plant better because its name links it in my head with dainty little kitty feet.

Most of these new occurrences are likely the result of long-distance dispersal rather than seed bank stimulation, especially those that have not been recorded at the Preserve before. Long-distance dispersal is often risky for individual organisms, but in a constantly changing environment, a species may depend on range expansions and genetic mixing for persistence. Large, infrequent flood events provide both a dispersal vector for plant propagules as well as the water needed to grow. The role that these events play in long-distance dispersal can be considered another benefit of flooding.





Climate Science Alliance Director Dr. Amber Pairis and Alliance Advisors Dr. Megan Jennings and Dr. Julie Kalansky opened the conference with their thought-provoking plenary: *Conservation and Management for San Diego's Changing Climate*.

An Outstanding Celebration in San Diego!

If I were only given one word in which to describe SERCAL's 25th Annual Conference in San Diego, I would have to say *Convivial*. During each break there was a steady buzz of excited conversations, meetings, reunions, networking, and more. So many thanks to SERCAL's Commander in Chief, Ralph Vigil of Habitat Restoration Sciences, for crafting an amazing gathering revolving around the theme of "In the Blink of an Eye."

In Wednesday's plenary, Climate Science Alliance's Megan Jennings and Amber Pairis introduced *San Diego County Ecosystems: The Ecological Impacts of Climate Change on a Biodiversity Hotspot*, a recent assessment led by a unique collaboration of local ecologists and climatologists (see page 12 for an excerpt from this report). For

Thursday's plenary, we asked some of restoration's finest — Vic Claassen, Gigi Hurst, Kevin MacKay, Ted St. John, Christina Schaefer, and Peter Tomsovic — to discuss SERCAL's role in moving the field of restoration forward, bringing diversity to and promoting the profession, and our role in "looking back" — monitoring, analysis, and success criteria challenges.

Thanks to the generosity of all involved — from sponsors to session chairs, from presenters to fieldtrip leaders, and from the San Diego folks who found a way to attend even in their busiest season to the attendees who traveled the length of California to join us — all of you made this a conference we will long remember.

— Julie St John, Administrative Director

Lifetime Achievement Award: Patrick Shea

Patrick has always had a profound interest in the natural world much to the credit of his two older brothers, also professional biologists. His professional career in natural resource management began in 1970 when he joined the U.S. Forest Service's Pacific Southwest Research Station in Berkeley as a biological technician. Through 35 years of service from which he retired as Principal Research Entomologist, Pat conducted research throughout the United States, Canada, Mexico, and China, first studying the effects of pesticides on non-target organisms — especially insect parasites and predators — and then attempting to unravel the significant role that bark beetles play in affecting the dynamics of western coniferous forests. The latter research area centered on studying the chemical pheromone system of bark beetles and understanding the role bark beetles play in creating critical habitat for avian species, especially woodpeckers. Among his many accomplishments is the publication of over 100 peer review publications in national and international scientific journals and books.

About one year after his retirement, the US Forest Service asked Pat to create and take leadership of the Sudden Oak Death Research



California Society for Ecological Restoration
2018 Lifetime Achievement Award

Pat Shea

Recognition & Contributions to the Field of Ecological Restoration
SERCAL's 25th Annual Conference, San Diego, California, 10 May 2018



Program. The causal agent of the syndrome we know as "SOD" is caused by the plant pathogen, *Phytophthora ramorum*. During his five-year tenure as Program Manager of the SOD Research Program, Pat oversaw the awarding and monitoring of over \$10 million of competitive grants to researchers and land managers throughout the United States.

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An Outstanding Celebration: Patrick Shea *continued*

Soon after stepping away from the SOD Research Program, a long-time friend asked Pat to join the Wildlife Heritage Foundation's (WHF) Board of Directors as a founding member. WHF was a newly registered conservation-oriented non-profit organization within the State of California; its primary business model to hold conservation easements that resulted from mitigation requirements dictated by various regulatory agencies as a consequence of development. Early on, WHF had no paid staff, so most of the conservation easement negotiations were carried out by one or two board members, and between 2001 and 2003, WHF took on three conservation easements, covering about 400 acres and about \$300,000 worth of endowments. However, at the end of 2003 it was becoming clear that WHF would need an Executive Director and the beginnings of a staff. Pat was asked by the Board to take on that responsibility. By the time he stepped away in 2016, WHF was holding approximately 104 conservation easement covering over 100,000 acres of critical habitats and managing in excess of \$55 million of endowments. The protected habitats ranged from wetlands such as vernal pools in northern California to the dry deserts of southeastern California. WHF now

has a staff of 10 professionals conducting business throughout the state. WHF also acquired and has held national accreditation from the Land Trust Alliance and is approved by the various regulatory agencies to hold and manage mitigation properties. Pat describes his 12 years with WHF as one of the most enjoyable and fulfilling times of his professional life — participating in the process of protecting in perpetuity over 100,000 acres of critical habitat, not only for the enjoyment of future generations, but also for the future existence of a myriad number of plant and animal species, is incredibly satisfying.

Pat's latest career is chasing 5 grandsons as they make their way in life. He takes great joy in their achievements in both the classroom or in sharing outdoor experiences such as fishing for river-run chinook salmon on the coast of Oregon or hunting waterfowl in the wet nasty weather of the Sacramento Valley. He considers himself a dedicated conservationist as described in Aldo Leopold's *Sand County Almanac*.

Pat earned his B.S and M.S from the University of California, Berkeley, in Entomology, and a Ph.D. from the University of California, Davis, in Insect Ecology.

President's Award: Margot Griswold

Margot Griswold was born and raised in the Central Valley of California. She attributes her appreciation of nature to her family and growing up 'free range'. In 1971, she received her degree fine art from the University of California, Berkeley, 1971. After supporting herself as a gardener in the Bay Area, she returned to the Central Valley to farm stone fruit and nuts on the family farm. It was on the farm that she expanded her understanding of plants and their pests, including weedy plant species. She returned to the University of California, Berkeley to embark on a science curriculum that led her to earn a Masters degree in Entomology at the University of California, Riverside in 1984, and her Ph.D. from the University of California, Irvine, in 1989 studying plant-herbivore interactions and resource allocation in plants.

After graduate school, Dr. Griswold worked as a consultant, and subsequently, started her own company, EARTHWORKS Restoration, in 1995 specializing in habitat restoration, reclamation, and land management. Over the past 28 years, she has prepared restoration/ revegetation plans and supervised implementation and monitoring for projects including over 600 acres of riparian and wetland mitigation projects, 1,700 acres of upland habitat revegetation and restoration projects, as well as over 4,000 acres of land reclamation projects in California. She loves working with teams of ecologists, engineers and soil scientist on complex, multi-stakeholder projects to plan and implement workable, cost-effective ecological programs.



California Society for Ecological Restoration
2018 President's Award

Margot Griswold



Presented at SERCAL's 25th Annual Conference, San Diego, California, 10 May 2018

One of the things she loves about being a restoration ecologist is that all the projects are different and demand research and creative solutions. One of the most challenging projects over the years has been the Owens Lake dust control project. On this project, Dr. Griswold was responsible for planning and oversight of various aspects of transmontane alkali meadow creation as 'managed vegetation dust control' on the lake, including managing collection of local seed and saltgrass seed production farms to provide enough local seed from Owens Lake for the project. During the past 10 years, she has been a member of the Owens Lake Habitat Working Group, a group of stakeholders and scientists who developed a Habitat Suitability Model that is used to assess specific wildlife habitat within

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An Outstanding Celebration: Margot Griswold *continued from page 9*

the dust control project, and to manage the habitat through monitoring and adaptive management.

Dr. Griswold values public service. She served on the board of SERCAL and was president in 2003. She also served on the board of the Ojai Valley Land Conservancy for five years. For the past eight

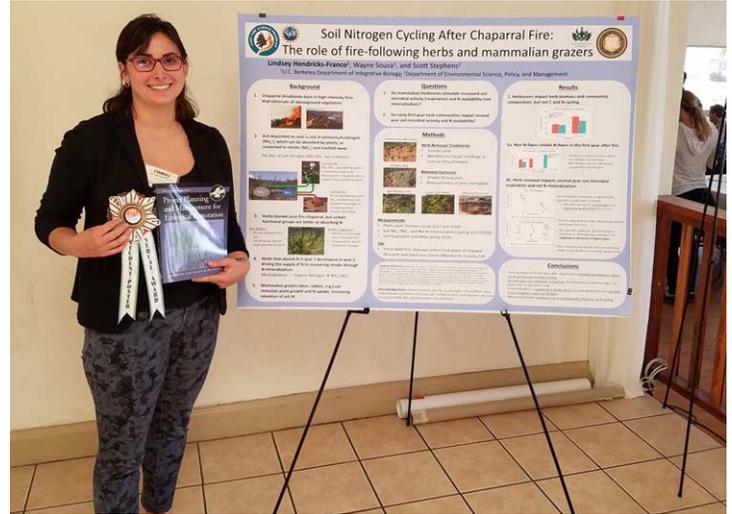
years, Dr. Griswold has been on the board of Los Angeles Audubon Society and currently serves as President. Her proudest achievement with Los Angeles Audubon Society has been the creation of a successful environmental education program serving traditionally underserved areas of Los Angeles.

Student Poster Award: Linking herbaceous plant growth and soil recovery after fire in California shrublands

Lindsey Hendricks-Franco^{*1}, Wayne P. Sousa¹, and Scott L. Stephens²

¹University of California, Berkeley, Department of Integrative Biology, lindsey.g.hendricks@berkeley.edu ²University of California, Berkeley, Department of Environmental Science, Policy, and Management

Restoration strategies that target soil quality can drive revegetation efforts, enhance soil-based ecosystem services, and increase resilience to future disturbance. However, a challenge in implementing soil-based restoration goals is the lack of research linking above-ground and below-ground ecology. I investigated how naturally occurring herbs drive the recovery of post-fire soils in California chaparral shrublands. After fire, bare soil is coated with ash rich in mineral nitrogen, which provides fertilizer for recovering plants, but can also be washed away from soils, polluting nearby bodies of water and slowing shrub growth. Luckily, burnt chaparral soil is rapidly colonized by abundant and diverse native herbaceous plants. While these herb communities may only live for the two years after fire, they play a potentially important role in retaining ash nitrogen in soil and rebuilding soil organic matter. To test the impact of herb functional diversity on post-fire soil N-cycling, microbial activity, and organic



matter formation, I introduced a landscape-scale herb-manipulation experiment (Mendocino County, CA). I weeded 2m x 3m plots so that they contained: (1) all naturally occurring herbs, (2) non-N-fixers only, (3) N-fixers only, or (4) no herbs. In tandem, I established fenced plots to exclude mammalian herbivores, which are predicted to accelerate soil recovery. Preliminary results show that post-fire soil restoration is driven by a mix of N-fixing and non-N-fixing herbs, and that herbivores stimulate soil recovery, especially where herb cover is naturally low. These results will help managers improve disturbed soils through strategic revegetation and grazer introduction.

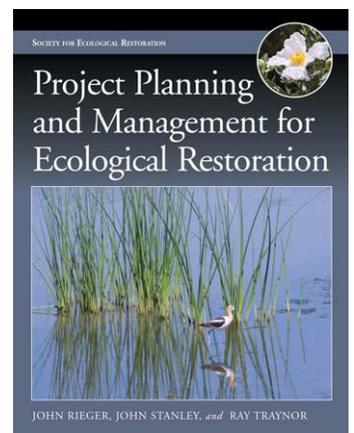
Celebrating the Contributions of John Rieger

Yet another highlight from SERCAL's 25th Annual Conference was a gift made by John Rieger of his vast library (over two dozen boxes of books, journals, and guides) of all things ecological restoration to the UC Irvine Masters in Conservation and Restoration Science program. Not only is he one of SER's key founders and leaders, but also integral to the soon-after founding of the California Society for Ecological Restoration. Educated as a Wildlife Biologist, retired from a long and fruitful career as Caltrans Project Manager, he is now enjoying his new career as a fine woodworking craftsman.

But the story doesn't end there. Over the course of at least a decade, he and his co-authors, Ray Traynor and John Stanley, painstakingly produced a manual based on their popular

workshops. It was published by Island Press in 2014. As you will see, in the above photo, Lindsey is holding a copy which John donated for the winning student poster presentation. SERCAL plans to make this a conference tradition and give all future Student Poster Awardees a copy of this powerful resource.

No longer a student? You can purchase one for yourself from Island Press or Amazon.



Ecological Impacts of Changing Conditions:

Anthropogenic or Climate Drivers of Change	Projected shift	Confidence in shift (based on IPCC definitions of confidence)	Associated ecological impacts	San Diego or southern CA example
Mean annual temperature	General increase	Very high confidence	Species range shifts, novel assemblages	Narrowly endemic, gabbro-associated plants may experience unsuitable temperatures where suitable soil conditions exist
Heat waves	Increase in frequency and severity	Very high confidence	Increased mortality, decreased reproductive success	Potential for exceeding thresholds for some species with known temperature thresholds, e.g., the California owl (<i>Strix occidentalis occidentalis</i>)
Spring drying	General increase	High confidence	Potential to affect biomass	Decreased reproductive success for species that breed in aquatic systems, e.g., arroyo toad (<i>Anaxyrus californicus</i>)
Precipitation variability	General increase	High confidence	Impacts to ephemeral and riparian environments; less stabilizing vegetation and increased erosion can increase allochthonous input	Decrease the shredder functional group of macroinverts, reducing downstream detritus food sources for zooplankton and fish
Droughts	General increase	High confidence	Potential structural shifts in ecosystems	Oak tree (<i>Quercus agrifolia</i>) stress and die-off during the 2012–2016 drought
Pests and pathogens	Increase for some pests and vectors	Medium confidence	increased lethal and sub-lethal effects	Bark beetle-caused mortality in coniferous forests and riparian tree dieback caused by shothole borer and fusarium fungal pathogen
Land use change + habitat fragmentation	General increase	Very high confidence	Habitat degradation and loss of landscape connectivity	Disconnected habitats for species like the mountain lion, leading to lack of gene flow and population declines
Fire frequency	General increase	High confidence; depends on urbanization combined with fire	Type conversion to non-native grasses	Reduced habitat for shrubland species like the California gnatcatcher that has lost nesting habitat to repeated fires
Santa Ana winds	Unknown	More research needed	Plays a role in fire cycle	Longer dryness extending into Santa Ana Wind season may increase fires under dangerous fire weather conditions
Coastal low level clouds and fog (CLCF)	Unknown	More research needed	Future decreases in CLCF may result in shrub cover decrease and exotic grass cover increase degrading coastal sage scrub	Future decreases in CLCF could increase shrub seedling mortality during summer

An excerpt from *San Diego County Ecosystems: The Ecological Impacts of Climate Change on a Biodiversity Hotspot* Visit April 6 post at www.climate-science-alliance.org/blog for link to complete report

<i>Availability of data/info to understand ecological responses</i>	<i>Existing management options or strategies</i>	<i>Suggestions for future management, research, or monitoring?</i>
Low: Strategic weather monitoring in complex topography and high gradient climatic settings and inconsistent information among species; need trend data	Habitat management for persistence, protection of refugia, adaptation through connectivity or facilitated migration	Conduct trend monitoring for species of interest
Low: Logistical and ethical issues for experimental studies of ecological response of fauna	Maintain adequate habitat to support populations that can persist; provide connectivity for species to move to refugia	Determine if analysis of existing data can provide insight into impacts on plant and animal populations; model climate refugia and focus conservation efforts on those areas
Low: Insufficient long-term data to understand how prolonged droughts affect ecosystem structure	Monitoring of at-risk species and recovery efforts for those that have or can be hardest hit by spring drying	Continuous long-term monitoring at a diversity of habitats
Medium: Monitoring data can be synthesized to examine impacts of large interannual precipitation variability by using monitoring data over the last 7–10 years	The SWAMP includes targeted monitoring of streams; existing focus on cataloguing changes to covered species and habitats	Redesign of current monitoring plans to include indicator sites and species; improved stream gauge monitoring
Medium: Information from recent drought show vulnerabilities of a diversity of species; thresholds that might trigger landscape changes are unknown	Existing monitoring beyond rainfall tracking is unknown	Climate-quality precipitation, wind, humidity, solar radiation, and soil moisture observations in strategic locations, and higher density array of precipitation gauges along topographic gradients in selected ecosystems in conjunction with habitat monitoring
Medium: Information for some pests and pathogens are somewhat well-studied, but potential for novel pathogens is unknown	Surveillance of known pests and pathogens in the region and use of earth detection and rapid response efforts to address outbreaks	Expand surveillance programs to include pathogens with high probability of reaching San Diego or with potential for significant impacts to humans or ecosystems
High: Information on the effects of fragmentation on many species is known and many more species are being researched to determine the population-level effects	Identification and preservation of connectivity across landscapes, including aquatic systems	Identification of spatially-explicit linkage zones for functional connectivity; linkages should be prioritized for conservation with multi-agency stakeholders, and focus on land acquisition and mitigating barriers
High: Existing data support our understanding; the major unknown is degree of future population growth and land use change	Coordinating of fire management with land management on conserved lands	Increased efforts to track type conversion or areas at risk; fire suppression and prevention efforts should be focused on these areas
See fire	See fire	Same as fire
Medium: Knowledge can be gleaned from work in other regions of California (e.g., northern CA and the Channel Islands) but research linking to impact of CLCF to biodiversity is sparse	Recent remote sensing work has made spatial CLCF data available, thus making investigating the effects of CLCF on San Diego ecosystems much more accessible	Monitoring to determine if coastal plain with CLCF can act as a climate refugium

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- Lindsay Teunis**
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SERCAL Board member Shirley Innecken and 2017–2018 SERCAL President (and Conference Chair Extraordinaire) Ralph Vigil made sure everyone felt welcome at the conference. Thanks to ALL our Board members for their help! *Photo courtesy Cindy Thompson.*

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