Talk Abstracts

Devil to pay: detection and ten years of management of *Chromolaena odorata* (devil weed) in Hawai'i. Jane R. Beachy, Army Natural Resource Program, O'ahu. beachy@hawaii.edu

In 2011, devil weed (*Chromolaena odorata*) was spotted during an early detection road survey in the U.S. Army's Kahuku Training Area on the island of O'ahu, Hawai'i. This was the first Hawai'i state record of *C. odorata*, touted as one of the 100 worst weeds in the world by the Global Invasive Species Database. The Army Natural Resources Program on O'ahu (ANRPO) uses early detection inventory surveys and incidental observations to identify new invasive plant threats to native habitats and Army training lands. Threats posed by new finds are assessed using a variety of tools, and management actions are developed and implemented for priority invasive taxa. While some of ANRPO's early detection taxa require comparatively low effort (person hours) to eradicate, *C. odorata* continues to pose major challenges. ANRPO ground control averages 1,200 person hours annually. Early efforts focused on surveys, infestation control, vector minimization, interagency communication, and outreach. Despite aggressive control and strong partnerships, particularly with the O'ahu Invasive Species Committee, *C. odorata* spread to roughly seventeen watersheds across the island over the last ten years and jumped to the island of Hawaii in February, 2021. Particular challenges include a wide variety of difficult to mitigate human vectors, vocal anti-herbicide activists, steep terrain, dense vegetation, bees, UXO, resource and staffing limitations, and the shockingly invasive characteristics of *C. odorata* itself. While ground control continues, interagency working groups are actively pursuing a biocontrol, encouraging landowners to control infestations, and soliciting volunteers to survey and control plants on public trails.

PRESCRIBE: online database for protection of endangered species from pesticides. Catherine Bilheimer, California Department of Pesticide Regulation. Catherine.Bilheimer@cdpr.ca.gov

For over 20 years, the California Department of Pesticide Regulation (DPR) has worked with local stakeholders to develop an endangered species protection program that integrates information on all federal and state listed species, species habitats, and related use limitations for all pesticides registered in California. The core of DPR's Endangered Species Program is a free, Web-based database application that allows pesticide applicators and others to identify local habitat for endangered animals and plants, and advises applicators on required use limitations when necessary. The system is called PRESCRIBE, for "Pesticide Regulation's Endangered Species Custom Real-time Internet Bulletin Engine." PRESCRIBE (https://cdpr.ca.gov/docd/es/prescint.htm) replaced more than 2,500 pages of endangered species protection bulletins for the state's 58 counties. It contains location records for over 1,300 endangered, threatened, and other special status species, encompassing almost 80,000 unique land sections. It also can search for 30,000 pesticides by brand name, as opposed to the previous paper bulletins that listed only the name of an active ingredient. In PRESCRIBE query, the user selects the location where they intend to apply pesticides and the pesticide they intend to use. The database application looks up the species that occur in the selected section(s) and the active ingredients in the selected pesticides and generates a report of what listed species occur in the area and what use limitations may apply to the selected pesticides for protection of those species.

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Raising awareness and building capability to manage early invader weeds in Victoria, Australia. Kate Blood, Bianca Gold and Bec James. Department of Environment, Land, Water and Planning, Victoria, Australia. kate.blood@delwp.vic.gov.au

In southeastern Australia, a small team is helping biodiversity managers, including community groups, deal with early invader weeds. The Weeds at the Early Stage of Invasion (WESI) project in Victoria focuses on high-risk invasive plants at the early stage of invasion that threaten biodiversity on public land. The WESI team builds capability and raises awareness through training activities, webinars, social media, newsletters, and other communication methods. The project team are active on social media and have found it a great way to help people with weed identification and share other advice. A popular quarterly newsletter helps to keep over 600 subscribers up-to-date with recent early invader weeds and training activities. Weed identification training around the State of Victoria has helped raise awareness about early invader weeds. A webinar series about weed management after fire received interest from around the world. These engagement activities are accompanied by the team's support of over 90 weed cases for the last 12 months. WESI = https://www.environment.vic.gov.au/invasive-plants-and-animals/early-invaders Facebook Group = https://www.facebook.com/groups/earlyinvaderweeds.vic
Webinar series = https://tinyurl.com/WeedsAfterFire

Implications of climate change for invasive species. Carrie Brown-Lima, NY Invasive Species Research Institute, Cornell University. cjb37@cornell.edu

Invasive species and climate change are two of the most prominent forms of anthropogenic global change identified by the Millennium Ecosystem Assessment. Invasive species have pronounced negative impacts on ecosystems and economies, and these impacts may be exacerbated by climate change. But for most invasive species and invaded ecosystems, the outcomes of this interaction remain unknown. This presentation will review the current state of knowledge about how climate change influences invasive species as well as describe the work of the Regional Invasive Species and Climate Change networks that are bringing together researchers and practitioners to address this challenge. This information is critical for conservation efforts like 30x30 that seek to protect biodiversity and provide climate resiliency.

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Weed Alerts and other Invasive Plant Updates for 2021. Jutta C. Burger, California Invasive Plant Council, jburger@cal-ipc.org. Robert Price, California Department of Food and Agriculture. robert.price@cdfa.ca.gov

New species that have been introduced from other parts of the world are regularly found growing wild in California. Some of these spread quickly and impact native habitat, waterways, and agricultural lands. Others do not. Each year, we select a handful of the species that are newly discovered in the state or a cause for concern because of spread within the state to highlight as our “Weed Alerts”. This year, Cal-IPC and CDFA are again joining together to showcase our selection of new and notable non-native plant species for 2021, chosen from nominations provided by regional land managers and botanists across the state. We will also provide an update on the Cal-IPC inventory and CDFA-listed weeds.

Drone imagery and a simple spatial analysis technique for long-term mapping of stinknet (*Oncosiphon piluliferum*). Emily Burson, San Diego Zoo Wildlife Alliance. eburson@sdzwa.org

Spatial data on changing populations of invasive plant species over time is important for land managers assessing the effectiveness of invasive plant management efforts. Stinknet (*Oncosiphon piluliferum*) is an invasive plant native to South Africa which has established populations in areas of the Southwestern United States. The San Diego Zoo Safari Park Biodiversity Reserve (SPBR) has a large, dense population of stinknet covering at least 200 acres of coastal sage scrub. In spring, stinknet plants produce distinctive, bright yellow blooms visible in aerial imagery. In 2018, we began mapping and monitoring stinknet in the SPBR by digitizing polygons from aerial

photographs taken in 2017 during peak stinknet flowering. In 2021, we captured new, higher resolution 3D imagery using a Trinity F90+ drone in the SPBR. By comparing older satellite imagery with the new imagery, we updated original digitized polygons and conducted a sampling analysis using geographic information system (GIS). This allowed us to quantify changes in stinknet distribution in the SPBR, and test for the effect of our treatments as well as seasonal differences in precipitation and phenology.

Conserving a Global Biodiversity Hotspot: Aligning 30x30 goals at the state and global scale. Dick Cameron and Carrie Schloss. The Nature Conservancy in California. dcameron@tnc.org

The California Floristic Province is a global biodiversity hotspot primarily due to high native plant diversity. California has almost half the state in some sort of land ownership and management that can contribute to biodiversity conservation. Yet, oak woodlands and grasslands are relatively poorly protected, are subject to significant land use and climate change impacts, while harboring high biodiversity. Increasing ownership and management, including invasive plant control, for these habitat types is critical. This presentation will focus on geographic patterns of biodiversity and conservation management and highlight opportunities to meet 30x30 targets while putting ecosystems on trajectory to adapt to accelerating climate change.

Building the data pipeline for managing drone layers. Greg Crutsinger, Planet Inc. greg@scholarfarms.com

Mapping vegetation is undergoing a phenomenal revolution when it comes to imagery. In particular, drones and satellites are producing incredible amounts of imagery data that needs to be processed into 2D and 3D map layers, as well as analytics. This talk will discuss a range of tools and strategies for managing imagery as it relates to vegetation mapping.

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Why justice, equity, and belonging matter in environmental restoration work. Shelana deSilva, Shelana deSilva Consulting. wordwallah@gmail.com

Why do justice, equity, and belonging matter for the work of environmental restoration and stewardship? Beyond the moral case, I will present the case for improved project outcomes, more durable partnerships, and more resilience for the human communities that make up our field of practice. We will go over definitions of basic terms so land managers have a basic understanding of what equity means in the context of land stewardship and identify resources available for further learning and investigation on one's own time. I will present examples of how this looks in practice, how restoration projects, related policy and funding, and partnerships can be strengthened by skill-building in this area of work. Examples from my own experience include restoration legislation and bond funding development; equitable access policy and its relevance to creating future environmental stewards; and how building connections within our network of practitioners can support equitable workforce development, resilience for our field of practice, increased resource-sharing and funding, and stronger partnerships.

Investigating drivers of plant abundance and community structure on fuel breaks. Robert Fitch[1]*, Carla D'Antonio[1], and Nicole Molinari[2]. [1]University of California, Santa Barbara. [2]USDA Forest Service. robertfitch@ucsb.edu

As the number of large and destructive wildfires increase across California, emphasis has been placed on fuel modification. Thousands of miles of fuel breaks have been created which become dominated by non-native annual grasses and forbs which along with anthropogenic wildfire, pose direct threats to biodiversity. Thus, there is a need to balance the ecological impacts of fuels management and the stability of shrubland ecosystems. However, these areas are subject to novel disturbances and are comprised of novel communities. Previous studies have examined the effects of fuel break construction on vegetation cover, invasive species, and fuel structure. Yet, we do not understand how biotic factors, abiotic factors, or

disturbance regimes influence community structure in these types of novel habitats. This information will allow land managers to identify strategies to reduce impacts of invasive species and potentially serve to inform future restoration or rehabilitation. We surveyed fuel breaks within the Los Padres National Forest, estimating plant cover within 1m x 1m quadrats stratified across a 50m baseline transect intersected with perpendicular transects every 5m. We used USFS records, aerial imagery, and fire incidence reports to recreate their disturbance history. Using GIS and online data repositories, we complied several abiotic variables. To measure biotic interactions, we created community weighted means of species traits related to competition and dispersal. We then analyzed how these factors affected plant abundance, diversity, and community structure. Differences in community structure were mostly driven by differences in disturbance regime (type and frequency) creating distinct communities across fuel breaks of the region.

Post-Fire Surveys for Rare and Invasive Plants in the San Bernardino Mountains, San Bernardino and Riverside County, California. Naomi Fraga, Joy England, and Duncan Bell. California Botanic Garden. nfraga@calbg.org

In 2020, California experienced a record-setting year of wildfires that burned across the state, as measured during the modern era of wildfire management and record keeping. Post-fire spread of non-native plant species are a significant concern in recently burned habitats because they are vulnerable to invasion due to changes in resource availability (e.g. increased light and nutrients) and there is potential for firefighting activities to disperse propagules into novel locations. In 2021 the California Botanic Garden, in partnership with the San Bernardino National Forest (SBNF) and in collaboration with the California Native Plant Society San Bernardino/Riverside Chapter conducted post-fire surveys with an emphasis on documenting invasive species and their potential impact to rare plant populations. The SBNF is notable for its high diversity of rare and endemic plant species, some of which are fire followers (e.g. *Sidalcea hickmannii subsp. parishii*). These post fire surveys provide botanists with an opportunity to investigate the impacts of non-native plant species on rare plant populations and facilitate early detection and rapid response (e.g. treatment and eradication). Example invasive species that we documented include: *Carduus pycnocephalus*, *Chondrilla juncea*, *Oncosiphon piluliferum*, and *Secale cereale*.

Plant-soil feedbacks: the benefit of field-based community level study in uncovering their role in restoration. Sarah Gaffney[1]*, Carolyn Malmstrom[2], Valerie Eviner[1]. [1]Plant Sciences, UC Davis, CA. [2]Plant Biology, Michigan State University. sagaffney@ucdavis.edu

Plant-soil feedbacks (PSFs) occur when a plant changes soil properties that then directly affect plant growth, influencing community assemblage. Often, plant species experience negative feedbacks (perform worse in their own soil) due to pathogen build up, which allows for species diversity. However, invasive plants often produce positive feedbacks that hurt native species. In California grasslands, Eurasian grasses are known to alter nitrogen cycling, deep soil organic matter, and microbial community composition. Short-term greenhouse studies suggest these changes negatively affect native grasses. We investigate the significance of PSFs in California grasslands in a more realistic long-term field setting as well as their relative importance in relation to competition. From a larger grassland experiment in Davis, CA, 90-cm deep soil cores were taken from 16 plots dominated by either exotic or native grasses for 10 years to compare soil properties. Denuded plots were divided into subplots, seeded with either native mix, exotic mix, or native+exotic mix. Plant performance variables encompassing all life stages were measured for two growing seasons. Exotic-conditioned soils had lower net mineralization and nitrification rates in the top 15-cm of soil, as well as distinct bacterial and fungal community composition. Native grasses performed better in exotic-conditioned soil in height, community-level cover, and community-level flowering individual count, but only in the native mix, as natives did not establish well in competition with exotics. These results suggest that native performance is not hurt by exotic changes to the soil, but is instead likely governed

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by pathogen build up, and more importantly, competition.

Aerial drone application and uses in treating wildland invasive plants. Troy Gibbs, T&T Endeavors LLC, Rantizo. troy.gibbs@rantizo.com.

Drone technology has taken off in recent years. Imaging and data collection drones have proven to be valuable tools in agriculture. Now, drones capable of putting that data to use by applying targeted spraying and seeding applications are being utilized across the US. This technology has uses well beyond agriculture and has proven effective in natural resource management efforts to control invasive plants. Drones can maneuver difficult terrain and apply product precisely where it needs to be. In this presentation we will take an in-depth look at how drones are being used to identify, map and spot treat invasive species on a large scale.

Giant reed (*Arundo donax*) control on the San Luis Rey River Watershed from 2000 to 2021- persistence, perspective and patience (transformation, but still on the wheel). Jason Giessow, Dendra Inc. jgiessow@cox.net

A detailed review of a large-scale watershed based giant reed (*Arundo donax*) control program on the San Luis Rey Watershed that seeks to eradicate this plant that once covered over 650 acres of riparian habitat from the main river stem and multiple tributaries (creeks). Role of watershed based permitting, mapping, and grant funding strategies (for both initial control and long-term retreatments). Review of methods for both initial control and re-treatments, the challenge of dealing with Arundo biomass, and low effort re-vegetation (cuttings). Exploration of the complexities of maintaining Right of Entry (ROE) agreements for over 500 properties and tracking 'holdouts' over time. Comparative results of before, during, and current condition of multiple areas over 20 years using both aerial, ground based photo points, transect and re-treatment GPS point data. This information demonstrates that the program is achieving nearly 100% control, but that at large scale, re-treatments are still required to push the program toward eradication. Current strategies to speed up the efficacy of re-treatments are also explored as well as obstacles that are jeopardizing comprehensive control at the watershed scale.

Herbicide Symptomology Refresher for Restoration Practitioners. Brad Hanson, UC Davis. bhanson@ucdavis.edu

Herbicides can be incredibly powerful and effective tools for control of invasive and endemic weeds in wildlands and restoration sites as well as crops and non-crop areas. Weed control is critical for site restoration and practitioners have access to a number of herbicide active ingredients with different modes of action. Some of these are nonselective and others are selective. Some are applied to soil and are taken up by roots while others are applied to the foliage of emerged plants. Occasionally, herbicides injure non-target plants due to drift, misapplication, carryover in soil, or other types of inadvertent exposure. A basic understanding of herbicide action, typical symptoms caused by different classes of herbicides, and potential routes of exposure can be invaluable to the investigator when diagnosing plant problems known or suspected to be caused by herbicides used in site restoration.

Making UAVs part of your research toolkit: Some common workflows for vegetation mapping. Maggi Kelly, Sean Hogan, Andy Lyons. UC ANR, UC Berkeley, CA. Maggi.kelly@gmail.com

Unoccupied aerial vehicles (UAVs) or drones are increasingly being used in ecological and environmental research, particularly in applications that involve mapping of vegetation. There are multiple steps required to ensure smooth flying with a UAV in vegetation mapping: equipment, regulation, flight and data collection, analysis, and use of data products. This talk will review some of the key lessons learned in incorporating UAVs into your research workflow, and suggest key resources available for continued expertise.

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Cycles of EDRR on Mt. Tamalpais. Rachel Kesel, David Greenberger, Michael Sturtevant. One Tam Conservation Management Program, CA. rkesel@onetam.org

The One Tam Conservation Management Program completed the second cycle of EDRR surveys of the road and trail network on Mt. Tamalpais in 2021. Analysis of data from the first cycle and lessons learned from six years of survey and treatment point to a need for modest program revisions in the third cycle. EDRR on Tam remains an adaptive practice, with important changes in target species, survey geography, and staffing models to ensure robust program delivery. This talk will look at the sweet spot between structure and flexibility in executing an EDRR protocol in a partnership environment.

Utilizing pathways of invader dominance to identify natives of concern. Marina LaForgia[1], Andrew Latimer[2], Susan Harrison[3]. [1]Department of Evolution and Ecology, UC Davis. [2]Department of Plant Sciences, UC Davis. [3]Department of Environmental Science and Policy, UC Davis. marina.laforgia@gmail.com

In California annual grasslands, native forbs are often restricted to less fertile serpentine soils while surrounding non-serpentine soils are dominated by native annual grasses. In finely textured serpentine soils with higher nitrogen content however, invasive grasses are able to invade, resulting in a unique community of high invasive grass abundance and high native diversity. This native diversity is declining. Understanding the pathways of invader dominance over natives in these remnant communities as well as which natives may be most resistant to invasive grasses can help target effective methods to conserve and increase native forb abundance in these systems. Here, I present the results of various studies describing how invasive annual grasses alter the competitive and structural environment that natives experience in serpentine grasslands. I highlight how these pathways of invader dominance differ between forbs with contrasting growth strategies and how rainfall affects the strength of this dominance. Together these studies reveal the importance of grass litter in maintaining dominance over natives and our need to focus conservation on native forbs with fast resource acquisition.

Leveraging partnerships to advance giant reed (*Arundo donax*) removal and restoration in a large, biodiverse southern California river. Dr. Adam Lambert[1], Sean Carey[1], Laura Pavliscak[2], Pete Dixon[3], Evan Hobson[1], and Shawn Kelly[2]. [1]University of California, Santa Barbara, [2]Santa Clara River Conservancy, [3]The Nature Conservancy. alambert@ucsb.edu

The Santa Clara River (SCR) is the largest river system in Southern California remaining in a relatively natural state and retaining the functional hydrology to serve as a critical coastal water resource for the region. The watershed supports numerous rare natural communities and 38 special-status species, including more than 20 that depend on the waters of the SCR and/or its associated riparian ecosystems. A key stressor is the widespread invasion by *Arundo* (giant reed; *Arundo donax*), which displaces native vegetation and riparian-dependent wildlife, exacerbates erosion and flooding, promotes wildfire, and transpires excessive amounts of water. In 2000, the State Coastal Conservancy initiated the Santa Clara River Parkway Program with the primary goals of conservation land acquisition, riparian habitat restoration including *Arundo* eradication, and public access. Over time, watershed stakeholders have developed this initiative into a robust and collaborative restoration effort including non-profit, university, private landowners, and agencies. While a 'headwaters down' approach to *Arundo* removal is logistically unfeasible in a large watershed, the ultimate goal is to reduce the impacts of Arundo at a sufficient spatial scale that significant landscape-level benefits for wildlife and humans are realized and permanently maintained. To date, *Arundo* has been removed from over 1000 acres of riparian floodplain habitat with an emphasis on protecting and maintaining these *Arundo*-free zones. This substantial effort and financial investment has only been possible by building watershed-wide cooperation and leveraging the expertise of diverse stakeholder groups.

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Challenges managing the novel large-scale invasion of stinknet (*Oncosiphon pilulifer*) post-fire on the Santa Rosa Plateau Ecological Reserve. Hailey Laskey[1], Zachary Principe[2]. [1]Center for Natural Lands Management. [2]The Nature Conservancy. hlaskey@cnlm.org

Land managers may normally implement early-detection rapid-response surveys after disturbance events like wildfires to detect new invasions of non-native species—either new species or invasions into new areas. If detected, the extent of the occurrence and the available resources are assessed to inform a plan for treatment. Eradication may not always be an achievable goal, depending on circumstances and available resources. In September 2019, the Tenaja Fire burnt through 1,700 acres of 40-year-old oak woodland and chaparral habitat on the Santa Rosa Plateau Ecological Reserve. We conducted early detection and rapid response surveys in the Winter of 2020 within the burn scar and stinknet (*Oncosiphon pilulifer*) was discovered throughout the burn area shortly after the California State lockdown for the COVID-19 pandemic. With limited staff and volunteer capacity influenced by the pandemic, we focused Spring 2020 rapid response treatment around high public access areas to prevent the spread of stinknet throughout the Reserve. We hand-pulled over 600 plants within approximately 500 acres of the 1,700-acre burn. Unfortunately, many more stinknet plants were left untreated in the remaining 1,200 acres at the ecotone of high-quality purple needle grass (*Stipa pulchra*) perennial grasslands. Fall 2020, Winter 2021, and Spring 2021 mapping and treatment area priorities continually shifted as stinknet was discovered adjacent to sensitive species habitat. Within this presentation we provide insights on how we adapted management priorities for the large-scale invasion of a noxious plant adjacent to one of the last remaining contiguous areas of perennial grasslands in Southern California.

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How soil microbes drive and respond to plant invasions in Mediterranean ecosystems: insights from Australian acacias. Jaco Le Roux, Macquarie University. jaco.leroux@mq.edu.au

It is only recently that ecologists have begun to appreciate the impacts of invasive species on the unseen majority: microbial communities. Microbes play critical roles in the outcomes of non-native species introductions, e.g. release from pathogens or mutualists in the new range. I will discuss the role of mutualisms between legumes and rhizobia in the extraordinary invasion success of Australian acacias (genus Acacia) in Mediterranean ecosystems. In areas like South Africa's Fynbos biome, different acacia species show variable invasiveness, yet highly and less invasive taxa share the same rhizobia, suggesting that mutualist limitation is not at play. Phylogenetic analyses illustrate that these rhizobia were co-introduced with acacias from Australia. So, what are the consequences of these co-invading plant-bacterium partners for native biodiversity? Ecological networks indicate that acacias and native legumes form highly distinct interaction modules with their associated rhizobia. Co-introduced Australian rhizobia are also distinct from native South African rhizobia, and specialist native legumes are more severely impacted by the presence of acacias and their co-introduced rhizobia than generalist native legumes. Experimental data confirm that co-introduced rhizobia give acacias a competitive advantage over native legumes. Ex planta, dense acacia invasions also homogenise soil rhizobium communities, contributing to positive acacia-soil feedbacks. I will discuss all of the above in the context of invasive species ecology and how this knowledge can be used to assist ecological restoration in Mediterranean ecosystems.

Community scientists help to map post-fire recovery on California's central coast. Josephine Lesage[1], Denise Knapp[1], Steve Windhager[1], and John Gallo[2]. [1]Santa Barbara Botanic Garden, CA. [2]Conservation Biology Institute. jlesage@sbbg.org

Following fires, invasive species can gain footholds in new areas and spread across landscapes. As the acreage of California affected by wildfires grows larger each year, surveying for invasive species in burn scars

becomes increasingly difficult. Working with community scientists provides an opportunity to develop informed maps of invasive plant distributions, while also engaging local trail users in conservation. The Mapping Recovery project at the Santa Barbara Botanic Garden leveraged the enthusiasm of over 100 volunteers to survey invasive plants in the Thomas and Whittier fire scars of Ventura and Santa Barbara Counties using iNaturalist. Our twin goals were to improve the known distribution of invasive species in these fire scars (thus informing the next phase of restoration action) and to compare the effectiveness of community scientist mapping with staff surveys. Together, we gathered over 4000 datapoints on the locations of plants in these fire scars. We significantly expanded the known locations of many common invasive species, while also identifying populations of some rare or new invasive species. Community scientists were effective surveyors of showy, easy to identify species, but they generated erroneous data for cryptic species and grasses. We also found that there were pitfalls associated with plant identification and technology use that should be considered when designing successful community science projects. Overall, we argue that programs that involve local recreators as surveyors are effective tools for mapping invasive species at local and regional scales, providing invasive species education, and developing community support for invasive species management.

Batman on a budget: affordable gadgets, gear & workflow for collecting field data. Brooke Mahnken and Adam Knox, Maui Invasive Species Committee. mahnken@hawaii.edu

Data collection for fieldwork is a critical component for any invasive plant management team. Often underfunded and overcommitted, teams need inexpensive tools to get the job done while exhausting as few resources as possible. There are now many options to choose from. Presented herein is an assemblage of devices and gear used for spatial and tabular field data collection in Maui, Hawaii by the Maui Invasive Species Committee. These tools are used in a variety of environments ranging from dense tropical jungle, dry scrubland, or wet montane forest. While there are increasingly more options coming online, we've highlighted a range of affordable equipment that has suited our needs well in some of the most rigorous environments while meeting our data needs for complex analysis. With savings like this, Bruce Wayne will be able to afford to keep Alfred on full-time status.

Using plastic tree shelters and mechanical weeding practices to improve post-fire ecological restoration of highly invaded California native plant communities. Mark Mazhnyy* and Erin Questad. California State Polytechnic University, Pomona, CA. mvmazhnyy@cpp.edu

Many Southern California shrubland communities are highly invaded and in need of restoration. Plastic tree shelters, typically used to protect tree seedlings from herbivory, have been shown to ameliorate physical stresses experienced by seedlings and facilitate their growth. This study examined how tree shelters affect shrub seedling germination and establishment in a restoration of a highly invaded mixed chaparral and coastal sage scrub community in the Angeles National Forest. The study incorporated 30 sites, which were weeded regularly using a string trimmer. At each site, locally harvested seed of native shrub species was seeded in exposed, caged, and sheltered treatments. Seedling presence and survival after ten months were recorded. Abiotic data collection included total solar radiation, soil volumetric water content, and air temperature. A nursery-raised outplant treatment was included to compare the cost of seeding into shelters versus outplanting. Seedling presence and survival were highest inside shelters, which was especially evident on steep, south-facing slopes. Although shelters increased air temperatures, they were also able to reduce total solar radiation exposure and retain higher soil moisture levels, as well as protect seedlings from herbivory. All restoration treatments reduced invasive cover during the first year and most increased native cover; however, the cost of outplanting was nearly eight times higher than the cost of seeding into shelters. Therefore, tree shelters are recommended for low-cost plant community restoration from seed in arid and semiarid environments, where amelioration of environmental

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stresses, including herbivory, is crucial to seedling survival.

Lessons learned after nearly 10 years of managing and monitoring stinknet (*Oncosiphon pilulifer*) across Southern California. Chris McDonald**,** University of California Cooperative Extension. cjmcdonald@ucanr.edu

Stinknet is an annual weed that over the past decade has become abundant in several parts of Southern California and has been rapidly spreading. It continues to spread across California, Arizona and Northern Mexico. We started managing stinknet by conducting herbicide trials with partners and teaching land managers how to identify and report stinknet. Proper timing of applications is very important to ensure successful control. In addition, several post-emergent and pre-emergent herbicides were found that provide excellent control of stinknet populations. Since 2015 the number of stinknet populations that have been reported has also increased 10-fold.

What NOT to do when applying herbicides. LeeAnne Mila, El Dorado and Alpine County Agricultural Commissioner's Office. Leeanne.mila@edcgov.us

Do you live in fear that you might not be complying with state code when applying herbicides? Fear no more. This presentation will show you examples of the most common pesticide application violations for wildland weed workers and easy steps to correct them. All aspects of the pertinent laws and regulations will be discussed along with various ways to ensure compliance. Laws from the Food and Agriculture code, Divisions 6 and 7 will be discussed as well as the California Code of Regulations, title 3. You'll be getting a refresher on worker protection issues, container requirements, transportation issues, and more.

Understanding Herbicide Labels and How to Use Them. Beau Miller, Corteva. beau.miller@corteva.com

This presentation will review labels of several of our most commonly used herbicides in wildlands, how to increase efficacy and safety when applying them. Beau Miller will describe herbicide label basics, recent changes to Personal Protective Equipment requirements, and methods to improve treatment results by combining herbicides with different modes of actions. Finally, he will provide examples of how different formulations (e.g., amine, ester, and cholines), surfactants and water conditioners can affect drift and efficacy.

***Caulerpa prolifera* eradication and monitoring in Newport Bay.** Brian Owens, Senior Marine Biologist, California Department of Fish and Wildlife. Brian.Owens@wildlife.ca.gov

In April 2021, the non-native alga *Caulerpa prolifera* was confirmed growing in the China Cove area of Newport Bay. The species has invaded seagrass and soft-bottom habitats in the Suez Canal (A-F.A. Gab-Alla 2007), the Canary Islands (Tuya et al. 2013), and Portugal (Parreira, et al. 2021), dramatically displacing native biota. Further, based on environmental impacts of other *Caulerpa* species, this alga is potentially a serious invasive species. Allowing any species of *Caulerpa* to become established and spread within California coastal areas and embayments is likely to result in considerable economic, recreational, and biological impacts. The seriousness and acknowledged threat from its close relative, *Caulerpa taxifolia*, prompted an effective, highly successful *C. taxifolia* eradication project in two southern California locations over a period of eight years at a cost of over seven million dollars (M&A 2006). In April, the California Department of Fish and Wildlife and the Santa Ana Regional Water Quality Control Board reconvened the Southern California Caulerpa Action Team (SCCAT), a multiagency working group, for the purposes of addressing the *Caulerpa prolifera* infestation in Newport Harbor. A group of technical experts drafted a Rapid Response and Eradication Plan for the SCCAT's consideration. The SCCAT approved the plan on May 19 and took immediate action to begin implementing it. Funding for implementing Phase 1 of the Eradication Plan (i.e., removal/treatment of the *Caulerpa* in China Cove) is being provided by the State Water Resources Control

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Board's Cleanup and Abatement Account. The Regional Water Board's consultant, Merkel and Associates, completed removing the *Caulerpa* from China Cove on July 14 using diver operated dredging and teams of divers collecting loose material, "rollers". The collected material was hauled away for upland disposal by the City of Newport Beach after thorough drying to kill the algae. Additional four-week surveys were completed between August 11 and August 17. These surveys found 121 fragments including attached and rollers. The collected material shows evidence of emergence from sand burial and remains represented by small fragments, and Phase 1 eradication is still ongoing. The SCCAT is currently considering revising the schedule of the post-removal surveys due to the continued high finds of new fragments, even though the overall biomass remaining has been decreasing. The SCATT is also reviewing Phase 2 and Phase 3 plans for post eradication surveys and long-term monitoring. One goal is to use eDNA as a survey tool for both post eradication surveys (to ensure the algae has been completely removed from Newport Bay) and for first strike detection in the future to prevent Caulerpa from establishing in this bay or others in Southern California. Outreach efforts will continue with updated materials, public signs, pamphlets and via the Department's website to ensure the public is aware of what to look for and how to handle finding *Caulerpa*, should it appear again.

Chile and California: What can we learn from comparing plant invasions across regions and hemispheres? Aníbal Pauchard, University of Concepción. pauchard@udec.cl

Biological invasions are causing major impacts in multiple regions of the world but what can we learn from comparing invasions in different regions and hemispheres? Can we improve management by comparing experiences in the Northern and Southern hemispheres? For years, my lab, my collaborators and I have been studying plant invasions in these biomes and have conducted comparative analyses to understand what drives plant invasions and how to better manage them. We have focused on nonnative floras, but also have looked at plant communities in mountain systems.

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In this presentation, I will present results from our comparative work between climatically similar regions and global analysis of the Mountain Invasion Research Network (MIREN). For example, we have compared the non-native flora of the State of California in the United States and central Chile, which reveals a higher naturalized species diversity for California compared to Chile, at all taxonomic levels and more diverse origins for species in California. However, in both regions, human ecological footprint is the main factor driving invasions. In the case of mountain plant invasions, and with a much larger dataset, we have been able to determine a very similar pattern of invasion independently of the biome and hemisphere. Finally, I will use the genus Pinus, which is highly invasive in South America, to briefly discuss management challenges in these biomes and how comparative approaches may help to broaden our policy and management toolbox.

Restoring Gaviota tarplant in a sea of ice plant: challenges and opportunities. Laura Riege, M.S.[1], Heather E. Schneider, PhD[2], and Jutta Burger, PhD[3]. [1]The Nature Conservancy. [2]Santa Barbara Botanic Garden. [3]Cal-IPC. lriege@tnc.org

Gaviota tarplant (*Deinandra increscens ssp. villosa*) is a federally endangered species endemic to the central coast region around Point Conception, Santa Barbara County, CA. Tarplant populations on The Nature Conservancy's Jack and Laura Dangermond Preserve are a stronghold for the species, which is threatened by habitat loss due to development and encroachment by invasive species like *Carpobrotus spp*. and *Ehrharta calycina*. The Nature Conservancy convened a science working group to address the many challenges of removing more than 1,000 acres of *Carpobrotus* and restoring native plant communities on the coastal bluffs, wetlands, and headland dunes at Point Conception on the Dangermond Preserve. TNC's collaborators at the Santa Barbara Botanic Garden and Cal-IPC are monitoring Gaviota tarplant populations and reproductive success on the preserve at sites currently dominated by invasive species. This talk presents early results from population and reproductive studies and approaches to remove invasive species in the light of

on-the-ground restoration challenges, including cultural resource protection and shifting drought patterns associated with global climate change.

Linking the accounting with the inspiration: The challenge of bold time-bound conservation goals like 30x30. Tom Robinson, TOGETHER Bay Area, tom@togetherbayarea.org

The state's goal of conserving 30% of lands and waters by 2030 is a bold, measurable, and time-bound goal against which progress can be measured. The challenge for 30x30 is linking the accounting framework to set goals and measure progress, and the inclusive approach which inspires conservation across the state. The San Francisco Bay Area conservation community established a similar goal in 2019: to conserve 50% of the region by 2050. The blueprint for achieving this goal is called the Bay Area Conservation Lands Network (CLN). The product of 15 years of regional collaboration, the CLN tracks conservation action over time and compares it against habitat-level acreage goals and the overall 50x50 goal. In this way, the CLN acts both as an accounting framework to track and communicate progress and an inspiring vision that focuses conservation efforts across the Bay Area. The CLN can serve as a model for the statewide 30x30 initiative. But the state and the CLN need to evolve our current modes of accounting and our vision for conservation to include metrics of stewardship and ecosystem health, and inclusion of all communities in the planning process, especially Indigenous people who stewarded California lands and waters for thousands of years. As a core aspect of stewardship, invasive plant management is important to capture in CLN and 30x30 as we move forward.

Protecting Wild Spaces through Invasive Species Management: A Case Study from British Columbia. Jodi Romyn and Gail Wallin, Invasive Species Council of BC. gwallin@bcinvasives.ca

Invasive species don't respect boundaries. The Invasive Species Council of BC recognizes that it is critical to build and maintain partnerships and cultivate strong leaders to increase collaboration, improve on-the-ground efficiency, influence relevant research, and provide timely information to help protect the biodiversity of British Columbia's unique wild spaces. As such, ISCBC works with a wide array of partners including local governments, Indigenous communities, industry and governments to develop training, recognition programs, best practices and management strategies. We know our goal of minimizing the spread and impact of invasive species is an ambitious one. To help us succeed, we take every opportunity we can to communicate the benefits of protecting biodiversity and stopping the spread of invasive species to people and organizations across BC through behavior change programs, public campaigns and training programs. Recognizing that community engagement is key to our vision we cultivate awareness and action through outreach, school education, community science programs and youth volunteerism. Our efforts show great promise in the journey towards protecting BC's biodiversity, as we inspire action in future generations. This presentation will look at how we engage with our diverse partners and audiences to prevent the spread of invasive species and protect biodiversity in BC.

The Role of Invasive Species Management in Achieving 30x30. Christina Sloop[1], Madeline Drake[1], and Dr. Jennifer Norris[2]. [1]California Department of Fish and Wildlife. [2]California Natural Resources Agency. christina.sloop@wildlife.ca.gov

In October 2020, Governor Newsom issued Executive Order N-82-20 calling for California to conserve 30% of its lands and coastal waters by 2030 to protect biodiversity, combat climate change and expand equitable outdoor access for all Californians. The executive order called for the California Natural Resources Agency and the California Biodiversity Collaborative, a network of conservation organizations and leaders across the state, to coordinate on advancing 30x30. The California Natural Resources Agency has been working through the California Biodiversity Collaborative and an inclusive public engagement process to develop the "Pathways to 30x30" document that will report on strategies for achieving 30x30, and the "CA Nature" geographic

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information system that will track progress and present opportunities for reaching the 30x30 goal. To protect the State's exceptional biodiversity, it will be necessary to consider the importance of prevention, early detection/rapid control, and eradication of invasive species on lands and coastal waters as part of the 30x30 goal. In this light, the State recognizes the need for invasive species monitoring; for science informing active management, long-term stewardship; and to consider invasive species when thinking about connectivity.

Drone regulations and safety. Brandon Stark, UC Merced. bstark2@ucmerced.edu

Interested in flying a drone for agricultural purposes? In this brief presentation, we'll go over drone regulations and safety. This session will review the background of drone safety practices and describe the landscape of regulations from the local to the national, highlighting what you need to know to stay out of trouble. Recent and upcoming changes to FAA rules will also be described. Although this is not a Part-107 study session, resources for getting your remote pilot license will be shared.

Building continuity across state plant lists: predicting invasion risk of horticultural plants. Alexandria Stubblefield, PlantRight and California Invasive Plant Council. info@plantright.org

The Plant Risk Evaluator (PRE) tool is an online assessment tool used to predict the risk of plants becoming invasive. It was designed by researchers at UC Davis and University of Washington in collaboration with PlantRight, an interdisciplinary partnership convened to prevent introduction of invasive plants through horticulture. Its original focus was solely on ornamental plants since horticulture has been a top pathway for introduction of invasive plants. The PRE tool has also been used by Cal-IPC for assessing risk of invasiveness for other plants that are not yet broadly distributed in California. Those species determined to have a high risk of becoming invasive have been added to its inventory with a "Watch" designation. Funded by a one-year grant from the Western Integrated Pest Management Center (WIPM), Cal-IPC and PlantRight
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have teamed together to form a multi-state work group aimed at expanding use of the PRE tool. The group includes partners in California, Arizona, Oregon, and Washington. As part of this project, we have trained additional users on PRE and are finalizing evaluations for 25 additional species, with 10 being evaluated for California. By broadening adoption of the tool, we can promote collaboration and consistency in invasive plant listing, share information about emerging problem species, and better ensure the ongoing maintenance of this valuable web tool. Our work will be integrated into the ongoing collaborative process convened by the National Association of Invasive Plant Councils (NAIPC) to build continuity across state invasive plant listing efforts.

Direct versus indirect effects of invasive grasses on native plant diversity. Elizabeth Wandrag. University of York. lizzie.wandrag@york.ac.uk

Worldwide, temperate grasslands are highly invaded by non-native grass species introduced for agriculture. These invasions are often associated with a decline in native plant biodiversity. However, it is unclear whether invasive grasses are competitively displacing native species to directly impact biodiversity, or whether they are simply taking advantage of changed environmental conditions to occupy sites that native species can no longer occupy. Understanding which of these two alternatives drives invasion has implications for restoring native biodiversity: management of invasive species may not lead to biodiversity increases where invasions are driven by changed environmental conditions. Compounding this issue is the potential role of soil microbes in modulating the invasion and impact of non-native grasses. Some invasive plant species gain a performance advantage from escaping soil-borne natural enemies when invading new areas, but it is unclear whether this advantage is enough to influence the outcome of competition between native and invasive species to drive invasion. Nevertheless, even if soil biota rarely modulate the outcome of invasion, invasive plant species could alter native soil microbial community composition to indirectly impact native species. I will summarize findings from our research in Australian temperate grasslands that aims to identify

how non-native grass species invade, whether invasive grasses directly impact native biodiversity, and the role of soil microbes in modulating both the invasion and impact of invasive grasses. I will highlight new insights we have gained from studying Australian grasslands relative to more productive grasslands in other locations and discuss the implications for management.

Opportunities to deliver on the promise of 30x30 and "nature-based solutions." Andrea Williams, Director of Biodiversity Initiatives, California Native Plant Society. awilliams@cnps.org

Governor Newsom's executive order directed California agencies to work within and outside state government on a tripartite mission: address climate change, biodiversity loss, and equity. Of the eight points in the order, the second on producing a plan by February 2022 to conserve 30% of California's lands and waters by 2030 has garnered the most attention from the conservation community. But biodiversity surveys, conservation, multi-benefits land management, and building equity as an essential part of our work are also part of the executive order. Removing stressors such as invasive plants, and preventing conversion of intact wildlands, have always been part of a "no regrets" strategy to protect biodiversity and increase resilience to climate stressors. I will also discuss how our work as land stewards must also include expanding opportunities for local communities to engage in meaningful ways, and how policies can support biodiversity preservation and climate resilience and justice without sacrificing or ignoring any of these three essential goals, as well as highlight good work underway around the state.

Plant invasions and their management in Africa. Dr. Arne Witt, CABI. A.witt@cabi.org

There are no comprehensive lists of invasive alien species for most countries in Africa. Significantly more is known about introduced crop pests than invasive alien plant species (IAPS), especially those that pose a threat to natural ecosystems. Although a number of electronic databases have been developed these are largely incomplete. South Africa has the most complete list with over 350 IAPS recorded. Recent surveys in eastern Africa (excluding Burundi), revealed the presence of 164 IAPS in 110 genera and 47 families. Over 140 naturalized and IAPS were recently recorded in Malawi and Zambia. The most widespread and damaging IAPS on the continent include *Chromolaena* (*Chromolaena odorata*), *Parthenium* (*Parthenium hysterophorus*), tickberry (*Lantana camara*), water hyacinth (*Pontederia crassipes*), *Prosopis* spp., *Acacia* spp., *Opuntia* spp., *Mimosa* spp., and *Tithonia* spp. Most of these have their origins in the American tropics and were intentionally introduced as ornamentals or for agro-forestry. These species have a significant impact on livelihoods since most people in Africa are directly dependent on natural resources for their survival. Their management is impeded by a lack of policies, or implementation thereof; limited capacity; little awareness; and insufficient funds. In fact, little is known about the distribution, impacts and best management practices for most IAPS in Africa. With climate change, increased land degradation, population growth, and rapid economic development, especially infrastructure expansion, the situation can only get worse. Here we report on the impacts of the worst IAPS in Africa, and efforts that have been undertaken to manage them.

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Lightning Talk Abstracts

Managing for biodiversity across property lines in California central coast. Jenna Allred, Jackson Brooke, and Rodrigo Sierra Corona. Santa Lucia Conservancy, CA. jallred@slconservancy.org

The Santa Lucia Conservancy (SLC) manages 20,000 acres of conservation land, either owned (10,000 acres) or through easements (8,000 acres) with a variety of partners within the Santa Lucia Preserve (SLP) in the Central Coast of California. The SLP includes a diverse ecosystem mosaic, including coastal prairie, oak savanna, redwood forest, chaparral and scrubland. In 2018, in response to the declining grasslands health the SLC develop the Grasslands Initiative focusing on promoting native biodiversity in its five 500 acres of grasslands by decreasing brush encroachment, practicing weed management, and conservation grazing. The weed management component focuses on the reduction of yellow starthistle (*Centaurea solstitalis*), French broom (*Genista monspessulana*), milk thistle (*Silybum marianum*), bull thistle (*Cirsium vulgare*), Italian thistle (*Carduus pycnocephalus*), poison hemlock (*Conium maculatum*) and Harding grass (*Phalaris aquatica*) are targeted by manual, mechanical, and chemical efforts. SLC partnered with the easement landowners to develop management plans. These lot-specific plans give the landowner the guidance and permission to manage their property by following best practices. To date, SLC has developed a weed prioritization map and has managed 2000 acres through grazing and brush/weed management. The 35 lot-specific plans add an additional 1000 acres to the overall management acres. In total, over 3000 acres are actively being managed within the SLP by the SLC and the individual landowners.

Early detection rapid response invasive plant removal project targeting knotweeds, *Arundo*, and shiny geranium on the far north coast of California. Carla Avila and Susannah Ferson. Redwood Community Action Agency. carla@nrsrcaa.org. susannah@nrsrcaa.org.

Redwood Community Action Agency and multiple partners received funding from the Wildlife Conservation Board in 2015 to map, monitor, and treat six invasive plant species including Japanese knotweed (*Fallopia japonica*), Himalayan knotweed (*Periscaria wallichii*), giant knotweed (*Fallopia sachalinensis*), giant reed (*Arundo donax*), shiny geranium (*Geranium lucidum*), and rush skeletonweed (*Chondrilla juncea*) in Humboldt County, California for seven years. The target species were chosen in accordance with the Humboldt Weed Management Area priority list for species with populations small enough to benefit from an early detection/rapid response (EDRR) treatment effort. Project goals included a 95% reduction in target populations and public outreach to encourage community members to report sightings of target species and to teach individuals how to properly treat target species located on their property. Glyphosate and imazapyr were used to treat target species after annual monitoring. To date, there has been an approximate 99% reduction in all of the knotweed species and the giant reed population, and an increase in the shiny geranium population. These results have occurred on populations that have been treated for multiple years; there are some sites that were reported later in the project that received fewer treatments and would benefit from several years of additional treatment. There were several untreated populations on private property where landowners were either not willing to sign an access agreement or were opposed to herbicide use. We hope that our experiences can guide other EDRR programs as they develop and implement similar programs to control/eradicate these species.

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Identifying native plants that promote riparian insect community recovery after giant reed (*Arundo donax*) removal. Charlie Braman, Dr. Adam M. Lambert. University of California, Santa Barbara. charliebraman@ucsb.edu

Invasive giant reed (*Arundo donax*) forms dense monoculture stands throughout California's riparian systems, disrupting biodiversity and ecosystem functions. Restoration via active revegetation after *Arundo* removal is often warranted to improve ecosystem properties while reducing potential for reinvasion through rhizome deposition on exposed soil. When evaluating restoration efforts, ants function as model indicators tracking ecosystem change. To assess whether particular plants have greater impact for biodiversity and food webs, both vegetation and ant communities were evaluated at our study sites along the Santa Clara River (Ventura and Los Angeles Counties). The sites are situated within over 470 acres that have undergone *Arundo* removal since 2012, with removal and active restoration still underway in many areas. During the Summer 2019 and Winter 2019-20, ant communities were sampled (11,333 ants collected) using baits, pitfalls, and leaf litter along sixteen 50-meter transects stratified throughout a range of *Arundo* removal and restoration treatments. Transects plant cover/richness were assessed during the summer with coverage data used to evaluate which of the 46 plant species encountered contribute to differentiation in ant communities. Non-metric multidimensional scaling ordination found distinct ant communities associated with five riparian/wetland microhabitats, and nonparametric linear vectoring indicated each microhabitat had at least one native plant positively associated with its community. These plants share a suite of characteristics, producing ground cover, abundant leaf litter, and nutritional resources for insect communities. These traits make them ideal native plants for promoting arthropod recovery and diversity, as these taxa represent important trophic resources for broader community recovery.

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Celebrate California Invasive Species Action Week. Elizabeth Brusati, Invasive Species Program, California Department of Fish and Wildlife, Sacramento, CA. elizabeth.brusati@wildlife.ca.gov

The California Department of Fish and Wildlife (CDFW) has coordinated California Invasive Species Action Week (CISAW) since 2014 to increase public awareness of invasive species issues and promote public participation in the fight against invasive species' impacts. CDFW encourages local organizations to highlight their work on invasive species during the week by hosting events such as habitat restoration workdays, citizen science monitoring, in-person lectures, webinars or exhibits. In 2019, 43 events were held across California. While COVID restricted in-person events in 2020 and 2021, some organizations expanded their use of online events. CISAW also includes a Youth Art Contest for grades 2-12 centering on a different theme each year, such as "Be an Invasive Species Detective". In 2021 we added the EDDMaps app to allow community members to track invasive species all year long. The app focuses on animal species but includes a list of plants developed with Cal-IPC and Calflora. It also communicates with other apps such as iNaturalist. Detections are submitted to CDFW for verification and will help us target our work. We encourage you to join CISAW as an organizer or participant! Hold an event or distribute social media posts (#CISAW)! See the CISAW website for more information and email Elizabeth.Brusati@wildlife.ca.gov to be added to the CISAW contact list. Dates and art contest information for CISAW 2022 will be posted in early 2022.

Avian Responses to Riparian Restoration on the Santa Clara River. Sean Carey[1], Dr. Linnea Hall[2], Dr. Adam Lambert[1], Dr. Li Kiu[1], Charles Braman[1], David Kisner[3]. [1]Marine Science Institute. [2]Western Foundation of Vertebrate Zoology. [3]Kisner Restoration and Ecological Consulting. spcarey@ucsb.edu

The University of California, Santa Barbara (UCSB) has been conducting large-scale restoration and ecological research in the Santa Clara River (SCR; Los Angeles and Ventura Counties) floodplain for over a decade. This system provides critical habitat and ecosystem functions to sustain a number of listed avian species

and other wildlife. The primary objective of our program is to significantly reduce the primary stressor to riparian habitats in the SCR system: the non-native, invasive *Arundo* (*Arundo donax*, giant reed) and its degradative impacts (e.g. excessive water use, wildfire, low quality habitat). Following *Arundo* removal, in 2015-2021, passive and active revegetation methods have been used to re-establish diverse riparian habitat types. A key element has been implementing a robust monitoring program to track the effectiveness of restoration treatments for recovering affected wildlife species, especially avian populations. Long-term monitoring and analysis are vital for understanding how restoration may benefit bird populations more broadly across the landscape. Project partners have been conducting avian surveys at permanent point count stations throughout since 2015, with intensive monitoring taking place during the breeding season. Avian activity (i.e., changes in density, richness, behavior, and distribution) at all points show encouraging responses to restoration. Abiotic factors, such as climate (esp. drought) and flood disturbance are also interacting with restoration to regulate avian populations over time. This analysis will take a closer look at these interactions, thus providing valuable information for planning and conducting riparian restoration projects.

Case Study: The Mystery of Perennial Pepperweed and Chlorsulfuron in Sierra Valley. Thomas Getts[1], Gabe Miller[2], and Tracy Schohr[1]. [1]UC Cooperative Extension, Susanville, CA. [2]Feather River Land Trust. tjgetts@ucanr.edu

Perennial pepperweed (*Lepidium latifolium*), is one of the most troublesome weeds to control in pastures and riparian areas throughout California. Throughout the decades, there has been a tremendous amount of effort and research to discover effective methods to control perennial pepperweed. Two products, chlorsulfuron and 2,4-D, have been shown to be effective materials either alone or as part of an integrated program, while providing perennial grass safety. Chlorsulfuron typically offers multiple year suppression of perennial pepperweed with a single application. In the past years, there have been reports from ranchers and land managers in Sierra Valley of chlorsulfuron not offering effective pepperweed control. The issue was investigated, by conducting a randomized complete block field trial at two locations in Sierra Valley over the course of 2018, 2019 and 2020 growing seasons. The first trial had the untreated check over sprayed by the grower, but found chlorsulfuron was effective for pepperweed control. The second trial consisted of four treatments applied in the summer of 2019 and 2020 to the same plots (chlorsulfuron 68 g. ai./ha + 1% MSO, chlorsulfuron 136 g. ai./ha + 1% MSO, chlorsulfuron 136 g. ai./ha + 0.25% NIS, 2,4-D 3.1 kg ae./ha+ 1% MSO, and a untreated check). Plots were visually evaluated in the summer of 2019, 2020, and 2021 to assess herbicide efficacy. At the second site is case study site, no chlorsulfuron treatment offered greater than 20% control of perennial pepperweed in the 2021 growing season, whereas 2,4-D offered greater than 80% control. Results may have been impacted by high soil organic matter, or by potential herbicide resistance.

Pollinator response to the removal of giant reed (*Arundo donax*) and restoration strategies in a Southern California riparian system. Evan T. Hobson and Adam M. Lambert. University of California, Santa Barbara. ehobson@ucsb.edu

The University of California, Santa Barbara (UCSB) and partners are conducting large-scale restoration and ecological research in the Santa Clara River (SCR; Los Angeles and Ventura Counties). Invasive giant reed (*Arundo donax*) is considered to be the most problematic invasive species in riparian and aquatic systems in California and dominates much of the SCR by forming dense, monotypic stands that are associated with declines in native flora and dependent fauna. Insect pollinators provide critical services to riparian communities and surrounding agriculture, and can serve as indicators of ecosystem improvement (and decline). In 2019, we initiated an invertebrate monitoring program focusing on insect pollinators to evaluate how this invertebrate guild is responding to restoration. Using a combination of sampling techniques including pan trapping, sweep netting, and observational point count stations, and aligning these sampling efforts with long-term vegetation monitoring

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transects, we are assessing the effects of invasive plant management (giant reed removal) and restoration efforts on pollinator abundance and diversity. Comparing baseline conditions to temporal changes in these parameters as giant reed removal and active restoration proceed will increase our understanding of how effective restoration strategies are for sustaining or improving wild and native pollinator populations in riparian systems. We present our early findings and discuss our efforts to further develop a science-based and data driven understanding of the relationship between insect pollinators and invasive plant management practices.

Ailanthus Control Methods. Bill Neill, Riparian Repairs. bgneill@earthlink.net

Most broadleaf trees can be controlled by herbicide application to cut stumps or girdled bark. One exception is Ailanthus (*Ailanthus altissima* or Chinese Tree of Heaven) because cutting fluid communication between tree crown and roots caused abundant sprouting of suckers from lateral roots. For stems and trunks up to 12 inches in diameter, basal bark treatment without cutting is effective using Pathfinder II ® herbicide, which is Garlon 4 ® (triclopyr) diluted in refined oil that promotes bark penetration. For larger trunks with thicker bark, chopping the bark with columns of a half-dozen horizontal cuts, separated by vertical strips of uncut bark, followed by basal bark application, is effective (also call hack & squirt) and avoids the sucker-growth problem, although the necessity of hatchet cuts is not proven. For controlling abundant sucker growth that follows wildfire or untreated cutting, imazapyr herbicide (Habitat ® or Stalker ® or Polaris ®) is effective because it translocates well through lateral root networks.

The effects of *Vicia villosa* invasion on grassland plant-pollinator interactions. Rebecca A. Nelson* and Dr. Susan Harrison. University of California, Davis. ranelson@ucdavis.edu

Plant-pollinator mutualisms contribute to California's biodiversity. Invasive species decreased plant diversity in California annual grassland ecosystems. The invasive hairy vetch (*Vicia villosa*) is prevalent in California grasslands. The extent to which *V. villosa* shares pollinators with native California plants remains a knowledge gap. To address this knowledge gap, we investigated whether proximity to the *V. villosa* invasion front influenced the composition of plant-pollinator networks in a northern California grassland. At the University of California McLaughlin Reserve, we conducted floral visitor observations of 2 m x 2 m plots of naturally-occurring native flowers at 1 m, 10 m and 50 m distances from the *Vicia villosa* invasion front as well as in 2 x 2 m plots of *V. villosa*. We further examined whether *V. villosa* pollinator communities differed between burned and unburned areas. *Vicia villosa* and native plants differed strongly in floral visitors. European honeybees were the most common visitor to *V. villosa*, followed by native bumblebees, including the endangered Crotch's bumblebee (*Bombus crotchii*). In contrast, shorter-tongued native bees were the most common visitors of native flowers. Goldfields (*Lasthenia californica*) was the most visited native plant. *V. villosa* pollinator communities did not differ between recently burned and unburned sites. We will use our findings to provide better tools for land managers tasked with restoring plant-pollinator mutualisms in California grasslands. Furthermore, as a volunteer for the UC Davis Kids into Discovering Science program, we helped local elementary schoolers conduct a plant science experiment in an effort to engage with the community.

A public data resource for tracking invasive plants: the Consortium of California Herbaria's CCH2 portal. Katie Pearson[1], Steve Buckley[2], and Jenn Yost[1]. [1]California Polytechnic State University, San Luis Obispo, CA. [2]Californian Invasive Plant Management Team, National Park Service. kdpearso@calpoly.edu

Herbarium specimens—pressed, preserved plants collected by botanists, ecologists, and other naturalists—document historic and recent occurrences of native and introduced plant taxa. The Consortium of California Herbaria has built an open-source, publicly accessible database containing data from 3.4 million specimens from West Coast herbaria, 70,000 of which

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are Cal-IPC Inventory species. Over 2.2 million specimens include geocoordinates, and over 1 million include a specimen image. Any member of the public can search and view these specimen data, and they can use built-in tools to create and customize regional checklists to aid in land management and plant identification. Aggregated specimen data can help us understand the origins of and the invasion patterns of potentially harmful plant taxa. Here, we demonstrate how to access and query specimen data in CCH2, use cases of the data for invasive plant research, and where to learn more about using these data and resources.

Tracking Change Over Time in the Calflora Mapping Tool Using History Stacks. Cynthia Powell, John Malpas, and Ed Dorrington. Calflora. cpowell@calflora.org

When a land manager is monitoring a population of a plant species, s/he benefits from knowing how that population changes. With this knowledge, any treatment (grazing, hand-pulling, chemicals, prayer) may be adjusted to work toward effective management. A Calflora history stack is a way of organizing multiple records concerning the condition of a weed patch over time. In a history stack, all of the records concerning the patch are linked back to the earliest, or root, record. Using this tool to monitor plant populations over time is not only useful for invasive plants, but also for native and rare plant species. Using Calflora, land managers may better plan for the future and know how invasive plant populations are changing on their properties.

Increasing the diversity of people and ecosystems through urban restoration projects. Joanna Tang* and Dr. Carla D'Antonio. University of California, Santa Barbara. joannatang@ucsb.edu

Ecosystem management provides a unique platform to invest in diversity. An overarching goal of ecological restoration is to increase biodiversity due to its benefits to ecosystem function. Does this principle extend to the diversity of the people restoring biodiversity? One hypothesis is that, analogous to how increased biodiversity allows an ecosystem to be more productive, increased stakeholder diversity in restoration projects will allow projects to produce better outcomes and success. A literature review shows there is great opportunity for a broad diversity of stakeholders to be included in restoration, such as local communities, scientists, government agencies, NGOs, and natural resource industries. Several case studies illustrate how inclusively engaging with a variety of stakeholders can benefit project outcomes and success by collating intellectual, labor, and financial capital. In particular, urban restoration projects provide an opportunity for a more equitable diversity of people to both contribute to and benefit from restoration. Our research work in vernal pool restoration in urban landscapes involves local community members. Working with undergraduate interns, we have successfully decreased exotic species cover and increased native species diversity. Although urban restoration projects are constrained by small land parcel size, vernal pools can be successfully created in <1 acre parcels, and their charismatic flora engages the community. Whereas large wilderness preserves can be exclusive, urban restoration projects allow urbanites access to nature. Urban restoration projects allow people to both experience nature and have the opportunity to contribute to the project, thus accruing benefits for both the human and ecological systems.

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Poster Abstracts

Exorcists of Invasive Plants, Devil Weed Crew - Oahu, HI. Erin Bishop, Oahu Invasive Species Committee. oisc@hawaii.edu

Over the past 100 years, devil seed (*Chromolaena odorata*) introductions have spread to India, Africa, SE Asia and the South Pacific islands. It is now one of the world's worst 100 invasive species! An aggressive invader of disturbed soils and open areas, toxic to livestock, it takes over pastures and farmlands. First detected on O'ahu in 2011, devil weed has spread beyond existing resources for island-wide eradication. The Devil Weed Crew volunteer program is designed to engage the community in surveying for and controlling invasive devil weed (*Chromolaena odorata*) along trail sides. The project is aimed to reduce risk of long-range introductions by removing plants from high-risk pathways, to identify infestations in their early stages, and to collect location data for the island.

Proactive planting to preclude persistent plant pests. Gina Darin[2], Jorge L. Renteria[1], Jamie Silva[2], Rhiannon Mulligan[2], Elise Gornish[3], and Edwin Grosholz[1]. [1]University of California, Davis. [2]California Department of Water Resources. [3]Univeristy of Arizona, Tucson. jlrenteriab@ucdavis.edu

Two revegetation experiments were carried out to assess the potential use of native plants for plant invasion management and habitat restoration at two sites in the San Francisco-San Joaquin Delta. Adult transplants of the natives *Schoenoplectus acutus* and *Persicaria amphibia* were planted in both single and mixed species treatments to assess their competitive abilities against the invasive *Ludwigia spp* at Dutch Slough in the Delta. Transplants of *S. acutus* had moderate establishment success right after installation; however, by the end of the experiment, almost all plants from both species were outcompeted by *Ludwigia spp*. It appears that conditions at the experimental site were not favorable for the establishment of the transplants. A second experiment to test revegetation strategies for local native plants was established at Bradmoor Island in Suisun Marsh. Adults, rhizomes, and seeds from *S. acutus, Schoenoplectus americanus, and Typha latifolia* were planted in experimental plots to evaluate their potential use in revegetation projects. Adults and rhizomes of the three species had a promising establishment success; however, seeds produced negligible results. Factors related with seed dormancy and site conditions might have affected the seed germination process. The two revegetation experiments provided valuable insights that should be considered for implementing large-scale wetlands restoration projects. Selection of the plant species for revegetation projects will be subject to on site-specific conditions. It is important to get a better understanding of species' tolerance thresholds to flooding conditions, species' tolerance might vary even within the same area. Although the competitive abilities of three native species remain to be seen, these species are good candidates for revegetation projects.

The impact of small vertebrate consumers on community assembly in degraded California sage scrub. Taylor Edwards* and Erin Questad. California State Polytechnic University, Pomona. tnedwards@cpp.edu

Native consumers have been found to influence plant recruitment and community assembly, depending on what species they prefer. In California sage scrub, little is known about the preferences of small vertebrate consumers, although their feeding behavior may affect interspecific competition between native and invasive plant species. There is also an unexplored opportunity to investigate which plant functional traits are preferred by herbivores in the sage scrub community. We established caged and uncaged native restoration plots in degraded sage scrub on the Cal Poly Pomona campus in order to investigate the effects of consumers on community assembly. Thirteen native species were

*Student Contest entrant

hand-seeded into research plots dominated by invasive annual grasses and forbs. Plant species cover and functional traits were measured in experimental communities while motion activated trail cameras recorded consumer activity. Preliminary results showed that most species grew better in caged conditions compared to uncaged; however, invasive short-pod mustard (*Hirschfeldia incana*) and Maltese star thistle (*Centaurea melitensis*) had higher cover in uncaged plots. Overall, consumers appeared to prefer native over invasive species, suggesting that herbivores and granivores may promote non-native success in sage scrub communities. By evaluating the influence of consumer activity on native and invasive competition, this study aims to inform future invasive plant management and native plant restoration efforts.

The removal of invasive woodland leads to community shifts in arbuscular mycorrhizal fungi. Jennifer Perez*, Neil Shah, David C. Banuelas, and Dr. Kathleen Treseder. University of California, Irvine.
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The Brazilian pepper tree (*Schinus terebinthifolius*) was introduced to North America from Brazil in the late 1800's. Since then, *S. terebinthifolius* has spread throughout Florida, Southern California, and Hawaii. Recent findings showed *S. terebinthifolius* associates with a variety of arbuscular mycorrhizal fungi (AMF) compared to native plant species. In Southern California, stakeholders have raised 1.5 million dollars to remove *S. terebinthifolius* from the Upper Newport Bay estuary. The goal of this study was to assess AMF communities prior to removal and post-removal. We used collected soils and roots from *S. terebinthifolius* and the native arroyo willow (*Salix lasiolepis*) prior to treatment efforts. Following treatment completion, only *S. lasiolepis* was surveyed for roots as *S. terebinthifolius* was mechanically removed from the project site. We used DNA sequencing and staining to identify AMF in soils and roots. Preliminary results showed that *S. terebinthifolius* had 32% higher colonization rate of AMF compared to *S. lasiolepis*. We expect to see higher OTU abundance of AMF in *S. terebinthifolius* compared to *S. lasiolepis*. While roots and woody debris from the of *S. terebinthifolius* were removed from the project site, secondary invasions have encroached the project site. Within the first four months since the removal of *S. terebinthifolius*, the site has been heavily invaded. Our preliminary research show that invasive woodland led to significant shifts in taxa of AMF following the removal of *S. terebinthifolius*. Therefore, AMF play an important role in facilitating plant invasions.

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Keeping a pulse on the sale of invasive plants in California retail nurseries. Alexandria Stubblefield, PlantRight. info@plantright.org

PlantRight is a collaborative, science-based, and voluntary program that serves to promote the use of non-invasive plants in California gardens and landscapes. Through partnerships with stakeholders in the nursery industry, conservation, government, and academia, PlantRight has effectively prioritized and tracked the sale of invasive plants of horticultural origins in California retail nurseries. Every spring, PlantRight volunteers conduct a survey of plant retailers across California to gather information about the retail market for invasive plants. The Spring Nursery Survey tells us which invasive plants can be found for sale in retail markets, where they are being sold, and helps us measure what effect our retail partnerships are having. We use the results from the survey to make changes as needed to our Priority Invasive Plant List and to fine-tune our approach. To ensure statistically significant results, we work with a data analyst to pull a random, stratified sample of nurseries from the CDFA licensed nursery list. The list is stratified by store type and county, and the number of each type of store in each county is determined by the proportion of those stores present. This establishes a representative sample of California retail nurseries. Trained volunteers then visit stores in person to collect data on invasive plants specified by PlantRight, and they submit the data to be verified and analyzed. The results are then distributed publicly through PlantRight's network of relationships within the nursery and conservation fields.

Re-evaluating the Test of the Natural Herbicide Weed Slayer for Management of Invasive Plants. Don Thomas, San Francisco Public Utilities Commission. don_e_thomas@yahoo.com

The natural herbicide Weed Slayer®, containing clove oil (eugenol) as its active ingredient, was claimed by its manufacturer to have a systemic herbicidal activity. This distinguishes it from all other organic herbicides, which have only a burn-down effect. A study was conducted to test for this effect on invasive plants in the Peninsula Watershed of the San Francisco Public Utilities Commission, and some efficacy was observed. The results of this test were reported in a poster for the 2020 Cal-IPC Symposium. Weed Slayer® is sold as two components that are mixed together, one containing clove oil, called Weed Slayer, and another called Agro Gold® containing biological amendments. It was subsequently revealed the Agro Gold component contained two synthetic herbicides, glyphosate and diquat. The present study is a follow-up to the previous study, conducted to determine how much of the observed herbicidal effect of Weed Slayer was due to the clove oil-containing component and how much was due to the other component containing glyphosate and diquat. Each component was applied separately and in combination in spray treatments to test plots containing a mixture of grasses and English plantain (*Plantago lanceolata*). Each component was also applied separately in cut-stem treatments to jubata grass (*Cortaderia jubata*), coyote brush (*Baccharis pilularis*) and to Spanish broom (*Spartium junceum*) to test for systemic effect. The results of the follow-up test indicate that all of systemic activity is attributable to the Agro Gold component but that the clove oil-containing component also produced a foliar herbicidal effect.

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