California Invasive Plant Council
2013 Symposium Abstracts

Cal-IPC

WEDNESDAY, OCTOBER 2

PRE-SYMPOSIUM SESSION: DPR LAWS & REGULATIONS

Registering a pesticide in California. *Spas, Richard. California Department of Pesticide Regulation. spas@cdpr.ca.gov*

This is a presentation for how companies register a product for sale and distribution in California. The registration process in California is slightly different that it is at the federal level. It will go over the processes, time frames and the necessary requirements of what is involved in a registration. There are certain items that are required from the U.S. EPA to complete a product registration, including label requirements and the necessary forms and accepted documentation. It will cover some of the data requirements for chemistry, efficacy, medical toxicity and worker health and safety. An examination of the different review stations will be discussed. Since adjuvants are considered "California Only" registrations, how companies register these products will also be relayed to the audience. It will also discuss the label amendment process and what is required by registrants for altering the label after it has been registered in California.

Assessing herbicide risks to threatened or endangered wildlife species. *Trumbo, Joel. California Department of Fish & Wildlife, Sacramento, CA. jtrumbo@wildlife.ca.gov*

The process by which herbicides are assessed for their toxicological impact to wildlife species is not well-understood, even by individuals who use these chemicals to improve wildlife habitat. The lack of understanding about this topic often results in incomplete or erroneous estimations of risk. Herbicide hazard assessment generally involves the determination of a hazard quotient value (HQ) derived from the following calculation; an exposure estimate based on either field-collected data or computer modeling divided by a toxicity value such as an LD50, LC50 or No Observable Effect Level (NOEL). The HQ is then compared to a pre-established Level of Concern (LOC). HQ values that exceed the LOC are assumed to pose a significant risk to wildlife species. Beyond this simple calculation however, there are a number of other factors that need to be considered, such as what LOC value should be used. The U.S. Forest Service uses an LOC of 1 for all species, but the U.S. EPA uses a range of values based on several factors such as whether or not the herbicide was used in a terrestrial or aquatic site, and whether the non-target species is threatened or endangered. Another important issue involves the use of toxicity data from surrogate species. For example, most bird toxicity data is derived from tests that use bobwhite quail or mallard ducks and most fish toxicity tests are conducted with fathead minnow or rainbow trout. Further, understanding the differences between formulated and technical product data or data derived from active ingredient or acid equivalent values is also critical. Understanding these types of issues, and having a strong, overall grasp of the HQ determination process, is essential for land managers who are concerned about both controlling invasive weeds and protecting non-target wildlife species.

Interpreting pesticide regulations and labels. *Chang, David. County of Santa Barbara Agricultural Commissioner's Office. dchang@co.santa-barbara.ca.us*

It's often said that, "The label is the law," and those of us who regularly read pesticide labels know that there are parts of a pesticide label that could be written more clearly. Learn how the agricultural commissioners interpret pesticide labels and regulations, so that you can be more informed on how to properly apply pesticides.

WEDNESDAY, OCTOBER 2 (cont.)

PRE-SYMPOSIUM SESSION: DPR LAWS & REGULATIONS (cont.)

Assessing Human Risk from Pesticide Exposure.
Krieger, Robert. Natural and Agricultural Sciences, University of California-Riverside, Riverside, CA. bob.krieger@ucr.edu

Dr. Krieger will present on the basic factors that go in to how pesticide toxicity risk to pesticide-handlers and the public are assessed, including information on the risks posed by invasive weed herbicides. His research focus is the identification and movement of pesticides and other chemical residues from environmental compartments to children and adults. Indoor, turf, and agricultural settings are included. In agriculture this research has supported development of exposure-based field entry times, as opposed to adverse effect based entry times that were extensively used prior to implementation of the risk assessment process. Effective entry times require accurate human pesticide exposure data and clear definition of work tasks so that short-term and long-term exposures can be considered. Dr. Krieger will continue to investigate the relationship between surface chemical exposures including dislodgeable foliar and surface residues on turf or agricultural crops or indoor pesticide residues in homes.

THURSDAY, OCTOBER 3

SESSION 1: LEARNING FROM SOUTHERN CALIFORNIA DESERTS AND MOUNTAINS

Plant ecology of desert annuals. *Huxman, Travis E. Ecology and Evolutionary Biology, University of California, Irvine, CA. thuxman@uci.edu*

Global change requires plant ecologists to predict future states of biological diversity to aid the management of natural communities, introducing a number of significant challenges. One major challenge is considering how the many interacting features of biological systems, including ecophysiological processes, plant life histories, and species interactions, shape the composition of ecosystems. We have employed a functional trait approach to understand the individual, population and community dynamics of desert annual plants of the Southwestern US, with a goal of understanding long-term patterns of biodiversity and the mechanisms underlying species invasion. This has led to a fairly robust understanding of past and contemporary dynamics to changes in climate and an understanding of some of the constraints on novel species introductions. Our functional trait-life history trade-off framework has provided a mechanistic explanation to the recent warming, drying and climate variability that has driven a surprising shift in species composition in desert annuals. Our focus on ecohydrological partitioning by vegetation has allowed us to think about the resilience of biodiversity in the protracted drought of the recent century. These types of comprehensive approaches may be especially needed now to predict future of plant dynamics, as the non-stationarity of the contemporary climate constrains our use of simplistic statistical representations of past plant behavior in predicting the future.

The Station Fire: invasive plant management lessons learned. *VinZant, Katie. United States Forest Service, Angeles National Forest, Arcadia, CA. kvinzant @fs.fed.us*

The 2009 Station Fire burned 160,000 acres, consuming more than 25% of the Angeles National Forest (ANF), including habitats supporting over 2000 different native plant species in 35 different vegetation types from desert scrub oak to subalpine mixed conifer forests to coastal sage chaparral. During the Station Fire, bulldozer lines, hand lines, trails, roads, newly burned soil, and areas previously infested by invasive weeds increased the vulnerability for invasive weed establishment across most of the burn area. From the spring of 2010 to the present the ANF has created and employed a

botany crew whose primary tasks involve mapping, documentation, and control/eradication of high priority invasive plant species in the Station Fire and other recently burned areas. Based on surveys in the Station Fire at least 35 species of invasive weeds found to occur within the burn area are hindering recovery of native and sensitive plant species, including twenty-three special status wildlife species and fifteen plant species of concern. To date over 700 infestations have been mapped, with over two-thirds of those infestations having entire individuals or at least reproductive parts removed. This equates to invasive plant inventories and control treatments being completed on over a total of 4500 acres, 200 miles of riparian corridors, 130 miles of dozerline, and 100 miles of roads/trails. Qualitative monitoring results show the success of eradication varies greatly on species type and how long the infestation has persisted in the area. However, after three years of eradication efforts tamarisk populations are showing an average 95% eradication success rate and Spanish broom an average 90% eradication rate, while tumble mustard success rates are much lower in many cases, at around 70%. It is clear from these eradication efforts that multiple years (at least 3-5) of repeated and timely treatments are necessary for success.

A regional perspective: invasive plants in the Mojave Desert. *Hoines, Josh. Joshua Tree National Park. Josh_Hoines@nps.gov*

The Mojave Desert is often considered too dry and harsh to support the diversity of plant life found in other eco-regions. The harsh reality of the desert has limited the number of people willing to live in the desert; as a result the federal government is the main land owner in the Mojave Desert and manages more than 80% of the total area. In spite of its inhospitable reputation, the Mojave Desert shares the threat of invasive species. Learn what invaders exist, similarities with other regions, and the control and coordination of exotic plants in the Mojave Desert.

SESSION 2: ANNUAL MEMBER MEETING (KEYNOTE)

State of change: forgotten landscapes of California. *Cunningham, Laura.*

Author Laura Cunningham will discuss her book State of Change: Forgotten Landscapes of California. Through the use of historical ecology, we will walk through vernal pools, oak savanas, grassy hills rich in bunchgrasses and other habitats which have been impacted by invasive plants and other changes. Combining the skill of an artist and training as a naturalist and paleontologist, Cunningham spent more than two decades poring over historical accounts, biological research, and archaeological data. Traveling with paintbox in hand, she tracked the remaining vestiges of semipristine landscape seeking clues that reveal the California of past centuries with grizzly bears, wolves, condors, and herds of elk. In her studio, Cunningham created paintings of vast landscapes and wildlife from the raw data she had collected, her own observations in the wild, and her knowledge of ecological laws and processes. Her particular interest has been the ecology and restoration of the varied native grasslands of the Golden State.

SESSION 3: COMMUNICATION AND NEW THREATS

Crossing the line: working with private land owners and slender false brome *(Brachypodium sylvaticum)*. *Gartside, Ellen. Midpeninsula Regional Open Space District, Los Altos, CA. egartside@openspace.org*

Slender false brome *(Brachypodium sylvaticum)* is an invasive, perennial bunchgrass spreading through the redwood forests of Woodside, California. Slender false brome (SFB) forms dense stands and outcompetes native plants and tree seedlings; it has spread to over 10,000 acres in Oregon. Designated a Class A noxious weed in California, SFB could eventually alter the native redwood ecosystem if left unchecked.

In collaboration with private property owners, the Midpeninsula Regional Open Space District (District) developed the SFB Integrated Pest Management (IPM) program to address infestations of SFB on private property. Implementation of the SFB IPM program

began in 2009 and I reported our first years progress at 2009 CA-IPC symposium. Since then, 92 property owners have had their land surveyed for SFB, a total of 183 acres of private land have been treated between one and four times, and infestation densities are beginning to decrease.

As the program has developed, many lessons have been learned and our attitudes, strategies, and goals have changed. This presentation will discuss the challenges encountered and the positive aspects of developing a collaborative reimbursement program with the private sector. Some of these challenges include the coordination of surveys and treatment over multiple properties, differences of opinion regarding herbicide use, retention of program participants, modification of reimbursement with changing infestation densities, data management, and the realization that there is more SFB in San Mateo County than originally estimated. The involvement and passions of a diverse group of creative people who want to protect the redwood habitat have been the greatest positive outcome of the program.

With the continuing support of private land owners and other agencies, the District hopes to be able to manage slender false brome and to preserve the redwood groves in Woodside.

Red-sepaled evening-primrose *(Oenothera glazioviana)*: an increasing threat to native genotypes and natural and restored habitats.
Ferren, Wayne. ARCADIS-US, Inc., 2999 Oak Road, Walnut Creek, CA 94597. wayne.ferren@arcadis-us.com

Genetic pollution in plants is an increasing threat to native biodiversity, especially in the urbanize coast of California, where native diversity is high. Likewise the potential threat from non-local genotypes is increasingly problematic, introduced from a variety of sources including horticulture, landscaping, erosion control, agriculture, and restoration projects. In some cases, hybrid populations can invade habitats beyond those typical for native taxa or genotypes. Red-sepaled evening-primrose *(Oenothera glazioviana)*, for example, is an introduced hybrid that is commonly cultivated because of its stature, large and numerous flowers, and wide habitat preferences. It also commonly escapes along the central and southern California coastal and adjacent islands, particularly in disturbed areas and adjacent natural habitats, and has been reported as naturalized in Oregon and Washington. It resembles two native taxa, *O. elata* ssp. *hookeri* and spp. *hirsutissima*, collectively known as Hooker's evening-primrose, which it apparently has replaced in some portions of the natural occurrence of these taxa that generally prefer wetlands. Red-sepaled evening-primrose is spread along roadsides and highway margins and through wild-flower seed packets, and can invade adjacent wetland and upland habitats. It also has been used inadvertently or mistakenly in ecological restoration projects over the past decade, where it can rapidly invade the disturbed soils and become an aspect dominant in the "restored" environment. Characteristics of the invasive hybrid include multiple stems, crinkled leaves, and reduced fertility often approximating 50%. Red-sepaled evening-primrose is known to cross-pollinate, apparently facilitating its invasiveness within native populations of evening-primrose as well as within the natural landscape.

Reaching novel audiences with information about invasive species.
Drill, Sabrina, Leigh Johnson, Chris McDonald, Adina Merenlender. UC Cooperative Extension – Los Angeles, San Diego, and San Bernardino Counties, and Hopland Research and Extension Center. *sldrill@ucanr.edu*

While ecologists and environmental scientists recognize that invasive species are one of the foremost threats to biodiversity today, there are specific groups among professionals and the general public who need more information about the problem and about ways to alter their day-to-day work to help mitigate the spread of harmful or nuisance exotic species. Several projects undertaken by UC Cooperative Extension can help bridge the gap in knowledge and practices across these audiences: 1. outreach to fire professionals and wildland/urban interface residents about the links between invasive species and wildland fire; 2. information about the ecology and prevention of aquatic invasive species for public works operations and maintenance personnel; 3. invasive species education in the California Naturalist Program. We will present overviews of these programs, and describe impacts and successes so far.

Bridging the information gap between land managers and research scientists. *Matzek, Virginia*, Sophia Cresci, and Maile Pujalet. Santa Clara University, Department of Environmental Studies and Sciences. *vmatzek@scu.edu*

Many conservation disciplines may suffer from a knowing-doing gap, where scientific research is not used to inform management decisions. We investigated the existence of a knowing-doing gap in invasion biology by surveying 200+ California land managers who have decision-making power over invasive plant management at parks, preserves, and other wildland areas. We examined managers' engagement with scientific research by asking them about the sources of information they used, their own production of scientific information, and the kinds of research that would prove most useful to management. As a follow-up, we then searched the recent invasive plant literature to relevance to those manager-identified topics. We examined five years' worth of content in the 20 journals that publish the most invasive species research for articles of potential relevance to our manager population, based on three criteria: a) work in California field sites, b) work by California authors, or c) investigation of one of California's most troublesome invasive plant species. The resulting set of articles was then read and classified according to research topic, scope and type of scientific work, and attention to management implications. Here we report on our findings and provide suggestions for how both sides can bridge the gap.

SESSION 4: PROGRAM STRATEGIES

The Nature Conservancy's program to eradicate 24 non-native invasive plant dpecies from Santa Cruz Island. *Knapp, John* and Coleen Cory. The Nature Conservancy, 532 East Main St., Suite 200, Ventura, CA 93001. *jknapp@tnc.org*

Santa Cruz Island has been free of non-native ungulates since 2006, but non-native invasive plants remain one of the most significant threats to the recovery of the island's native ecosystems. Approximately one-fourth of the island's flora is comprised of non-native, naturalized plant species. In 2007, an island-wide invasive plant survey indicated that roughly 25 species were candidates for eradication based on their distribution and abundance, as well as their invasiveness. In 2008, The Nature Conservancy (TNC) and its contractor launched an ambitious eradication program utilizing novel methods such as helicopter-based access and herbicide ballistic technology to eliminate roughly 761 populations of 15 species from TNC property. As progress was made, an additional nine species were targeted in subsequent years with a combined total of 884 infestations targeted. Each infestation was monitored annually, and retreated if necessary. Over the last five years, 98.3% of the original target infestations have been controlled to zero density (elimination of all above-ground plants). The remaining infestations had either resurgence from the soil seed bank and/or the original plants had not completely died - a small portion of a plant was still alive. Continued monitoring and follow-up treatments will occur in 2014. Utilization of a small helicopter to access remote infestations was vital in providing applicators an optimal platform from which to detect individual plants, including new populations, and treat them before they set seed. Most important in achieving project success was consistent treatment from year to year, which prevented reproduction and recovery of infestations. Long-lived soil seed banks for some species will continue to be an issue for years to come, but the continued commitment to eradicate these weeds and the ability to detect incipient infestations and respond rapidly to eliminate them has proven to be a recipe for success.

***Vinca major* and stone pine control in an endangered island endemic plant population – an update.** *McEachern, Kathryn[1], Katie Chess[1], Karen Flagg[2], Ken Niessen[1], Ken Owen*[3], Kevin Thompson[3], David Chang[4], Clark Cowan[5], and Jim Roberts[5]. [1]US Geological Survey, WERC, Channel Islands Field Station, 1901 Spinnaker Dr., Ventura, CA 93001; [2]Growing Solutions Restoration Education Institute, P.O. Box 30081, Santa Barbara, CA 93130; [3]Channel Islands Restoration, 550 Maple Street Ste F., Carpinteria, CA; [4]Santa Barbara Weed Management Area, 263 Camino del Remedio, Santa Barbara, CA 93110; [5]Channel Islands National Park, 1901 Spinnaker Dr., Ventura, CA. *ken@cirweb.org*

This project highlights challenges involved in invasive plant removal from a Federally endangered plant

population. *Galium buxifolium* (sea-cliff bedstraw) is endemic to Santa Cruz and San Miguel Islands, with 26 known populations. A large population on Santa Cruz Island was growing in the shade of a massive stone pine *(Pinus pinaea)* and was infested with *Vinca major* (periwinkle). In 2009, we began removing the Vinca so that native habitat can recover and support a self-sustaining *Galium* population. Herbicide applications were made to eliminate *Vinca* from the steep bluff habitat. The *Vinca* and *Galium* were often literally intertwined, so we developed specialized techniques for *Galium* protection. In 2011, the stone pine was removed preventing its spread into the adjoining communities. Numbers of *Galium* plants have increased five-fold, from 123 in 2006, to 637 in 2011. Thus far our treatments have been successful in reducing *Vinca* competition without harm to the endangered Galium. We do not know what the long-term effects of reduced shading might be on Galium population growth. This project provides a strategy for invasive plant removal where exotics and endangered natives exist in close proximity, and it illustrates complications that arise when conflicting needs for invasive species control intersect.

Early planning tool for habitat restoration. *Lindsey, Pam[1], Sarah McGinnis[2], Noreen Murano*[3], Casey Lanier*[3]. [1]Ventura County Watershed Protection District, Ventura, CA. Pam.Lindsey@ventura.org; [2]AmeriCorps - Watershed Stewards Project. Sarah.McGinnis@ventura.org; [3]Wildscape Restoration, Inc., Ventura, CA. *Noreen@wildscaperestoration.com, *Casey@wildscaperestoration.com*

In order to facilitate and implement successful watershed restoration and mitigation projects, the Ventura County Watershed Protection District developed the Early Planning Tool for Habitat Restoration (Planning Tool) to identify past project and potential future project locations. The Planning Tool locates potential project sites that may provide a link between existing sites, eliminate possible overlap with other projects, and encourages a widespread restoration effort within local watersheds. Although located in the same region, local watersheds may have very different characteristics, which create unique challenges in identifying how to best approach and design a restoration project. The Planning Tool allows the user to customize results by enabling or disabling specific criteria (map layers) created with GIS data collected from stakeholders. For example, the user may want to focus removal efforts of giant reed to a particular reach or an entire creek while staying within a specified distance of existing projects. Alternatively, the mapping program can be used to identify areas to avoid such as critical habitat to comply with regulatory permit requirements. The results can be further refined to one particular species of interest, or within a certain distance of existing project sites. The Planning Tool will be accessible to stakeholders and professionals through the Ventura County Watershed Protection District website. The online map will contain all of the criteria layers and does not require specialized software to operate. This online mapping tool is meant to encourage collaboration and sharing of plans, projects, and ownership of parcels. Enhanced collaboration between multiple parties and stakeholders will encourage efficient and effective restoration plans and increase the potential success of a project.

An early detection pilot project in California State Parks. *Robison, Ramona, A. and Lana Meade. California Department of Parks and Recreation, Natural Resource Division, 1416 9th Street, Sacramento and Orange Coast District, Laguna Beach, CA. ramona.robison@parks.ca.gov and lana.meade@parks.ca.gov*

The California State Parks (Parks) Natural Resources Program spends a significant amount of its yearly budget on invasive plant management. Most of the effort goes toward management of known weed infestations. In order to become more pro-active, Parks is implementing a pilot project for early detection and rapid response (EDRR) in the Santa Cruz District's Mountain Sector, composed of Portola Redwoods, Big Basin, Castle Rock and Henry Cowell Redwoods State Parks. Methods developed include selection of an EDRR target list, survey routes, and preparation of training materials for field staff including a GPS data collection and management system as well as cost and budget estimates to extend the protocol to the entire Santa Cruz District and throughout the Parks system. Methods used in the Santa Cruz District are also being tested in coastal Orange County State Parks. The project is in collaboration with the Resource Conservation District of Santa Cruz County and California Invasive Plant Council. The talk will also include some lessons learned as well as unexpected successes and future collaborations.

SESSION 5: CURRENT STUDENT RESEARCH

Response of soil nitrogen cycling to the interaction of invasive plants, simulated cattle grazing, and nitrogen additions. *Carey, Chelsea[1]*, Stephen C. Hart[1]; Valerie Eviner[2]. [1]University of California, Merced, Environmental Systems Program, Merced, CA.; [2]University of California, Davis, Department of Plant Sciences, Davis, CA. *ccarey3@ucmerced.edu*

Since western colonization, the ecology of California has seen marked transformations. In particular, invasion of terrestrial ecosystems by exotic plants has altered plant community composition, disturbances, soil hydrologic regimes, and nutrient cycling. In addition, as a result of fertilization and combustion of fossil fuels, California experiences some of the highest nitrogen (N) deposition rates in the country. Land use has also changed with the introduction of domestic livestock grazing about 250 years ago. Currently, approximately 32% of land in California experiences grazing pressure. These ecological changes likely affect the ecosystems of California simultaneously. However, with multifactor global change experiments in their infancy, there is much to learn about potential interactive effects on ecosystem structure and function. Our study measured the response of soil N dynamics to a unique combination of treatments: invasion by exotic plants (*Aegilops triuncialis* and *Taeniatherum caput-medusae*), elevated N additions, and simulated cattle grazing (aboveground vegetation removal). Nitrogen is an important variable to measure because it is the limiting nutrient for plant growth in most terrestrial ecosystems. We found that invasion by exotic species reduced denitrification potential and total microbial biomass but not nitrification potential. Under both ambient and elevated N conditions, simulated grazing reduced the nitrification potential of invaded plots. In contrast, there was no effect of N additions or simulated grazing on denitrification potential. Exotic plant invasion had no effect on soil total inorganic N (TIN; NH_{4^+} and NO_{3^-}); however, simulated grazing significantly reduced TIN of fertilized plots. In addition, simulated grazing did not affect the soil microbial biomass of invaded plots unless combined with elevated N, in which case the microbial biomass increased. These results suggest that interactions between simulated grazing and N additions had the ability to affect the overall response of the system to invasion, which may have implications for management success.

The use of phenology and plant morphological traits to reassemble invaded plant communities. *Hilbig, Bridget E.* and Edith B Allen. University of California-Riverside, Dept. of Botany and Plant Sciences, Riverside, CA. *bhilb001@ucr.edu*

Understanding the composition of ecological communities that arise from potential species pools has implications for community assembly and applications for restoration. The trait-based approach to community assembly focuses on determining the key traits organisms possess and the environmental factors that filter these traits. Our study experimentally examines how phenology and plant morphological traits define vegetation structure and development during restoration of exotic annual grassland. Using native species differing in phenology and morphological traits we established restoration plots to address the question "Which functional groups will result in greater exclusion of *Bromus diandrus*?". Four plant functional groups were determined using phenology and morphological traits, these include: 1) perennial forbs, 2) tall winter annual forbs, 3) short winter annual forbs, and 4) summer annual forbs. In $1m^2$ field plots, we seeded the four functional groups with and without *B. diandrus*. Plots were raked, seeded, and seeds were tamped in the November 2012. Plots were irrigated to promote germination and survival of native and exotic species with an additional six inches of water. To maintain native plant species communities, exotic forbs and grasses were hand weeded throughout the growing season. Plots were sampled throughout the growing season, at peak flowering time, and at senescence for plant species richness, density, and percent cover. Traits considered and measured included: germination time, maximum height, inflorescence number, seed set, seed mass. It was hypothesized that native communities that are functionally similar to *B. diandrus* would be more resistant to its establishment through direct competition for resources. However, first year data suggests that none of the functional groups selected are significantly better at excluding *B. diandrus*.

Effects of nitrogen deposition on coastal sage scrub invasion and reestablishment. *Justin M Valliere*, Irina C. Irvine and Edith B Allen. University of California-Riverside, Dept. of Botany and Plant Sciences, Riverside, CA. *jvall007@ucr.edu*

The Santa Monica Mountains of southern California are subject to high levels of nitrogen (N) deposition due largely to vehicular emissions in the greater Los Angeles metropolitan area. Previous work has indicated that increased N availability may negatively impact coastal sage scrub (CSS), leading to increased invasion and altered soil microbial communities, specifically arbuscular mycorrhizal fungi. We investigated the impact of increased N availability on native seedling establishment, invasion of nonnative species and mycorrhizal fungal communities of CSS in experimental N fertilization plots at two sites in the Santa Monica Mountains. We hypothesized that N addition would favor nonnative plant species over native shrub seedlings, resulting in decreased native seedling establishment. We also hypothesized that N addition would alter mycorrhizal diversity and abundance, which may also favor nonnatives over native mycorrhizal shrub species. After one year of experimental N fertilization, we observed a significant reduction in mycorrhizal fungal spore density with increasing N availability. After two years of N addition, native seedling density was significantly lower in fertilization plots, possibly due to increased standing biomass of nonnative species. While effects on mature stands of CSS may be minimal, our preliminary results indicate that increased N availability due to anthropogenic N deposition may have strong negative effects on the establishment phase of this community through changes in nonnative plant abundance and cover. This in turn could have important implications for CSS succession and long-term vegetation dynamics in this system, as well as invasive species management and ecological restoration.

SESSION 6: TOOLS OF THE TRADE

Woody plant control. *Moore, Ken. Wildlands Restoration Team. kenmm23@gmail.com*

Strategies, methodologies, tools, tips & tricks used to control the super-size weedy plants in California. Both herbicidal and non-herbicidal control methods will be shown, many of which are not widely known. Emphasis will be given to thorough instructions using illustrations to facilitate proper use of all of these methods in the field. Information will be based on that provided at *www.wildwork.org*.

Status of biological control projects on terrestrial invasive alien weeds in California. *Lincoln Smith*[1], Patrick J. Moran[1] and William L. Bruckart[2]. [1]USDA-Agricultural Research Service (ARS), Exotic and Invasive Weeds Research Unit, Albany, CA.; [2]USDA-ARS, Foreign Disease and Weed Science Research Unit, Ft. Detrick, MD. *link.smith@ars.usda.gov*

In cooperation with state, federal, and foreign scientists, we are developing new classical biological control agents for six species of invasive alien terrestrial weeds in California:

Cape-Ivy. A gall-forming fly, *Parafreutreta regalis*, and a stem-boring moth, *Digitivalva delaireae*, have been favorably reviewed by TAG, and APHIS is processing release permit applications.

French broom. A psyllid, *Arytinnis hakani*, introduced to Australia and killing plants, is being evaluated for risk to native North American lupines. The seed-feeding weevil, *Lepidapion* nr *argentatum*, is beginning to be studied in France.

Russian thistle. A release permit for *Aceria salsolae* was denied by APHIS in 2006, and additional testing has been done to better describe the level of risk to nontarget plants. The rust fungus, *Uromyces salsolae*, was favorably reviewed by the Technical Advisory Group (TAG), and APHIS is processing the permit application.

Scotch thistle. Three weevils (*Larinus latus*, *Trichosirocalus briesei* and *Lixus cardui*) released in Australia are being evaluated for risk to native North American thistles (*Cirsium* spp.). Results indicate that the latter two pose risk to native thistles, but *Larinus latus* may be more specific and is still being tested.

Yellow starthistle. Prospective new agents include the rosette weevil, *Ceratapion basicorne*, a stem-mining flea beetle, *Psylliodes chalcomera*, an eriophyid mite, *Aceria solstitialis*, and a seed head

weevil, *Larinus filiformis*. A release permit for *C. basicorne* was denied by USDA-APHIS in 2006, but additional field and laboratory experiments indicate that there is no risk to safflower under field conditions. Testing of the other prospective agents is ongoing, including field experiments in Turkey and Italy for *L. filiformis* and in Bulgaria for *A. solstitialis*.

Arundo. Two European agents permitted for release in California, including the stem-galling wasp *Tetramesa romana* and the armored scale *Rhizaspidiotus donacis*, are being released in the Sacramento River watershed.

Smart phone app to collect weed data. *Powell, Cynthia*, John Malpas, Matthew Schulz, and Roy West. Calflora, Berkeley, CA. *cpowell@calflora.org*

Calflora is completing work for Yosemite National Park on an update to their popular Calflora Observer app for smartphones. The Observer application is used by a wide variety of people to collect plant observation data in the field, upload to Calflora to review privately, and then publish to the public or to private groups.

The new version of Observer features off-line maps and a flexible architecture for customizing the app for specific projects.

For example, a resource manager can log into the Observer application using their work email and get an organization-specific list of projects. When she picks a project, the app downloads plant lists, map tiles, and observation forms specific to that project. For Yosemite, this will include satellite imagery for the park to use even where there is no mobile data connection, a list of specific weeds of concern, and an observation form based on the OATS model (Observation, Assessment, Treatment, Survey). She can also access the full, searchable Calflora plant list for cases where she needs to make an observation of a plant that is not on her list.

This phone app is the major data collection component of the Weed Manager system, which Calflora is now building with partners. Once records are uploaded from the phone to the user's account, they are available to other members of the user's organization, and can be edited and viewed from other Weed Manager applications. Yosemite is one of the first organization clients of Weed Manager, but the system is designed so that other organization clients can define their own projects with plant lists (by region, rare plants, plants of concern for other reasons), areas of interest, and custom field sets for observation entry.

FRIDAY, OCTOBER 4

Weeding at sunset is like a prayer. *Roessler, Cindy. Midpeninsula Regional Open Space District, Los Altos, CA. croessler@openspace.org*

Weeding can be hard and weeds can be depressing. We need a coping mechanism. Every few days, I make sure to weed where I can watch the sun set. I originally wrote this short creative piece as a blog post to encourage those of us controlling invasive plants. I would be happy to read this ten-minute performance with photographs before one of the lunches at the symposium as a way to honor and encourage the dedicated weed warriors at Cal-IPC. As an organization, I think it is important that we start using social media to educate the general public and to support each other. Social media requires thinking about communication in a different way but it has great potential for reaching many people and recruiting new supporters. This short, casual presentation could serve as an introductory idea regarding the future of social media for Cal-IPC participants. To see the original blog post with photos, see *http://dipperanch.blogspot.com/2013/06/weeding-at-sunset-is-like-prayer.html*.

SESSION 7: THE NOVEL ECOSYSTEM DEBATE REFRAMED FOR LAND MANAGERS

Managing for the new normal: using novel ecosystems to achieve conservation and restoration objectives – an ecosystem perspective.

Seastedt, Tim. Dept. of Ecology and Evolutionary Biology and INSTAAR, University of Colorado, Boulder, CO. timothy.seastedt@colorado.edu

Conservationists are faced with managing for environmental changes they cannot control. Plant communities in many portions of North America now experience longer growing seasons, altered seasonality and amounts of precipitation, and increases in carbon dioxide and plant-available nitrogen that differentially affect competitive interactions within the plant community. These changes are acting upon both native and introduced species, with many of the changes benefitting the latter group. In addition to being influenced by these directional change drivers, more rapid transformations in vegetation communities now result from interactions of climate with natural disturbances such as fire and insect outbreaks, or by invasive plant-consumer interactions that also favor opportunist species. Here, observational and experimental results are presented that document changes in abundance of native and introduced grasses and forbs found in the Colorado Front Range. The extent to which management activities can influence these changes is presented. Using management options that exploit spatial heterogeneity in microclimatic and resource conditions are suggested to be the way forward for many conservation programs. Such programs can maintain and increase community resilience in parts of the landscape, but in other areas allow for transformations to more novel communities that provide acceptable ecosystem services and conservation values.

Managing for the new normal: using novel ecosystems to achieve conservation and restoration objectives – a population genetic perspective.

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Rapid climate change is contributing to changing distributions of native and naturalized non-native plants, creating novel plant communities. This situation not only exacerbates the longstanding issue of 'what is native' but potentially creates or increases the incidence of useful conservation roles for non-native plants. Determining the most appropriate response to those non-natives with apparent benefit will be directed by the management objectives—they reflect the societal values in each situation and provide the foundation for evaluating risk and defining costs and benefits. An appropriate decision-making process also requires an adaptive approach and perhaps a change in traditional perspectives, with consideration of the ecological context, evolutionary history, and genetic risks and benefits. Here, the principles of population genetics and the practices of restoration genetics are used as tools to investigate the potential for non-native plants to play positive and sustainable roles in habitat conservation. The potential consequences of introduction of non-local populations of native species are compared with those of non-native species. The potential for adaptation of non-natives to changing environments (an important consideration for sustainable components of ecosystems) is explored relative to their genetic diversity and invasion history. The potential for adaptation of native species to non-natives is considered relative to life-history traits and time scales. Finally, the importance of context is emphasized in making appropriate management decisions regarding the role of non-native plants in a rapidly changing environment.

SESSION 9: NITROGEN DEPOSITION

Distribution of reactive nitrogen species in California based on passive sampler monitoring campaigns.

Bytnerowicz, Andrzej[1], Susan Schilling[1] and Witold Fraczek[2]. [1]USDA Forest Service, Pacific Southwest Research Station, Riverside, CA.; [2]Environmental Systems Research Institute, Redlands, CA. *abytnerowicz@fs.fed.us*

Ammonia (NH_3), nitric oxide (NO), nitrogen dioxide (NO_2), and nitric acid (HNO_3) are important components of atmospheric deposition of reactive nitrogen (N) to California ecosystems. These compounds have been measured in various areas of California using passive samplers working on a principle of diffusion of gases into various types of collecting media. The point data from passive samplers have been converted to surfaces

(maps) of pollutant concentration by using the ArcGIS Geostatistical Analyst software (ESRI, Redlands, CA). Maps of distribution of individual N air pollutants and total reactive N have been developed for selected areas in California including the Sierra Nevada, the San Bernardino Mountains and the Mojave Desert. Steep gradients of NH_3 and HNO_3 across the Sierra Nevada are caused by air pollution generated in the San Francisco Bay Area (mostly urban pollution) and the California Central Valley (both urban and agricultural air pollution). Strong West to East gradients of NH_3, NO, NO_2 and HNO_3 in southern California are caused by the Los Angeles urban pollution and emissions from motor vehicles along the major traffic routes with much lower importance of the agricultural sources. Detailed maps of N pollutants distribution in the San Bernardino Mountains and the Joshua Tree National Park will be presented. Air quality data from passive samplers collected in summers of 2002-2006 in the San Bernardino Mountains have been used for development of a modified inferential method allowing for the fine-scale calculation of N deposition and estimates of critical loads exceedance for nutritional N. Rigorously quantifying the spatial distribution of N-deposition is a critical link to understanding enhanced weed invasions.

Critical loads for atmospheric nitrogen deposition in California. *Fenn, Mark. USDA Forest Service, Pacific Southwest Research Station, Riverside, CA. mfenn@fs.fed.us*

Large areas of California are exposed to elevated levels of atmospheric nitrogen deposition driven by air pollution from numerous urban and agricultural sources. Critical loads (CLs) for nitrogen (N) deposition describe limits to ecosystems at which harmful effects would not occur. Nitrogen CLs can be based on acidification or eutrophication (N as a nutrient) effects. In California, exceedances of nutrient-N CLs in terrestrial ecosystems have been characterized for the entire state and also for more specific sensitive areas. These areas include southern California (specifically the mixed conifer forests of the San Bernardino Mountains, desert communities of the Joshua Tree NP, coastal sage and chaparral of the Santa Monica Mountains and inland ranges), and the Sierra Nevada (with special emphasis on mixed conifer forests of the southern portion of the Sierra Nevada and the Lake Tahoe Basin). Nutrient-N CLs can be very low, near background deposition levels for community changes in epiphytic lichens, bryophytes, mycorrhizal fungi, and vascular plants. Enhanced weed invasions (especially annual grasses) in sensitive ecosystems can occur at relatively low deposition rates. This presents a challenge in setting appropriate CLs when large areas of the landscape are likely already in exceedance of the N CL for these sensitive responders. Critical loads development may take varied approaches, ranging from manipulative experiments and in-situ empirical field studies to dynamic modeling. These issues will be discussed and will be supported by examples from selected areas in California with a special attention to weed invasions in arid and semiarid ecosystems. Critical loads provide a rigorous policy framework to address impacts of N-deposition on ecosystems and biodiversity.

The California nitrogen deposition initiative: funding weed management through mitigation. *Weiss, Stuart B. Creekside Center for Earth Observation. stu@creeksidescience.com*

Overwhelming scientific evidence documents that atmospheric nitrogen deposition threatens California ecosystems and numerous threatened and endangered species through increased growth of invasive annual grasses and forbs. Since 2001, a confluence of several projects (gas-fired powerplants and highway improvements) in Santa Clara County set precedents for mitigation of N-deposition impacts on ecosystems via the Endangered Species Act. These projects have culminated in the Santa Clara Valley Habitat Plan, a 50-year $665,000,000 mitigation plan to conserve and manage habitat for 19 target species. Elsewhere, powerplants in San Diego and Contra Costa Counties have provided mitigation funds for habitat restoration and weed management. Cal-IPC, CNPS, Creekside Center for Earth Observation, and other groups are forming a coalition to extend this mitigation across California to generate money for weed management. Key elements of this nascent campaign include: 1) education of regulatory agencies, activists, and decision-makers about the threat; 2) generation of standard CEQA comments with project specifics for projects that increase traffic or generate nitrogen emissions; 3) encouraging state and federal wildlife agencies to raise the issue in consultations and Habitat Conservation

Plans; 4) policy and legal research to chart a course through the regulatory and political landscape; and 5) collating research on impacts and development of tools to document those impacts; 6) media outreach, and 7) coalition building. The main mitigation strategy is funding for local weed management and stewardship groups through fees. There is a desperate need for stable long-term funding of weed management on parks, preserves and other wildlands, and mitigating N-deposition could provide one major source.

SESSION 10: GRASSLAND MANAGEMENT

Three-year effects of aminopyralid on a grassland plant community.

DiTomaso, Joseph M. and Guy Kyser, University of California, Davis, Department of Plant Sciences, Davis, CA. *jmditomaso@ucdavis.edu*

To evaluate the long-term effects of aminopyralid on plant cover, biodiversity and species richness in grasslands, we established trials at two sites at the University of California McLaughlin Reserve (northern Coast Range in Lake, Napa, and Yolo counties). Plots were 30 x 30 m and treatments included aminopyralid (Milestone) at 0, 3, and 7 oz product per acre (equivalent to aminopyralid at 0, 0.75, and 1.75 oz ae/acre, respectively). Each trial included three replications in a randomized complete block design. The plant community was evaluated the year before treatment and the following three years using three point-intercept transects (50 points per transect) and eight quadrats per plot. Aminopyralid at 3 oz or 7 oz produced very similar effects on the plant community in the first year after treatment in both trials. The legume populations were completely inhibited, and the forb population declined from 80-90%. Because of the reduction in the forb species, the percent native plant cover was reduced by 45-50%. There were no first year effects on annual grasses, monocots, or total cover. By the third season after treatment, there were no longer any statically significant differences in legume cover, though the highest herbicide rate showed consistent lower cover. In addition, the forb population was higher in the treated plots in the first trial, but still somewhat lower in the second trial. Most importantly, the total cover of native plants were two to three times higher in the treated plots compared to the untreated plots in the first trial and about the same as the untreated plots in the second trial. We conclude that the effects of aminopyralid on legumes and other sensitive native plants are transitory, and by three seasons after treatment are no longer significant.

Long term recovery of native perennial grasslands utilizing scraping, seeding and hydromechanical obliteration treatments: a 5-year report.

Naumovich, Lech, Stuart Weiss, Christal Niederer, James Quenelle. Creekside Center for Earth Observation, Menlo Park, CA.*lech@creeksidescience.com*

Restoring native perennial grasslands is often an elusive task. In Woodside [Central Coast ecoregion], California, we experimented with a “scrape and seed” treatment. As of 2013, we conclude that we have recovered, or flipped, a non-native annual dominated grassland back into a native perennial grassland using a grader and native seed. Our first scrape and seed treatment is now 5 years old. Scrape and seeding effectively completes three tasks: a) removes the existing vegetation and thatch, b) removes a portion of the a-layer of the soil where the most recent, and fertile, seed bank resides, and c) adds viable, native seed onto a bare surface. After treatment, the only species we handpulled were thistles: *Carduus pycnocephalus*, *Cirsium vulgare*, *Silybum marianum*. The vegetation cover is 38% native as compared to an adjacent control which has 6% native cover. Although a few non-natives have become established (42.5% cover), they are limited to lower impact taxa like *Erodium* spp., *Avena* spp., and *Ranunculus muricatus*. Colonization of non-native taxa has been much slower than anticipated. Hydromechanical obliteration (HMO) was also used as a tool in improving grassland quality. HMO removed weedy annuals and maintained well-established perennial grasslands, increasing cover from about 15% native to 38% native. HMO treatment is a good follow-up to scraping treatments in terms of reducing non-native colonization. Subsequent scrape and seed treatments in different soil types have produced varying results but native forb and grassland cover is always appreciably increased as compared with the control treatments. We believe that this treatment could help restore significant patches of native grasslands.

Effects of four herbicides on the survival and growth of native perennial grasses. *Burger, Jutta C.*, Isaac Ostmann, and Ashley Brutto. Irvine Ranch Conservancy, 4727 Portola Parkway, Irvine, CA 92620. *jburger@irconservancy.org*

Native perennial grasslands are a threatened plant community in California. Perennial grasses compete poorly against non-native annual grasses and forbs and grasses; competition is most severe during the early establishment period of grasses and often challenges grassland management as well as the success of restoration efforts. We tested the effects of low doses of two broad-leaf specific, one grass specific, and one broad spectrum herbicide (Milestone VM®, Element 4®, Fusillade®, and Roundup ProMax®, respectively) occasionally used in grassland restoration and management on seedlings and young plants of three native perennial grass species (*Stipa pulchra*, *Elymus glaucus*, *Bromus carinatus*). Two replicate blocks of 12 seedlings in cones were sprayed with each herbicide treatment at the 2-4 leaf stage. A second set of young plants was treated four weeks later once grasses had begun to tiller. Broad-leaf herbicides both caused more die-back and mortality in grasses than controls and Milestone VM+ had a similar effect to Roundup ProMax in young seedlings of *Stipa pulchra*. In contrast, *Bromus carinatus* was more sensitive to the grass-specific herbicide Fusillade than other species. Treatment effects were substantially less severe once grasses had begun to tiller. Results suggest that broad-leaf herbicides can have a non-trivial effect on seedlings of perennial grasses so care should be taken in their use as selective control agents early in the growing season.

Session 11: IMPACTS OF INVASIVE SPECIES ON ECOSYSTEM SERVICES

Building an *Arundo* control jobs program. *Rentner, Julie R. River Partners, Modesto, CA. jrentner@riverpartners.org*

Although unemployment rates are dropping nationally, unemployment rates in the San Joaquin Valley remain substantially higher than in California or the US, seasonally reaching twice the national average. At the same time, the San Joaquin River hosts extensive infestations of giant reed *(Arundo donax)* and other noxious weeds across over 150 miles of its main stem and its major tributaries. In late 2011, the San Joaquin River Partnership (a coalition of 13 conservation organizations focused on supporting the San Joaquin River Restoration Program) partnered with the US Bureau of Reclamation to deliver funding to this important problem. Working with a network of regional groups including the California Conservation Corps, Local Conservation Corps, local colleges and universities, landowners, labor contractors, and the existing weed management networks, this project has grown from one grant into a watershed program. Funding has now been secured from five federal, state, local and private sources to employ the next generation of conservation leaders in the San Joaquin Valley. Since its inception, this program has attained all necessary environmental permitting approvals, gained support from 48 landowners and 8 land management agencies, and employed over 60 people in Merced, Madera, and Fresno Counties. The guiding principles developed in the first few years of this project include leveraging investments amongst complimentary programs; working with existing networks and local experts; meeting the needs of the resource agencies, labor and environmental interests; and maintaining program flexibility to promote growth. In addition to managing and removing hundreds of acres of invasive weeds, anticipated project outcomes include broadening community support for environmental enhancement, strengthening engagement from regional educational institutions, and the development of a stronger ecological restoration industry in the region.

Do invasive plant species negatively affect diet and preference of a native California bumble bee? *Harmon-Threatt, Alexandra N.*[1] and Claire Kremen[2]. [1]Washington University in St. Louis, Dept. of Biology; [2]University of California-Berkeley, Dept. of Environmental Science, Policy and Management. Berkeley, CA. *aharmont@wustl.edu*

Pollinator diet and preference has recently garnered increasing amounts of attention. Despite this, no general trends have been found on the interaction between native bees and native or non-native plants. One major limitation to understanding the effect of invasive plants on native bee species is a lack of knowledge about whether bees simply use or prefer invasive species and

what characteristics of the plant affect this relationship. Using *Bombus vosnesenskii*, a generalist and widespread pollinator, as a model species, we examined pollen usage to determine the preference of native and non-native plants. By directly examining pollen collection with respect to pollen availability we are able to determine direct preference for pollen resources, a more sensitive and selective resource for bees. We also examined the nutritional quality, protein and amino acid content, offered by available plant species to better understand the preference of each species. All pollen loads carried by *B. vosnesenskii* included both native and non-native plant species. *B. vosnesenskii* does not uniformly prefer native species over invasive, nor does it simply collect pollen in proportion to its availability. Bees use a combination of native and invasive species to maintain a uniform nutritional intake which may suggest that some invasive species can replace or supplement bee diets. However, we do not anticipate this affect to be uniform across native bee species as other bees will be more selective in their resource use and may be more adversely affected by the spread of invasive species.

Aquatic weed ecology and influence on ecosystem services in lakes: case study from Emerald Bay, Lake Tahoe. *Shaw, Dan*[1], Zach Hymanson[2], and Tamara Sasaki[1]. [1]California State Parks, Sierra District. [2]Alpine Solutions. *dshaw@parks.ca.gov*

The character of a lake can be altered by establishment of aquatic weeds. Reports detailing the impacts and challenges of aquatic weed infestations have been detailed from lakes across the country in popular and scientific literature. These challenges cover a wide range of ecosystem services from impacts to our drinking water intake systems, alteration of micro-climate conditions, support or competition with other species, and tremendous changes observed by long-time residents and recreationists. Some of the potential challenges include: localized degradation in water quality and clarity; changes in water chemistry; changes in habitat conditions to favor other non-native species; declines in native fish abundance; crowding and shading of native aquatic plants; alteration of the substrate to favor increased weed expansion; adverse swimming conditions and negative impacts on recreational boating; plant material washing up and fouling beaches; rapid spread to other water bodies; a reduction in property values; and tremendous expense of capital on control actions. Aquatic weeds started to spread rapidly in Lake Tahoe over a decade ago, including into the iconic Emerald Bay. A group of regulatory and management agencies, scientists, and professional divers comprising the Lake Tahoe Aquatic Invasive Species Working Group was established to combat aquatic invasive species in Lake Tahoe with an approach that included a rigorous inspection program, scientific surveys and research on control techniques, and active control actions. In cooperation with this effort, California State Parks has been monitoring the aquatic weed infestations in Emerald Bay and tracking some of the changes in ecosystem services and ecological conditions.

POSTER ABSTRACTS

STUDENT POSTERS

The effects of invasive pollen on the seed set of a native plant. *Bruckman, Daniela. University of California – Irvine, Department of Ecology and Evolutionary Biology, Irvine, CA.*

Invasive plants may threaten the reproductive success of native sympatric vegetation in various ways. One important mechanism can occur through the deposition of invasive pollen on native stigmas when pollinators are shared among species. In this study, we investigated the impact of pollen deposition from invasive species, Brassica nigra, on seed set of California native, *Phacelia parryi*. *P. parryi* flowers were hand-pollinated with either pure conspecific pollen (the control) or with *B. nigra* pollen applied prior to, simultaneously with, or following conspecific pollen. Simultaneous treatments resulted in a 50% reduction in seed set, although the amount of *B. nigra* pollen deposited was similar to the

other invasive pollination treatments. *P. parryi* flowers treated with *B. nigra* pollen followed by conspecific pollen produced similar seed sets as the control indicating the possibility of pollen competition, but only when invasive pollen is deposited simultaneously. These results may be explained by short-acting allelopathic effects of *B. nigra* pollen since species in the *Brassica* genus are known to contain glucosinulates, a compound known to be harmful to neighboring plants.

The feasibility of chaparral restoration on type-converted slopes. *Engel, Megan*[1], Kimberlyn Williams[1], Christopher McDonald[2], and Jan Beyers[3]. [1]CSU San Bernardino Dept. of Biology, San Bernardino, CA; [2]UC Cooperative Extension, Riverside, CA; [3]US Forest Service Pacific Southwest Research Station, Riverside, CA. *engelm@coyote.csusb.edu or 909-844-7122*

Non-native annual grass competition is an obstacle in the restoration and reestablishment of chaparral on type-converted slopes. This study compared several methods of restoration on type-converted slopes in the San Timoteo Canyon on an ecological preserve owned by the Riverside Land Conservancy. The objectives of this study were to assess the effectiveness of a broad-spectrum herbicide and a grass specific herbicide, assess the difference between seeding and planting seedlings as a mode of restoration, and analyze the seed bank to see if there was a relict seed bank that can be manipulated (e.g. through smoke water application) to promote restoration. In the fall of 2012, the experiment was set up using a factorial design with four levels of restoration (no planting/no smoke-water, addition of smoke-water only, seeding only, and planting started plants only) across three levels of herbicide treatment (no herbicide, Glyphosate plus Fusilade follow-up, Fusilade-only) yielding 12 treatment combinations. Treatments were replicated three times. Applying Glyphosate just prior to planting with a Fusilade follow-up after planting, promoted the survival and growth of chaparral shrub seedlings *(Adenostoma fasciculatum, Eriogonum fasciculatum, Quercus berberidifolia,* and *Rhus ovata)*. Seeding 6 different chaparral species (Those above listed above plus *Gutierrezia sarothrae* and *Rhus trilobata*) was not successful, possibly due to the lack of precipitation. At this site the relict native shrub seed bank appeared minor. Measurements of soil water content in April 2013 of Glyphosate + Fusilade-follow up plots had higher soil water content than the Fusilade-only and control plots. There was little to no difference in the soil water content between plots that were irrigated and planted and those that were not, suggesting that the difference in the soil water content was due to non-native grass competition.

Effects of *Ehrharta erecta* on the redwood understory and implications for restoration. *Godinho, Anna*, Courtenay Ray, and Ingrid Parker University of California-Santa Cruz Department of Ecology and Evolutionary Biology, Santa Cruz, CA. *agodinho@ucsc.edu*

Biological invasions, particularly by exotic grasses because of their ability to establish quickly in dense stands, have the potential to reduce native biodiversity and alter ecosystem function through competition and abiotic and biotic indirect effects. *Ehrharta erecta* (panic veldt grass) is an evergreen perennial grass invasive to California's central coast region. To gain a greater understanding of the physiological effects of *E. erecta* on the native plant community, as well as to develop more effective management methods, I studied *E. erecta* in the redwood understory on the University of California, Santa Cruz campus. Motivated by an earlier pilot study, I tested whether *E. erecta* reduces the photosynthetic rate of native plants. I compared the photosynthetic rates of two native species before and after the manual removal of *E. erecta*. In another experiment I am comparing the effectiveness of herbicide and manual removal in controlling *E. erecta*. I will evaluate the recovery of natural communities by out-planting the redwood understory forb, *Clinopodium douglasii* (yerba buena), into treated plots. This experiment will reveal 1) the effect of *E. erecta* removal on native plant survivorship and growth rate, and 2) the potential benefits of restablishing a native plant community as an additional treatment to manage the reinvasion of *E. erecta*. A better understanding of the degree and mechanisms of impact of *E. erecta* on native species will serve to guide restoration priorities for invasive species management.

Summer irrigation as a tool for restoring invaded serpentine grassland? *Hoffacker, Madison* and Jennifer L Funk. Chapman University, School of Earth and Environmental Sciences, Orange, CA. *madisonh@gmail.com*

A weed eradication technique called "stripping the seed bank" takes advantage of flexible germination cues and has been effective in removing weed seeds from soil in agricultural systems. This technique prescribes a pulse of irrigation during the summer resulting in germination. Immediately following germination, irrigation is halted and germinated seedlings perish in the hot, dry summer conditions. This method could be used to restore invaded plant communities if invasive species have flexible germination cues and native species have more rigid germination cues such as longer periods of soil saturation, day length or minimum temperature. We conducted two experiments using native and invasive species from California serpentine grassland. First, we conducted a greenhouse experiment to assess how well native and invasive forbs and grasses germinate at low (16 C, spring) and high (30 C, summer) temperatures. Across 23 species, we found that native forbs did not germinate at high (summer) temperatures, while invasive annual and native perennial grasses did. These results suggested that summer irrigation may trigger germination of invasive grasses and we tested this in the field by applying late summer irrigation to invaded serpentine grassland at Kirby Canyon, Santa Clara County. After 21 days of irrigation, few individuals germinated. Irrigation had no effect on native or invasive species cover the following spring. Half of our treatment plots experienced grazing by cattle while half were protected from grazing. Our species composition data showed reduced percent cover of both native and invasive species; however, native species richness was higher in grazed plots. Thus, grazing may be a more effective restoration than summer irrigation in invaded serpentine grassland.

Evolutionary responses of California grassland species to variation in precipitation and nitrogen levels following prescribed fire. *Ortega, Amy*, Monica Nguyen, Jennifer L. Funk and Sarah Kimball. Chapman University, School of Earth and Environmental Sciences, Orange, CA. *amieorteg@gmail.com*

Climate models suggest that southern California will experience reduced annual precipitation and higher inter-annual variation in precipitation over the next century with unknown consequences for invasive species performance. Invasive plant species may be able to respond to environmental variation with rapid genetic changes and/or phenotypic plasticity. We established a two-year project to investigate how drought and nitrogen deposition have influenced selection over five years in a southern California grassland system, specifically the Loma Ridge grassland in Orange County, California. We focused on two grass species *(Avena barbata, Bromus madritensis)* occurring in six plot types: ambient precipitation (low and high nitrogen), supplemental precipitation (low and high nitrogen) and reduced precipitation (low and high nitrogen). Seeds were collected from experimental plots and seedlings were grown in pots in a common environment. We measured a number of physiological, morphological, phenological and reproductive traits across the growing season. We found a significant effect of water availability and no effect of fertilization. For *Avena*, we found that plants from water addition plots had higher water-use efficiency but lower leaf chlorophyll content and smaller size, particularly under fertilized conditions. In *Bromus*, water addition reduced leaf chlorophyll content, photosynthetic rate, and plant size. Thus, neither species was adversely affected by reduced precipitation. These results are from the first year of our experiment. The experiment will be repeated next year using seeds collected under our common environment growing conditions to differentiate between selection and maternal effects. Thus far, our results suggest that these two dominant invasive grass species will be able to maintain constant performance under reduced precipitation scenarios.

A Frankenstein experiment gone awry: ecology and evolution of an invasive veldt grass. *Ray, Courtenay. University of California, Santa Cruz Ecology and Evolutionary Biology Dept., Santa Cruz, CA. courtenay.ray@gmail.com*

Ehrharta erecta (panic veldt grass) is a highly invasive perennial grass that is found in seventeen counties in California and across broad habitat types. During the early-mid 20th century, *E. erecta* was used in genetic studies by botanist and geneticist, G. Ledyard Stebbins to explore how artificial polyploidy affects invasiveness. As part of his study, Stebbins deliberately introduced *E. erecta* to several counties in California, providing an opportunity to explore the evolution of local adaptations in *E. erecta* and the invaded plant communities. Preliminary results from surveys in redwood understory in Santa Cruz County suggest that contrary to common assumptions in invasion ecology, *E. erecta* does not decrease native plant biodiversity nor cover. However, in one early pilot study, transpiration was reduced in *Stachys bullata* (California hedgenettle) when sympatric with *E. erecta*. Fieldwork is ongoing to investigate if these trends are characteristic of *E. erecta* invasion.

GENERAL POSTERS

Invasive aquatic weeds: implications for mosquito and vector management activities. *Charles E. Blair, MD, Trustee, Mosquito and Vector Management District of Santa Barbara County (MVMDSBC). blairce@verizon.net*

Healthy natural wetlands are far less likely to be breeding areas for disease-carrying mosquitoes than degraded ones. Degradation of these bodies of water by invasive aquatic weeds and other influences can result in their being potential habitat for mosquitoes that can carry the West Nile Virus, encephalitis, and other diseases. Control of these invasive plants can be an important part of the Integrated Weed/Pest Management efforts of both Weed Management Areas and Mosquito and Vector Control Agencies. This poster focuses on continuing problems with control of water evening-primrose, *Ludwigia* spp. Successes in on-going control of smooth cordgrass, *Spartina* spp., *S. densiflora* x *foliosa*, in the San Francisco Estuary will be shown. Presentations on the importance of smooth cordgrass in San Francisco Bay have been made at recent statewide Cal-IPC and Mosquito and Vector Control Conferences. Demonstration of these relationships can enhance both agency and public awareness of their importance.

WHIPPET: online tool for prioritizing control of invasive plant populations. *Brusati, Elizabeth*, Dana Morawitz, and Doug Johnson. California Invasive Plant Council, Berkeley, CA. *edbrusati@cal-ipc.org*

To prioritize which invasive plant populations to control, land managers have to consider the species biology, species impacts, size of populations, difficulty of control, and location of population in relation to propagule sources and vectors of dispersal. WHIPPET (Weed Heuristics: Invasive Population Prioritization for Eradication Tool) was developed by UC Davis and CDFA as an algorithm that combines these factors on based on species and populations to create a ranked list of the most effective populations to remove first, focusing on those that are highest-priority for eradication. Cal-IPC has developed an online version of WHIPPET that makes this tool more accessible and easier to use at a range of geographic scales.

Online WHIPPET combines a database of species characteristics and dispersal vectors with population data entered by users and locations from Calflora to provide a list of ranked populations. The results come from a weighted set of criteria. WHIPPET can work at local to multi-county scales and does not require GIS expertise. Users can rely on locations already in Calflora or enter their own mapping data. Users can choose to use pre-loaded GIS layers or to upload layers with more detail for their area. Results are provided in a map and a spreadsheet, allowing the user to interpret and adjust the results for field work. Coordinates in the spreadsheet can be added to GIS software or Google Earth to create a map for field crews.

Online WHIPPET is planned for release in fall 2013. In the future, pending available funding, we hope to add additional features.

Utilizing volunteers for resource management.
Durant, Reginald. Back to natives restoration, Irvine, CA. reggie@backtonatives.org

Reginald Durant, Director of Restoration for Back to Natives Restoration, will discuss the use of volunteers for natural resource management projects (invasive plant removal, biological surveys, habitat restoration, etc.). Back to Natives has consulted with the USFS since 2008 to conduct a restoration training program. Learn how habitat restoration projects can benefit from the use of volunteers, and how your volunteer programs can enrich the experience of park visitors. In the true spirit of "service learning" participants take part in community service projects while learning about the resource, developing and strengthening their conservation ethic, and eventually influencing others to respect and care for our resources as well.

Artichoke thistle control and endangered species habitat in preserved land. *Edwards, Tiffany*, and Geoff Smick. WRA Inc., San Rafael, CA. *Edwards@wra-ca.com*

The Ridge Top Ranch Wildlife Conservation Bank (Bank) in Solano County demonstrates the balance of conservation and weed management goals as the property transitions from an intensively-grazed cattle ranch to a conservation area. The Bank hosts several species listed under the federal Endangered Species Act, including the Callippe Silverspot Butterfly (*Speyeria callippe callippe*; CSB). The Bank contains more than 662 acres of suitable habitat for CSB, including habitat for the larval host plant, California golden violet *(Viola pedunculata)*, and the nectar forage species California buckeye *(Aesculus californica)*. The Bank has integrated grazing into its management plan, which allows for the maintenance of the Bank habitats for special-status species.

However, the site is threatened by the encroachment of invasive artichoke thistle *(Cynara cardunculus)*, which can form monotypic stands, reducing available forage for grazing and competing with native species essential to the life cycle of the butterfly. The management plan for the Bank defines successful maintenance of species habitat as maintaining artichoke thistle populations in the Bank below 25 percent relative cover. This goal is further complicated by the fact that the entirety of the Bank is within critical habitat unit SOL-1 for CRLF and is thus barred from using many common pesticides by the EPA.

Annual artichoke thistle control was implemented in the form of spot-spraying and mechanical removal. Budget constraints limited the extent of spraying in 2012, which saw an increase in high densities of artichoke thistle throughout the site. WRA took the lessons learned in 2012 and negotiated revised management targets and a more thorough weed control program in 2013, with surveys currently ongoing. In addition, a carefully managed grazing regime using WRA's program Cowpacity has allowed for the existing tenant to continue using the ranch while contributing to passive species habitat management.

Database of management trials to provide site-specific decision support tool for invasive species control. *Eviner, Valerie*, Mel George, Andrew Latimer, David Lewis, Anthony O'Geen, Kevin Rice, Kenneth Tate, Truman Young. University of California- Davis Dept. of Plant Sciences, Davis, CA. *veviner@ucdavis.edu*

- Why does one management project succeed, while a similar one does not?
- Which sites are most (or least) likely to achieve a management goal?
- What suites of goals are possible at my site? Which management practices will be most effective in achieving those goals at my site?
- Given the weather this year, how do I alter my management practices to achieve my goals?

These questions frustrate both managers and scientists--"it depends" often seems to be the one consistent generalization we can make. However, our project is working to answer these questions by compiling the results of thousands of on-the-ground management trials across California's diverse climate, soil, and topographical conditions. This database will provide a powerful platform to tease apart the interactions between site conditions, management practices, and annual fluctuations in weather; which, in turn, will improve our ability to make site-specific management recommendations.

The project's initial focus is on California's grasslands and oak woodlands, as well as the riparian areas found within these systems. It is collaborating with a diverse group of land managers in these systems (e.g., ranchers, conservation groups, agencies, consultants) in order to consider how environmental conditions and management practices impact multiple goals, such as: forage quantity and quality, invasive species control, native species abundance and diversity, wildlife habitat, soil erosion control, soil fertility, soil water infiltration and storage, water quality, and soil carbon storage.

This poster presentation will be an opportunity for our project team to get input on how to make the database and decision support tools most useful and accessible for stakeholders. We're looking for your guidance to prioritize management practices, goals, and measurements. We're also looking for groups with records (formal or informal) of large numbers of management trials, and can work with you to facilitate including them in the database. Once this database is established, it will be available on-line and will allow you to search for management projects based on environmental conditions, location, goals, and/ or management practices. There will also be a decision support tool, where you can enter your location and management goals, and it can synthesize the database for you—suggesting which goals are most feasible at your site, and which management practices are most promising, based on your goals.

Impacts of native vs. exotic grassland vegetation on multiple ecosystem services. *Eviner, Valerie*, Joanne Heraty, Jill Baty, Carolyn Malmstrom, Kevin Rice. University of California - Davis Dept. of Plant Sciences, Davis, CA. *veviner@ucdavis.edu*

California's grasslands have been dominated by annual exotic grasses for the past 200-300 years. More recently, newer invasive grasses have become prevalent, such as medusahead and barbed goatgrass. Control of these newer invasive grasses, or restoration of natives is not possible in all impacted areas, due to the broad extent of these invasions. Ecosystem services are a potential criteria to prioritize areas for restoration and weed control . We planted plots consisting of three community types: naturalized exotic species (that have dominated California's grasslands for 200-300 years), invasive weeds (goatgrass and medusahead), and native species (common mix of species used for restoration in California's Central Valley). After 3 years, we assessed the impacts of these vegetation types on multiple ecosystem services. When comparing natives to naturalized species, natives increased soil nitrogen availability, and were much better at suppressing invasive weeds. However, the naturalized species plots provided better erosion control, mitigation of soil compaction, water quality, and soil water storage. This suggests that restoration of natives will be most beneficial in areas with high invasive weed pressure, but could be detrimental in areas where erosion, compaction, and water quality are of concern. Invasion of noxious rangeland weeds into the naturalized community did not enhance any ecosystem services, and greatly decreased palatable spring forage quantity. However, there is a tradeoff between invasive weeds and native species. Invasion of noxious weeds into native communities decreased spring forage availability and decreased soil nitrogen availability, but enhanced soil water storage, compaction alleviation and water quality. This suggests that sites that are less vulnerable to soil degradation would be best to prioritize for invasive weed control. While the impacts of invasive grasses on California's flora are an important criterion for restoration and weed control, it is not possible to manage all invaded areas. Thus, prioritization of sites for management should consider that some of these invasive grasses are improving soil conditions and water quality.

Impacts of native vs. exotic grassland vegetation on multiple ecosystem services. *Funk, Jennifer L.*[1], Virginia Matzek[2], Matthew Bernhardt[1] and Doug Johnson[3]. [1]Chapman University, School of Earth and Environmental Sciences, Orange, CA.; [2]Santa Clara University, Department of Environmental Studies and Sciences, Santa Clara, CA; [3]California Invasive Plant Council, Berkeley, CA. *jlfunk@chapman.edu*

In 2012, many weed management programs were cut from state and federal budgets. Because invasive species can reduce biodiversity and impair critical ecosystem processes, it is essential that resource managers find and pursue additional sources of funding for weed management. We conducted a survey of directors from California's Weed Management Area (WMA) program

to assess the anticipated effects of budget shortfalls. Results indicated that the largest budget declines will be felt in what are arguably the most important aspects of invasive species control: on-the-ground removal of plant invaders (-63%) and early detection of invaders (-60%). Even though funds from the WMA program amounted to a relatively small amount ($15,000 per county), WMA directors anticipated outsized effects. First, WMA funds had been used to leverage additional funding and in-kind contributions at a ratio of 3 matching dollars to every state dollar funded, in part by hiring personnel to apply for additional funding. Over 3/4 of WMA directors were not confident they could replace lost funding within three years. Second, the loss of WMA funds amounted to the entire budget for some areas, which represents a potential loss of institutional memory and capacity as staff positions are cut, with some areas not able to participate in region-wide grant proposals because they cannot logistically use the funds. Third, WMA directors noted that the ability of managers to travel to symposia or workshops, or to coordinate with other managers, will be compromised. We suggest that managers broaden the case for invasive species management by considering the impacts of invasive species on ecosystem services, such as carbon sequestration, water delivery, or pollination services. We provide examples of successful programs, such as South Africa's 'Working for Water' program, that control invasive species while maintaining ecosystem services and promoting critical social services.

Sunrise powerlink: adaptive weed control strategy. *Hobbs, Robert W.*[1], Marc Doalson[2]. [1]RECON Environmental, Inc., San Diego, CA.; [2]San Diego Gas & Electric, San Diego CA.*rhobbs@reconenvironmental.com*

San Diego Gas and Electric (SDG&E), in consultation with RECON Environmental, developed an Adaptive Weed Control Strategy (AWCS) for the Sunrise Powerlink Energy Project that focuses on enhancement of large, biologically significant parcels of land as opposed to traditional weed control specifically within the powerline right-of-way. SDG&E created this strategy with the purpose of using allocated funding for the betterment of native flora and fauna with a target of restoring land that has the potential to re-connect disturbed areas with adjacent native habitat. Using a series of key variables including, fire potential, non-native abundance/Cal-IPC rating, connectivity to undisturbed land, and presence of sensitive biological resources, as a means to determine appropriate areas for treatment; SDG&E , in coordination with land owners, is able to address weed control at the source. This strategy allows stakeholders to focus funding at the most appropriate location or the source of the issue. The AWCS strategy is truly an adaptive approach to weed control activities, it allows regulatory agencies, land managers/owners, and other stakeholders a formalized mechanism to address key weed and habitat restoration issues on their lands. For the duration of the Sunrise Powerlink Project, approximately 50 years, SDG&E and these groups will have a program and allocated funding to target critical weed issues from the standpoint of need and not prescription.

The effects of soil on coastal sage scrub and invasive Harding grass *(Phalaris aquatica)* to improve restoration success. *Bullock, Eric L.[1], Justin M. Valliere[2], Brooke M. Pickett[2], and Irina C. Irvine*[1]. [1]Santa Monica Mountains National Recreation Area, Division of Planning, Science and Resource Management, Thousand Oaks, CA.; [2]University of California-Riverside Dept. of Botany and Plant Sciences, Riverside, CA. *irina_irvine@nps.gov*

Rancho Sierra Vista (Santa Monica Mountains National Recreation Area) has a long history of ranching and agriculture that has transformed much of the landscape from chaparral and coastal sage scrub (CSS) to nonnative grassland. Harding grass *(Phalaris aquatica)*, an invasive perennial bunchgrass, was introduced, formed monocultures and rapidly expanded to ~25 acres. *P. aquatica* removal began in 2006, however there is little CSS recruitment in post-treatment areas even years after removal, despite having intact CSS bordering the treatment areas. This suggests there may be unfavorable soil conditions for natives or perhaps legacy effects of *P. aquatica*. We investigated which natives might survive best in the post-treatment soils and if additional mitigation would be necessary or feasible to improve native establishment during restoration. We asked whether three native CSS species and *P. aquatica* germinate or grow better in CSS or *P. aquatica* soil and which species might survive best in the post-treatment soil. In a nursery experiment

using a fully factorial experimental design, we tested germination and growth of CSS species in soil collected from an intact CSS population and nearby post-treatment *P. aquatica*-infested areas of Rancho Sierra Vista. We tested the natives, *Artemisia californica, Salvia leucophylla* and *Baccharis pilularis*, because they are bordering the 10-acre restoration site and are candidate species for use there. We also tested the invasive, *P. aquatica*, in both soil types. Seedling weight and length of *S. leucophylla* and *B. pilularis* did not appear to be affected by soil type. *P. aquatica* consistently had the greatest growth in CSS soil, but had 50% more germination in *P. aquatica* soil. *A. californica* growth was over 50% higher when grown in CSS soil in every measurement except seedling length and root to shoot ratio. Further studies will explore the mechanisms and mitigations to improve post-*P. aquatica* restoration success.

Searching for a silver bullet: Reducing the invasive Sahara mustard while preserving wildflowers. *McDonald, Christopher, J.*[*1] *and Carl E. Bell*[2]*. [1]University of California Cooperative Extension, San Bernardino, CA. [2]University of California Cooperative Extension, San Diego, CA. *cjmcdonald@ucanr.edu*

Sahara mustard *(Brassica tournefortii)* is invading deserts and semi-arid landscapes across the southwest United States and northern Mexico. This species is becoming the dominant herbaceous species in many areas that were formerly dominated by native spring wildflowers. This invasion also threatens the ecotourism of several communities that are located in landscapes with abundant wildflowers. In addition, research on diverse control methods for Sahara mustard is lacking. Hand pulling can be effective, but because it is labor-intense large areas cannot be treated, which reduces wildflowers and potentially ecotourism. The goal of this research is to determine the most effective means of reducing Sahara mustard over large-scales, while preserving native wildflower populations. We tested the efficacy of four different herbicides (glyphosate, triclopyr, chlorsulfuron and pelargonic acid) each at two application rates (high and low). We measured the effectiveness of these herbicides against hand-weeded plots. Sites in Borrego Springs and Coachella, California were chosen because these sites formerly had significant wildflower populations and now have high densities of Sahara mustard. We found that most herbicides were able to significantly reduce the cover of Sahara mustard, but effects on other plant species, including native wildflowers, varied.

Cost assessment of different methods of reducing the abundance of Sahara mustard in Borrego Springs, California. *McDonald, Christopher, J.*[*1] *and Carl E. Bell*[2]*. [1]University of California Cooperative Extension, San Bernardino, CA. [2]University of California Cooperative Extension, San Diego, CA. *cjmcdonald@ucanr.edu*

Sahara mustard *(Brassica tournefortii)* is a winter annual that has spread across most of the arid and semi-arid Southwestern US in the past 80 years. This plant is very competitive and outcompetes native herbaceous annuals. In Borrego Springs, California hundreds to thousands of acres of wildflowers were abundant across the region in years with moderate precipitation. Sahara mustard became the dominant winter annual in 2010 in most of the Borrego Valley. The dominance of Sahara mustard also threatens ecological tourism in the region. There are a wide variety of ways of reducing the abundance of Sahara mustard and land managers and landowners are implementing several methods. We compared several different removal methods (hand pulling, hoeing, spot spraying herbicides and broadcast spraying herbicides) to estimate the costs and efficacy associated with each method. We found that each method can provide a very good measure of control of Sahara mustard and each method also has significant disadvantages. We find that herbicide application methods are much more efficient at killing Sahara mustard and land managers can cover significantly large infestations in the same time as using mechanical methods. We also find that hand pulling is the slowest removal method and produces results similar to the somewhat faster method of hoeing.

Prospects for biological control of Cape-ivy with the Cape-ivy fly and the cape-ivy moth. *Moran, Patrick J.*, Christopher N. Mehelis, and Angelica M. Reddy, USDA-Agricultural Research Service (ARS), Exotic and Invasive Weeds Research Unit, Albany, CA. *patrick.moran@ars.usda.gov*

Cape-ivy *(Delairea odorata,* Asteraceae*)*, native to coastal floodplains and mountain riparian zones in eastern South Africa, is an invasive vine in coastal riparian, woodland and scrub habitats in California and southern Oregon. Cape-ivy smothers native vegetation and may impair water flow in coastal riparian areas. The Cape-ivy moth, *Digitivalva delaireae* (Lepidoptera: Glyphipterigidae), and the Cape-ivy fly, *Parafreutreta regalis* (Diptera: Tephritidae) have been recommended for field release by the USDA-APHIS-Technical Advisory Group on Biological Control of Weeds (TAG), an international peer panel with members from the U.S., Canada, and Mexico. Applications to release both candidate agents in California and Oregon are currently being reviewed by regulatory agencies. The Cape-ivy fly and Cape-ivy moth were selected for biological control evaluation because they are widespread and damaging in the native South African range. In laboratory efficacy tests, the Cape-ivy fly galled shoot tips, reducing stem growth by 50%, and the Cape-ivy moth killed leaves and entire vining stems, reducing plant growth rate, stem length and shoot and root biomass by 30 to 40%. Among 100 other plant species evaluated in host range choice tests, including 27 native California members of the family Asteraceae that includes Cape-ivy, the Cape-ivy moth fed and reproduced only on Cape-ivy. Similar results were obtained for the Cape-ivy fly in tests across 93 plant species. Both insects complete their life cycle in two months. Once released, the Cape-ivy fly and moth will reduce the ability of Cape-ivy to spread vegetatively and smother other vegetation, and will reduce the long-term survival of Cape-ivy.

Effects of native establishment in late summer. *Paternoster, Joseph. DriWater, Santa Rosa, CA. joe@driwater.com*

The purpose of this study was to answer several questions. When is the best time of year to plant for both optimum survival rates and minimal water use? Can a time-release water gel (TRWG) provide enough moisture to establish a plant with reduced costs and less maintenance than hand watering? Is there substantial difference in the growth of a plant (both root mass and upper body growth) when established using a time-release water gel with the micronutrient zinc and glacial acetic acid (IAA), over hand watered plants. When plants feed, or photosynthesize, they grow and increase their carbohydrate storage (energy). If plants are given adequate time and moisture to grow and develop roots prior to the dormant season, it is assumed that the roots have more capacity to increase carbohydrate storage. By having this "food" available when spring comes the plants have a head start to better uptake spring moisture and nutrients making plants stronger for the coming growing season. With today's unstable climates spring may be the only time that plants have to develop and strengthen before possible summer drought, so the extra push the plants have received from carbohydrate reserves the better prepared they are to handle dryer climatic conditions. Our findings showed that late summer planting allow sufficient photosynthesis resulting in ample carbohydrate storage for spring plant growth. That the addition of zinc and glacial acetic acid contributes to the production of essential growth over potable water with no nutrients. That using TRWG-Z significantly lowers water use while efficiently establishing plants. The initial study show August plants with a 139% average increase in root mass, and a 68% increase in upper plant growth for plants established with TRWG-Z over hand-watered plants.

Nitrogen deposition, invasion by *Bromus* sp., and competition for water in a California grassland. *Questad, Erin*[1] and Katharine Suding[2]. [1]California State Polytechnic University-Pomona Department of Biological Sciences, Pomona, CA. [2]University of California-Berkeley Department of Environmental Science, Policy, Management, Berkeley, CA. *ejquestad@csupomona.edu*

Anthropogenic nitrogen (N) deposition can alter invasion rates and competitive interactions among species. We hypothesize that N deposition will accelerate invasion by non-native annual grasses into California grasslands through increased competitive dominance by annual species under high N conditions. We experimentally examined how N inputs affect competitive interactions

between species by applying N fertilizer treatments to plots containing the invasive annual grass, *Bromus hordeaceus*, and native perennial grass, *Stipa pulchra*, planted in a checkerboard pattern. We measured percent cover, seed production, aboveground biomass, and indicators of water use for each species. We also recorded the impact of an unmanipulated invasion by *Bromus diandrus* into the experiment. In 2012, the first year of the study, N addition increased the cover of both *B. hordeaceus* and *S. pulchra*. Between 2012 and 2013, the cover of *S. pulchra* declined by 23%, *B. hordeaceus* increased by 11%, and *B. diandrus* increased by 28%. Effects of N addition were not strong in 2013. Instead, patterns consistent with competitive interactions between species were apparent. In 2013, the cover of *B. diandrus* was negatively associated with changes in abundance of *S. pulchra* and *B. hordeaceus*, suggesting that competition with *B. diandrus* may reduce the abundance of the other two species. The cover of *S. pulchra* in 2012 was negatively associated with the total abundance of invasive species in 2013, suggesting that competition with the native grass may reduce invasion rates. Soil moisture was lower in *B. hordeaceus* patches, compared to *S. pulchra*, during periods of plant uptake that followed rain events. N addition significantly lowered soil moisture in plots of both species. This experiment occurred during two dry years and is ongoing, but these early results suggest that competition for water was a significant driver of invasion in this grassland, and that N deposition could intensify these competitive interactions.

A study of drought resistance of stinkwort *(Dittrichia graveolens)*. *Thomas, Don. San Francisco Public Utilities Commission. dethomas@sfwater.org*

Stinkwort *(Dittrichia graveolens)* is a Mediterranean annual composite that flowers in the fall in California at the very end of the dry season after most other annuals have completed flowering and seed set. It can be observed growing on roadsides and in disturbed habitats in hard, compacted soil that appears to be very dry. This seems to indicate that the plant possesses a high degree of drought resistance.

This study sought to investigate two attributes of the plant that might confer drought resistance: plant water use efficiency (WUE) and plant root/shoot ratio. WUE is defined as the ratio of shoot dry weight to weight of water transpired. Root/shoot dry weight ratio is a measure of a plant's ability to maximize use of available soil moisture by developing an extensive root system.

Water use efficiency was determined by growing stinkwort plants in containers, obtaining dry weight values and measuring water lost through transpiration. Corn plants were also grown in this study as a reference crop because the WUE has been well characterized in previous research. It was found that stinkwort plants grown under well-watered conditions did not exhibit high relative water use efficiency. They were found to have a relative WUE value only 51 per cent that of corn. To measure root /shoot ratio, stinkwort plants were collected in the field, and root and shoot dry weights were measured. A relatively low root/shoot ratio of 0.16-0.21 was obtained.

The results of this study did not indicate that stinkwort has the ability to avoid drought stress by means of high water use efficiency or through investment in an extensive root system. Further research is needed to determine whether it employs another mode of drought resistance, such as tolerance of high internal water deficits (low tissue water potential).

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