Updated September 1

20TH ANNUAL CAL-IPC SYMPOSIUM: INVASIVE PLANTS AND ECOLOGICAL CHANGE

Granlibakken Conference Center & Lodge, Tahoe City

TUESDAY, OCTOBER 4

Field course: "Field Techniques for Recording and Reporting Invasive Plants" (Granlibakken)

Oktoberfest! (After dinner, included with registration) (Ski Hut)

WEDNESDAY, OCTOBER 5

7:00 Registration and breakfast (Mountain & Lake Rooms foyer)

8:00 Session 1. Plenary Session: Ecological Change (Mountain & Lake)
Moderator: Edie Allen, UC Riverside

8:00 Welcome and Introduction

8:10 Opening Keynote: Nuance, naysayers and twenty years of studying species impacts.
Carla D'Antonio, UC Santa Barbara

8:40 The ghost of invasions past: the soil legacy of invasive plant species.
Katharine Suding, UC Berkeley

9:10 Smog is fertilizer: atmospheric nitrogen deposition drives weed invasions and biodiversity loss. *Stuart Weiss, Creekside Center for Earth Observations*

9:40 Fire, climate change, and opportunities for invasion. *Max Moritz, UC Berkeley*

10:10-10:30 Break

10:30 Session 2. Membership meeting and lunchtime keynote address (Mountain & Lake)

Weed Alerts! *Dean Kelch, California Department of Food & Agriculture*

Executive Director's update. *Doug Johnson, Cal-IPC*

Board President's update. *Jason Giessow, Cal-IPC*

Lunchtime Keynote: Sustainable forests, healthy communities and vibrant rural economies.
Kim Carr, Sierra Nevada Conservancy

12:00-1:20 Lunch (provided, Garden & Mountain Decks)

1:20 Session 3. Student Paper Contest
(Mountain & Lake) Moderator: TBD

1:20 *Dittrichia graveolens*- a study of invasive plant biology with a focus on

1:20-2:40 Discussion groups

1) Prioritization schemes for weed management. *Gina Darin, CA Dept. of Water Resources, and John Knapp, Native Range.*

management. *Rachel Brownsley, UC Davis*

1:40 Alteration of nitrogen cycling processes by exotic annuals in a California grassland. *Chelsea Carey, UC Merced*

2:00 How does light attenuation affect giant reed (*Arundo donax*) establishment? *Kai Palenscar, UC Riverside*

2:20 The importance of landscape context in invasive plant patterns within conservation linkages. *Marit Wilkerson, UC Davis*

(Bay Room)

2) Licensing and contracting mechanisms for getting work done! *Mark Heath, Shelterbelt Builders* (Pineview)

3) State-level strategies for rapid response and management of aquatic weeds: new approach needed? *Lars Anderson, USDA- ARS Exotic and Invasive Weed Research*. (Courtview)

2:40-4:00pm **Poster session & sponsor exhibits** (Pavilion)

4:00 Session 4. Prevention (Bay Room). Moderator: Wendy West, UC Cooperative Extension

4:00 Working with mineral materials producers and suppliers – Got Clean Gravel? *Wendy West, UC Cooperative Extension*

4:20 Prevention BMPs for invasive plant managers. *Jen Stern, Cal-IPC*

4:40 Challenges to early detection and rapid response - spotted knapweed eradication: building successful partnerships between local, federal, and private entities. *LeeAnne Mila, El Dorado Co. Dept. of Agriculture*

4:00 Session 5. Spatial Data (Mountain & Lake) Moderator: Ramona Robison, CA State Parks

4:00 Using public domain remotely sensed data to predict *Taeniatherum caput-medusae* (medusahead) infestations, a case study from the central California foothills. *Jim Alford, CA Dept. of Fish & Game*

4:20 Invasive plant management in California State Parks. *Ramona Robison, CA State Parks*

4:40 Using distribution information to understand and conserve California flora: recent results and prospects for further future improvement. *Daniel Gluesenkamp, Calflora*

5:00 Social Hour, Raffle, & Silent Auction

7:00 Banquet, Awards, and Live Auction
(included with registration, Mountain & Lake Rooms)

Thursday, October 6

7:00 Breakfast

8:00 Session 6. Climate Change in the Sierra Nevada (Mountain & Lake).
Moderator: Valerie Eviner, UC Davis

8:00 Climate change in the Sierra Nevada; Processes, projections, and adaptation options. *Constance Millar, Pacific SW Research Station, USDA Forest Service*

8:30 Effects of changing precipitation patterns on the spread of *Bromus tectorum* L. in the eastern Sierra Nevada and implications for management. *Amy Concilio, UC Santa Cruz*

9:00 Predicting the spread of invasive plants in the Sierra Nevada with climate change. *Elizabeth Brusati, Cal-IPC*

9:30-10:00 Break

10:00 Session 7. Pesticide Laws and Regulations (Mountain & Lake) Moderator: Edmund Duarte, Alameda Co. Dept. of Agriculture and LeeAnne Mila, El Dorado Co. Dept. of Agriculture. Offers 2.0 hours of Laws and Regulations credit for certified pesticide applicators

10:00 Records and storage requirements for pesticide applicators. *Charlene Carveth, El Dorado and Alpine Co. Agricultural Commissioner's Office*

10:30 The Pesticide Use Monitoring Inspection. *LeeAnne Mila, El Dorado and Alpine Co. Agricultural Commissioner's Office*

11:00 Best Management Practices establishing a closed chain of custody for herbicide use in the utility vegetation management industry, laws and regulations for utility vegetation managers. *Nelsen Money, PCA, NRN-VMS, Inc.*

11:30 Recent court orders and injunctions for the protection of endangered species. *Polo Moreno, California Department of Pesticide Regulation*

10:00 Session 8. Management & Restoration (Bay Room) Moderator: Sara Jo Dickens, UC Berkeley

10:00 Sustainable solutions to cross restoration thresholds and build ecological resilience: Orange County Invasive Management (OCIM) project. *Sara Jo Dickens, UC Berkeley*

10:20 Tipping the balance: using natives to combat weeds and promote ecological resilience of riparian restoration. *Hejo Tjarks, River Partners*

10:40 Evaluating distribution and prevalence of non-native vegetation percent cover in a Southern California wetland and its application to inform habitat restoration and non-native vegetation control. *Elena D. Tuttle, The Santa Monica Bay Restoration Commission*

11:00 Effectiveness of aquatic invasive plant control in Emerald Bay, Lake Tahoe. *Dan Shaw, CA State Parks*

11:20 Containing the spread of invasive plants by implementing a comprehensive roadside weed removal initiative. *Tony Summers, Catalina Island Conservancy*

11:40 Prioritizing and promoting region-wide invasive plant management: a report on successes from the Bay Area Early Detection Network. *Mike Perlmutter,*

	BAEDN
12:00-1:30 Lunch (provided, Garden & Mountain Decks) Student Lunch (room to be determined) *All students are invited to learn about our student chapter.*	
1:30 Session 9. Examining Broader Impacts (Mountain & Lake) Moderator: Drew Kerr, Invasive Spartina Project 1:30 Designing wildlife avoidance into invasive species control projects. *Rick Austin, Santa Clara Valley Water District* 1:50 Invasive *Spartina* Project at a turning point: eradication on the horizon, reconciling clapper rail impacts, and charting a course towards tidal marsh revegetation with native cordgrass. *Drew Kerr, Invasive Spartina Project* 2:10 Distribution and impacts of *Arundo donax* from Monterey to Tijuana. *Jason Giessow, DENDRA, Inc.* 2:30 Cost-sensitive risk assessment for invasive plants in the United States. *Michael Springborn, UC Davis*	**1:30-3:00 Discussion Groups** 1) Invasive Plant IPM. *Invasive plant experts from around the state.* (Bay Room) 2) Integrating the Student Chapter into Cal-IPC *Cal-IPC student chapter.* (Pineview) 3) Prevention efforts across the state: Weed-free materials and prevention Best Management Practices. *Wendy West, UC Cooperative Extension and Jen Stern, Cal-IPC.* (Courtview)
3:00-3:30 Break	

3:30 Session 10. Science, Management, and Policy interactions (Mountain & Lake). Moderator: John Knapp, Native Range

3:30 Emerging large landscape conservation initiatives create new opportunities to control invasive plants. *Steven Frisch, President, Sierra Business Council*

4:00 Science, policy, and management Interactions: The past is not a template for the future of the national parks. *Dave Graber, Chief Scientist, Pacific West Region, National Park Service*

(Field trip participants, please remain for a brief meeting after the session.)

Friday, October 7 – Field trips

8:00 All field trip participants meet in the Granlibakken lobby and sign field-trip waivers.

Post-Angora Fire Weed Tour and Upper Truckee Marsh Bike Ride

Leaders: Robert Cummings, California Tahoe Conservancy; Nicole Cartwright, Tahoe Resource Conservation District; Sue Donaldson, UNR Cooperative Extension. Presenters: Jen Creasy, Tahoe Resource Conservation District

Invasive plants: bull thistle (Cirsium vulgare), Dalmatian toadflax (*Linaria dalmatica*), St. John's wort/klamathweed (*Hypericum perforatum*), oxeye Daisy (*Chrysanthemum leucanthemum*), cheatgrass (*Bromus tectorum*), medusahead (*Taeniatherum caput-medusae*), Eurasian watermilfoil (*Myriophyllum spicatum*), mullein (*Verbascum thapsus*), perennial pepperweed (*Lepidium latifolium*)

On this half-day field trip you will see invasive species in the post Angora Fire area, followed by a bike tour of the Upper Truckee Marsh. In 2007, more than 3000 acres of public and private lands burned in the Angora Fire. The disturbance of the lands created opportune conditions for the spread of invasive plants. We will visit 3-4 sites within the fire zone to discuss early detection and rapid response efforts, restoration, and post fire monitoring of the California Tahoe Conservancy, USFS, and Tahoe Resource Conservation District. Next we will visit the Evans Family Demonstration Garden to show preferable plants for post fire conditions, water efficient zoning, and defensible space with decorative landscaping.

Next we will take a bike tour of the Upper Truckee Marsh, the largest tributary and public meadow in the Basin providing environmental, recreation and access benefits. The first stop will be to the perennial pepperweed restoration site, highlighting efforts by attendees of the 2003 Cal-IPC Symposium field trip. We will then continue to Hidden Beach on the shore of Lake Tahoe to visit more invasive weeds sites. From the beach, we will walk to the mouth of the Upper Truckee River to see and discuss the effects of Eurasian watermilfoil and sediment loading created by the channelization of the river.

Emerald Bay Cruise: Prevention and Control of Aquatic Invasive Species

Leaders: Dan Shaw, California State Parks; Tahoe Resource Conservation District staff. Presenter: Kim Boyd

Invasive species: Eurasian watermilfoil (*Myriophyllum spicatum*), curlyleaf pondweed (*Potamogeton crispus*), Asian clams (*Corbicula fluminea*)

On this full-day field trip, we will take a cruise to Emerald Bay and learn about the intricacies of the nationally recognized Lake Tahoe Watercraft Inspection Program. In 2007, with the confirmation of Quagga mussels in Southern Nevada waters, the Tahoe Basin community began planning for aquatic invasive. That summer volunteer inspection and survey prevention efforts began. Four years later, in 2011, Tahoe has local ordinances requiring all motorized vessels to undergo the most rigorous inspection and decontamination protocols in the nation. Tour state of the art decontamination equipment where the Tahoe Resource Conservation District and the Tahoe Regional Planning Agency perform inspections. After learning about this unique prevention program, come aboard and glide across the waters of Lake Tahoe. We will discuss the history of Tahoe's Aquatic Invasive Species (AIS) Control Program with detailed descriptions of current projects.

Preventing the Spread of Invasive Plants

Leaders: LeeAnne Mila (El Dorado County Dept. of Ag) with Rena Escobedo (USFS – Lake Tahoe Basin Management Unit) and Martin Hutten (Yosemite NP)

Invasive plants: Canada thistle (*Cirsium arvense*), yellow starthistle (*Centaurea solstitialis*), perennial pepperweed (*Lepidium latifolium*), diffuse knapweed (*Centaurea diffusa*), spotted knapweed (*Centaurea maculosa*)

Tour the route and effects of an infested gravel/building material distributor in Douglas County, NV. Travel to and tour Alpine County eradication projects and learn how invasive plants have impacted ranchers and private landowners. We will visit a Washoe tribal lands site that has been invaded with diffuse knapweed and yellow starthistle, both brought in with "dirty" gravel. We will visit the South Tahoe Public Utilities Ranch which has ditch banks which invasive plant treatments have left free of invasive plants; we will see Canada thistle along canal benches. We'll make a stop at Turtle Rock Park where we'll find spotted knapweed growing in asphalt cracks. Finally, we will wind up at Grover Hot Springs State Park where you can choose to discuss their eradication projects or take a soak in the pool!

Posters

Alphabetical by presenter. Please see abstracts for a full list of authors on each poster.

(Student Poster) The interaction of soil surface gravel content and nitrogen deposition on the seedbank of the invasive grasses *Schismus arabicus* and *Schismus barbatus* in the northwest Sonoran Desert. *Michael D. Bell, UC Riverside*

Invasive aquatic weeds: Implications for mosquito and vector management activities. *C. E. Blair, Mosquito and Vector Management District of Santa Barbara County*

Performance attributes of aminocyclopyrachlor herbicide in controlling invasive plants. *John Cantlon. DuPont Land Management*

A predictive model of *Bromus tectorum* occurrence in Yosemite National Park. *Steven Del Favero. Yosemite National Park*

A common data model for weed monitoring data. *Deanne DiPietro, Sonoma Ecology Center*

Monitoring environmental responses to *Tamarix* biocontrol and ecosystem recovery in the Virgin River watershed. *Tom Dudley, UC Santa Barbara*

Mapping, monitoring and removing medusahead. *Joan Dudney. Arastradero Preserve Stewardship Project*

Mapping invasive weeds: scaling up and down for different end user scenarios. *Ingrid Hogle, San Francisco Estuary Invasive Spartina Project*

Public-private cooperation results in improved restoration of reed canarygrass (*Phalaris arundinacea*) infested areas. *Jonathan Humphrey, Sequoia and Kings Canyon National Parks*

The evolution of arundo removal efforts on Camp Pendleton. *Benjamin M. Lardiere, MCB Camp Pendleton*

Mechanical control of yellow starthistle: impacts on target and non-target vegetation. *Virginia Matzek, California State University, Sacramento*

Eradicating Algerian sea lavender (*Limonium ramosissimum*) from San Francisco Bay wetlands. *Mike Perlmutter, Bay Area Early Detection Network*

Population expansion and regional management of red sesbania (*Sesbania punicea*) in California. *Ramona A. Robison, California Department of Parks and Recreation*

Evaluating the effects of horizontal and vertical mulches for restoration of a degraded site in the Mojave Desert: first year findings. *Heather Schneider, US Geological Survey*

Results from four years of early detection invasive plant monitoring in Golden Gate National Recreation Area. *Robert Steers. National Park Service*

Comparison of four herbicide treatments on *Oxalis pes-caprae*. *Lewis Stringer, Presidio Trust*

Evaluation of control techniques for velvetgrass (*Holcus lanatus*) in the Kern Canyon of Sequoia National Park. *Rich Thiel, Sequoia and Kings Canyon National Parks*

Progress in the restoration of the habitat of fountain thistle (*Cirsium fontinale*) invaded by jubatagrass (*Cortaderia jubata*). *Don Thomas, San Francisco Public Utilities Commission*

Oral Presentation Abstracts

In order by session

Wednesday, October 5
Session 1. Ecological Change

Nuance, naysayers and twenty years of studying species impacts. *D'Antonio, Carla M.* Environmental Studies Program, University of CA, Santa Barbara, CA 93105. dantonio@es.ucsb.edu

Understanding the impacts of invasive non-native plant species is fundamental to the creation of lists such as Cal-IPC's Wildland Invaders lists that in turn can help managers to prioritize species for control. In the twenty years since the formation of Cal-IPC (and EPPC) scientific research on the impacts of non-native species has skyrocketed. Yet there are surprisingly few studies documenting the many purported impacts of both Cal-IPC listed and more importantly few that evaluate the context specific nature of impacts. In addition an overarching framework for understanding impacts is lacking and the value laden nature of why we care about species has contributed to controversies about whether non-native invaders are indeed 'problematic'. In this talk I will discuss a framework for assessing traits that give rise to different types of species impacts as well as stressing some of the nuances of impacts for some presumed high impact invaders. Attention to the context specific nature of impact as well as to the subtleties of how species change ecosystems can help us refine the prioritization and management process.

The ghost of invasions past: the soil legacy of invasive plant species. *Suding, Katharine N.* University of California Berkeley Dept. of Environmental Science, Policy and Management, Berkeley, CA. suding@berkeley.edu

Aside from their obvious disrespect for fence lines, some problematic invasive plant species can continue to edge out native species even after they have been removed due to their effects on soils. Evidence is accumulating that some invasive species can shift microbial communities, nutrient cycling and other soil processes, that the shifts in ecosystem processes may be advantageous to the modifying species, and that these effects may persist beyond the life of the invader. Similar legacy effects may also occur "top-down" through animal communities, changing trophic – rather than soil – interactions. Legacy effects might contribute to cases where restoration gets "stuck" with limited native recovery or where is takes a trajectory that leads to unintended outcomes. In such cases, invasive species management may need to consider setting control abundance thresholds and including additional intervention measures to address legacy effects.

Smog is fertilizer: atmospheric nitrogen deposition drives weed invasions and biodiversity loss. *Weiss, Stuart B.* Creekside Center for Earth Observation. stu@creeksidescience.com

The global nitrogen cycle has been massively altered by human activities. Emissions of nitrogen oxides and ammonia from combustion, agriculture, and soils are transported and chemically transformed in the atmosphere and deposit onto land and water. This atmospheric nitrogen deposition effectively delivers high quality nitrogen fertilizer to ecosystems. In California, 20% of the land surface receives greater than 5 kg-N ha^{-1} $year^{-1}$, with hotspots receiving greater than 50 kg-N ha^{-1} $year^{-1}$. This profound ecological change enhances growth of invasive weeds, and threatens native biodiversity. Documented effects include

increased growth of annual grass and other invasives in coastal sage scrub, serpentine grasslands, vernal pools, and deserts, altered nutrient cycling and fuel accumulation of montane forests, enhanced fire cycles, and nitrate leaching into surface and groundwater, and eutrophication of montane lakes such as Tahoe. Weed management is central to mitigating the impacts. This talk will review the scope of the problem in California and suggest some policy avenues, including CEQA, critical loads, mitigation fees to support Weed Management Areas, ESA consultations, Habitat Conservation Plans, and other possibilities.

Fire, climate change, and opportunities for invasion. *Moritz, Max A*. University of California-Berkeley Environmental Science, Policy, & Management Dept., Berkeley, CA. mmoritz@berkeley.edu

Fire is an important process in many California ecosystems, and human activities have altered natural fire regimes in a variety of ways. Natural fire regimes have also been altered by the spread of non-native species of plants, especially in southern portions of the state (e.g., annual grasses in both desert and shrubland areas). Climate change is very likely to disrupt future fire patterns, but shifts can be difficult to predict. In some locations, future fire activity may be driven by altered temperatures, yet in others it may be due largely to precipitation timing and/or amount. Future human development and fragmentation of natural landscapes will also play a role in many locations. A goal of this talk is therefore to review the varying constraints on fire in different ecosystems of California and some of the modeling approaches we have developed for predicting future fire probability patterns. While future fire could conceivably facilitate desired range shifts in some plant and animal species, fire is often considered an agent of vegetation "type conversion" when it provides a window of opportunity for invasion and establishment of non-native species. Such a window is much more likely when certain fire-related thresholds are crossed, such as in the interval between fires. We will therefore also examine where the greatest disruptions in future fire frequency are likely in California, to assess whether the locations in question lend themselves to this kind of vulnerability.

Session 2. Membership Meeting

Sustainable forests, healthy communities and vibrant rural economies. *Carr, Kim*. Sierra Nevada Conservancy, Auburn, CA. kcarr@sierranevada.ca.gov

The Sierra Nevada mountain range is the home to almost half of California's plant species. As the cost to monitor and control the plants is increasing, the federal and state land management funds are declining. These conditions are causing land managers to become more creative in addressing the problem by building broader partnerships to design projects to address multiple objectives, including invasive plant removal.

The Sierra Nevada currently has unprecedented collaboration of diverse stakeholders addressing ecological restoration. These collaboratives are planning restoration work at a larger scale and across public and private lands. Furthermore, the discussions are including the relationship between ecological restoration and the myriad of services that are protected by healthy watersheds such as habitat, biodiversity, water quality, and carbon sequestration. There is greater focus on the need for investment in the land and the people to advance ecological restoration and create local jobs to support rural community vitality. These new approaches help expand the traditional framework that has been used to address more specific challenges such as invasive plants. This framework will be described by way of details of the Sierra Nevada Forest and Community Initiative and by providing specific examples of on-the-ground work.

Session 3. Student Paper Contest

Dittrichia graveolens- a study of invasive plant biology with a focus on management.

Brownsley, Rachel, Guy B. Kyser, and *Joseph M. DiTomaso,* University of California, Davis, Dept. of Plant Sciences, rnbrush@ucdavis.edu, gbkyser@ucdavis.edu, jmditomaso@ucdavis.edu

Dittrichia graveolens (L.) Greuter (stinkwort; Asteraceae) is a rapidly expanding and poorly studied annual invasive plant that is becoming a focus of resource managers in California. *Dittrichia graveolens* degrades forage quality, can be toxic to livestock, and can cause contact dermatitis in susceptible people. Currently, *D. graveolens* primarily infests roadsides, right-of-ways, detention basins, and mining facilities, and requires additional management due to its asynchronous life cycle (late summer growth followed by flowering and fruiting in the fall). Potential for *D. graveolens* invasion in natural ecosystems is not well understood at present; a better characterization of plant biology and life history traits is needed to assess this potential. Plants produce tens of thousands of small seeds with a bristly pappus. Seeds are easily dispersed by wind, vehicles, and animals (including people). Based on its rapid expansion at a state level and effective seed dispersal at a local level, we have focused our initial research on the germination phase of the *D. graveolens* life cycle to better understand its capacity for establishment under a variety of environmental conditions. Preliminary results indicate that there is no innate seed dormancy, germination occurs with the first rainfalls of the season and thereafter throughout the rainy season. In addition, germination will occur at a very wide range of temperatures (5°-35°C), and does not require light. Overall seed viability is high (96% for mature, filled seeds). However, subsequent growth studies show that plants require high light and are dramatically suppressed by shade. These germination and growth studies contribute to a larger research program that will describe the biology and life history traits of *D. graveolens* to strengthen predictive models and develop effective and timely control strategies.

Alteration of nitrogen cycling processes by exotic annuals in a California grassland.

Carey, Chelsea and Stephen C. Hart,* University of California-Merced, Environmental Systems Graduate Group, Merced, CA. *ccarey3@ucmerced.edu

California has a heterogeneous landscape with many diverse microclimates that house more than 1,000 exotic plant species, of which 300 occur in California's grasslands. It has long been established that invasive exotic plants have the ability to impact aboveground biodiversity, but the effects of invasive plants on the soil microbial community and thus ecosystem nutrient cycling is much less understood. Microorganisms responsible for key steps in the nitrogen cycle, such as nitrifying bacteria and archaea and denitrifying bacteria, are important to consider during invasion events because changes to the nitrogen availability in soils may be partly responsible for the competitive exclusion of native plants by invasive plants. As such, the objective of this study was to assess how communities of invasive weeds (*Aegilops triuncialis*, *Centaurea solstitialis* and *Taeniatherum caput-medusae)* and exotic forage annuals *(Avena fatua, Bromus hordeaceus, Lolium multiflorum,* and *Trifolium subterranean)* affect the soil nitrifying and denitrifying community and subsequent nitrogen cycling in a California grassland. Soil from invasive weed, exotic forage annual, and native plant communities was collected in April 2011 and stored for DNA analysis of the microbial community; nitrogen measurements were analyzed on fresh soil. Results indicate that soils associated with invasive weeds had significantly higher soil carbon:nitrogen ratios, lower total nitrogen, and lower nitrification potential rates than native soils. Carbon:nitrogen ratios and total nitrogen values for soils associated with exotic forage annuals were not statistically different from those of invasive weeds. The

nitrification potentials of exotic annual soils were intermediate between invasive and native soils, though this relationship was not significant. These results indicate that soil nitrogen dynamics were impacted by the presence of invasive weeds and additional data on nitrogen cycling microorganisms will provide a mechanistic insight into this change. Both microbial and nitrogen cycling results will be discussed during the presentation.

How does light attenuation affect giant reed (*Arundo donax*) establishment?
*Palenscar, Kai T.** and *Holt, Jodie S.* University of California-Riverside Dept. of Botany and Plant Sciences, Riverside, CA.
*Kai.Palenscar@student.ucr.edu

Giant reed (*Arundo donax* L.) is an invasive, asexually reproducing clonal grass brought to California for stream bank erosion control. Clones infest riparian habitats in much of the state, reducing wildlife habitat quality. Mechanical or chemical methods provide short-term control, but long-term management may require additional activities including restoration. A greenhouse experiment was conducted to test how carbon starvation affected plant establishment. Shade structures (1 m^3) were constructed and covered in neutral density cloth, creating 3 shade treatments (100, 35, and 5 % ambient light, r = 3). Certain riparian species have canopies able to attenuate light to below 5%. Plants were grown from rhizome fragments with harvests occurring at 3 and 6 months. Plants receiving 5% light displayed rapid stem elongation, had longer internodes, fewer leaves, and less total leaf area than higher light treatments at 3 and 6 months, with differences increasing with plant age. At 6 months plants in the 100 and 35% light treatments looked robust and healthy, with similar total leaf area, total stem length, and leaf chlorophyll content, but had different relative growth rates, root to shoot ratios, and net rhizome growth. There was a direct relationship between available light and resource allocation, with plants grown in high light allocating more carbon to root mass, vegetative reproduction, and belowground storage, whereas plants grown in lower light allocating to light-harvesting structures (leaves and stems). Results indicate that carbon starvation alters giant reed resource allocation at moderate shading and only under deep shade are both above and belowground growth negatively affected, making these plants susceptible to herbivory and drought. Management utilizing restoration practices that maximize native shading potential, such as through species selection and planting density, could reduce giant reed success and provide long-term control when used as part of an Integrated Weed Management Program.

The importance of landscape context in invasive plant patterns within conservation linkages. *Wilkerson, Marit*. University of California-Davis, Graduate Group in Ecology, Davis, CA 95616.
mlwilkerson@ucdavis.edu

Conservation linkages, such as highway undercrossings, hedgerows, and riparian corridors, are widely promoted to combat the negative effects of fragmentation. An often-discussed though understudied concern is that linkages will also aid invasive plant movement. Edge habitat has often been linked to invasion, and because of their relatively long and linear shape, conservation linkages could promote plant invasion. This consequence may largely depend on a linkage's landscape context, such as the nature of the surrounding matrix. As part of a broad study to address the potential problem of linkages encouraging invasive plants, I am focusing on large-scale conservation linkages in Southern California that are part of region-wide attempts to enhance landscape connectivity. I am examining the patterns and potential mechanisms of plant invasion associated with these landscape features, emphasizing the role of edge effects and the impact of matrix types. I collected data from nine linkages dominated by chaparral and coastal sage scrub in San Diego and Riverside

Counties. Surveys confirm that plant invasion has a spatially explicit structure with linkage interiors being more invaded than their edges. These spatially-explicit patterns varied among invasive species with different dispersal syndromes (wind vs. animal vs. bird). In turn, these patterns depend upon the types of matrix that surround the linkage. Therefore what constitutes a landscape for a wind-dispersed invasive species is not the same as that of an animal-dispersed invasive species or a bird-dispersed species. Few if any studies have examined this landscape ecology concept in a comparative, large-scale manner. This observational study complements research I am conducting in northern California in an agricultural hedgerow system. Conclusions from both the small-scale and large-scale aspects of this research will help land-managers/owners prioritize invasive plant management within their linkages and will advance our conceptual understanding of invasive plant patterns and connectivity at the landscape level.

Session 4. Prevention

Working with mineral materials producers and suppliers – Got clean gravel? *West, Wendy.* University of California Cooperative Extension, Placerville, CA. wkwest@ucdavis.edu

Invasive weeds are a major problem in California and the Sierra Nevada Mountain region, affecting water quality, forest productivity, recreational opportunities and use and wildlife habitat. New weeds continue to move into the region, and as the climate changes more species are likely to invade at higher elevations. Gravel pits infested with weeds can spread invasives to hundreds of new sites. This presentation will highlight current efforts to: identify and promote programs that support the production, availability and use of weed-free mineral materials; development and dissemination of educational materials to mineral material suppliers to build awareness and understanding of the issue; develop, expand and support material weed cleanliness verification programs.

Prevention BMPs for invasive plant managers. *Stern, Jen*. California Invasive Plant Council, Training Program Manager jrstern@cal-ipc.org

Throughout the community of invasive plant managers in California, several best management practices (BMPs) are used to prevent introduction and spread of invasive plants. However, there is not a single set of BMPs used. To address this need, the California Invasive Plant Council developed a set of prevention best management practices (BMPs) for invasive plant managers who work in wildland settings. The goal of these BMPs is to prevent accidental introduction and spread of invasive plants by those managing invasive plants in California. This presentation will provide an overview of how to use these prevention BMPs in your day to day activities. While conducting restoration work, invasive plant managers often travel from one site to another or from one work area to another. Equipment, vehicles, animals, clothing, boots, and mulching materials moved between sites can accidently become vectors for the introduction and the spread of invasive plants. However, accidental introduction and spread of invasive plants can be prevented if standard prevention practices are followed. For example, equipment cleaning, and use of weed-free materials. These prevention BMPs also aim to help invasive plants managers make efficient use of limited resources, as the least expensive and most effective way to manage highly invasive plant species is through prevention.

Challenges to early detection and rapid response - Spotted knapweed eradication: Building successful partnerships between local, federal, and private entities*. Mila, LeeAnne*, El Dorado County Dept. of Agriculture, leeanne.mila@edcgov.us.

Spotted knapweed, an "A" rated pest by California Department of Food and Agriculture, was discovered in the "Cleveland Fire" area of the Sierra Nevada Mountains in El Dorado County. The Cleveland Fire Burned 22,485 acres in 1992 after a small 5 foot fire exploded in a matter of hours. Spotted knapweed was most likely brought in on equipment used during fire suppression, erosion control, and timber salvage efforts. The site was initially found on private timber property, but soon was found on adjacent USFS property as well.

From a regulatory perspective the El Dorado County Department of Agriculture wanted to see this pest eradicated as quickly as possible. The challenge became getting all affected entities to be able to quickly react to and treat this pest. Spotted knapweed is an aggressive invader that responds best to chemical treatment due to its ability to reproduce from root fragments, produce 40,000 seeds per plant, and its adaptive ability.

Four factors stood in the way of quick implementation of survey and eradication efforts: 1.) The Eldorado National Forest had no environmental document in place to allow them to treat with chemicals 2.) dense fire and slash debris hid many plants from view, 3.) very steep canyon terrain made detection difficult and labor intensive, 4.) funding for the eradication efforts was limited and insufficient. El Dorado County Department of Agriculture, as the regulatory agency, spearheaded efforts to bring all parties together and secure the necessary funding to allow for delimitation and treatment. A project partnership was formed that included the Eldorado National Forest, Sierra Pacific Industries, El Dorado County Department of Agriculture and volunteers from the El Dorado Chapter of the Native Plant Society.

Session 5. Spatial Data

Using public domain remotely sensed data to predict *Taeniatherum caput-medusae* (medusahead) infestations, a case study from the central California foothills.

Alford, Jim,* California Department of Fish and Game, Vegetation Classification and Mapping Program, *Daniel Benedetti*, U.S. Army Corps of Engineers, and Nathan Jennings, American River College. jim.alford @comcast.net

Wild lands managers must deal with ever more limited resources. This project demonstrates the utility of remote sensing to identify invasive plant infestations. The data is freely available from the National Agricultural Information Program.

The study site is New Hogan Lake, Calaveras County, California. It is managed for recreation and flood control by the Army Corps of Engineers. They have an aggressive weed removal program but are hampered by a lack of botanical staff. The site is highly disturbed by historic and current mining, dam operations and roads. The grasslands are typical of central California low elevations - dominated by Eurasian plants. In this case, the highly invasive medusa head, *Taeniatherum caput-medusae* dominates grasslands of intermediate disturbance.

We used ENVI 4.8 for image processing and ArcGIS 10.0 for mapping. Data were acquired from the National Agricultural Information Program. Field surveys established 214 points greater than $1m^2$ dominated by the target species. The simple algorithm, the Normalized Difference Vegetative Index, was used. We concluded that (1) Woody plants could be identified to species even if congeners and (2) prediction of medusa head presence is possible. We also used k-means unsupervised classification transformation. These results support the idea that medusa head is limited to soils with high late spring moisture. Future research includes a supervised classification and implementation

of soil-water algorithms to further refine the procedure.

These methods are easily repeatable. While image processing software is prohibitively expensive for agencies and non-profits, free or low cost access is available to students. In this case, the total project software cost was less than $200. Community College GIS programs make good partners. The students benefit from real world conditions and produce materials for an effective portfolio. Wild lands managers benefit by adding to their weed management tools.

Invasive plant management in California State Parks. *Robison, Ramona, A.* California Department of Parks and Recreation, Natural Resource Division, 1416 9th Street, Sacramento, CA. rrobison@parks.ca.gov

The State Parks Natural Resources Program spends a significant amount of its yearly budget on invasive plant management. We will present examples of innovative programs developed to manage a wide range of invasive plants throughout the State. Many of the methods employed and lessons learned can be used to inform management elsewhere. Highlighted programs will include: European beachgrass removal on the north coast, riparian restoration in the Central Valley, aquatic plant management in Lake Tahoe, management with fire on the central coast and restoration design to address sea level rise on the south coast. Monitoring using TNC's Weed Information Management System (WIMS) and early detection-rapid response (EDRR) principles are also important components of the invasive plant management program. Most important among the strategies to continue existing programs in light of budget cuts and park closures has been development of innovative partnerships with other agencies and non-profits. Examples include Weed Management Areas and Resource Conservation District partnerships throughout the state. We will also present some approaches under development within Parks to address ecological change, as well as implications of possible park closures for invasive plant management.

Using distribution information to understand and conserve California flora: recent results and prospects for further future improvement. *Gluesenkamp, Daniel* and John Malpas.* The Calflora Database. *conservation@gluesenkamp.com

Assessment, prioritization, and management of invasive plants depend strongly on comprehensive distribution information. Since the early 1990s, the Calflora database has provided information on wild plants in California for use by scientists, conservationists, and citizens. Originally an 8-character dos code available only as a file, the emergence and expansion of the World Wide Web has made Calflora's services widely available to nearly 19,000 registered users. Recently, supporting partners (including BAEDN, Cal-IPC, CNPS, and NRCS) have invested in data compilation efforts, as well as exciting new tools for mapping and understanding our changing flora. This talk reviews some of these new tools and describes current upcoming partnerships and tools under design. Finally, we present analyses of existing data that are of interest to invasive plant specialists. These analyses include peer-reviewed studies that use the database to understand patterns and mechanisms in invasive plant biology, analyses of overlap between invasive plants and rare plants, and the identification of significant geographic and taxonomic gaps in mapping information.

Thursday, October 6

Session 6.
Climate Change in the Sierra Nevada

Climate change in the Sierra Nevada; Processes, projections, and adaptation options. *Millar, Constance I.*, USDA Forest Service, Pacific Southwest Research Station, Albany, CA 94710, cmillar@fs.fed.us

Earth's natural climate system is characterized by continually changing climates, with climate regimes that oscillate quasi-cyclically at multiple and nested scales from annual to multi-millennial, and commonly change abruptly. Under naturally changing climates, plant species in the Sierra Nevada track changes at diverse scales in individualistic manner, with plant communities changing as dominances fluctuate and species ranges shift. The capacity of plant species to adapt to changing natural climates depended historically on their ability to move over the landscape following favorable conditions. The human-dominated climate system, into which earth entered in the mid 20th century, extends beyond relevant historic reference in the nature of control (greenhouse gas emissions), rapid and global rates of directional change (warming), and super-elevated carbon dioxide and methane levels. Modeled future climates for the Sierra Nevada anticipate continuing trajectories of climate and greenhouse gases even if greenhouse gas emissions are reduced soon. The extensive human footprint of land use severely restricts the capacity of plant species to adapt to the rapid changes. General principles for conservation and biodiversity protection under anthropogenic climate change are rapidly being developed and implemented. I summarize a strategic framework toward adaptation as a toolbox approach. Conceptual tools to be mixed and combined include the "5Rs": *Reduce* greenhouse gas emissions; *Resist* change; create *resilience* to change; anticipate and proactively enable *response* to change; and *realign* ecosystems that are far out of natural variability. Priority-setting becomes more critical than before. Taking this framework to practice, I outline a process for evaluating needs and decision-making using case-study examples from the Sierra Nevada and similar mountain regions.

Effects of changing precipitation patterns on the spread of *Bromus tectorum* L. in the eastern Sierra Nevada and implications for management. *Concilio, Amy* * and *Michael E. Loik*. University of California-Santa Cruz, Dept. of Environmental Studies, Santa Cruz, CA. *aconcili@ucsc.edu

Increasing atmospheric accumulation of greenhouse gases will likely entail far-reaching climatic effects, both through increased temperature and changing precipitation intensity and frequency. Much work has been done to predict ecosystem responses to changing temperature; however the effects of changing precipitation patterns are not as well understood. Precipitation may be equally (or more) important in influencing changes in vegetation patterns, particularly in arid ecosystems. Of special concern is the response of invasive plant species- especially at the edge of their invaded range. At high elevation in the eastern Sierra Nevada, the exotic annual grass, *Bromus tectorum* L., is present but has not yet seriously impacted the native plant community- in contrast to lower elevation Great Basin sites where it has completely displaced natives and caused dramatic changes to the fire cycle. Over the past 3 years, we have used a series of experiments to evaluate how *B. tectorum* might respond to changing snow levels and increased spring rain. We used snow fences to manipulate snow depth and irrigated plots to simulate a shift toward increased spring rain. Snowpack affected the timing of germination and early growth, but had little to no effect on final seedset or biomass. In contrast, spring rain increased *B. tectorum* growth dramatically, with the largest effects occurring on individuals growing in the inter-shrub zone, which implies an increased

potential for more frequent fires. Results suggest that *B. tectorum* may become more competitive with a shift from snow to rain events, with the potential to increase its range and have more serious impacts at higher elevation sites. Monitoring and control efforts for *B. tectorum* in a future climate should focus on transportation corridors and invasion-risk areas at elevations above current occurrence.

Predicting the spread of invasive plants in the Sierra Nevada. *Brusati, Elizabeth*, Doug Johnson, Dana Morawitz, Falk Schuetzenmeister, Cynthia Powell, Suzanne Harmon, Tony Morosco.* California Invasive Plant Council, Berkeley, CA. *edbrusati@cal-ipc.org

Cal-IPC developed a "risk mapping" approach to set regional priorities for invasive plant management, and develop recommendations for the Sierra Nevada. These recommendations are derived from maps of current distribution for each species combined with projected suitable habitat. We developed models of suitable habitat for 29 invasive plants based on climate conditions in 2010 and 2050. Some of these plants are already widespread, such as yellow starthistle (*Centaurea solstitialis*), while others are just beginning to move into the Sierra Nevada. We generated the models using Maxent software with GIS datasets compiled from throughout California, and a commonly-used set of 19 bioclimatic variables from Bioclim. These results are based on the A2 emissions scenario. When overlaid with maps of current distribution, suitability maps help show vulnerability to spread. Some species show likely range expansion with climate change, while others contract or shift their ranges. In other cases, the projected range does not change but the level of suitability does. This "risk mapping" approach has been used to determine priorities for eradication, containment and surveillance in the Sierra Nevada. An online tool will allow natural resource managers to generate maps and management recommendations for their area and to update quad data. The system will be linked to existing online occurrence databases such as Calflora. This presentation will show examples from the risk maps completed in spring 2011 and describe our next steps for refining the modeling methods and integrating results with other conservation information. It will also include a demonstration of the CalWeedMapper online system.

Session 7. Pesticide Laws & Regulations

Records and storage requirements for pesticide applicators. *Carveth, Charlene*, El Dorado and Alpine County Agricultural Commissioner's office, charlene.carveth@edcgov.us

Pesticide laws and regulations for pesticide applicators topics covered will include; licensing and registration requirements, pesticide records and use reporting, hazard communication and notification requirements, medical supervision, worker safety and training requirements, respiratory protection programs, proper pesticide storage and container disposal.

The Pesticide Use Monitoring Inspection: what every applicator needs to know. *Mila, LeeAnne*, El Dorado and Alpine County Agricultural Commissioner's office leeanne.mila@edcgov.us

Laws and regulations for pesticide applicators highlighting the inspection process. Learn what to expect if you are inspected, and how to deal with any issues that may arise in the field. Topics covered will include; work requirements, the pesticide label and safety requirements, protection of persons, animals, and property, personal protective equipment, safe container transport, mixing and loading procedures, accurate measurement, field postings, safe equipment, backflow prevention, wellhead protection, and enforcement procedures.

Best Management Practices Establishing a Closed Chain of Custody for Herbicide Use in the Utility Vegetation Management Industry and Laws and Regulations for and Utility Vegetation Managers. *Money, Nelsen*, NRN-VMS, Inc., nelsen.money@gmail.com

An outline of laws and regulations pertaining to Utility Vegetation Management will be reviewed with a detailed discussion on how the closed chain of custody can help manage reporting for utility vegetation managers. The Utility Arborist Association (UAA) has established a new Best Management Practices (BMP) focusing on a closed system using returnable, reusable containers. The new BMP defines an end-to-end strategy for managing the herbicide chain of custody from manufacturer to custom blender, distributor, utility owner, and applicator and improves compliance with use reporting, safe handling, and environmental protection requirements in utility vegetation management.

Recent court orders and injunctions for the protection of endangered species. *Moreno, Polo*, California Department of Pesticide Regulation, pmoreno@cdpr.ca.gov

Recent court injunctions to protect endangered species have placed use-restrictions on a large number of commonly used herbicides in California. The 2004 injunction and court order for Salmonid protection imposed a consultation schedule between U.S. EPA and the National Marine Fisheries Service (NMFS). In the case of pesticide registrations by U.S. EPA, the consultation centers on the potential effects of 37 pesticide active ingredients on Pacific Salmon and Steelhead. Under the injunction, there are exemptions provided to vector control and invasive weed programs. However, once consultation is completed, for each active ingredient NMFS issues a Biological Opinion with a series of recommendations/requirements known as Reasonable and Prudent Alternatives (RPA). U.S. EPA is expected to incorporate these RPAs into FIFRA-enforceable county bulletins, to be followed by all pesticide applicators. The latest drafts of the county bulletins provided for comment to DPR and county agriculture departments don't provide exemptions to invasive weed programs. The implications on herbicide applications by weed control agencies will be highlighted, along with earlier court injunctions, and informational resources for complying with injunction requirements.

Session 8. Management & Restoration

Sustainable solutions to cross restoration thresholds and build ecological resilience: Orange County Invasive Management (OCIM) project. *Dickens, Sara Jo[1]*, Seema Mangla[1], Kristine Preston[2] and Katherine Suding[1].* [1]University of California Berkeley Department of Environmental Science, Policy, and Management, Berkeley CA. [2]Nature Reserve of Orange County, Irvine, CA. *sara.jo.dickens@berkeley.edu

Sustainable restoration of invaded, degraded lands has had mixed success due to numerous factors including low rainfall, soil compaction, poor water infiltration and exotic plant competition. In order to efficiently allocate a limited land management budget, land managers must weigh various ecological constraints and long-term recovery in planning for invasive management, recognizing tradeoffs among outcomes and imposed by economic constraints that vary across the landscape. The objective of this study was to assess the effectiveness of differing restoration intensities and identify possible environmental and anthropogenic variables that may be used as predictors of restoration success. These predictor variables would then be used to create a web-based tool to aid managers in making more informed restoration and exotic plant control decisions based on site environmental and historical land used variables. We compared across environmental and anthropogenic

gradients of soil type, aspect, slope, elevation, vegetation percent cover, land-use history and exotic plant management history (no action-control, passive, active, intermediate) across the Central and Coastal Reserves of Orange County, CA. Collaboration with land managers led to sampling of 131 sites and a clear identification of land use issues and management needs that will be incorporated into the planned web-based tool. Preliminary vegetation analysis indicates that all levels of management intensity lead to higher native cover as compared to no action, whereas, native plant richness was higher in active and intermediate restorations only. Target exotic plant species (*Brassica nigra* and *Cynara cardunculus*) were effectively reduced by all management intensities, however, only the intermediate and active levels of restoration led to overall reduction of exotic plant cover. These preliminary results indicate that restoration efforts at any intensity can lead to increases in the native plant community, but more intense restoration efforts will be necessary to increase native richness and reduce overall exotic plant invasion.

Tipping the balance: Using natives to combat weeds and promote ecological resilience of riparian restoration.
Hammond, J.E. and F.T. Griggs. (Presenter: Hejo Tjarks) River Partners. 580 Vallombrosa Avenue, Chico, CA.
jhammond@riverpartners.org

The existing ecological conditions on most floodplains in the Central Valley currently do not favor establishment of native woody or herbaceous species, which are frequently outcompeted by aggressive invasive weeds. Restoration projects implemented on the Sacramento River over a decade ago have established vast expanses of riparian forests with native woody species, frequently, however the herbaceous layer is dominated by annual grasses or other weeds including yellow starthistle or milk thistle.

More recent restoration projects undertaken by River Partners employ an aggressive approach to combat understory weed presence by establishing an herbaceous understory of perennial natives alongside woody vegetation. Our approach on the San Joaquin River National Wildlife Refuge (SJRNWR) has been; during the first project year, install rows of woody trees and shrubs, followed by aggressive weed control during the first two growing seasons. A sterile seedbed approach is employed to the aisles between rows, where repeated discing and irrigation events flush the existing seed bank of non-native and invasive species. Hand labor is used to remove weeds occurring on planting rows, where discing or herbicide use would damage planted woody species, occurs routinely throughout the growing season to ensure seed set does not occur. This reduces competition for native grasses and forbs that are installed at the end of the second growing season by broadcast and drill seeding. The seeded native understory will receive irrigation for one year, and may be mowed if dense weeds are noted in the field. To help ensure successful establishment of a robust herbaceous understory, River Partners collects seeds from local ecotypes, found either on the SJRNWR or nearby in the watershed. This approach has resulted in a dense cover of native herbs: 65% and 71% absolute cover of native herbaceous species on two fields surveyed in 2010; typical of many of our projects in this region and more recent projects implemented on the Sacramento River as well.

Evaluating distribution and prevalence of non-native vegetation percent cover in a Southern California wetland and its application to inform habitat restoration and non-native vegetation control. *Tuttle, Elena*, Karina Johnston* and *Ivan Medel*. The Santa Monica Bay Restoration Commission, Marina Del Rey, CA.
*etuttle@santamonicabay.org (310) 417-3962

The Ballona Wetland Ecological Reserve (BWER) in Los Angeles, California has been impacted by many anthropogenic, hydrologic, and geomorphic modifications, and has been subject to non-native vegetation invasions and extensive habitat degradation. The goal of this paper is to present the preliminary findings including: 1) identification of habitats with high non-native species presence, 2) determination of the prevalence of native and non-native vegetation percent cover in each habitat type, 3) use of percent cover to define dominant species in each habitat, 4) explore possible correlations between prevalence of non-native vegetation percent cover and other parameters collected on each transect (including elevation and invertebrate productivity).

Vegetation was assessed using a stratified random sampling method. Habitat types were assessed to vegetation alliance level while species level data and percent cover were collected on each transect. Soil quality, elevation, and inundation information was collected on a subset of the transects used for vegetation surveys. Upland habitats were found to be dominated by non-native vegetation percent cover and to contain higher non-native species diversity and presence. The dominant species in these habitats were *Carpobrotus spp., Bromus diandrus, Brassica nigra,* and *Chrysanthamum coranarium*. The dominant species in native vegetation dominated habitats were *Cressa truxillensis, Jaumea carnosa,* and *Salicornia virginica*. Percent native cover was found to be negatively correlated with elevation ($r = -0.558$, $p < 0.001$); percent non-native cover was found to be positively correlated with elevation ($r = 0.589$, $p < 0.001$). Inundated areas had the lowest non-native cover.

These results will inform the restoration alternatives and aide in non-native vegetation control and habitat restoration. Identifying conditions favorable to non-native vegetation cover will also assist in forecasting possible changes in non-native percent cover resulting from climate change, sea-level rise, and anthropogenic stressors.

Effectiveness of aquatic invasive plant control in Emerald Bay, Lake Tahoe. *Shaw, Dan**[1], *Zach Hymanson*[2], *Kim Boyd*[3], and *Tamara Sasaki*[1]. [1]California State Parks, Sierra District. [2]California Tahoe Conservancy. [3]Tahoe Resource Conservation District. *dshaw@parks.ca.gov

Emerald Bay is a unique, high profile attraction in the Lake Tahoe basin and is a primary destination for photographers, boaters, campers, hikers, and other recreationists. The establishment of invasive aquatic plant species in Emerald Bay is of great concern to a large variety of interests due to the adverse effects these plants can have on near shore ecology and visitor enjoyment. A cooperative effort among management and regulatory agencies, scientists, and professional divers was initiated to combat invasive aquatic plants in Emerald Bay after dramatic expansion of Eurasian watermilfoil (*Myriophyllum spicatum*) was discovered in 2003. A series of small-scale treatments were deployed in Emerald Bay between 2005 and 2009, but the infestations continued to persist and expand. In 2010 we pursued a combination of two treatment methods, benthic barriers and diver-assisted suction removal, over an entire infestation site in a strategic attempt to attain control and eventually complete removal of a discreet infestation area. By combining methods, a large continuous area was treated more efficiently, with benthic barriers treating the main area of the infestation, and diver-assisted suction removal specifically targeting hard to reach areas, margins and gaps in the barriers, and sparsely infested patches. This combination of treatment methods maximized the cost/benefit ratio, and one method reinforced the effectiveness of the other. Approximately one-third of the total infested substrate in Emerald Bay was reduced to a level that can be maintained with small scale annual retreatment as post-project effectiveness monitoring detected zero plants in the sample plots with an

estimated 95% reduction in overall plant cover within the discreet infestation.

Road(sides) to recovery: containing the spread of invasive plants by implementing a comprehensive roadside weed removal initiative. *Summers, Tony*. Invasive Plants Program Supervisor, Catalina Island Conservancy. Avalon, CA. tsummers@catalinaconservancy.org

It is well documented that invasive plants utilize human-made transportation routes to spread their propagules. Disturbance caused by routine maintenance and the distribution potential afforded by resource users creates an ideal situation for weed establishment and dispersal. This is readily apparent when hiking trails or driving along the highway. The Catalina Island Conservancy (CIC) has taken an aggressive stance against this threat by establishing and maintaining a 200 foot weed free buffer zone along all roads (220 miles) on CIC property and a 50 foot buffer along all trails (37 miles). The roadside project addresses 18 species of invasive plants over 10,155 acres and began in August 2009. It has been an effective tool reducing the spread of several widespread weeds and has been useful in opening dialogue with island residents who frequently engage weed workers.

The evolution of the project follows the logical progression of:

- Containment- preventing the spread of common weeds by reducing the amount of seed that lands on transportation routes.
- Reduction- eliminating connectivity between large populations by removing plants inside the buffer zone.
- Eradication- removing individual populations that became isolated because of the weed-free buffer zone.

We have learned many lessons after completing the third treatment season and the project has significantly evolved. We are eager to share our success and lessons with the Cal-IPC community.

Prioritizing and promoting region-wide invasive plant management: a report on successes from the Bay Area Early Detection Network. *Perlmutter, Mike**,*Williams, Andrea, Gluesenkamp, Dan* and *Klochak, John*. *Mike@BAEDN.org

This talk reports on outcome of work conducted by the Bay Area Early Detection Network (BAEDN). BAEDN partners have built an Early Detection / Rapid Response (EDRR) system to protect the entire nine county San Francisco Bay Area, which has recently completed its second field season. In the first season staff downloaded thousands of unique plant occurrence reports from the Calflora database, and evaluated distribution of potential target species in the Bay Area. Weed risk assessment identified species known to have high impacts but not yet widespread in our area. Occurrences of 73 target species were prioritized for treatment using the WHIPPET model, which ranks infestations for elimination based on a number of characteristics. Staff worked through >800 infestations, contacting land managers to verify status and encourage rapid response. The result is that 1/3 of infestations were under treatment as of September 2010. In this second field season, BAEDN provided funding to partners and contractors to ensure treatment of these infestations. In this talk, we review the results of this effort to promote and subsidize region-wide EDRR, and we summarize important lessons learned. We also present results of recent efforts to prioritize species and occurrences of Bay Area wetlands, and discuss planned assessments that will expand effective coordination to protect these valuable and sensitive habitats.

Session 9.
Examining Broader Impacts

Designing wildlife avoidance into invasive species control projects. *Austin, Rick L. Santa Clara Valley Water District – Vegetation Management Unit, San Jose, CA* raustin@valleywater.org

Empirical data and conventional wisdom states that invasive plants provide either degraded habitat or no habitat value for native wildlife. As more native habitat is lost, wildlife has increasingly become adapted to using non-natives for cover, nesting and other important functions. Invasive species control often overlooks the need to perform adequate pre-project surveys and incorporate wildlife avoidance into implementation plans.

The Santa Clara Valley Water District identified a project to remove Arundo donax from an island in a small lake in Southern San Jose. Arundo had created a monoculture on the island. Casual observation and biological surveys showed heavy use by local birds including nesting by heron and egret populations.

Vegetation Management staff and wildlife biologists developed a strategy that removed Arundo from the island in phases while simultaneously replanting native species to provide alternative habitat for avian residents. The island was divided into three geographic areas that would be addressed over 3-4 years depending on successful control and the response of the wildlife. The implementation plan assessed wildlife functions provided by Arundo and developed a plant palate as well as creative structural elements to meet these needs. The plan also looked at the specific avian species using the habitat for nesting and timed control to accommodate nesting cycles.

Arundo control began in 2009 with follow-up planting. Year 2 control took place in summer 2010 with additional planting.

The project has been highly successful. Birds are using the plantings as well as the remaining Arundo on the island. The final stage of control will be done in summer of 2011 or will be deferred for one season depending on overall native cover.

Wildlife impacts could have completely derailed this project. Early surveys and the development of a creative control plan that specifically addressed wildlife needs have been critical elements to the project's success.

Invasive *Spartina* Project at a turning point: eradication on the horizon, reconciling clapper rail impacts, and charting a course towards tidal marsh revegetation with native cordgrass. *Kerr, Drew*. State Coastal Conservancy's San Francisco Estuary Invasive *Spartina* Project, Berkeley, CA. drew@spartina.org

The bay-wide infestation of hybrid *Spartina alterniflora* has been reduced from over 800 net acres in 2006 to less than 100 scattered over 35,000 acres of tidal habitat. Only a handful of sites still have greater than 1% cover of hybrid *Spartina*, and ISP hopes that 90% of their 170 sites will be to zero-detection by 2013. *Spartina densiflora* was so reduced by annual imazapyr applications that by 2009 the IPM strategy could shift to purely manual removal at 93% of those infestations. Twice-annual inventory and removal of *S. densiflora* by ISP has since depleted the seed bank and sites are approaching eradication.

The biggest challenge to *Spartina* eradication has been the extensive use of the invaded habitat by endangered California clapper rail. With 85% of the Bay's tidal marshes lost to development, dense stands of hybrid *Spartina* provided welcome refugia and rail densities soared beyond historical levels at some sites. As predicted, these elevated populations could not be maintained after hybrid removal, especially at areas that were simply mudflat before the invasion. Fortunately, many high quality marshes were only moderately infested and their clapper rail populations appear to be stabilizing near pre-invasion levels.

Tidal habitat will greatly expand in the coming decades as the South Bay Salt Ponds Restoration progresses, and the eradication of hybrid *Spartina* is a key first step. But years of backcrossing left a large area of the central bay with no native *Spartina foliosa*, and successful hybrid treatment has resulted in the absence of a cordgrass component. This presents an opportunity for reintroduction of native cordgrass and other valuable plants like *Grindelia* to both established and newly-opened marshes. ISP began pilot revegetation projects in 2010 and is coordinating a multi-year effort at up to 30 sites where passive recruitment is not expected to be sufficient.

Distribution and impacts of *Arundo donax* from Monterey to Tijuana. *Giessow, Jason*,* DENDRA, Inc., *Jason Casanova*, Los Angeles/ San Gabriel Rivers Watershed Council, and *Rene Leclerc*, Northwest Hydraulic Consultants, Inc. jgiessow@cox.net*

Arundo was mapped in high resolution on all coastal watersheds from Monterey to Tijuana. At *Arundo*'s maximum extent (prior to control efforts) 8,907 acres were present in the study area. Significant progress in controlling the plant has occurred to date with 3,000 acres under treatment in the study area, and two larger heavily invaded watersheds with over 90% control completed. Impacts from *Arundo* invasion were explored in detail and then calculated over the study area using the spatial data set. Included in the study were evaluations of impacts to/from: biomass production, water use, fire, geomorphic and fluvial processes, and endangered species. New findings include: documentation of a new class of fire event, fires starting in *Arundo* stands versus wildfires that burn stands (both impacts are accounted for), and significant modification of fluvial processes. The study confirms that *Arundo* stands on coastal watersheds are extremely productive (high biomass yield) and utilize large amounts of water. All impacts are quantified over the study region and by watershed. A detailed assessment of endangered species impacts for 22 federally listed species is presented, including an *Arundo* Impact score and level of interaction by watershed for *Arundo* and listed species populations. Cumulative impact scores are summarized by species and by watershed. A coarse CBA was applied to the spatially defined impacts to determine an approximate monetary valuation of the wide range of impacts. The benefit to cost ratio of 1.9 to 1 demonstrates the value of *Arundo* control programs, particularly those implemented systematically over watersheds. The spatial data set and *Arundo* Impact Report are available for download at: http://www.cal-ipc.org/ip/research/arundo/index.php

Cost-sensitive risk assessment for invasive plants in the United States *Schmidt, John Paul, Michael Springborn*, and John M. Drake.* University of California, Davis**,** Department of Environmental Science & Policy, Davis, CA. *mspringborn@ucdavis.edu

Extensive environmental damages have been caused by invasive non-indigenous plant species in many ecosystems worldwide with significant economic costs. Because new species continue to be introduced intentionally, the adoption of screening methods to identify potentially invasive species in horticultural trade is a promising approach for reducing the rate of pest invasion. To warrant adoption, however, any such screening protocol should be sufficiently accurate to render positive expected net benefits (ENB). Determining the level of predictive performance required to achieve this outcome has been an outstanding problem for policy analysis. Further, because high costs are associated with only a few invasive species, the costs of errors made when discriminating invasive from non-invasive species are highly asymmetric. Invasive species mistakenly permitted for introduction are more economically damaging than non-invasive species mistakenly prohibited. Here we report on a method for cost-sensitive risk classification of potentially invasive plant species that aims to minimize net costs (equivalently, to maximize

net benefits) rather than errors. Boosted regression trees were used to predict pest class from biological traits. Key predictors were seed mass, maximum height, facultative wetland association, and maximum chromosome number. Economic decision criteria were applied and models were validated using holdout test sets. Graphical decision trees are provided to enable application of this model to new species not considered by us. Our estimates indicate the application of this screening tool would result in ENB per species assessed of $80,000-$140,000 under very conservative estimates for the losses from pest plants.

Session 10. Science, Management, & Policy Interactions

Emerging large landscape conservation initiatives create new opportunities to control invasive plants. *Frisch, Steven R.*, Sierra Business Council, Truckee, CA. sfrisch@sbcouncil.org

Across the country new collaborative efforts are emerging designed to aggregate efforts of private sector conservation organizations, public agencies and the private sector. The defining characteristics of these initiatives is that they not only cross sectors, but they engage multiple jurisdictions, cover landscapes in the many millions of acres, engage the best available science to prioritize land acquisition and management, and employ a 'protected mosaic' land conservation and restoration strategy rather than solely place based protection. The emergence of these Large Landscape Conservation Initiatives comes as there is a growing consensus that the most important land and water issues facing North America – climate change, energy development, water management, and land use patterns – require something more than business as usual. These challenges can be summarized as follows: (1) the world cannot afford to wait any longer to deal with the threat of climate change and increasingly frequent droughts; yet (2) we are in the throes of historic, worldwide economic dislocations that will make it difficult to mobilize the political will to address that global ecological threat. (3) Meanwhile, security and climate concerns make energy security a pressing priority, just when we must reduce our dependence on domestic carbon fuels. (4) Open lands, including working landscapes, will be called on to provide more "ecosystem services" like clean water, flood protection, and secure habitat, while under ever greater development pressure from growing populations in emerging mega-regions. In the Sierra Nevada several large landscape initiatives are seeking to address these issues, and the solution shave huge implications for our opportunity to protect native species, and manage lands to provide refugia in anticipation of changing climate. The Northern Sierra Partnership is seeking to preserve 250,000 acres of the most important lands within a 5 million acre landscape spanning the area from Calaveras County in the south to Lassen County in the north. The Southern Sierra Partnership is engaged in a similar effort to protect more than 300,000 acres of land within a 7 million acre landscape spanning the Tehachipi/Sierra Nevada linkage and the southern Sierra foothills.

Science, policy, and management Interactions: The past is not a template for the future of the national parks. *Graber, David*. National Park Service, Pacific West Region. 47050 Generals Highway, Three Rivers, CA 93271-9599. david_graber@nps.gov

After its establishment in 1916, the National Park Service was strongly influenced by landscape architects who sought to preserve and enhance the scenery for which many national parks had been designated. Likewise, "good" wildlife such as ungulates were encouraged while "bad" wildlife—predators—were culled. By the 1980s, however, NPS had responded to the science of

ecology by "managing for naturalness" as its fundamental paradigm for the conservation of nature. This meant that anthropogenic influences would be identified and rooted out to the extent possible. Non-native plants and animals that were sufficiently extensive to have ecological influence would be removed if the tools were available to do so. Anthropogenically extirpated native species would be reintroduced if possible. Although the ecological concept of homeostasis was already being abandoned by the scientific community, for the national parks it remained an article of faith: Native ecosystem elements and processes should interact unimpeded; the past is a guide to the future. However, increasing use of science to inform policy, and thus management, has led to the realization that there are systemic stressors of such a scale that they are not easily amendable to mitigation. For the national parks of the Sierra Nevada, these include atmospheric contaminants, altered fire regimes, landscape-scale habitat fragmentation, invasive species, and climate change. Not long after NPS established an ambitious program to identify and remove introduced plant species as a component of "managing for naturalness," and as its ecological restoration efforts have become far more ambitious, extensive, and successful, climate change science is predicting dramatic changes in habitats that will savagely undermine the meaning of "native" and "natural," confounding management goals. Today, NPS is exploring what adapting to climate change may look like for the national parks.

Poster Abstracts

The interaction of soil surface gravel content and nitrogen deposition on the seedbank of the invasive grasses *Schismus arabicus* and *Schismus barbatus* in the northwest Sonoran Desert. *Bell, Michael D.** and *Edith B Allen*. University of California-Riverside Dept. of Botany and Plant Sciences, Riverside, CA. *michael.bell@email.ucr.edu

The exotic grasses *Schismus arabicus* and *S. barbatus* (*Schismus*) are winter annual invasive species in arid and semi-arid regions that have been shown to increase in cover under nitrogen addition. *Schismus* can produce enough biomass to carry fire in arid regions when subjected to greater than 5 kg/ha/yr of anthropogenic nitrogen deposition during an average rain year. Field studies have shown a decrease in *Schismus* cover in areas that have increasing levels of surface soil gravel. The objectives of this study were to examine the seedbank present in the top 5cm of soil at 8 sites spanning a nitrogen deposition gradient in Joshua Tree National Park. At each site, four 5cm deep soil samples were taken and composited from the north and south side of 4 different *Larrea tridentata* shrubs. Two of the shrubs from each site were growing in areas of high surface gravel and two of them in low surface gravel. The soil was then watered continuously under greenhouse conditions and seedlings were identified, counted and removed as they germinated. 39 plant species germinated across all of the plots with an average richness of 6.5 species per plot. Sites located in areas of high N deposition had a higher species richness than those at lower levels. There was no direct correlation between the number of seeds germinated from the seedbank and subsequent field cover of *Schismus* the following year. Principal components analysis revealed that surface gravel content and soil nitrate levels were the most significant factors affecting the seed bank. These results are important because they show that while exotic seeds are present in the soil, physical and environmental factors are preventing them from growing in certain parts of the desert. This may assist managers in predicting areas that are at highest risk of invasion.

Invasive aquatic weeds: implications for mosquito and vector management activities. *Blair, C.E.* Trustee, Mosquito and Vector Management District of Santa Barbara County (MVMDSBC) and active member of Cal-IPC & CNPS , Lompoc, Ca.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. Adverse effects of Water Hyacinth, *Eichhnorina crassipes,* hydrilla, *Hydrilla verticillata,* Water Evening-primrose, *Ludwigia spp,* Smooth Cordgrass, *Spartina spp., S. densiflora foliosa,* and other species on water quality and facilitating mosquito breeding will be shown. Presentations on the importance of *Spartina spp.* In San Francisco Bay were 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.

Performance attributes of aminocyclopyrachlor herbicide in controlling invasive plants. *Turner, Ronnie, Bruce Finkelstein, Fredrick O'Neal, Robert McKelvey, Cecilia Hirata, Aldos Barefoot, Jon Claus and John Cantlon**. DuPont Land Management, Lakewood, CO., *john.d.cantlon@usa.dupont.com, 303-716-3932

Aminocyclopyrachlor is a new class of chemistry known as the Pyrimidine Carboxylic Acids. It is a new generation of herbicides belonging to the family of herbicides known as synthetic auxins. Aminocyclopyrachlor is a low rate herbicide (0.25 oz. to 4.5 oz. ai.), effective on difficult to control species such as ALS and glyphosate resistant weed biotypes, invasive weeds and brush species. Targeted perennial broadleaf species include leafy spurge, spotted knapweed, diffuse knapweed, yellow star thistle, bindweed, Canada thistle and kudzu. Brush species include huisache, mesquite, poison ivy, oaks, maple, juniper and Russian olive. Annual weeds controlled include kochia and Russian thistle. Cogongrass is labeled for special management control. The half-life of aminocyclopyrachlor ranges from 37 to 103 days. In bareground field soil dissipation studies, the degradation half-life ranged from 80 to 164 days. Aminocyclopyrachlor is metabolized by soil microbes to numerous minor degradation products, mineralized to CO2 and other unextractable degradates. Leaching is moderated by low use rates and field degradation. Aminocyclopyrachlor is a new DuPont herbicide which received registration in October of 2010 for non-cropland and turf grass uses. Commercialized products of Perspective, Viewpoint, Streamline and Imprelis herbicides were granted federal registrations. Pasture and rangeland registration research continues for control and eradication of problem and invasive annual weeds, perennial weeds and brush species. Technical properties and performance data will be reviewed.

A predictive model of *Bromus tectorum* occurrence in Yosemite National Park. Del Favero, Steven. Yosemite National Park, El Portal, CA. steven_delfavero@nps.gov

The exotic grass, *Bromus tectorum*, is expanding throughout Sierra Nevadan ecosystems. *B. tectorum* quickly establishes and dominates in disturbed areas and is known to alter fire regimes by increasing fire intensity and frequency. Therefore, it is of the highest concern for natural resource managers looking to controlling it. The vast distribution of *B. tectorum* is an incredible challenges for land managers working to control its' spread. Despite *B. tectorum*'s commonality, it is commonly overlooked and is poorly documented. This lack of data is an unnecessary barrier for Yosemite's land managers trying to understand the species' extent and its potential to spread. In order to overcome our lack of knowledge, a Maximum Entropy (MAXENT) species distribution model for *B. tectorum* was created in Yosemite National Park. *B. tectorum* is documented along an elevational gradient in Yosemite, but only along major roads. MAXENT predicts species distribution using species presence data, biotic factors and abiotic factors. MAXENT models are unique in that they perform well against other habitat models without the inclusion of absence data, and therefore circumvent the lack of systematically collected data outside of developed areas. MAXENT predicted that elevation and mean annual minimum temperature are the greatest contributing factors to predicting *B. tectorum* presence. Ground-truthing shows *B. tectorum* has not yet filled its potential niche. This model represents an easy and cost-effective method for Yosemite's resource managers to slow *B. tectorum*'s spread by targeting its distribution and prioritizing areas on the boundary between *B. tectorum*'s realized and unrealized niche.

A common data model for weed monitoring data. *DiPietro, Deanne[1]*, Dan Gluesenkamp[2], John Malpas[3], Falk Schuetzenmeister[4], Zhahai Stewart[1].* [1]Sonoma Ecology Center, Sonoma, CA., [2]Bay Area Early Detection Network, [3]CalFlora, [4]Cal-IPC. *deanne@sonomaecologycenter.org

There are many weed data systems successfully serving the purposes for which they were designed. They vary in structure and semantics, and in the data management systems used, and these differences present stumbling blocks to sharing between organizations, aggregating or moving data between data management systems, and re-using the data for new purposes. California's weed managers would benefit from improved weed data support, and many of these services require coordination across our existing data systems.

A major goal of this project is to reduce the effort and errors involved in sharing weed monitoring data by defining a conceptual and practical structure into which weed data can be transformed for transport between data capture systems, aggregation systems, online mapping systems, and modeling and analysis systems. Those seeking to develop new or enhanced database systems for storing weed mapping data can also benefit by basing their schema or structure on this model, reducing the effort and improving consistency of new database designs. The model serves to structure any weed monitoring data, from simple observations to the time-sequenced data produced by monitoring weed populations and tracking treatments.

Cal-IPC, CalFlora, BAEDN, and Sonoma Ecology Center are partnering on implementation of the common weed monitoring data model with the goal of exchanging data between efforts and improving support to California weed managers.

Monitoring environmental responses to *Tamarix* biocontrol and ecosystem recovery in the Virgin River watershed. *Dudley, Tom[1,]*, Matthew Brooks[2]* and 23 others. [1]Marine Science Institute, University of California, Santa Barbara, [2]TU.S Geological Survey, Western Ecological Research Center. *tdudley@msi.ucsb.edu

The program to develop biological control of *Tamarix* spp. using the specialist saltcedar leaf beetle, *Diorhabda* spp., has produced some spectacular results and more failures, but also some exceptional political conflicts, primarily over perceived threats to endangered southwestern willow flycatchers (SWFL) nesting in tamarisk. This controversy was elevated by the recent introduction of Diorhabda into the Virgin River in Utah, Arizona and Nevada, the only location where the beetle has established within the Critical Habitat of the SWFL, and has led to lawsuits and massive breakdown of the biocontrol program. In this context a multi-disciplinary research team has implemented a large-scale ecosystem and biodiversity monitoring program to document responses of biota and ecosystem functions to the introduction of this novel herbivore into the riparian system. This will allow us to track both short-term effects of tamarisk defoliation, as well as long-term responses to the changes in the structure of the vegetative assemblage. These data will provide the objective information needed to eventually resolve the legal dispute concerning the biocontrol program, and illustrate the process of anticipated ecosystem recovery, particularly in light of proposed restoration of native riparian vegetation in key locations.

Mapping, monitoring and removing medusahead. *Dudney, Joan.* Arastradero Preserve Stewardship Project, Acterra. 3921 East Bayshore Rd., Palo Alto, CA 94303. joand@acterra.org

Pearson-Arastradero Preserve located in Palo Alto, California hosts a large diversity of native and non-native species. Since 1998, Acterra has partnered with local

organizations to restore the Preserve and encourage local stewardship. Four years ago, Acterra's botanist documented the existence of Medusahead grass, *Taeniatherum caput-medusae* across approximately 20 acres of grassland. Medusahead is an aggressive, annual grass from the Mediterranean region that outcompetes native grassland species, quickly establishing robust populations. In an effort to create a strategic eradication plan, Acterra conducted extensive mapping and monitoring surveys to assess the Medusahead population's current distribution at Arastradero Preserve. A team of five interns and staff monitored 600 acres using hand-held GPS units and Google Earth. Staff quantified the extent of invasion and delineated a "no-spread line" that described the highest priority populations for removal the subsequent year. After extensive research and feasibility assessments based on available funds and resources, staff decided to use flaming and mowing using scythes, weed whips or industrial mowers as two control techniques. In order to remove populations during the "soft-dough" stage, staff monitored growth on north and south facing slopes biweekly after observing the first inflorescence. Staff also conducted frequency monitoring on 20 populations of Medusahead to compare the efficacy of mowing and flaming over three years. Quadrat frequency is relatively simple and efficient, measuring the presence of target species to determine population change over time. After removing over 300 documented populations, staff continued to monitor mowed areas for regrowth throughout the summer. The careful mapping and monitoring exemplified in this project has enabled staff to efficiently prioritize and plan a comprehensive eradication plan that can be used as an example for land managers in their efforts to remove invasive species.

Mapping invasive weeds: scaling up and down for different end user scenarios.

Rohmer, Toby and *Ingrid Hogle**. San Francisco Estuary Invasive Spartina Project, Berkeley, CA. *ibhogle@spartina.org

The San Francisco Estuary Invasive *Spartina* Project has been mapping invasive *Spartina* using GIS and GPS since 2001 in support of control efforts and to analyze the efficacy of control efforts. We have reduced the Baywide population to approximately 10% of its former cover…but now our site-level maps tend to make the situation look worse than ever before! This is a result of the point/line/polygon conundrum: in a GIS, by default, points are usually displayed much larger-than-life as one zooms out, whereas lines and polygons maintain their true on-the-ground size. In the past, we often mapped large, uncontrolled meadows of invasive *Spartina* as polygons and lines. Following six years of successful regional treatment, we now map more point features to record the many small, remaining patches requiring treatment. When zoomed out to the site level, this extensive point data gives the impression that populations have increased dramatically compared to the previous polygon data. To resolve this false impression, we have begun using a dot density symbology in ArcMap to allow for a more realistic display of the actual footprint of invasive *Spartina* remaining at the site level. We will explain the process we went through to develop the old & new layers, and give examples of how we now use both to ensure that our maps display our data at the appropriate scale for different end user scenarios.

Public-private cooperation results in improved restoration of reed canarygrass (*Phalaris arundinacea*) infested areas.

Humphrey, Jonathan, Melanie Baer-Keeley, Athena Demetry, and Matt Bahm.* Sequoia and Kings Canyon National Parks, Three Rivers, CA. *jonathan_humphrey@nps.gov

Montane meadows are among the most rare and biologically diverse vegetation types in Sequoia and Kings Canyon National Parks

(SEKI). Reed canarygrass is a major threat to native wet meadow and riparian plant communities throughout developed areas within the Grant Grove area of SEKI. Many of these meadows are located with Wilsonia, a private in-holding in SEKI, and upstream of NPS properties. Effective eradication of reed canarygrass on NPS properties required control of populations on private property. Prior to project initiation, residents of Wilsonia were contacted to determine interest in allowing control and restoration efforts on private property by NPS personnel. Many residents signed cooperative agreements to allow work to be conducted on private holdings. Eradication measures were conducted in FY 09 - FY 11, and have resulted in successful control of reed canarygrass. The focus of work in FY11 was to plant native species in areas where reed canarygrass has been successfully controlled and restore functioning wet meadow ecosystems. Residents have taken a strong interest in the project and several have volunteered time with NPS crews. The success of the project could not have been achieved without participation from Wilsonia residents, and shows how important cooperation between public and private entities is when attempting to restore functioning ecosystems.

Tulare County WMA Yellow starthistle control program. *Isner, Andrew L*. and Jim Sullins*.* University of California Cooperative Extension, Tulare County, Tulare, CA. *ALIsner@co.tulare.ca.us, JLSullins@co.tulare.ca.us (559)-684-3300

Yellow starthistle colonizes an estimated 20,000 acres of Tulare County foothill range. UC Cooperative Extension Tulare County (UCCE) office conducted trials from 1997-2008 to determine effective control strategies for yellow starthistle. In 2000, the Tulare County Weed Management Area (TCWMA) was established by UCCE Tulare County; USDA Natural Resources Conservation Service, and Tulare County Agricultural Commissioner, as lead agencies, and United States Forest Service, U.S. Geological Survey, Sequoia Riverlands Trust, Tulare County Cattlemen's Association, and California Native Plant Council as cooperators. Establishment of the TCWMA facilitated the acquisition of a California Department of Food and Agriculture (CDFA) grant in 2001, which provided funds for a yellow starthistle control program. Success of this program led to initiation of a cost-share spray program in 2002. Between 2002 and 2011 a total of 2228 acres of infestations have been controlled through several years of Transline and Milestone applications. In 2011, the cost-share program experienced the highest level of participants since being enacted. The cost-share program has significantly reduced infestations within rangelands and provides landowners an affordable method of control. Landowners are subject to a cost-share of $50 up to three acres and $15 per acre for any area greater than three acres. In 2009, CDFA and ARRA funds were appropriated to continue cost-share program, hire a program coordinator, and develop a "Leading Edge" program effort. Acquisition of a program coordinator has improved the program's impact through various community outreach efforts, improved surveying and monitoring strategies; improved use of GIS. Currently base line state funding for the yellow starthistle program is at risk, however additional funding sources are being sought. Continuation of this program is important to the communities and would have a positive impact on the conservation of biodiversity within Tulare County and surrounding natural lands of the National Parks and Forest.

The evolution of arundo removal efforts on Camp Pendleton

Lardiere, Benjamin M., and Deborah Bieber. Land Management Branch, AC/S Environmental Security, Bldg. 22165, MCB Camp Pendleton, CA, 92055, USA, (760)763-5850, Fax: (760)725-9722. *benjamin.lardiere@usmc.mil

In February of 2010, Camp Pendleton completed initial removal efforts on the final 200 acres of arundo (*Arundo donax*) and salt cedar (*Tamarix* spp.) infestations on the Santa Margarita River. Since treatments began in 1995, the methods used to remove arundo have been changed or modified over the years to account for a range of issues facing the Base. From pulling arundo rhizomes out with a backhoe to mowing and leaving the biomass on site, methods have been altered to achieve better results with less money. The presence of threatened and endangered species have necessitated treatment methods and timing to change over the years to minimize negative impacts to riparian and estuarine wildlife. Eventually native plantings were incorporated for the final segment to shorten recovery time and discourage exotic annuals from dominating the site. Other issues, like the floods of 2010, caused unintentional effects that required additional efforts outside of the treatment area.

With the help of numerous individuals, organizations, and companies throughout southern California, Camp Pendleton has removed more than 700 acres of arundo and 140 acres of salt cedar from the Santa Margarita River and other drainages.

Mechanical control of yellow starthistle: impacts on target and non-target vegetation

*Matzek, Virginia** and *Shannon Hill*. California State University, Sacramento, Department of Environmental Studies *vmatzek@csus.edu

Yellow starthistle (*Centaurea solstitialis* L.) is a non-native pest of rangelands that decreases forage quality and yield. Mowing may control starthistle effectively and complement herbicide use in an integrated pest management strategy, but little research has investigated its effects on non-target vegetation. We monitored biomass and seedbank size of annual and perennial herbs, in addition to starthistle, in response to three years of mowing treatments, either mowing alone or in combination with solarization tarps or thatch removal. All mowing treatments were very effective at reducing starthistle biomass and seedbank: mowing alone reduced biomass 92 ±2 %, mowing with thatch removal 91 ± 1%, and mowing with solarization 95 ± 1%. Compared to seedbank sizes in the control plots, yellow starthistle seedbank decreased by 100% (mowing alone), 92% (mowing + thatch removal), and 100% (mowing with solarization), after three years of treatment. Mowing also significantly improved perennial biomass. Annual species' biomass varied on a year-to-year basis, but was not significantly affected by any treatment. Seedbank sizes of annuals and perennials also did not differ according to mowing treatment. This research indicates that late-season mowing can effectively reduce starthistle biomass without adverse effects on other vegetation, and that mowing alone is sufficient to reduce starthistle seedbank size without additional methods of decreasing seed rain.

Eradicating Algerian sea lavender (*Limonium ramosissimum*) from San Francisco Bay wetlands.

Perlmutter, Mike, Archbald, Gavin, and Boyer, Kathy*. Bay Area Early Detection Network, Berkeley, CA. *Mike@BAEDN.org

Beginning in 2006, several densely growing populations of Algerian sea lavender (*Limonium ramosissimum*), were discovered in San Francisco Bay salt marshes. A perennial, salt-tolerant forb of Mediterranean origin, Algerian sea lavender has spread to marshes and tidal lagoons in southern California, from San Diego to Santa Barbara. There, the plant displays invasive characteristics including broad salinity

tolerance, prolific seed production and the ability to compete with native plants.

In San Francisco Bay, Algerian sea lavender has been found in the high marsh and upland transition zone where it forms near-monocultures and competes directly with native salt marsh species. At the upper end of this elevation range, Algerian sea lavender grows taller, more robustly and produces more seed, competing directly with perennial pickleweed, and altering high tide wildlife refugia habitat.

San Francisco Bay Algerian sea lavender infestations have been detected on scattered marshes, and cover approximately 4 net acres within a combined 50 acre gross area. Such limited establishment offers a rare opportunity for eradication without great economic expenditure and without the harm caused by allowing this invasive to spread. Eradication also pre-empts the long term impacts and loss that will be required to control this species if it is not stopped in the early stage.

Many partners around San Francisco Bay have already initiated detection and eradication efforts against Algerian sea lavender and are actively coordinating with the Bay Area Early Detection Network (BAEDN) on this and other priority eradication species. BAEDN is working to bring additional stakeholders and support on-board. Working together we can eradicate invasive Algerian sea lavender from San Francisco Bay. Please report new sightings to the appropriate land managers as well as the occurrence database at www.Calflora.org.

Population expansion and regional management of red sesbania (*Sesbania punicea*) in California. *Robison, R.*,* D. Pooley and N. Barve. ICF International, 630 K Street, Suite 400, Sacramento, CA. *rrobison@parks.ca.gov

Red sesbania is an invasive South American shrub forming dense stands along California waterways. It can increase flooding, alter hydraulic roughness in shallow channels and decrease biodiversity of riparian corridors. Over the past decade, red sesbania has rapidly expanded its range in California, emphasizing the need to prioritize eradication sites at a regional scale. To accomplish this, we updated baseline location data in summer 2010 using field surveys. The regional survey identified major propagule inputs, upstream and downstream extents for each watershed, and provided data in areas where there was no previous information, such as the Sacramento River between Redding and Verona. We then employed the Weed Heuristics: Invasive Population Prioritization for Eradication Tool (WHIPPET) to prioritize individual populations for eradication. WHIPPET prioritized small populations isolated from the main infestation, as well as outliers in residential areas. WHIPPET also identified small, upstream populations along riparian corridors that act as sources for seed migration downstream as management priorities. Results from WHIPPET and expert opinion were then used to select a location for a control program. Churn Creek in Redding was selected due to its upstream location, size of infestation and engagement of community groups. Western Shasta Resource Conservation District was engaged to remove red sesbania biomass from Churn Creek and volunteer watershed groups were trained to monitor the creek in the future to look for re-sprouting sesbania plants. This type of community partnership is vital in maintaining long-term control of this highly-invasive plant.

Evaluating the effects of horizontal and vertical mulches for restoration of a degraded site in the Mojave Desert: First year findings
Heather Schneider, US Geological Survey, 21803 Cactus Avenue Suite F, Riverside, CA 92518 and Mary Kotschwar, Desert Tortoise Preserve Committee, 4067 Mission Inn Avenue, Riverside, CA 92501
*hschneider@usgs.gov

Anthropogenic disturbance and the invasion of exotic plant species are major drivers of ecosystem change in California's deserts. These two phenomena can lead to soil compaction, loss of species diversity, and alteration of ecosystem processes such as hydrology and fire regime. Restoration in arid environments poses a difficult challenge for conservationists and managers due to the harsh, dry climate and slow recovery of native plants. In this study, we compared two mulching strategies used to encourage recovery of annual plants at a heavily disturbed, highly invaded site in the Mojave Desert. Horizontal (H) and vertical (V) mulches were constructed in shrub interspaces to simulate a 'fertile island' effect. These treatments may create a favorable environment for the germination of native annual plants and attract rodents, aiding in soil decompaction. Vegetative percent cover, biomass, and species richness were measured in both mulch treatments, as well as open areas (OA) between shrubs and beneath *Larrea tridentata* (LT) shrubs. Rodent burrows were also counted. Invasive species made up the majority of the plant cover in all treatments; however, functional group abundance differed between treatments. V plots had higher cover of invasive forbs than both H and OA plots. Native annual percent cover was twice as high in LT and OA plots as H plots. V plots had intermediate cover but had higher native species richness than LT plots. Total productivity analyses indicate that V plots are more productive than H and OA plots but only one-third as productive as LT plots. Mulch did not increase rodent activity in the first year. This study will be monitored in future years and the information collected can be used to make management recommendations for other desert sites.

Results from four years of early detection invasive plant monitoring in Golden Gate National Recreation Area. *Steers, Robert** and *Eric Wrubel*. National Park Service, San Francisco Area Network, Inventory and Monitoring Program, Fort Cronkhite, CA. *robert_steers@nps.gov

Since 2007, the San Francisco Area Network, Inventory and Monitoring Program have collected data on invasive plant species occurrences in Golden Gate National Recreation Area through its Invasive Species Early Detection Program. This monitoring effort is primarily focused on non-native plants that are not yet well-known for their ecological and/or economic impact to the study area, but have a high potential of being problematic if left unchecked. Early detection surveys occur along roads and trails only. The roads and trails are sub-divided by the subwatersheds they cross, which are ranked as high, moderate, and low priority. Portions of a road or trail that occur within the differently ranked subwatersheds have a corresponding sample frequency of every year, every two years, and every five years, respectively. Thus far, monitoring efforts have resulted in over 2000 new occurrences of targeted invasive plant species. Overall, the number of new occurrences each year has decreased while the number of treatments (by hand-removal) has increased. Separate analyses of detection rates for each species reveals that for some, we have likely found most of the extant populations and they do not appear to be colonizing new areas rapidly. However, the rates of new occurrences for other species are either steady or climbing. Separate analyses of the spatial distribution of early detection occurrences also confirms that subwatersheds in close proximity to human disturbances or urban settings have higher invasive species richness and a higher number of invasive plant occurrences than areas in more natural settings. Continuation of these surveys and their linkage into the Bay Area Early Detection Network will improve our understanding of invasive

species patterns and will be used to maximize the effectiveness of control efforts within the park and region-wide.

Comparison of four herbicide treatments on *Oxalis pes-caprae.* *Stringer, Lewis** and *Mark Heath*. Presidio Trust, San Francisco, CA and Shelterbelt Builders.
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O. pes-caprae has increasingly become a management issue for managers of California coastal systems. To better understand the effects of herbicide on *Oxalis pes-caprae*, a trial was conducted in 2009 in the Presidio of San Francisco. Four herbicide treatments with five replications were applied to 1 x 1 m plots in December 2009. The treatments were: A. *1% Garlon 4 Ultra + Competitor*; B. *½%Garlon4 Ultra + Competitor;* C. *1% RoundUp Pro Max + Trifol water conditioner*; D. *1% Rodeo Aquamaster +Syltac + Trifol water conditioner*. Oxalis individuals were counted in an inner 0.5 x 0.5m area in October 2009 and again in December 2010. A one-way Anova revealed a significant difference between the change in mean number of Oxalis individuals pre and post treatment ($p<0.05$). Only Treatment B was significantly different that Treatments A,C and D in 2010 ($p=0.03$). Comparison of results to a study of manual treatments on *O. pes-caprae* (Stringer 2005) suggest that herbicide may be a more effective method than the manual treatments conducted in that study, with the exception of tarping.

Evaluation of control techniques for velvetgrass (*Holcus lanatus*) in the Kern Canyon of Sequoia National Park. *Thiel, Rich*, Erin Degenstein, Matt Bahm, and Athena Demetry.* Sequoia and Kings Canyon National Parks, Three Rivers, CA. *rich_thiel@nps.gov

The Kern Canyon is the least developed and most naturally-functioning watershed in Sequoia and Kings Canyon National Parks, and visitors to the Kern experience among the most intact wilderness character in this region. Velvetgrass (*Holcus lanatus*) is one of only nine non-native plant species known in the Kern Canyon and is present in relatively few patches. Velvetgrass was detected very recently, in 2004 and 2006, and is extremely invasive in montane meadows, forming pure stands that displace native meadow vegetation. It has recently become very widespread in wilderness meadows in Yosemite, where they've begun large-scale control efforts. In 2009, we initated a control project to investigate the efficacy of the control methods for eradication of velvetgrass: hand-pulling with large work crews (> 10 people), glyphosate herbicide application, and tarping. Velvetgrass percent cover and stem counts have been recorded annually for the hand-pulled and herbicide treatments. The tarping treatments remain in place for three growing seasons and vegetation measurements will be recorded following removal to allow comparison to the other treatments. After the initial two years of the study, hand-pulling and herbicide application have resulted in greater than 50% reduction in velvetgrass cover. Preliminary observation of tarped areas shows near elimination of vegetation after two growing seasons. The results from our comparisons will provide managers with useful information for managing velvetgrass infestations.

Progress in the restoration of the habitat of fountain thistle (*Cirsium fontinale*) invaded by jubatagrass (*Cortaderia jubata*). *Thomas, Don*, IPM Specialist, San Francisco Public Utilities Commission.
dethomas@sfwater.org

Fountain thistle (*Cirsium fontinale*) is a rare native thistle endemic to the San Francisco Peninsula that is listed as a federal and state endangered species. Two of the populations have been heavily invaded by jubatagrass, which displaced fountain thistle from much of the habitat.

One population occurring on Caltrans property was reduced to fewer than 100 plants after invasion by jubatagrass. Through the efforts of Jacob Sigg, volunteers of the California Native Plant Society and Caltrans,

all of the jubatagrass has been removed, and the population is recovering to a level of several thousand plants. In a study of the efficacy of establishing the native bunchgrass California hairgrass (*Deschampsia cespitosa*) to restore fountain thistle habitat and prevent re-invasion of non-native plants, 1,000 hairgrass plugs were planted in 2009 and were individually marked with metals tags. Based upon the retrieval of metal tags from plants failing to grow, it is estimated that approximately 50 per cent of the plants have become established.

Another fountain thistle population invaded by jubatagrass occurs in the watershed of the San Francisco Public Utilities Commission (SFPUC), and almost all of the jubatagrass has been removed by SFPUC staff and Earth Stewards of the non-profit group The Garden Project. An annual monitoring study of the population employing permanent transects has been conducted to track the progress of re-colonization of the invaded habitat. The study revealed that the population expanded by an average distance along its outer edge of 13.2 feet between 2007 and 2011, or an average of 3.3 feet per year.

The rapidity of re-colonization seems to indicate the presence of some unknown mode of long-distance dispersal of seeds, or of unexpectedly long seedbank dormancy, or both. Secondary invasion by invasive plants remains a serious problem impeding reclamation of fountain thistle habitat at both sites.

Updated September 1

Discussion Groups
Wednesday, October 5, 1:20-2:40 pm

Prioritization Schemes for Weed Management. *Leaders: Gina Darin, CA Dept. of Water Resources, and John Knapp, Native Range, Inc.* Bay Room

How do we predict whether a plant species is likely to become an invader? How do we decide whether to allow a new species to be imported into our area? How do we separate innocuous species from invasive ones in wildland settings? How do we decide where to focus resources when we have too many weed infestations to deal with?

In this discussion group, we'll emphasize the importance of prioritization in planning weed control projects, and show off some tools for answering these prioritization questions. Hope you'll join us, and bring your prioritization conundrums.

Licensing and Contracting Mechanisms for Getting Work Done! *Leader: Mark Heath, Shelterbelt Builders.* Pineview

A primer on hiring or being a contractor for invasive species management. Learn what licenses, certifications and qualifications are necessary and/or recommended to do weed work in California. Do you know what types of contracts control fixed costs versus allow for flexibility and uncertainty? Within those contracts, how can you insure quality treatments and get results without spending too much? How can you make sure your contractors are working safely? Learn about how different types of funding impact your overall budget, Dept of Labor reporting requirements and the need for registered apprentices on your projects. Do you know the difference between the Davis-Bacon and Service Contract acts? If not, come and join us and bring all your other questions for an engaging discussion on the business side of weed management!

State-level Strategies for Rapid Response and Management of Aquatic Weeds: New Approach needed? *Leader: Lars Anderson, USDA- ARS Exotic and Invasive Weed Research, Davis.* Courtview

Over the past 30 years California has spent from $2 million/year (early years) to >$10 million/year (approximate current levels) to eradicate or control 5 species of aquatic/riparian plants : Hydrilla (*Hydrilla verticillata*), Brazillian waterweed (*Egeria densa*), Water hyacinth (*Eichhornia crassipes*), Purple loosestrife (*Lythrum salicaria*), and "Invasive Spartina/Hybrids" (*Spartina alterniflora*/ *S. alterniflora* X *S. foliosa*). Although this "single target species" approach has led to some success at the eradication level (e.g *H. verticillata*), the successful "management" (i.e. suppressive) actions on others have merely opened up habitat for increased spread of co-occurring invasive plants that were not "blessed" by legislative mandate with what amounts to "special target status".

Please join in this discussion on the pros/cons of changing to a more integrated and holistic "aquatic vegetation management" (AVM) approach in California's natural aquatic sites. We'll focus on such areas as the Bay-Delta, its tributaries and lakes such as Lake Tahoe and Clear Lake as examples. How can existing state agencies better allocate resources for AVM ? What statutory changes are needed to implement a more ecologically based strategy? What opportunities would this present for successful restoration efforts

Discussion Groups
Thursday, October 6, 1:30–3:00pm

Invasive Plant IPM. *Panel: Joe DiTomaso, UC Davis; others to be determined .* Bay Room.

Bring your questions on Integrated Pest Management of invasive plants to discuss with our panel of experts and fellow attendees. This will be an open forum to discuss management strategies for particular plants or situations. Learn from other Symposium attendees' expertise.

Integrating the Student Chapter into Cal-IPC. *Cal-IPC Student Chapter.* Pineview

After 4 years of building a base of outreach and educational materials, the Cal-IPC Student Chapter wants to increase student involvement across the state and strengthen our interactions with the community. This discussion section will review current materials in the Student Chapter's three main avenues of outreach (speaker's bureau presentations, K-12 Education, and public table displays) as well as information about how students can get involved with their local community (such as a WMA). We want to create a dialog amongst students and professionals about how the Student Chapter can be better integrated into Cal-IPC's overall goals and how we can keep students active without interfering with their research.
Prevention Efforts across the State:

Weed-Free Materials and Prevention Best Management Practices.

Leaders: Wendy West, University of California Cooperative Extension and Jen Stern, Cal-IPC. Courtview

Come hear what is in the pipeline regarding statewide weed-free materials programs and invasive plant prevention across the state. Following the 2010 Cal-IPC Symposium, a group of land managers formed a Prevention team to address these issues in California. The goals of this group include: implement systems to support the production, availability and use of weed-free forage, mulch and mineral materials in California, and disseminate prevention best management guidelines for use by agencies and land managers. In response to the need for prevention best management guidelines, Cal-IPC developed a set of prevention best management practices (BMPs) for land managers. Jen Stern will give a short presentation on how to incorporate these BMPs into your land management activities. Wendy West will then lead a discussion on how we can work with regulators and material suppliers to increase the availability and use of weed-free materials. Please bring your ideas, experiences and questions.