Proceedings

California Invasive Plant Council Symposium 2007

Cal-IPC

Featuring Special Theme Sessions on

"Communication and Conservation:
The Human Dimension in Invasive Plant Management"

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Volume 11:2007

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September 20-22, 2007
Bahia Resort Hotel, San Diego, California

These Proceedings are available online at www.cal-ipc.org

Contact Cal-IPC at info@.cal-ipc.org

California Invasive Plant Council
1442-A Walnut St. #462
Berkeley, CA 94709

Recommended citation format:
Chang, David. 2007. Invasive plant control and the California red-legged frog injunction. Proceedings of the California Invasive Plant Council. 10:pg. Cal-IPC, Berkeley, CA.

On the cover: Biological monitor Bonnie Peterson of Merkle and Associates in front of a treated Phoenix canariensis in Peñasquitos Canyon Preserve. Photo by Mike Kelly

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* Indicates presenting author in multi-author papers.

Foreword

San Diego, the county with the highest botanical diversity in the lower 48 states, served as the site for Cal-IPC's 16th Annual Symposium. In addition to our usual complement of talks on research and management of invasive plants, this year we addressed the need for improving communication and developing partnerships. Two sessions on "Conservation and Communication: The Human Dimension in Invasive Plant Management." featured invited speakers who described how to bring a variety of stakeholders into invasive plant issues. One session focused on building coalitions, while the other addressed communications. To continue the theme of involving the public in weed work, this year's keynote speaker was Jon Rebman, Curator of Botany for the San Diego Natural History Museum, who described how "citizen scientists" provide data for the San Diego Plant Atlas. Several working and discussion groups, whose notes are included in this volume, also addressed communications and outreach programs.

The Weed Control Techniques discussion group meets on the William D. Evans sternwheeler at the Bahia Hote

Building Lasting Coalitions

The California Rangeland Conservation Coalition

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Building and maintaining winning coalitions is not easy – it is an art and a science. There are key components that must be present for any coalition to be successful over time. This presentation will focus on how to build and maintain coalitions, drawing upon past examples from experiences at the national and state level and highlight one particular example from California. In 2006, Defenders of Wildlife, along with the California Cattlemen's Association, worked with California ranchers, environmentalists and agencies to create the California Rangeland Conservation Coalition. This is an unprecedented effort to bring together disparate parties to conserve and enhance private working landscapes and wildlife habitat within the Central Valley, surrounding foothills and interior coast range. Members of the Coalition mutually recognize the benefit of our unique partnership and the potential to work together to preserve the environment and the ranching.

The California Horticultural Invasives Prevention (Cal-HIP) partnership and the PlantRight campaign

Betsy Peterson, California Seed Association and*
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Many government and environmental groups have made headway removing invasive plants once they've taken root, but what if we could prevent invasions before they start? The horticultural industry is starting to answer that very question. The California Horticultural Invasives Prevention (Cal-HIP) partnership is a collaborative effort to prevent garden and landscaping plants from invading California's natural wildlands. Nurseries, landscapers, wholesalers, retailers, scientists, environmental groups and governmental agencies have joined forces to find voluntary solutions to the invasive plant problem – solutions that can protect the environment and strengthen the gardening community. Cal-HIP is creating tailor-made solutions through a transparent, participatory process.

By working together, the project partners are finding practical ways that gardeners and the industry can make the transition from invasive plants to non-invasive alternatives. The first step was to identify when and where certain nursery and landscaping plants cause environmental problems, basing our assessments on the Cal-IPC Inventory process. The group has developed a powerful outreach campaign called PlantRight to educate professionals about the problem of invasive plants and the non-invasive plants they can feature in their place. In early 2008, the PlantRight campaign will open up to the public so that home gardeners can participate in protecting California wildlands from horticultural invasive plants.

Betsy Peterson, a Cal-HIP Steering Committee member and representative from the California Seed Association, will give an update on the progress of this powerful collaboration and share ways that the Cal-IPC community can play an important role in the project. She will also introduce the breakout session "Bootcamp for working with nurseries" that will provide hands-on training for interacting with horticultural businesses in a positive, effective way. For more information on Cal-HIP, please visit the Sustainable Conservation website at www.suscon.org/invasives/index.asp.

Cache Creek Conservancy: Building tribal partnerships

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The Cache Creek Conservancy (CCC) is a 501 3(c) whose mission is to preserve, restore, enhance and promote the stream environment along Cache Creek from the Capay Dam to the Settling Basin. Currently, representatives from the aggregate mining companies, governmental agencies, local landowners, Native American groups and other community members work together to bring the CCC to the forefront of innovative projects such as non-native invasive plant species control. This presentation will focus on the CCC's partnership with the Native American Community and how we have dealt with weed eradication, restoration and cultural preservation issues.

Mapping and Planning

Why walk when you can fly: Systematic aerial weed survey of Santa Cruz Island, California

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Kelvin Walker, Prohunt, Rachel Wolstenholme and Coleen Cory, The Nature Conservancy

Land managers are often faced with making critical weed management decisions based on limited knowledge of weed distribution and abundance. As a result, limited resources may be directed towards low priority weed control activities. A comprehensive weed map is essential for prioritizing work. Weed mapping via remote sensing and aerial photograph interpretation are expensive and do not allow for detection of incipient or small-scale populations, while ground mapping is time-intensive and impractical in extremely rugged terrain. In 2007, The Nature Conservancy (TNC) contracted Prohunt Incorporated to complete an island-wide survey of 55 weed species on Santa Cruz Island, a 96 mi^2 island jointly owned and managed by TNC and the National Park Service. This survey differed from other weed surveys in that the entire landscape was scanned in person and mapped with a hand-held global positioning system, yet was completed in only 41 days. Approximately 88% was conducted from a two-person helicopter, traveling at an altitude of 5-30 feet above the ground. The remaining 12% was conducted on the ground by two or more mappers walking parallel to each other along drainages and valley floors to ensure maximum species detection. Aerial surveys used in concert with ground surveys can be a fast and accurate way to effectively map multiple species over entire landscapes while minimizing weed dispersal and damage to native vegetation. Aerial surveys have been developed into an effective tool for early detection and have great potential for rapid response.

How to develop user friendly riparian corridor invasive exotic species/habitat restoration master plans: Experiences on the San Diego and Otay Rivers

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An overview of the development of two master plans to restore riparian habitat along 12-13 mile segments of two major river corridors in San Diego County. Projects included mapping major invasive exotic species on urban portions of the San Diego and Otay Rivers combined with design of restoration master plans to eradicate exotics and restore riparian habitat after invasive eradication. Included were innovative lowlevel aerial polygon mapping methodologies that permitted easy translation of weed eradication areas to a range of publicly and privately funded restoration efforts to be used to fund the plans. Both master plans included calculations of percent cover of each exotic species mapped throughout these typical southern California riparian systems, including giant reed (*Arundo donax*), pampas grass (*Cortaderia selloana*), palms (*Washingtonia* spp. and *Phoenix canariensis*), broadleaf exotic trees, tamarisk (*Tamarix ramosissima*), ludwigia (*Ludwigia peploides*) and castor bean (*Ricinis communis*). Finally, the San Diego River Project included implementation of a pilot project that allowed comparison between master plan mapped areas of exotics with actual acreages of exotic eradication found during eradication implementation.

Distributional patterns of perennial pepperweed (*Lepidium latifolium*) in the San Francisco Bay, a CalFed project

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Perennial pepperweed (*Lepidium latifolium*) is an aggressive invasive plant species in the San Francisco Bay Delta. Under the CALFED Ecosystem Restoration Program, Environmental Science Associates (ESA) addressed two questions: what is the extent of the perennial pepperweed invasion within the San Francisco Bay? Can its distribution be explained and predicted using environmental variables? Perennial pepperweed was mapped along the shoreline of the San Francisco Bay using GPS. Spatial relationships between its distribution and environmental variables were tested using binomial logistic regression. Habitat, tidal regime, elevation, distance to water, distance to roads, distance to levees and distance to agriculture were all considered in the analysis. Resulting predictive models were mapped using GIS and high risk areas in the San Francisco Bay were identified. Perennial pepperweed was found to occur within marsh habitats, with full tidal action, near open water. This study demonstrated that habitat variables from widely available GIS layers can be used to predict distribution patterns for perennial pepperweed. Distribution maps created in the study will serve as a baseline for future monitoring and control efforts, and will be publicly available on CDFG's BIOS Project. Prediction maps outside of mapped areas will assist in identifying high risk wetland habitat areas and increase the efficiency of management efforts.

Developing early detection networks to abate the invasive species threat

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Prevention and early detection & rapid response (EDRR) practices are the most effective strategies for managing the invasive species threat over the long-term and at large-scales. When new invasive species are immediately detected and identified, and rapid responses are taken to contain and eradicate those new infestations, environmental and economic damages and subsequent impacts can be significantly mitigated. In this presentation, two different models of an EDRR program will be presented, demonstrating how an EDRR program can be constructed and implemented at both the site and at larger state/regional scales. We then detail how we have created several local site-based EDRR networks with local CWMA partners in Oregon using volunteers, citizen scientists and staff. The goal of this presentation is to enable and to motivate practitioners to create and implement their own EDRR program.

Management

Managing herbaceous perennials in the Tahoe Basin

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Several weedy herbaceous perennial species have recently established within the Tahoe Basin and surrounding areas. While control methods exist for these species, they cannot be implemented in sensitive areas. We compared a new herbicide delivery method that deposits herbicide on the lower side of a stem's cut surface with cutting only and spot spraying. In greenhouse studies we evaluated the effectiveness of several herbicides applied in two different growth stages of perennial pepperweed (PPW) (*Lepidium latifolium*), at the flowerbud and flowering stages. Results showed that applications made to PPW reduced belowground biomass by 79, 82 or 42 % if plants were treated with glyphosate (50 % solution of Roundup[1]), chlorsulfuron (0.282 oz Telar[1]/ gallon water) or cut only respectively 45 days after treatment compared to untreated controls. No differences were found between herbicides used, method of application, or phenology of plants. Field studies were also initiated to evaluate the effectiveness of this method on PPW, diffuse knapweed (DKW) (*Centaurea diffusa*) and dalmation toadflax (DT) (*Linaria genistifolia* ssp. *dalmatica*). Excessive rainfall occurred in the winter/spring of 2005 reducing densities 29, 37 and 27 % in untreated treatments for PPW, DKW and DT respectively compared to the previous year. Cover of plants treated with this new method was reduced 76-81, 90-99, and 63-81 % for PPW, DKW and DT respectively. This new method provides land managers with an effective management option for the eradication of establishing infestations of herbaceous perennial weeds in/near sensitive areas.

For more information on this method, please see our University of Nevada Cooperative Extension Special Publication 06-09 at: www.unce.unr.edu/publications/SP06/SP0609.pdf

[1]Brand names are provided for example purposes only. Other brands may also be licensed for use in your area. Information herein is offered with no discrimination. Labels should be adhered to for all herbicides for appropriate use.

The break-up and dispersal of *Arundo donax* by bulldozers

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A two-year study of *A. donax* (giant reed) in the Tijuana River Valley showed that bulldozers (and other earthmovers) played a significant role in the spread of *A. donax*. I found that: (a) bulldozers, during channel maintenance, easily cut and moved large sections of *A. donax* rootstocks and frequently left *A. donax* debris in the channel and on the channel banks; (b) after channel maintenance, several new *A. donax* recruits became established on the channel bank and the number of *A. donax* plants increased five-fold on the bank; and (c) there were many new *A. donax* recruits downstream of the bulldozer work and the recruits were 61 times more abundant than in the valley as a whole.

I combined these findings into the Bulldozer Hypothesis, which is a descriptive model identifying one of the causes of *A. donax* break-up and dispersal. The model is divided into three steps. In the first step, bulldozers inadvertently break up *A. donax* rootstocks and disperse the rhizome fragments over short distances – some rhizomes are deposited on the banks along with dredge spoil while other rhizomes are left in the river channel after an incomplete cleanup. In the second step, river flows disperse some of the rhizome fragments long distances downstream. In the third step, the live rhizomes sprout into new recruits. These recruits are in areas where the rhizomes were deposited by the bulldozers and in areas where the rhizomes were washed by the flows. Therefore the result of a single bulldozing event is that many new clumps become established at, and downstream of, the bulldozed site. If the bulldozing is repeated later, the abundance of *A. donax* in the reach will again be increased. In this way, bulldozers break up and disperse *A. donax* rhizomes and promote *A. donax* expansion.

This Bulldozer Hypothesis predicts that much of the recruitment of new *A. donax* clumps will be separated, in both space and time, from the bulldozer event that produced them. The dislodged rhizomes may be dispersed hundreds of meters and the period of time between the bulldozer impact (Step 1) and the obvious growth of the new recruits (Step 3) can be up to a year. This separation of cause and effect has probably contributed to our slow appreciation of the role that bulldozers play in the dispersal of *A. donax*.

One of the predictions of the Bulldozer Hypothesis is that a frequently-bulldozed site will have a greater density of *A. donax* than a non-bulldozed site immediately upstream. I tested this prediction at seven locations in San Diego County known to have frequent bulldozer activity – four channel maintenance areas and three quarries. At each location, I found that *A. donax* was significantly more abundant at the bulldozed site. This result strongly supports the Bulldozer Hypothesis.

I conclude that bulldozers and other heavy equipment play an important – and currently overlooked – role in the break-up and dispersal of *A. donax.*

Spraying over the top of *Ambrosia pumila*, a federally listed species, to control invasive weeds

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Kelly & Associates, with the City of San Diego's Multiple Species Conservation Program, tested a grass specific herbicide, Fusilade II (fluazifop-P-butyl), over the top of San Diego Ambrosia (*Ambrosia pumila*), a federally listed species in the ragweed family. Is it possible to control invasive grasses that threaten this rare species without harming the rare plant itself. The experiment was done in three phases. Phase I was a backyard test with 35 potted *Ambrosias*. Fusilade II was tested at three strength levels, all with and without surfactant, with an untreated control population, for a total of 35 plants. The spray-to-wet experiment appeared to have no negative impact on the sprayed plants. Phase II involved field spraying Fusilade II on several native cohort species that might occur with the *Ambrosia*, including *Nassella pulcra*, a perennial bunch grass. Phase III involved spraying Fusilade II on five plots of a natural population in Mission Trails Region Park; all five were paired with a control plot that received no spraying. Prior to spraying a stem count was done for the *Ambrosia* in all plots. Fusilade II was sprayed to wet over

100% of each treatment plot, including the *Ambrosia*, several invasive grasses, and *Erodium*. Monitoring results showed no apparent negative impact to the *Ambrosia*, with plants appearing robust in treated and untreated plots, and stem counts up in both. All but one invasive grass species was killed in treatment plots, while flourishing in untreated plots. *Erodium* spp., a broadleaf invasive, was killed in treatment plots, an unexpected "bonus." Fusilade II can now be added to the "tool box" of methods for controlling weeds threatening this rare plant.

Management

Evaluation of herbicide application rates, soil residues, and off-target effects resulting from basal bark treatment of densely-stemmed groves of invasive fig trees with Garlon®4

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The aggressive spread of invasive plants into wildlands has caused triclopyr to become one of the most commonly used herbicides in natural areas. Restoration activities often utilize basal bark herbicide applications, since this method allows treatment of individual invasive plants within a community of natives. Basal bark treatments require the use of concentrated herbicide solutions and, when applied to invasives with high stem densities, may result in the application of large quantities of herbicide for a given area. We tested the effects of basal bark treatments of 25% triclopyr (Garlon® 4) on research plots located in six different groves of *Ficus carica* (edible fig), a densely-stemmed, problematic invader of riparian forests in California. These treatments resulted in application rates that exceeded the labeled maximum use rate. After 5-6 months, soils near the fig trunks contained high levels of triclopyr residues, suggesting that the chemical made its way into soils during this period and was not completely degraded. The overall mortality of native plants planted within treated fig groves, however, was not significantly different from native plant mortality at companion control sites. Although effective in controlling invasive fig trees, the high herbicide application rates from basal bark treatment preclude the use of this treatment in large fig groves. These treatments may be appropriate, however, when fig groves are small or isolated enough to prevent over-application on a per area basis. In addition, neither limited basal bark applications of 25% triclopyr (less than 40% stems treated) nor foliar spray treatments of 2% glyphosate and 1% triclopyr were effective control measures. Further investigation is needed on ways to control large invasive fig groves, including basal bark treatments with more dilute solutions of triclopyr and stem injections with either triclopyr or another systemic herbicide.

Non-chemical exotic control in coastal sage scrub restoration at an Audubon Preserve

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Restoration of rare coastal sage scrub habitat at Audubon California's Starr Ranch Sanctuary in southern California commences the second year of non-chemical control of the exotic herbaceous perennial, artichoke thistle (*Cynara cardunculus*), which has invaded 700 acres of native and degraded grassland stands at the 4000-acre preserve. An effective treatment for artichoke thistle, repeated removal of leafy rosettes, was derived from a series of experiments. After one to two years per stand, we have reduced artichoke thistle to <5% cover on 365 acres. The second year of thistle control we restore to either needlegrass grassland or coastal sage scrub. Analyses of aerial photoseries taken over 48 years revealed gradual coastal sage scrub colonization of some grassland stands. Thus, we decided to actively restore 250 acres of artichoke thistle-

infested sites in which shrub species have begun colonization to scrub. Exotic annual plant species require control during the restoration process. An experiment that investigated non-chemical techniques suggested that flaming and early brush cutting could control exotic annuals while natives established in early stages of restoration. Monitoring of active and passive restoration processes over three years showed 50-60 percent native shrub cover in treatment areas with baseline 0-5% native cover and a baseline thistle cover of 40 to 90%.

Artichoke thistle (*Cynara cardunculus*) control efforts and community recovery in historic southern California rangeland

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Artichoke Thistle (*Cynara cardunculus*; CYCA), a deep-rooted perennial thistle, is an extremely problematic invader of disturbed grasslands in southern California. It has invaded large areas (over 4,000 acres) of the Nature Reserve of Orange County (NROC). The NROC, working with The Nature Conservancy (TNC), instituted control program for CYCA involving direct application of herbicide to individual plants. Thousands of acres have been treated annually since 1994. We resurveyed 102 areas initially surveyed in 1998, to ask whether CYCA has declined due to these control efforts and, if so, what is replacing CYCA. Specifically, we were interested in whether passive restoration of native perennial grasses (e.g., *Nassella pulchra*, NAPU) was occurring or if other problematic exotics (such as *Brassica nigra*, BRNI) were replacing CYCA. Since 1988, CYCA cover has decreased from a mean cover of over 50% to cover less that 5%. CYCA cover remained highest on sites high in clay content. Over this period, BRNI cover moderately increased (8%), but mostly in sites where CYCA cover remains high, and does not appear to replacing CYCA removed by the control effort. Natives, and particularly NAPU, did not appear to be affected, either positively or negatively, by the cover of CYCA. These results inform the future control program and restoration decision-making, suggesting that sites high in clay with few established natives may require more active restoration efforts.

Assessing non-target vegetation response in the wake of perennial pepperweed (*Lepidium latifolium*) eradication at the Cosumnes River Preserve

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Perennial pepperweed (*Lepidium latifolium*) is identified as one of the major threats to successful restoration of riparian and grassland habitats at the Cosumnes River Preserve. In order to effectively manage pepperweed and associated habitats, we eradicated pepperweed in three meter by three meter plots. We then assessed the response of non-target vegetation prior to treatment and for two years post-treatment. Following treatment by mowing, plots were treated with either Telar® or Rodeo® herbicides at four sites to assess which herbicide had the smallest impact on plant communities in restored riparian and grassland communities. Initial analyses show that both herbicide treatments were successful at eradicating pepperweed, but that

plots treated with Rodeo® were more diverse and contained more native species than plots treated with Telar®. Plots in riparian plant communities surveyed one year post-treatment are more diverse and contain a higher composition of native species. Data collected from seed bank trials indicate soil collected from riparian communities at the Cosumnes River Preserve include more species in the seed bank and a higher proportion of natives than soil collected from grasslands. These results will enable managers at the Cosumnes River Preserve to make informed decisions about future eradication efforts.

Biological Control

Evaluation of the rosette weevil, *Ceratapion basicorne*, a new biological control agent of yellow starthistle.

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Abstract

Ceratapion basicorne (Coleoptera: Apionidae) is a weevil native to Eurasia whose larvae develop in root-crowns of yellow starthistle. This insect was "rejected" as a prospective biological control agent about 15 years ago after preliminary evaluation of its host plant specificity showed that it could develop on safflower. However, the insect is known to attack very few plant species in the field and has never been reported from safflower. We conducted a series of no-choice, choice and field experiments to measure the risk that this insect would pose to nontarget plants. Larval development occurred on nine plant species, including safflower and bachelor's button (*Centaurea cyanus*). All these host plants are within a small taxonomic group within the subtribe Centaureinae. Three years of field studies conducted in eastern Turkey, at three sites with natural populations of the insect, demonstrated that the weevil does not damage safflower plants despite attack rates of 48-98% on yellow starthistle. The insect does not attack any native North American plants. We have requested permission to release this insect as a biological control agent of yellow starthistle.

Introduction

Yellow starthistle (*Centaurea solstitialis,* Asteraceae) is an invasive alien weed that has been targeted for classical biological control because of its widespread distribution and high economic and environmental impact (DiTomaso et al. 2006). Classical biological control involves using "natural enemies" (naturally occurring insects, mites or pathogens) that help to control the plant in its native range, but that are lacking in its introduced range (Smith 2006a). The strategy is to explore for natural enemies on the plant in its native range (in this case southern Europe and Turkey), find species likely to be host specific, collect them, test their host plant specificity and potential impact on the weed, obtain federal and state permits, then release them. The insects will multiply in the field and reduce the weed population until the two reach equilibrium, thus providing self-perpetuating control. The safety of this approach depends on conducting thorough host specificity and ecological studies before releasing the agent (Smith 2006b).

So far, six species of insects that attack yellow starthistle flowerheads have been permitted and released in California and one was accidentally introduced (Balciunas and Villegas 2001, Pitcairn et al. 2004). Of these, two species are widely distributed and appear to be reducing seed production, but may not be sufficient to control the plant in most parts of the state (Pitcairn et al., 2005, 2006). A rust pathogen (*Puccinia jaceae* var. *solstitialis*) was approved in 2003 for release in California and has now been released in 42 counties, but so far, does not appear to be establishing well or significantly impacting the plant (Woods and Villegas 2005, 2006). We have been evaluating two other insects that would complement the previously introduced biological control agents: *Ceratapion basicorne*, a weevil that develops in the root crown of rosettes, and *Psylliodes chalcomera*, a flea beetle that attacks leaves and stems.

The yellow starthistle rosette weevil, *Ceratapion basicorne*, naturally occurs from Spain to Azerbaijan (Smith 2006c) and has been reported to develop on yellow starthistle, bachelor's button (*C. cyanus*), *C. depressa* and blessed thistle (*Cnicus benedictus*) in the field. Adults feed on the rosette leaves in late winter, larvae develop inside the root crown and complete development by the time the plant bolts (Smith and Drew 2006). This weevil is abundant in Turkey, attacking up to 100% of plants at a site and many larvae can be found developing within one plant (Uygur et al. 2005). Preliminary studies conducted in Italy indicated that this insect can develop on safflower (*Carthamus tinctorius*) when young larvae were artificially transferred to them (Clement et al. 1989). However, because this insect has never been reported from safflower in the field, we decided to conduct further experiments to determine if this or other plants are susceptible to attack. No-choice and choice experiments were conducted in the USDA-ARS quarantine laboratory in Albany, CA and field experiments were conducted at three sites during three years in eastern Turkey (Smith 2006c, 2007, Smith et al. 2006).

Results and Discussion

The species of plants that are attacked by host-specific herbivorous insects usually are taxonomically closely related because they have similar chemical, morphological and phenological properties that are important to the insect. Under no-choice conditions (one female caged on a leaf for five days, Figure 1), the weevil oviposited primarily on plants in the subtribe Centaureinae, but occasionally a few eggs were placed on other plants (Figure 2). Larvae could develop only on plants within the subtribe Centaureinae, including safflower (*C. tinctorius*). There was no development on any native species, including *C. americana, C. rothrockii, Saussurea americana* or any *Cirsium*, which are the ones most closely related to yellow starthistle. Under choice conditions in the laboratory, females preferred yellow starthistle (74% of eggs) to bachelor's button (20%) and there was a little oviposition on safflower (1%). Because safflower is a significant crop in California, we decided to conduct field experiments to determine if there would be any attack on this plant. Experiments conducted at three sites in eastern Turkey during three years showed no attack of *C. basicorne* on the 568 safflower plants sampled (Table 1, Smith et al. 2006). However, three other species of Ceratapion: *C. scalptum, C. orientale*, and *C. onopordi* were reared from safflower plants.

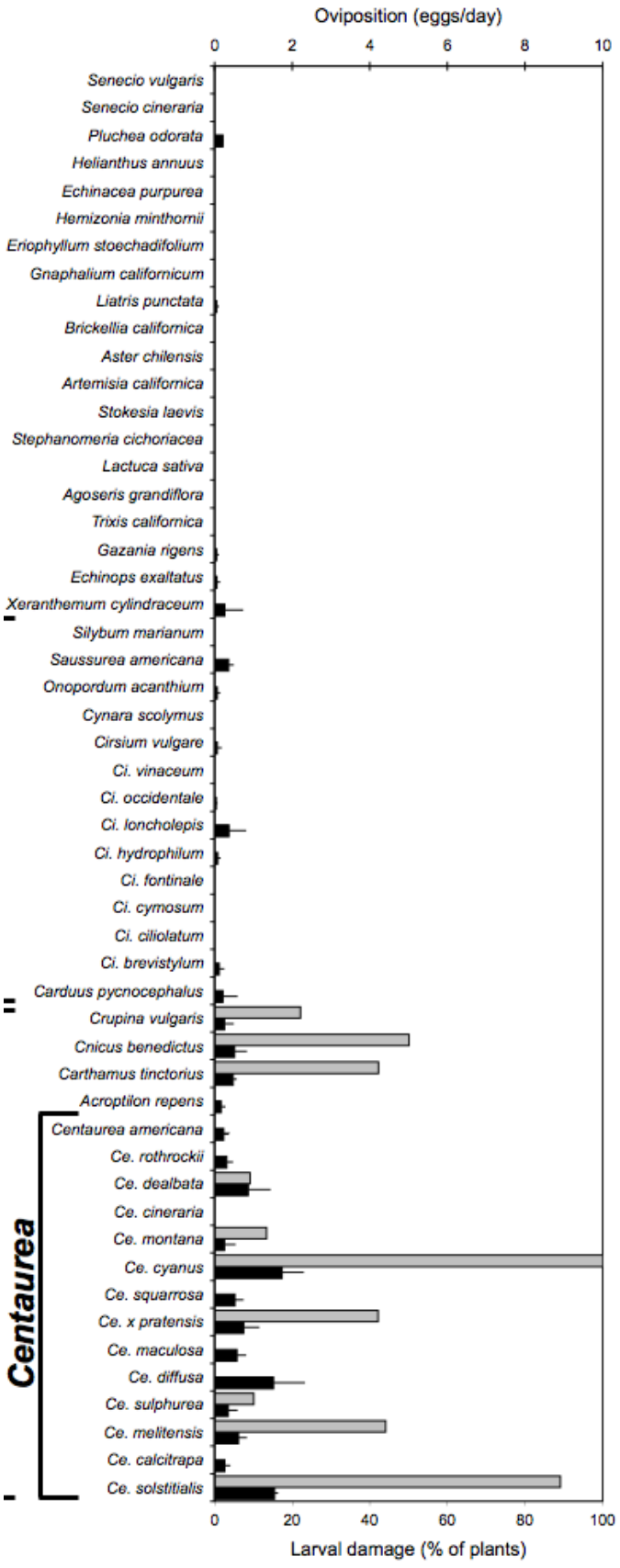
Year / Site	Test plant YST(US)	YST(TR)	Oleic	Linoleic
2002				
Horasan	83 b	100 a	0 c	0 c
Cat	28 b	67 a	0 c	0 c
Askale	59 b	87 a	19 c [b]	16 c [c]
2003				
Cat	37 a	45 a	0 b	0 b
Askale	—	77 a	8 b [d]	—
2004				
Horasan	—	98 a	0 b	—
Askale	—	100 a	26 b [e]	—

[a] Values followed by the same letter in the same row are not significantly different (chi-square test, $P < 0.01$).
[b] Adults identified: 4 *C. scalptum*, 1 *C. orientale*, 2 *C. onopordi*.
[c] Adults identified: 2 *C. scalptum*.
[d] Adults identified: 3 adults unidentifiable.
[e] Adults identified: 8 *C. scalptum*, 2 *C. orientale*.

Conclusion

The results of the host specificity experiments conducted in quarantine laboratory and field experiments conducted in Turkey indicate that the rosette weevil, *C. basicorne*, will not damage or develop on any plant other than a few species in the subtribe Centaureinae, all of which are alien weeds in North America. However, one of these species, bachelor's button (*C. cyanus*), is grown commercially as an ornamental. It is possible that the weevil will cause some damage to the stems of this plant, creating a small bump where the larva develops. However, the

weevil has a short season when it is capable of laying eggs (April to May), and it is adapted to attacking rosettes, which bachelor's button does not form. Furthermore, this insect has not been reported to be a pest of ornamental bachelor's button in Eurasia, where this insect is native. Thus, any damage to bachelor's button is expected to be infrequent and minor. The other plants likely to be attacked are the alien weeds: tocalote (*Centaurea melitensis*) common crupina (*Crupina vulgaris*), and blessed thistle (*Cnicus benedictus*). A petition was submitted to USDA-APHIS in Jan. 2006; the Technical Advisory Group (TAG) issued a favorable review in Sept. 2006; and a request for a release permit was submitted to APHIS on 26 Sept. 2006. We are currently waiting for a permit to begin releasing this insect.



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The effects of *Puccinia jaceae* on yellow starthistle competition and growth

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A new bio-control rust, *Puccinia jaceae* var. *solstitialis*, was introduced to control yellow starthistle (*Centaurea solstitialis*) in 2003. To test the effects of the rust on the weed under field conditions, we are performing two experiments. The objective of the first experiment is to examine the effects of the pathogen on the above ground biomass production of yellow starthistle (YST). As part of this experiment, we are also evaluating the effect of the rust on the competitive ability of YST with the common rangeland annual grass wild oat (*Avena fatua*). The objective of the second experiment is to test the interaction of the rust with two common insect bio-control agents (*Eustenopus villosus* and *Chaetorellia succinea*). In both experiments, infection rates were monitored and recorded over the field season and chlorophyll rates, seedhead production and vegetative biomass were measured. Insect attack rates are also being determined on a subset of seedheads. Unexpectedly, we found the rust spread rapidly in the first season after inoculation. Initial regression analyses suggest that the rust may not have an effect on the overall biomass or seedhead production of YST under optimal conditions. There is potentially a negative correlation between increased rust infection) and total leaf chlorophyll levels. Initial relative crowding coefficient values indicated that the rust decreased the competitive ability of yellow starthistle with wild oat by about 60%. We are currently repeating the experiment in a second field season and will report on our findings at the conference.

Regional testing of *Diorhabda 'elongata'* ecotypes for the biocontrol of saltcedar (*Tamarix* spp.) in western US

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The Eurasian saltcedar leaf beetle *Diorhabda elongata* (*sensu lato*) has been introduced into several western states for the biocontrol of saltcedar (*Tamarix* spp.). Establishment was successful at some sites, with heavy defoliation and subsequent mortality of plants observed at sites in northern Nevada. However, at sites south of 37-38°N in latitude, the original form of *D. elongata* (collected in Fukang, China 44.1° N) failed to establish. Incubator studies indicated that failure was because these Fukang beetles responds to declining daylength by entering reproductive diapause too early in the season to successfully overwinter.

The purpose of the present study is to test different ecotypes of *D. elongat*a, currently held under quarantine in the US (Fukang, China 44.1° N, Turpan, China 43.5° N, Uzbekistan 38.1° N and Crete, Greece 35.1° N), inside double secure cages in the field at sites in nine states ranging from 35-48° N in latitude; seven of these sites are within California. Our predictions are: 1.) The time period when beetles are reproductively active will match the time period when foliage is available at those latitudes that match the beetles latitudes of origin, and 2.) beetles will have the highest over-wintering survival at matching latitudes. The experiment, which is currently being conducted in 2007, will provide crucial knowledge about how to promote biocontrol of tamarisk over the widespread range of infestations in western US.

Gray leaf spot of kikuyugrass: An invasive pest of an invasive pest

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Pyricularia grisea is a fungal pathogen that affects a diverse range of graminaceous hosts, causing gray leaf spot of turf and blast of rice. It was recently discovered in California in 2001 on perennial ryegrass and 1997 on rice, causing significant economic damage on both crops. Kikyuygrass (*Pennisetum clandestinum*) is a noxious weed that was introduced into California in 1918 and is widespread in the southern and central coast of the state and is often managed as the primary turf species in landscapes, parks, sports fields and golf courses. In 2003, *P. grisea* was found to be causing a new disease of kikuyugrass in multiple locations throughout California. Genetic analyses indicated that these populations are different from those that infect perennial ryegrass or rice. Both mating type idiomorphs, lacking in U.S. rice and ryegrass

populations were also found, suggesting that kikuyugrass populations are capable of sexual reproduction. These results indicate that this is a novel population of *P. grisea* in the U.S. of unknown origin. The management of this pathogen is complicated by the emergence of fungicide-resistant populations and the lack of commercially available disease-resistant kikuyugrass varieties. Best management practices for the sustainable control of this pathogen in turfgrass are being developed and the utility of *P. grisea* as a biocontrol of kikuyugrass is unknown at this time.

Designing Effective Communication Strategies

New ways to connect: Taking the pulse, eliminating the rumors

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Public outcry, lawsuits and project delays have motivated project managers to develop innovative public involvement strategies to build support for resource management efforts. Staff working within the Golden Gate National Recreation Area (GGNRA) have been focused on increasing public engagement for more than a decade, but in the last two years, with the formal integration of Project Information Coordinators (PICs) into large-scale invasive plant control projects, those efforts have become increasingly effective. The use of PICs was tested at six different project sites within the GGNRA. PICs developed messages relevant to particular communities, engaged a broader and more diverse public and created a mechanism for responding rapidly to community concerns. Over the last two years PICs interacted with more than 6,000 park visitors. Data from those interactions and visitor logs reveal some key lessons and upend hoary planning myths. What did not happen was as important as what did happen. Unlike other resource management projects, projects using PICs generated no negative calls to upper-level park management, the press, or elected officials and public conflict never halted project activities. The subsequent use of PICs in other settings has confirmed the efficacy of active public engagement activities.

Strategic interactions across property boundaries in invasive plant control and implications for cooperation

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Invasive species managers face a combination of biological and social factors that influence project success. Invasive species population dynamics are driven by management across the entire landscape, not just in conservation and restoration areas. A socially aware and strategic management approach can improve landscape-scale success by creating opportunities for cooperation. When invasive species managers recognize and address the priorities, beliefs and expectations of other landowners, they are much more likely to succeed, especially if there are fundamental disagreements among stakeholders. When the expectations of others have not been adequately addressed, as in the case with some large-scale restoration efforts in the Sacramento River valley, projects can be stalled and forced to revise their goals. Game theory and behavioral economics provide insights for improving outcomes under such scenarios. These insights are illustrated, using empirical data from the upper Sacramento River valley.

Beyond the knowledge deficit model: Changing environmental behaviors

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There is ample evidence that certain human behaviors increase the damage caused by invasive plants (gardening with invasive plants) while other behaviors ameliorate it (controlling outlying infestations early). What will lead to changes in human behavior such that there is less of the former and more of the latter? Social science researchers, particularly those working in the fields of public health and cognitive psychology, have learned hard-won lessons about what works and what doesn't. Addressing knowledge deficits – informing people that some garden plants can become invasive in wildland situations – is seldom enough. (Just ask any smoker.) So what works? A combination of factors, often involving effective communication, appropriate incentives and efforts to shift social norms. This presentation reviews findings relevant to invasive plant managers from widely dispersed literatures in conservation psychology, community-based social marketing, environmental education, public health, behavioral economics and other social science disciplines.

Research

Invasive Plants for Sale! A survey of nursery professionals

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Many invasive plants in California wildlands originally were introduced for gardening, landscaping and erosion control. Yet invasive plants continue to be actively imported for these uses. With very little government regulation of horticultural imports of invasive plants, efforts have turned toward voluntary initiatives to encourage self-regulation by the horticulture trade. We conducted a survey of nursery professionals in the S.F. Bay Area to gauge their perceptions of invasive species, the role of the horticulture trade in invasive plant introductions, and their participation – potential and actual – in preventive measures outlined in the St Louis Voluntary Codes of Conduct for nursery professionals. We found nursery professionals to be highly aware of invasive plants and to accept responsibility as a trade for horticultural introductions. Although very few had heard of the St Louis Voluntary Codes of Conduct, the majority reported having participated in at least two of seven preventive measures and most reported willingness to engage in the majority of preventive measures, including discontinuing sales of known invasive plants. The results of this survey reveal a major obstacle to participation in voluntary initiatives: general and scientific knowledge is not being sufficiently translated from scientists and practitioners to nursery professionals. We provide specific recommendations for improving voluntary prevention efforts in the horticulture trade.

This research has been published in the journal Biological Invasions and the full article can be accessed online at: http://www.springerlink.com/content/h3340553k0312411/fulltext.pdf

Article citation

Burt, J.W., A.A. Muir, J. Piovia-Scott, K.E. Veblen, A.L. Chang, J.D. Grossman, and H.W. Weiskel. 2007. Preventing horticultural introductions of invasive plants: potential efficacy of voluntary initiatives. Biological Invasions 9(8): 909-923

Interloper's legacy: Invasive, hybrid-derived California wild radish (*Raphanus sativus*) evolves to outperform its immigrant parents

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Hybridization between species and subspecies may lead to the evolution of invasive weeds by enhancing survival and reproduction in hybrid-derived lineages. California wild radish (*Raphanus sativus* × *Raphanus raphanistrum*) is a hybrid-derived species that has spread prolifically within the last 150 years, replacing all pure parental populations throughout California. Though highly plausible, a link between hybridization and invasiveness in California wild radish has never been empirically tested. In field experiments, we compared the survival and reproduction of several

populations of California wild radish with that of populations of its pure parents in multiple years and varied environments. California wild radish has high survivorship and generally produces more pods per plant, more seeds per pod and more seeds per plant than either of its progenitors. In year one in Riverside, CA, it produced three times more seeds per plant than *R. raphanistrum* and *R. sativus*. In Irvine, CA, reproduction was higher overall and California wild radish produced two-times and twenty-times more seeds per plant than *R. raphanistrum* and *R. sativus*, respectively. Individual populations of California wild radish also display a strong genotype-by-environment interaction, indicating genetic diversity may be partly responsible for the weed's ability to invade California's vast and varied landscape. Our results demonstrate that by limiting the introduction and subsequent hybridization of congeners, we may be able to prevent the evolution of new invasive lineages.

Toward understanding woody plant invasiveness: Phylogenetically independent contrasts of seedling growth traits and of performance under varying drought and nitrogen levels

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Understanding causal factors of invasiveness of some exotic species is important for managers. Previous studies have shown that invasive species have higher seedling relative growth rates (RGR), leaf area ratios (LAR), and specific leaf areas (SLA) than much less-invasive species. We compared the seedling growth traits of invasive exotic woody species with those of phylogenetically related less-invasive exotic woody species commonly cultivated in California (40 species in 13 sets of contrasts). Both LAR and SLA were significantly positively associated with woody plant invasiveness. High seedling RGR, in contrast to previous studies, was only marginally significant. Invasive species are also often thought to opportunistically use available resources and/or to exhibit more uniform performance across different environments. In many places, atmospheric nitrogen deposition adds an important resource to the environment. With climate change, many regions expect increasing drought. Again, using commonly planted exotic horticultural woody angiosperms (nineteen species forming eight contrasts), we examined the growth trait responses of invasive species and their related much less-invasive counterparts to two nitrogen levels (low typical California wildland level and high) and to three levels of drought (none, intermediate, and high). Plants were grown from seed at the two nitrogen levels under well-watered conditions for two months and then subjected to the drought treatments for one month. We found that for most traits, invasive species had different responses –behaving opportunistically in some contrasts, while maintaining trait levels across treatments in others, both, or in some cases, neither strategy.

Physiological and morphological responses of pampas grass (*Cortaderia selloana*) to variations in water table and soil nitrogen content

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Cortaderia selloana, or pampas grass, is a common ornamental throughout California that has escaped and has become invasive in coastal shrubland and riparian ecosystems. The purpose of this study was to determine how the growth and physiology of *C. selloana* respond to various combinations of soil nitrogen and water table depth. Growth factors examined included biomass production and shrub (height and width) and leaf morphology (specific leaf area, SLA). Physiological factors examined included water use, photosynthesis, and tissue nitrogen and phosphorous contents. These response variables were examined in a manipulative experiment using a 2 x 3 random factoral design with two water table and three nitrogen levels. Water, nitrogen and the interaction between the two were found to have a significant influence on many of the growth and physiological factors of *C. selloana*. Specifically, added nitrogen caused significant increases in biomass and tiller production, plant height and width, and water use. By examining which plant response factors are enhanced by the various combinations of water and nitrogen treatments, we hope to gain insight into the invasive nature and success of *C. selloana* in coastal shrubland and riparian systems.

Measuring roots, in situ, of two late summer perennial plant species, *Elymus glaucus* and *Grindelia camporum* and an invasive annual species, *Centaurea solstitialis*

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Roots of late summer plant species penetrate deep into the soil for acquisition of available resources. Root growth may allow *Elymus glaucus* and another native perennial, *Grindelia camporum*, to inhibit *Centaurea solstitialis* establishment in restored native communities. In 2006, field studies were conducted near Davis, California to determine root growth, activity and soil moisture use of *E. glaucus*, *G. camporum* and *C. solstitialis*. For *E. glaucus* and *C. solstitialis*, a maximum of 0.88 and 0.75 roots/cm^2 occurred at 30 cm on April 19 and 27, respectively, while the maximum number of roots (0.60 roots/cm^2) for *G. camporum* occurred on June 21 at 120 cm. After flowering of *C. solstitialis*, total roots declined to less than 0.16 roots/cm^2. During the same period, maximum *E. glaucus* roots at 180 cm reached 0.40 roots/cm^2 and the number of roots for *G. camporum* was 0.30 roots/cm^2. Soil moisture for all species was 100% of bare ground control on April 27. By July 5 or flowering for *C. solstitialis*, soil moisture was ≤ 50% of bare ground control for *C. solstitialis* and *G. camporum*, but ≥ 50% for *E. glaucus*. By October 31, soil water content at 180 cm for *C. solstitialis*, *G. camporum* and *E. glaucus* was 42, 48 and 74%, respectively, of the bare ground control. Growth and moisture use of *C. solstitialis* and *G. camporum* roots during late spring was similar, while *E. glaucus* roots were less active at depths ≥ 120 cm.

Genetic relatedness can limit reproduction in a wind-pollinated grass weed via pollen limitation

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Whether during colonization or spread, or following management failure, invasive species may have to survive as small populations on the way to becoming large ones. Conservation biology teaches about processes, such as pollen limitation and inbreeding, that limit reproduction in small populations, but not whether they apply to invasive species. To test whether small population sizes can depress reproduction in invasive weeds through pollen limitation and/or inbreeding, we created 50 independent, small populations of the invasive grass *Lolium multiflorum* from four wild California seed sources.

Our results indicated that populations with more plant biomass (and therefore, pollen) had greater absolute seed production, of course, but also greater seed production per floret. No effect of increased relatedness on seed production (e.g. classical inbreeding depression) was detected. Interaction between relatedness and population size, however, was significant. The correlation of population size to percent (per floret) seed production was greatest in populations that were most closely related, intermediate with intermediate relatedness and not significant for those that were nearly unrelated (most diverse). Thus, it appears that the reduced reproduction of individuals in smaller populations is caused by a genetic limitation acting via the pollen limitation. This suggests that introducing new genotypes into a region or population might increase the likelihood of invasion success.

Laws and Regulations

Mock pesticide use monitoring inspection: An interactive skit with Q and A

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A mock "Pesticide Use Monitoring Inspection", featuring herbicide application errors and appropriate procedures will be presented in the form of a skit. The script of the presentation follows the standard DPR Pesticide Use Monitoring Inspection form. The cast will include a newly licensed rookie applicator, a seasoned, knowledgeable, diligent applicator and an agricultural biologist from the local Agricultural Commissioner's office (we will use a recently retired Deputy Ag Commissioner for this part). A representative from the San Diego Department of Agriculture will also be present to provide input.

The agricultural biologist/inspector will use form PR-ENF-104 to perform two simultaneous inspections. The rookie applicator will perform a mock mix/load and a mock application, complete with props. The rookie will make "mistakes" during the entire process. These "mistakes" will be non-compliances and violations noted in DPR's list of violations and other common errors observed by agricultural commissioners' staff throughout the years. The audience will be provided with a copy of the standard form PR-ENF-104 and will be able to track and respond to questions about the committed errors.

Simultaneously the biologist will be monitoring a mock mix and load and application by the diligent applicator. The diligent applicator will have all the right answers and techniques to do a perfect mix/load and application. The biologist and diligent applicator will interact with the audience and the rookie to improve the rookie's knowledge and technique, leading to a fully compliant and sound application.

Invasive plant control and the California red-legged frog injunction

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The injunction ordered by the US District Court (Northern District of California) on October 20, 2006 requires the US EPA complete, within three years, formal consultations with US FWS on the impacts of 66 pesticides on California red-legged frogs (CRLF); prohibits the interim use of 66 specific pesticides within and adjacent to red-legged frog habitats, specifically designated critical habitat areas, aquatic features and upland habitats occupied by the frog; mandates pesticide-free buffer zones adjoining frog habitats (200 feet for aerial pesticide applications to prevent drift and 60 feet for ground applications to prevent runoff); allows exemptions for public health vector control programs, invasive species and noxious weed programs, and other specific applications that pose little or no risk to frogs; and requires US EPA to distribute an educational brochure for pesticide applicators and county agricultural commissions regarding the red-legged frog, impacts of pesticides and contaminants on frogs generally and describing the interim restrictions on pesticide use in the settlement.

Use of herbicides near threatened and endangered species' habitats

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California is second to Hawaii as the state with the highest number of threatened and endangered species. The Department of Pesticide Regulation (DPR) helps to protect those listed species by working with stakeholders (county agricultural commissioners, farmers, commercial applicators, wildlife agencies, and others) in the development and implementation of pesticide use limitations that take into consideration both the needs of the species and pesticide applicators. DPR's pesticide use limitations are methods of application, restrictions, or prohibitions that apply to any given active ingredient being considered for use in proximity to endangered species' habitat. Most use limitations are avoidance measures to keep active ingredients out of the species habitat. In order to assist pesticide applicators with the identification of endangered species and their habitats, as well as any applicable pesticide use limitations, DPR has developed an online database program called PRESCRIBE that tells pest control professionals where endangered species occur, what pesticides pose risks to listed species and how to avoid those risks.

Emerging Issues in Invasive Plant Management

Public policy and advocacy issues for the dedicated weed worker!

Mandy Tu, The Nature Conservancy and
Doug Johnson, Cal-IPC

Wildland weed work tends to be local, and those doing the work are immersed in day-to-day details of management. However, this work is performed within a broader context affected by state and federal policy. It is important for weed workers to know how they can affect these policies to best support their work. Critical state policies include: funding for local Weed Management Areas; implementation of the California Noxious and Invasive Weeds Action Plan and formalized inter-agency coordination at all levels. Federal policy includes: Q-37 horticultural importation regulations; the REPAIR bill to support early detection and early response; and the National Aquatic Invasive Species Act. Cal-IPC provides leadership in coalitions working at both the state and federal level, and Cal-IPC members can play a key role in promoting strengthened policy that supports their work on the ground.

Risky energy: Biofuels and invasive species

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In an effort to reduce greenhouse gas emissions, expand domestic energy production, and maintain economic growth, public and private investments are being used to pursue dedicated feedstock crops for biofuel production. The leading candidates for lignocellulose-based energy are primarily rhizomatous grasses, most of which are not native to the region for which production is proposed. From an agronomic perspective, the life history characteristics, rapid growth rates, and tonnage of biomass produced by these non-native grasses make them ideal feedstock crops.

Unfortunately, several of these candidate feedstock species being considered for commercial production in the United States are invasive pests in other regions where they have been introduced. Their invasiveness is mainly a result of their life history characteristics and rapid growth rates. The combination of being non-native and possessing weedy characteristics, along with their potential scale of cultivation, presents a significant risk that biofuel crops could escape cultivation and potentially damage surrounding ecosystems. Biofuel crops will likely be cultivated on lands surrounded by sensitive forest, prairie, desert, and riparian areas, as well as rangelands and agricultural commodities. The potential societal benefits of a biologically-based energy supply are great, but the introduction and development of biofuel crops should be conducted to minimize the risk of these proposed feedstock species escaping cultivation and causing economic and environmental damage.

We have proposed a series of ecological analyses that when combined with risk assessment and computer modeling can quantify the risk of each proposed biofuel feedstock escaping cultivation and invading natural and managed ecosystems.

Posters

Alphabetical by first author (* = presenter).

The Salmon River experience: Tools of the trade

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Over the last 12 years the Salmon River Restoration Council (SRRC) and its partners have developed an unusually effective model using a well-stocked Tool Kit for controlling several priority invasive plant species at a watershed scale in the Salmon River (approximately ½ million acres). Through its Salmon River Cooperative Noxious Weed Program (CNWP), the SRRC has developed an adaptive approach that includes some basic guiding principles and 13 Steps to attain effectiveness. The guiding principles that our community and partners have rallied around include: Early Detection, Rapid Response, Thorough and Persistent Management and the Use of the Appropriate Tools. We are currently controlling twelve targeted species of noxious weeds and are having a high level of effectiveness with our signature species being Spotted Knapweed which we have reduced by over 98% at more than 250 sites throughout the Salmon River wildland watershed. The SRRC has found that there are certain tools that are most appropriate to effectively manage different species in varying habitats. The SRRC tools are used for digging, mulching, burning, cutting, pulling, bagging and mashing the targeted plants. Members of our local community have been fabricating a line of tools, including the "Super L" digging bar, that are used by the SRRC paid and volunteer crews, Drivers That Care, and Adopt An Area programs.

Trials on chemical control of periwinkle (*Vinca major*) and Cape ivy (*Delairea odorata*)

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There is little quantitative research data, especially within native vegetation communities, on the effectiveness of different herbicides on invasive periwinkle (vinca) (*Vinca major*) and cape ivy (*Delairea odorata*) when applied to large infested areas. The most frequently used method for vinca removal has anecdotally been reported as foliar herbicide treatment of resprouts following mowing/mastication typically with weed wackers or weed whips and for cape ivy as foliar herbicide application to intact biomass. The goals of this study were to determine the most effective method for concurrent removal of both invasive species, 1) from large areas (> five acres) where methods used for removal of smaller patches may not be effective or possible, and 2) with limited impact to surrounding native vegetation. The study took place on 14 acres of rare riparian/floodplain forest on the lower Ventura River in Ventura County, California. Dense growth of vinca may be preventing recruitment of native tree and shrub species.

Treatment plots were configured with three replicates of five different herbicide treatments to create a total of 15 plots. Each plot was 30 x 30 feet in size, but only a concentric interior plot

of 20 x 20 feet was sampled. This established a five-foot buffer on all sides from adjacent treatment areas. Vegetation within each plot was surveyed using the line-intercept method. Within each replicate, herbicide treatments were randomly assigned to a plot using glyphosate, triclopyr, glyphosate and triclopyr, imazapyr and control (no herbicide). Initial biomass removal was accomplished by mowing eleven acres of riparian forest understory using a fixed tooth mower. Efforts were made to avoid native plant species and minimize soil disturbance. Plots were sampled eight weeks after mowing then treated with the assigned herbicide at application concentrations determined by a Pest Control Advisor (PCA). Only the targeted invasive species were treated. Plots were surveyed again three and nine weeks after the initial herbicide application. This poster will summarize preliminary analyses of the effects of different treatments to vinca, cape ivy and other vegetation.

Wildly successful restoration and mitigation: A contractors perspective

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Natures Image specializes and focuses its work on restoring native habitats throughout the West. During the past ten years the company has evolved to be a leading contractor and chosen partner for both public and private entities for their habitat restoration and mitigation needs. Given our breadth and depth of experience, what we would like to highlight here are three factors critical to wildly successful habitat restoration and mitigation. When these tools are used with discipline they have resulted in all stakeholders meeting and in some cases exceeding their restoration goals. The first factor, an in-depth understanding of all of the stakeholders, is pivotal and assists the contractor in defining the best installation approach. A second critical factor is having a voice during the planning process. We propose bringing in Natures Image during the initial planning process. Our expertise assists both the owner and biologists in reaching the best possible outcome. Third, communication during all phases of the project ensures that all parties are reaching milestones that are agreed upon and outlined at the outset. Last, we will profile two case studies that demonstrate the results of utilizing these important tools. One highlights an installation of 120 acres of coastal sage shrub that has resulted in documentation of the California gnatcatcher within one year. The other highlights removal of several acres of dense *Arundo donax* in difficult terrain.

Native plant restoration along highway rights-of-way in California

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The establishment of native perennial grasses along highway rights-of-way provides benefits of reduced weed infestations and herbicide use and increased sediment control and plant species diversity. Cultural and chemical management techniques are necessary to improve establishment success of native perennial grasses in the first two to five years after planting. Field studies were conducted along two roadway environments in northern California to determine the effect of 1) burning, spraying, cultivating and species selection on the establishment of native perennial grasses and persistence of non-native annual vegetation and 2) mowing, burning or spraying

alone and in combination on an existing stand of native perennial grasses with dense populations of non-native annual species, particularly yellow starthistle. In the Interstate 5 highway median, burning and spraying had the most significant effect on native grass establishment and reducing non-native vegetation persistence. Cultivation and species selection (wet or dry site seed mix) had no significant effect on native perennial grass establishment or annual weed persistence at this site. Along State Route 20 in Colusa County, native perennial grass stands that were overrun with non-native annual species, particularly yellow starthistle, were effectively treated with a combination of well-timed vegetation control techniques.

Coyote Creek floodplain reclamation project: Re-establishing native plant habitat

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The Santa Clara Valley Water District's (SCVWD) Vegetation Management Unit is conducting a three-year project to remove non-native invasive vegetation throughout Coyote Creek Floodplain located in Milpitas, CA. The floodplain consists of 6 acres located along Coyote Creek. As of 2003 95% was infested with non-native invasive vegetation, mainly *Lepidium latifolium, Conium maculatum* and *Brassica nigra*. During Year 1 (2004) all non-native invasive vegetation was mechanically and chemically controlled. Approximately .185 acres was planted with native herbaceous vegetation. During Year 2 (2005) an additional .122 acres were planted for a total of .307 acres. Plantings were installed in polygon clusters, mulched with compost, and watered by hand on a monthly basis for two years throughout the growing season. In Year 3 (2006) it was found that approximately 3.615 acres were vegetated with native plants equaling a 1000% increase in native vegetation and 60% native cover. The increase in native cover has led to a decrease in maintenance and herbicide costs. Costs in Year 1 totaled $83,572.47. Year 2 costs totaled $46,682.36. In Year 3, costs dropped to $41,852.63. This year, (Year 4) costs dropped significantly to $28,540.50. This is a savings of $55,031.97 in costs since the beginning of our project. Although we faced many challenges in establishing Coyote Floodplain with native vegetation our project proved successful by creating native plant habitat and allowing us to conserve resources that we can now use toward other projects.

Managing coastal sand dune on Camp Pendleton

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Camp Pendleton has approximately 17 miles of relatively undeveloped coastline, including rare Southern California coastal dune habitat. To help counteract non-native invasive plant species (NIS) spread, Marine Corps Base Camp Pendleton began management practices in 1994 designed to improve nesting habitat for California Least Tern (*Sterna antillarum brownii*) and improve the dune system. NIS control and native vegetation surveys have been implemented. A vegetation monitoring protocol was started to gauge vegetation changes during the ongoing management period. Here vegetation management methods and monitoring results are summarized.

GeoWeed: A new weed data management tool

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GeoWeed is a data collection and management tool for the invasive plant project manager. The system provides for recording location and status data for plant populations, monitoring the populations over time and tracking treatments and management activities. GeoWeed consists of a desktop MicroSoft Access database coupled with a customized ArcPad application for field use with a handheld computer and GPS. Data attributes are linked with geographic point and polygon data and photographs. The application is based on the features of other mapping programs combined with many new innovations, including:

- Enhanced data integrity and safety
- Clarified, refined and new data elements
- Intuitive user interface with many new features
- Web-based reports
- Basic data aggregation
- Data quality checks and diagnostics

GeoWeed has been developed by Sonoma Ecology Center with funding, input and help from California Bay Delta Authority, The Nature Conservancy, U.C. Davis Information Center for the Environment and the Golden Gate National Parks Conservancy and is currently in use by Team Arundo del Norte partners and the Golden Gate National Parks Conservancy. Future plans for the project include instant on-board maps, photo management utilities and enhanced data aggregation facilities. GeoWeed is free software shared under the GNU General Public License. http://GeoWeed.org.

Tributaries to the Upper Santa Clara River, Los Angeles

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Condor Environmental Planning Services, Inc. (Condor) mapped the vegetation and the locations of Arundo (*Arundo donax*) and Tamarisk (*Tamarix ramosissima*) within the 500-year floodplains of the tributaries to the upper Santa Clara River. The surveyed area encompasses more than 10,600 acres within the area stretching 32 miles from west to east, roughly from west of Interstate 5 to Highway 14. The work was conducted for the Ventura County Resource Conservation District and Amec Earth and Environmental. The District is leading a joint-agency effort titled "The Santa Clara Arundo and Tamarisk Removal Project". The objective of the project was to map Arundo and Tamarisk and the vegetation in the Santa Clara River and its tributaries in northern Los Angeles County and northeastern Ventura County. This information will help the agencies plan the weed eradication efforts.

Condor identified and recorded the types of vegetation to the series and (in some cases) association levels within the floodplains of the tributaries, recorded the locations of Arundo and Tamarisk infestations in the GIS and prepared detailed maps and a Geographic Information System (GIS).

Condor surveyed and collected data in 68 drainages (14 principal tributaries to the Santa Clara River, 35 secondary tributaries and 19 tertiary tributaries), having a combined total linear distance of approximately 181 miles. A total of 148 data collection points were

established and 24 vegetation series were observed. Arundo and/or Tamarisk were found in 10 of the 14 principal tributaries. A total of 43 vegetation maps were created to illustrate the results of the surveys. The report includes species lists for each of the drainages.

These maps will guide the agencies charged with removal of these infestations toward Arundo and Tamarisk locations to the locations of sensitive habitat and sensitive species. Having these locations recorded in the GIS will allow future researchers to return to these exact locations to monitor success of the weed removal efforts.

Controlling giant reed (*Arundo donax*) within the Tijuana River Valley

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EcoSystems Restoration Associates (ERA), in cooperation with Southwest Wetlands Interpretive Association (SWIA), has been conducting chemical and physical control of giant reed (*Arundo donax*) as well as habitat restoration throughout the Tijuana River Valley Regional Complex for the last three years. In the Tijuana River Valley, giant reed occurs in a patchy distribution in comparison to the large, dense stands that are more typical in San Diego County. Since the habitat surrounding infestation areas was primarily composed of riparian woodland, riparian scrub and open water, project specifications required that ERA avoid substantial impacts to sensitive biological resources such as the federally listed least Bell's vireo, while cost-effectively controlling this highly invasive species. This created a challenging situation to systematically eradicate the giant reed. The control techniques utilized included foliar treatment on intact and trampled stands of giant reed, as well as cut-stump treatment.

The foliar herbicide treatments included the application of 4%, 6%, and 7.5% glyphosate over a three-year period. The most effective means of control was achieved thorough foliar application of 7.5% glyphosate, which resulted in complete eradication within four weeks. The 4% and 6% glyphosate application rates resulted in approximately 60-80% suppression of the stands. The cut-stump treatment was overall unsuccessful with nearly 100% re-growth, although these results varied by year. From a cost perspective, using a 7.5% treatment was equivalent to using the cut-stump method. The results ran contrary to original beliefs, but confirmation from the third year of experimentation showed that the cost benefit and effective means were maintained by the using 7.5% application rates. To date, ERA has sprayed invasive giant reed from approximately 900-acres of riparian habitat within the Tijuana River Valley.

Restoring San Francisco's tidal marshes: The demise of invasive *Spartina*

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Eradication of invasive *Spartina* from the San Francisco Estuary is well underway following up to four years of treatment coordinated by the San Francisco Estuary Invasive Spartina Project (ISP). The ISP Monitoring Program has been documenting the extent of invasive *Spartina* throughout the estuary since 2001, using GPS, aerial photo interpretation, and photo point monitoring. We are finding that at most sites, two years of treatment using the herbicide imazapyr results in a very significant reduction of *Spartina* stands, leaving only sparse patches requiring follow-up treatment. Dominant marsh vegetation, including pickleweed, appears to recover quickly. Here we present successes and challenges evidenced by recent monitoring results at selected sites being treated by the ISP Control Program.

Applied ecology of Eurasian watermilfoil (*Myriophyllum spicatum L.*) in Fall River

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The Fall River in Shasta County, CA is a host to the exotic weed Eurasian watermilfoil (*Myriophyllum spicatum*). In 2003, the aquatic weed infestation resulted in decreased flow rates leading to a broken levee and the flooding of 3000 acres of grazing land. $200,000 was spent on plant harvesting downstream to restore flow to the river. In addition, the species is a hindrance for the local trout fishery and downstream power generation. We are mapping its distribution in the river and comparing sediment and plant characteristics between invaded and uninvaded locations in order to determine potential limitations for its spread. We are also monitoring nonstructural carbohydrates stored in root tissues to identify periods when reserves are lowest so that control operations may be optimally timed. Currently, nutrient addition experiments measuring biomass return and Rapid Light Curves (RLCs) indicate possible Nitrogen or Phosphorous limitation at two of six sites sampled for comparison of sediment characteristics between invaded and uninvaded sites. Also, root stored nonstructural carbohydrate lows appear to coincide with spring regrowth and flower development in midsummer.

Thread-leaved brodiaea weed control for habitat restoration: Implementation, maintenance and monitoring

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RECON Environmental, Inc. (dba RECON) is contracted to design and implement guidelines, maintenance tasks and monitoring methods through which thread-leaved brodiaea (*Brodiaea filifolia*) populations and habitat can be restored as mitigation for impacts on a development site in Carlsbad, California.

The development of this property resulted in the loss of sensitive habitats for the thread-leaved brodiaea. These impacts are considered significant and require mitigation through habitat restoration. RECON prepared the Final Habitat Restoration and Mitigation Plan in November of 2005. The plan is currently in its second year of implementation.

Thread-leaved brodiaea is a federal threatened, state endangered, California Native Plant Society List 1B.1 species. Approximately 95% of the population was preserved; the remaining 4.9% of the population was translocated using the soil transfer method into degraded valley needlegrass grassland.

Weed eradication within the grassland has been intensive and includes dethatching using weed whips, repeat, weed-specific herbicide application, and hand-pulling. Primary invasives include fennel (*Foeniculum vulgare*), Italian ryegrass (*Lolium multiflorum*), ripgut brome (*Bromus diandrus*), wild oats (*Avena* spp.) and black mustard (*Brassica nigra*). Native species within the grassland are limited and include thread-leaved brodiaea, purple needlegrass (*Nasella pulchra*), blue-eyed grass (*Sisyrinchium bellum*), and small-flowered morning glory (*Convolvulus simulans*). Weed eradication and habitat restoration are intended to result in reduced competition by invasives and an increase in native pollinator populations. Restoration methods include thread-leaved brodiaea seed collection and propagation, planting of container plants and direct seeding of annuals.

Noxious weed display of Gila County Arizona

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Accurate plant identification is a basic skill required for all noxious weed control efforts. However, collections to practice identification are not readily available. To address this deficiency, Master Watershed Steward (MWS) Volunteers Karrol Braddock and Til Zimmerman teamed up with USDA Tonto National Forest's Noxious Weed Program Manager Patti Fenner to collect 23 specimens of noxious weeds found in central Arizona's Gila County. Each specimen is prepared at a level of herbarium quality and displayed in a tabletop poster rack. Included are exotic knapweeds, starthistles, toadflax, annual grasses, salt cedar and others. The display rack and poster are used at trainings, workshops and other events for volunteers and personnel to examine physical weed specimens for identification purposes. Preserved field specimens are an exact, visual sample of species seen in the field, and they allow for quicker, more effective learning than using field guides. This collection benefits both Cooperative Extension and state agencies; it provides MWS participants with an improved training tool that better prepares them for volunteer work. The display rack also serves as a resource to compare weed specimens when delivered to the office for identification.

The Master Watershed Steward Program is a partnership of the University of Arizona Cooperative Extension and the Arizona Department of Environmental Quality, developed to educate and train citizens across Arizona to serve as volunteers to maintain healthy watersheds.

Drilling and injecting two invasive palm species

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Canary Island date palms (*Phoenix canariensis*) and Mexican fan palms (*Washingtonia robusta*) are two palm species common in Southern California riparian areas that were added to Cal-IPC's invasives list in 2006. Cutting down these palms is time consuming, dangerous and expensive. Landfills refuse to accept palm fronds for recycling. An alternative method of killing these palms was described in a Cal-IPC poster by this principal author. This method involved drilling holes into the center of these palms and injecting glyphosate herbicide into the holes. This author arbitrarily chose to drill three holes at different angles into the trees. The amount of herbicide and the number of holes were arbitrary. Killing certain invasive trees and leaving them standing has been approved by the resource agencies under certain conditions. The opportunity arose in 2006 under an invasive tree contract won by Kelly & Assoc. from the Metropolitan Wastewater Dept. of the City of San Diego to experiment with drilling methods, herbicide types and herbicide dosages on both these palm species. Hundreds of palm trees six feet and taller were experimented on. Trees were divided into different size categories of 6-12', 12-18', 18-24', 24' and larger. Two herbicides were tested, glyphosate (Glyphosate Pro II) and triclopyr (Garlon 4) at three different dosages: ¼ oz., ½ oz. and 1 oz. The number of holes varied from one to three. Monitoring of the numbered and tagged trees occurred on a quarterly basis. Clear results have emerged with the data on the fan palms, but not yet with the date palms. The next monitoring, July 2007, is expected to provide sufficient data on the latter to draw conclusions.

Eradicating 25 species: Challenges and successes of switching from population to seed bank management on Catalina Island, California

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In 2003 an extensive island-wide invasive plant mapping survey was conducted on Catalina Island; 76 species were prioritized for management action. Total area infested, number of populations and median population size were recorded and the data was used to develop a ranking matrix to identify species for eradication. A two-year funding campaign secured the initial support for eradication of 25 species including: *Arundo donax, Centaurea solstitalis, Delairea odorata* and *Tamarix ramosissima*. Physical removal and a variety of chemical application techniques were used to remove all living plants of species targeted for eradication over a three-year period. The program is now transitioning from treating live populations to managing seed-banks. This switch in management objectives has affected all aspects of the program from invasive plant awareness, program support, staffing, species detection, equipment needs, and funding acquisition. The program is now dependent on employing extremely detail-oriented field crews to conduct more precise surveys of small populations and seedlings, limiting our ability to use volunteers. Monitoring and control of these persistent seed-banks poses funding challenges.

Educating funding agencies and decision makers about the process of invasion, seed bank dynamics and the importance of consistent population treatment is vital to promote effective weed management programs.

Plant community and ecosystem effects of *Arundo donax* invasion

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Giant reed (*Arundo donax L.*) is a notorious invader of riparian communities in California, but its impacts on ecosystems has not been documented. We examined plant diversity and several biotic and abiotic processes in *A. donax* infested and uninfested areas of the active river channel and adjacent terrace. Plant diversity and percent cover, soil moisture and light availability were measured in permanent plots in May, August and November. Decomposition rates and C:N dynamics of native litter and *A. donax* litter were measured over the same period. Species richness and cover were significantly lower in *A. donax* infested areas; these effects were strongest on the terrace where *A. donax* stands were long established. During the peak growing season in May, soil moisture was 32% lower in *A. donax* infested areas, but was not significantly different in the dry season. Light levels at the soil surface were 65% lower with *A. donax* present, a trend that continued throughout the year. As *A. donax* percent cover increased, native percent cover, soil moisture, and light availability decreased ($r^2 = 0.537$, $p < 0.001$). Native litter decomposed at 3.5 times the rate of *A. donax* litter and had significantly more nitrogen and a lower C:N than *A. donax* litter. These results show that *A. donax* invasion substantially alters both biotic and abiotic processes in native riparian systems, with impacts most likely increasing over time. The low quality of *A. donax* litter may substantially alter nutrient cycling and limit nutrient availability for other plants and higher trophic levels in riparian systems. The slow decomposition of *A. donax* litter may 'clog' invaded systems with poor quality tissue high in lignin and lead to dry litter build-up enhancing fire risk.

Ecology and future biocontrol of cape ivy in southern California

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The increasing presence of the invasive vine, Cape ivy (*Delairea odorata*), poses a threat to riparian ecosystems and biodiversity in coastal southern California where it forms dense understory mats and arboreal tangles. It is listed by Cal-IPC as a high impact invader only in the central part of the state, owing to a general lack of information on its ecology and life history, competitive ability and mechanisms of invasion and negative impact in the southern portions

of its invasive range. Our work addresses these mechanisms by coupling observational field studies with experimental garden experiments. In infested areas Cape ivy reduces open substrate eight-fold, light by 50% and understory species diversity by approximately 35%, many of which are also non-indigenous. Species level impacts are assessed using physiological measures (photosynthetic and growth rates, water use, light availability) of native species with and without Cape ivy. We also compare phenological and physiological traits of Cape ivy with native vines to evaluate how it invades and why its detrimental influence on native ecosystems may be related to life-form differences. Baseline information is also being developed in order to test effectiveness of candidate agents (stem-boring moth, *Digitivalvia delaireae*, and a gall-forming fly, *Parafreutreta regalis*, as part of a proposed statewide biocontrol program.

Milestone™ (aminopyralid): New research results of efficacy on noxious and invasive weeds

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Milestone™ (*aminopyralid*) is a new herbicide developed by Dow AgroSciences for managing noxious and invasive plant in range and pasture, rights-of-way, and other non-cropland sites that controls over 50 susceptible herbaceous broadleaf plants including yellow starthistle (*Centaurea solstitialis*), Canada thistle (*Cirsium arvense*) and spotted knapweed (*Centaurea maculosa*). Research trials in California, Idaho, Montana, Nebraska, Oregon and Washington were initiated in 2005 and 2006 to assess the efficacy of Milestone on weeds not previously tested. Experiments were conducted to assess efficacy of Milestone at 3, 5, and 7 fl oz product/A applied with CO_2-pressurized backpack sprayers in spray volumes of 15 to 20 GPA. Percent visual control was taken at 73 to 378 days after application. Common mullein (*Verbascum thapsus*), Scotch thistle (*Onopordum acanthium*), purple starthistle (*Centaurea calcitrapa*), rush skeletonweed (*Chondrilla juncea*), St. Johnswort (*Hypericum perforatum*), meadow knapweed (*Centaurea jacea*), tall buttercup (*Ranunculus acris*), Italian (*Caduus pycnocephalus*), woolly distaff (*Carthamus lanatus*) and artichoke thistle (*Cynara cardunculus*) response to aminopyralid were assessed in the experiments. Milestone at 1.25 and 1.75 oz/A provided excellent control of woolly distaff thistle (92/100%), rush skeletonweed (92/95%), St. Johnswort (87/99%) and tall buttercup (100%) about one year after application. Milestone at 1.75 oz/A provided excellent control of meadow knapweed (99%), artichoke thistle (90%), and Italian thistle (88%) one year after application. Seasonal data showed excellent control of purple starthistle (98/100%) at 0.75, 1.25, and 1.75 oz/A and mullein (85/96%) at 1.0 and 1.75 oz/A, respectively. Based on the efficacy data these weeds were added to the Milestone label.

Figs and bridal creeper: Two stubborn weeds that require ingenuity

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Twenty-five invasive plant species are targeted for eradication on Catalina Island, following a systematic prioritization based on their limited abundance and invasiveness. No treatment recommendations were available for two of the species, fig (*Ficus carica*) and bridal creeper (*Asparagus asparagoides*), and effective control methods were difficult to perfect. The most successful treatments are presented here.

Figs were first treated with 100% Habitat® (Imazapyr) herbicide using the hack-and-squirt method during the summer and fall months that resulted in 0% control, but slowed leafing out of the trees in the spring. Basal bark application of Pathfinder II™ (Triclopyr) herbicide was then used throughout the year and resulted in effective control. This allowed for a follow-up treatment within the same season of small branches or seedlings that were hard to find or access during the original treatment. Several other challenges were encountered while controlling figs, including access to remote populations and the resulting skin reaction of the applicators to the tree sap. Bridal creeper was first treated unsuccessfully with Glyphosate Pro II (Glyphosate) herbicide at a variety of rates as foliar or wick applications. Treated bridal creeper appears to die back to the dense fleshy tubers that are part of its rhizomatous root system, then quickly re-sprouts from another tuber during the same season. Manually removing the rhizomes from the ground and solarizing them has proven to be a successful control method for this species and its bio-waste.

Invasive Species Research in National Parks

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The National Park Service has a mandate to base park management on the highest quality science and information available. The Pacific Coast Science and Learning Center provides a hub for researchers working in San Francisco Bay Area national park units. Of 122 active research permits, the Center is currently involved in 22 invasive species projects, examining both plants and fungi (17) and animals (5) in marine (5) and terrestrial (17) environments.

How Can You Conduct Research at a National Park?

1. Visit http://science.nature.nps.gov/research. This website will provide all the information you'll need to understand the simple permit process and to apply on line.
2. Contact a park you are interested in working at. What research priorities do they have? Do their priorities match your interests? Most parks are interested in applied research that can translate into improving park conditions.
3. Once you've found a park contact, decide on the project details, timeline and find out what's available for your research needs, equipment, lodging, office space, reference materials, etc.
4. Work closely with your park contact, communicate your activities and get ready to share your new findings with everyone at the next CalIPC meeting.

The following are three research case studies demonstrating the benefits and variety of invasive species research in national parks.

Case Study One: European Beachgrass Harbors Endangered Plant-Eating Rodents

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Study Design

Dr. Knight's study examines the effects of the invasive grass, *Ammophila arenaria* (European beachgrass), seed predation by native deer mice (*Peromyscus maniculatus*) and their interaction as potential threats to the viability of the endangered plant species *Lupinus tidestromii* (Tidestrom's lupine). *L. tidestromii* is an endangered plant endemic to California sand dunes; there are 18 extant populations left, 10 of which occur within Point Reyes National Seashore. Currently, European beachgrass occurs throughout the dunes of Point Reyes, and this likely precludes the expansion of the *L. tidestromii* populations.

Results

- Deer mice are more abundant inside European beachgrass
- Fruit and seed predation of Tidestrom's lupine is high, especially near European beachgrass
- Current levels of predation on Tidestrom's lupine are not viable

An intensive survey of small mammals in relation to the invasive plant European beachgrass was conducted at the largest population of Tidestrom's lupine (Pitts and Barbour 1979). Estimated densities of deer mice were considerably higher inside stands of European beachgrass (40 mice/ha) than inside native vegetation (15 mice/ha); this is presumably due to the greater cover that the invasive grass provides them from avian predators (Pitts and Barbour 1979). Dr. Knight measured the incidence of fruit predation on 300 reproductive Tidestrom's lupine plants. Fruit predation is consistently high (70% and 75% in 2005 and 2006 respectively). In 2006, she placed Lupinus fruits directly next to European beachgrass or 75m away (replicated at three separate infestations of European beachgrass). Fruit predation after five days was significantly higher near European beachgrass (ANOVA: $F_{4,1}=32.05$, $P=0.005$; Figure 1).

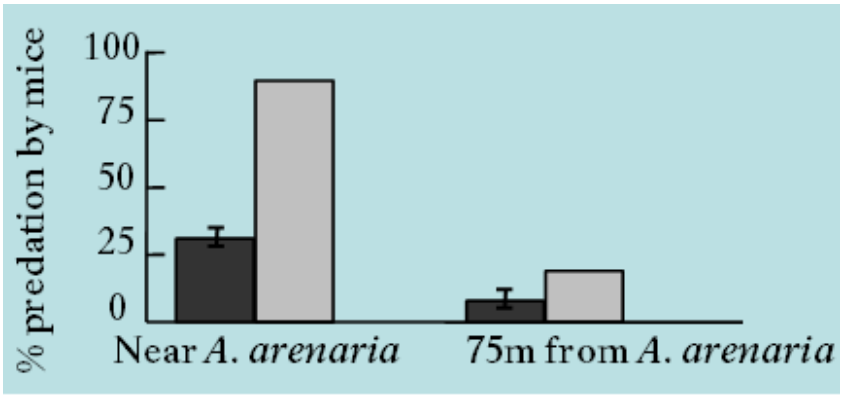


Figure 1. Incidence of Lupinus fruit (dark bars; +1SE) and seed (light bars) predation is greater near the invasive plant, European beachgrass.

In 2005, Dr. Knight measured the incidence of seed predation on Tidestrom's lupine. She placed five seeds in each of 100 locations within a square of cells each separated by 20m. After one night, 56% of the cells were found by mice and consumed. Seed predation was greater for seeds located near European beachgrass than for those 75m or more away ($\chi 2=25.3$, $df=1$, $P<0.001$; Fig. 1). Because seeds are vulnerable to predation at least until they are buried by sand and, perhaps even until germination, 56% is likely an underestimate of actual post-dispersal predation. Together, these results suggest that overall predation on Tidestrom's lupine would be greatly reduced if European beachgrass were eradicated.

Dr. Knight monitored the demography of 500 plants and 300 seeds within Point Reyes National Seashore from 2005-2007. She created a stage-based matrix model for the 2005-2006 data (Fig. 2) and assessed population growth rate (λ) in two ways: with ambient levels of predation and in the absence of predation. λ is 0.87 (95% CI 0.83-0.91) with ambient levels of predation, indicating that the population is expected to decline rapidly to extinction (13% loss of individuals each year) and 1.01 (95% CI 0.98-1.03) in the absence of predation, indicating stable population dynamics (1% increase in individuals each year).

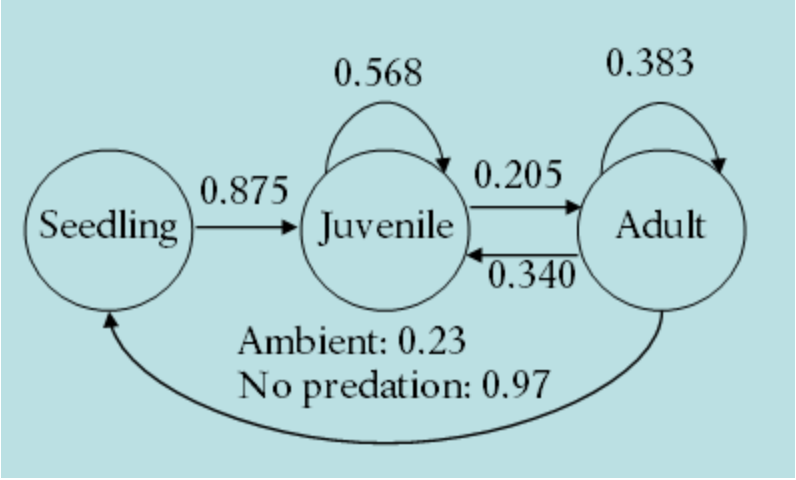


Figure 2. Matrix model for Tidestrom's lupine. Arrows indicate 1-year transition probabilities.

Future Work

Recently, Point Reyes National Seashore received a grant from the National Park Service for a large-scale restoration project. In 2010, Point Reyes National Seashore will remove European beachgrass from 300 acres of sand dune habitat near Abbotts Lagoon. This will provide open habitat that is undesirable to deer mice and should therefore allow for viable populations of Tidestrom's lupine. Dr. Knight will collaborate with Park Ecologists to conduct experimental rare plant restoration following European beachgrass removal.

Park Connection

In 2005, Dr. Tiffany Knight, Professor of Biology at Washington University, Saint Louis MO, approached the National Park Service with an idea to work on rare plant research questions of interest to park mangers. Point Reyes National Seashore responded with an SOS call, identifying critical research needs for 50 listed rare plant species. Dr. Knight's work at the Seashore has focused on rare dune communities, native and non-native thistles and rare grassland forbs. Her enthusiastic and collaborative approach has made her a mainstay at the park and she's been provided free park housing at the Sacramento Landing Research Center for the past three years. During this period, she's mentored (and put to work!) numerous undergraduate and graduate students on projects directly benefiting park management at Point Reyes.

Case Study Two: Cape-ivy Fragment Resprout Research Project

Serena Dennis

Study Design

Cape-ivy is a non-native species in the Golden Gate National Recreation Area (GGNRA) that is highly invasive. Cape-ivy seeds in California are generally considered sterile; the predominant method of spread is vegetative. Cape-ivy re-grows from cut stem fragments and little research exists documenting which parts of the ivy resprout. It is known that Cape-ivy stem fragments with one or two nodes resprout, however, for other parts, such as leaf petioles or roots, it is not known. Through this study we hope to find out more accurately which parts of Cape-ivy resprout and how to better improve Cape-ivy removal efforts.

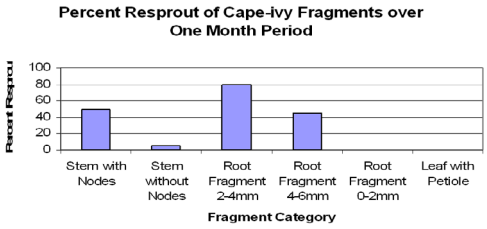
This study was conducted at Ft. Cronkhite in Rodeo Valley of GGNRA. Cape-ivy fragments were collected from current Cape-ivy project sites. Cape-ivy fragments were divided in two groups: one consists of leaf fragments, stem fragments without nodes and root fragments. The second group consisted of stem fragments with nodes. The first group served as the experiment and the second as the control because it is known that stem fragments with nodes do resprout. Twenty Cape-ivy fragments per category were sown in each of three 18"x18" flats, containing 100% Sunshine Mix and kept in the Marin Headlands Nursery greenhouse to ensure optimal resprouting of fragments. Flats were watered weekly. Each fragment planted had a nursery tag with its respective number placed next to it. Date of resprout and the size of the plant were recorded at set intervals.

Results

Two categories did not have resprouts: leaves with petioles and root fragments 0-2mm. (Figure 3). Stems without nodes had only one resprout.

The rest of the categories, stems with nodes, root fragment 2-4mm and root fragments 4-6mm, all had greater than fifty percent resprout rate (Figure 3).

Figure 3



Park Connection

Serena worked closely with staff at Golden Gate NRA to devlop her project idea, secure greenhouse space for her research and focus her work on an issue of management interest to NPS staff and the greater collective working on Cape-ivy eradication. Many parks have native plant nursery facilities available for small to large-scale research and may even have staff available to assist with the work.

Case Study Three: Evolution of Local Adaptation in the Invasive California Wild Radish (*Raphanus sativus*)

Caroline E. Ridley and NormanC. Ellstrand, University of California Riverside, CA

Project Summary and Findings

- The evolution of introduced organisms can result in newly invasive lineages.
- Rapid local adaptation can contribute to invasiveness by ensuring a good 'fit' of individuals to vastly different environments.
- Using a reciprocal transplant experiment, we are testing for rapid local adaptation of northern and southern populations of California wild radish to two California environments.
  - A. Wet, northern and coastal – Point Reyes National Seashore, CA.
  - B. Dry, southern and inland – Riverside, CA.
- Preliminary results indicate that southern California individuals flower and senesce more rapidly than northern California individuals in both environments, an

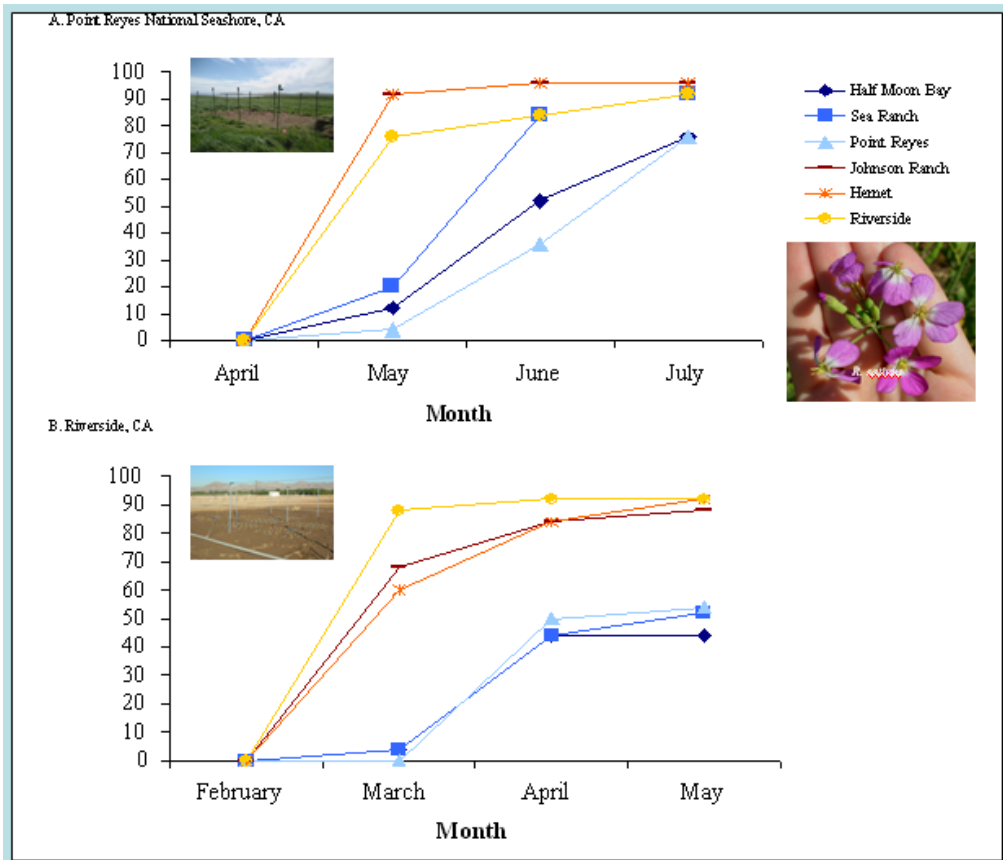


Figure 4: Percent flowering individuals of northern (orange) and southern (blue) populations of California wild radish during the 2007 growing season at two field sites (N=300).

apparent adaptation to limited seasonal rain in their desert-like home environment (A & B).

- Reproductive output will also be quantified as a direct measurement of invasiveness.
- Evolution will continue to help explain the success of many introduced organisms.

Park Connection

Caroline collaborated with Point Reyes National Seashore Range Ecologist John DiGregoria to identify her research site.

Literature Cited

Pitts, W. D. and M. G. Barbour. 1979. The microdistribution and feeding preferences of Peromyscus maniculatus in the strand at Point Reyes National

Seashore, California. Amer. Midl. Naturalist101: 38-48.

Effects of non-native aphids (*Hyalopterus pruni*) on competition between native and non-native *Phragmites australis*

Yoshi Tamagawa, Adam M. Lambert, Riparian Invasives Research Laboratory, Marine Science Institute, University of California, Santa Barbara, CA. yoshi819@umail.ucsb.edu 805-455-5617*

Common reed, *Phragmites australis*, is a common plant in wetlands across North America. A non-native *Phragmites* haplotype has been rapidly invading wetland communities and displacing native haplotypes. In the California desert, a haplotype whose native status has not yet been determined (Gulf Coast haplotype) is colonizing wetlands and oases. Studies have shown that native *Phragmites* haplotypes are more susceptible to non-native aphids (*Hyalopterus pruni*) than either the exotic or Gulf Coast haplotypes. Aphid feeding damages and kills native Phragmites and may be indirectly responsible for their decline. We are conducting a common garden experiment to determine if differential *H. pruni* herbivory mediates competition between native and non-native *Phragmites* haplotypes using five native haplotypes (two from CA), the non-native haplotype and the Gulf Coast haplotype. Native haplotypes were paired with either the non-native haplotype or the gulf coast in pots and are being grown either with or without aphids. After two months of growth, plants will be harvested and above- and below- ground biomass will be measured to compare growth differences among treatments. Our predictions are that both above- and belowground growth will be lower for native haplotypes in the aphid treatment compared to native plants without aphids. We expect that the non-native and Gulf Coast haplotypes will be relatively unaffected by aphids and will have similar growth in all treatments. Studies of invasive plants often focus on direct interactions among an invasive plant and the native plant community, but multitrophic level and positive interactions among exotic species may enhance a plant's invasiveness.

TNC's Weed Information Management System (WIMS): An application tool for invasive species management

Mandy Tu, The Nature Conservancy's Global Invasive Species Initiative, Portland, OR.*
imtu@tnc.org 503-802-8150

TNC's Weed Information Management System (WIMS) is a Microsoft Access-based relational database application that is designed to assist natural resource managers in managing their local weed data. WIMS keeps track of three types of data records: weed occurrences (GPS point locations), assessments (size and status of the weed infestation to facilitate monitoring over time) and management treatments applied to those weed infestations. Once data have been entered into the database, data can be easily exchanged between multiple users in a variety of formats, exported in NAWMA (North American Weed Management Association) standards, written to shapefiles for mapping in any standard GIS program and a variety of reports can be instantly generated. Additionally, WIMS can be used on a handheld computer with a GPS unit to facilitate weed mapping and data capture in the field. This enables the site manager to export data from the Access database onto a handheld unit, bring those data into the field, see imagery directly on the screen, map and collect field data, then immediately upload those new data into the Access database. We believe that WIMS is one good option for land managers to keep track of weed-related data.

Working and Discussion Groups

PlantRight Bootcamp for Effective Outreach to Nurseries

Topic Leaders: Bethallyn Black, UC Cooperative Extension, Master Gardeners Program and Betsy Peterson, California State Floral Association, California State Seed Association

Facilitator: Cora Puliatch, Cal-IPC

Notetaker: Jennifer Erskine-Ogden, UC Davis

Introduction

Cal-IPC: Working with the California Horticultural Invasives Prevention (Cal-HIP) partnership for several years. Cal-HIP is a steering committee of nurseries, landscape professionals, academics, and agencies.

Cal-HIP: people behind PlantRight project

PlantRight: brand/campaign that acts as a vehicle for achieving Cal-HIP goals

Fall 2007: Outreach to nurseries scheduled before outreach to public – more effective to go to nurseries first, public outreach next spring/ summer to help create trust with nurseries and prepare them for consumers aware of PlantRight.

Spring 2008: Outreach to garden clubs and gardening public – consumer education phase.

Introductory Discussion

How not to approach – aggressive, confrontational

How to approach – Immediately ask for a manager or buyer. Introduce yourself, saying something to the effect of: "Not sure if you're aware of Plantright campaign…" Give a brochure and say "The nursery association CANGC supports campaign, and here's a website your nursery can check out for more info. There will be major public outreach to gardening clubs in a few months and we wanted to let you know before the public campaign."

- Great if you approach as a local and consumer
- Local nurseries often have buyers on site
- Big box stores often don't have buyers on site, but may, and either way give them a brochure

Good things to do/mention

- Mention CANGC is a partner
- Great if you're a local consumer
- If the nursery supports the program, they can say they are part of the PlantRight campaign

Role-playing

Pairs of participants practiced effective interactions between a weed worker and nursery worker; each had a chance to be on both sides of the interaction. This activity was intended to facilitate thought about difficulties that might arise in "real life" and consideration of effective ways to deal with challenges before approaching high-stakes situations (talking with sensitive stakeholders about PlantRight) that can effect the success of others performing similar outreach.

Post-role-playing group discussion

What's needed/would help with outreach

- List of plants
- DPP brochures
- Branding of plants/nursery

What works

- Understanding your audience
- Promoting non-invasive plants
- Being attentive to context
- Mentioning cost to society/taxpayers
- Offering to help educate employees/be a resource

- Mentioning economics for nursery – e.g. if you have alternatives early (consumer demand) you could reap financial reward
- Letting them know that wholesale growers are at table
- Finding a point of agreement, common ground
- Going local, where you're known

What doesn't work

- Using jargon, technical terms
- Not realizing your audience
- Aggression
- Excessive idealism or doom and gloom scenarios

Conclusion

- Go out and spread the word!
- Joint the speakers bureau
- Spring 2008 outreach through speakers bureau, join in!

  Master gardeners

  Landscape architects

  Junior college horticulture departments

  and more being pursued
- Check out Cal-IPC's PlantRight web page for weed workers!

Crafting Better Public Outreach Strategies and Materials

Leaders: Asha Setty and Mary Petrilli, Golden Gate National Parks Conservancy

Notetaker: Joanna Clines

Language:

"Our" "We"

Future Generations

Stewardship

Promote

Protect

3 "W's": Water, Working Farms/Ranches?, Wildlife

Conservation

Natural Areas

Health

Safety

Introduction (Asha, Mary)

NPS work since 2000. Focus on native plants and weeds. Transition to realization that people are the most important part of the equation. Recognition of the value of communication and getting public buy-in to a project. We are hoping you invest the time in talking to people.

Question about "3% negative" what happens? Potential to stop project. We believe that communicators are the first to encounter the 3% and listen to them without letting the "negative" move on to a higher level. They may never agree with the project, but turns into project understanding and a "softer negative" (ie: no escalation).

Project Failures:

Dog-walkers lawsuit due to trail closures. Highlighted importance of finding common ground to build community advocacy and stewardship prior to implementation of work plan. From stopped projects came concept of putting project information coordinators in the field.

Case: Land's End Coastal Trail Enhancements—tree maintenance. Started outreach 1 year before work. Out every week letting public know what project was about and to provide feedback to the project manager. The issue was hazardous trees, but people were very attached to the trees themselves-pretty straightforward.

But what happens when the project is tree removal for view improvement?

Following hazard tree removal we started weed removal and trees for habitat restoration.

- Getting people accustomed to the work
- Hosted "walks" to get people up to speed on work
- Passed out fliers
- Communicated to public that trees were planted way too densely and so NPS was working to restore health (opening up canopy/get under story started).
- Had research (UC Berkeley) and did neighborhood meetings and forest walks featuring the "experts" describing why work needed to be done.
- Very few negatives

Was there a neighborhood? How did you contact the public?

1. Public affairs officers already established neighborhood groups.
2. Land's End Lookout was a newsletter that went out to the zip code
3. Signs along trail
4. People on trail talking to public
5. Created buzz that resulted in people wanting to know what was going on

Information sheet

1. Never fill it out when you are talking to the public
2. Information binder with photos of species then fill out sheets later
3. At the end of each week tally how many comments and transfer important comments back to managers. Example: "Why aren't there restrooms on site?" Then next time we were out there it was possible to explain that restroom facilities were coming.

We were able to turn a negative into a positive. Example (Asha): A neighbor knew that a bird was still nesting (after nesting search). The irate neighbor said that birds were still present. Asha stopped the project and added a wildlife biologist to the crew-the neighbor was able to meet the biologist, and though was still unhappy, at least respected that NPS was doing-ongoing conservations. "We acted on a negative so they didn't"

Unexpected Positives

We thought everything would be against trees, but found that public was so happy to have someone talk to them-we formed almost a small "community" at the site.

"Lesson: You don't have to have fear of public"

If reports go back to managers-see the 3% negative, what happens when the 3% stays the same-are real decision makers able to accept the 3% negatives?

Answer: Yes, managers are able to accept the 3% negatives. Have more support based on data. Managers read comments and understand that in an urban environment not everyone will agree but that work is along the lines of what general public wants.

So the data is not used to support the position that you wanted all along.

How do you fund?

Answer: It is a very small part of each project. Land's End example: a $45,000 project had about $3,000 for public outreach (about 10% to public outreach).

People you hire-how?

Answer: Typically they are contract hires, usually of people known to the park. We now have a permanent position: Information Coordinator.

I remember in past negative headlines "Plant Nazi's" etc. but I see positive changes in your effect.

Take home message: Public outreach should be part of the planning process rather than a response to negative feedback experienced during a project.

LISTENING: Importance of how can you be an active listener.

Language used is important.

Lessons learned

- Don't be so "right"
- Sometimes people have legitimate concerns
- Listening and Caring
- "Them" is "Us"
- Have empathy for public-this helps you care more about the person's concerns
- Smile-I hear what you're saying
- We are almost "therapists" out there. People out there seeking solace. This was a great way for them to express something that was inside them (not necessarily about your project)

At what stage are you engaging the public? (Person is dealing with native people but she is being ineffective in getting them to see her project as a positive. "This is our land" (Frustration)

How do we get them to move forest projects forward on tribal lands? When the tribal people do not want to change/undertake the problem?

Negative words	Positive words
Environmentalist	Conservationist
Endangered	Imperiled

Study by Nature Conservancy and Trust for Public lands

- Way to connect people through language
- Use the three "W's"
- Promote projects using words that strike chords/resonate
- Focus on language that promotes consensus. For example the words Health, Safety, Promote, Clean-up, Protect, We, Our, Diversity, Future Generations. These are powerful words that people can agree on.
- Accessibility-can have negative connotations. Joggers did not like hand-packed surfaces and wanted a trail with a wild look. The park knew about these concerns through a visitor use survey contracted out during the planning process. The trail is accessible for the first ¼ mile out to the great views and then the rest more wild. Public felt that the park had listened to their concern and responded.

Break into Groups to discuss the issues that people are most afraid to hear (20 min)

How would you speak to people that have that concern? How to frame the issues.

Issues

1. Endangered species and landowners
2. Herbicides/Chemical use
3. Historic/Cultural Use
4. Weeds as Habitat (birds etc.)
5. Lack of Action (Benign neglect)

Introduce yourself and take notes and present in 20 minutes

Group sessions

Summary

- This is an important part of what we do yet not enough time or money to do it.
- Commitment to take notes from these summaries/out to the public-share with the group.
- How to keep importance and values and find the right vocabulary to get support you need for a specific project.

Suggestion for list serve-Question poster to provide synopsis of the responses

Suggestion to post these tools on a website

Notes: Invasive Species as Habitat

- Yosemite—Bears and Blackberry
- Chico, Bidwell Park—Japanese Susan trees

The public does not differentiate nature as non-native. There is a "green is good" mentality.

East Bay Parks – Cape and Algerian Ivy, wants to encourage neighbors to become involved. Problem is that they like the ivy.

California Watershed Council - Arundo (*Arundo donax* giant reed?) as habitat for songbirds. Dealing with Audubon (dealing with our own.)

Trees for shade in public park as well as raptor roosting.

Open Space District-SOCA - Riparian Mexican fern? Palma-The community is upset about dead trees-A beauty issue.

Solutions

- Identify the concerns
- Show the concerned audience what the goals are and the long-term aesthetic benefits
- Use before and after photos/images
- Educate the public about how long the site will be a work site
- Identify limitations and concerns prior to any activity
- Public buy-in first
- Identify the concerns and questions that are going to arise
- Have a message that you know is going to work

More Issues

Consultant in Ventura – Watershed level invasive plant problems. Issues with Arundo as habitat, locals did not respond to SEQIA outreach efforts but then after attempts

Elkhorn Slough – Eucalyptus removal in Agricultural area. Wonders what the outcry will be.

Parks Conservancy – Coastal bluff with historical hedgerows of tamarisks and Eucalyptus

Conclusions

In advance, figure out the potential concerns and be prepared.

"Fighting" with our own--other environmental groups

Developing a Citizen Science Program: The San Diego Plant Atlas Project

Topic Leader: Mary Ann Hawke, PhD, Plant Atlas Director, San Diego Natural History Museum

Facilitator: Jamison Tuitele-Lewis, Sierra National Forest

Notetaker: Linnea Hanson, Botanist, Plumas National Forest

Jon Rebman is the Curator of Botany at the San Diego Natural History Museum. This was his idea. He gave talks at plant groups to get the idea going and had key organizational meetings. Mary Ann first volunteered in running the project. When money came in then she did this on a full time basis. That took two years to do. Her salary is not funded by the museum.

Why a Plant Atlas in San Diego?

- Significant botanical diversity
- Manageable size
- Floristic resources under threat
- Lack of scientific knowledge
- Insufficient data for sound, science-driven decision making
- Success with Bird Atlas - observation oriented

California is one of only five Mediterranean climate zones in the world.

San Diego County flora-2143 plant species, 1573 natives (73%), 26 endemic plants, over 200 sensitive species. San Diego's biodiversity is threatened from urban sprawl and other human-caused stresses.

Started with observational Bird Atlas, which is now going to look more like the Plant Atlas. There is a Mammal Atlas too. For the Mammal Atlas, data was collected and used mathematical modeling.

Key Unanswered Questions that Drove the Project

- What areas of the County have the greatest diversity?
- Are there new species yet to be discovered in the county?

- Where should we be conserving land?
- How can we provide decision-makers with sound, scientifically based information?

The San Diego County Plant Atlas Project:

1. Training to learn the procedures
2. Field work to collect plant specimens and record data about the plant and the location.
3. Press and dry plants.
4. Enter data online and submit specimens
5. Botanist verifies/corrects plant name
6. Volunteer mounters prepare specimens.

Specimens are kept together so that the parabotanists can look at their specimens before they are placed in the main herbarium.

San Diego County is divided into a three square mile grid. It is based on the Township, Range and section system with 36 sections divided into fourths. More than one person can collect in a square. Some squares lack data; some have lots of data. They let people go where they wanted to go at the beginning. Now they are suggesting where people should go to collect.

When a volunteer signs up for a square, they are sent a pact of information including maps and permits. They have organized grid gatherings on newly acquired land and have sent a staff member with the parabotanists.

For incentives, the parabotanists are all official volunteers of the museum, meaning they have free access to the lectures, discounts at the gift store, classes and field trips. The Bird Atlas volunteers were a very social group that had regular parties. With the plant atlas they have been having about one event a year. They have also had a contest with prizes to see who submitted the most plants. They plan to set up an auxiliary committee to organize social events. There are about 200 active parabotanists and about 500 people have been trained in total.

Main Products:

- Training Program – involves the public while increasing awareness and respect for local natural resources
- Specimen Collection – supports scientific research, teaching, consulting, and land management
- Online Searchable Database – for use by biologists, students, teachers, consultants, land managers, landowners, conservationists, garden clubs, etc.

Voucher Plant specimens:

- Physically document the plant
- Can be verified if taxonomy changes
- Available for genetic or microscopic study
- Last indefinitely
- Can be borrowed and lent like a book

Difficult to run program without a qualified paid staff. They provide step-by-step instructions that the majority of the parabotanists follow. 167 species have been added to the county checklist due to the plant atlas project. At their gatherings a parabotanist's nametag shows how many plants the person has collected. Half of the parabotanists are actually professional botanists from State Parks, Fish and Game, consultants, etc.

Parabotanist program

Involves interested members of the public in their local natural history

Trains parabotanists to collect proper plant specimens and field data

Provide voucher specimens and data for scientific study

Creates an organized system for receiving data and plant specimens

Parabotanist Training includes:

- Maps and Grid system
- Safety
- Access to property

- Permits-federal and state renew permits annually, cities are lagging behind. Very time consuming to get the permits.
- Special status species information
- What to collect
- Recording field data
- Submitting data and specimens

Mary Ann attends lots of meetings and networking to find parabotanists. She gives lots of talks, goes to all of the meetings that she can to find new folks. Partners have been very cooperative.

If special status plants are found they are recorded as a feature, a picture is taken and data recorded. A list of special status species for that particular square only is given to the parabotanist. The county has a species predictive model that is used to get a species list. There is a photo album to become familiar with the special status species.

The goal of the project is to get a sample of every species in every square in the county. There is an online form to fill out. The parabotanist can print out what has already been collected for that particular square. They follow the 1 in 20 rule, so if there are not enough plants to collect any then they take data and a photo and fill out an observational form.

Parabotanists

- Volunteers of the San Diego Natural History Museum who have completed training
- Do not have to be experts in plant identification since all specimens are verified by the Curator of Botany
- Collect plants and data from the field and submit them to the herbarium

Should I start a citizen science project?

- Need - is the project necessary?
- Recruiting - do I have a source of appropriate volunteers readily available?
- Workforce - how many volunteers will it take?
- Networking - collaboration is essential
- Funding - need money form many sources, write grants
- Staffing - lots of hand holding required
- Scope - be very clear about what you are not, not teaching to ID plants
- Procedures - develop clear instructions, guidelines and expectations
- Accessibility - make your project easy to use
- Legal issues - permits, liability insurance
- Management - don't expect to be able to manage such a time and labor intensive project with a volunteer staff! You WILL need to pay full time core staff to manage your project and maintain consistency!

Requirements to be a Parabotanist:

- Attend the training classes
- Have computer access
- Visit your collecting area at least three times per year
- Submit a minimum of 25 plant specimens per year
- Enter your data online and then deliver the specimens to the museum in a timely manner
- Follow SDNHM procedures and instructions to ensure the quality of the scientific information being gathered

Project Staff

- Jon Rebman - ten month endowment, two months paid through project
- Project Director - full time, grant funded, provides oversight
- Parabotanist Manager - full time, coordinates with parabotanists, reviews specimens with them and give feedback
- Database Manager - half time retiree
- Training - half time grad student
- Data Steward - half time

Plant Atlas newsletter

- Plant Atlas Happenings
- Schedule of Events
- Plant of the Month
- New county Record of the Month
- Wanted plants

Website: www.sdplantatlas.org

Prevention Tools: Assessing the risk for weed spread when planning ground-disturbing projects

Topic leader: Chris Christofferson, Plumas National Forest

Facilitator: Wendy West, UC Cooperative Extension

Notetaker: Mark Dedon

Introduction

Chris: An important first step is to educate the people who are performing the work on ground-disturbing projects, to become more knowledgeable about weed infestations. We need to write documents to analyze effects of the operations (timber, fire, etc), including effects on both rare plants and invasive species. Have a noxious weed risk assessment. In 1997, USFS had first meeting in Morro Bay. In 1999, Feinstein supported the Quincy Library Act. As part of that, biologists wanted to consider invasive species in environmental analysis. Every project on the Plumas NF must have a risk assessment. The Sierra Nevada Framework now requires noxious weed risk assessment for projects.

Chris spoke with a number of agencies to see what they currently do. A Noxious Weed Risk Assessment (NWRA) starts with an inventory to see what's out there.

Question and Answer Session

Q: Are NWRAs done at a project level?,

A: Yes. If you have a 5,000-acre project, then you do surveys for rare plants and invasive species. Go to campground, trail heads, etc. Look for habitat vulnerability, and for Project Dependent Vectors (e.g. bulldozers and fire). On mitigation measures, USFS differs than most other organizations. USFS can codify that "you will" clean equipment before it comes on the job site.

Q: How do contractors get trained?

A: USFS has developed a relationship over many years to educate contractors.

Q: Do construction contractors police themselves?

A: No, the persons doing the policing are the USFS inspectors. These are the "sale administrators." One of the biggest things we do is clean equipment. If you know you will be operating in a contaminated area, you can mandate that it gets cleaned before moving. Another contract clause is for weed-free mulch and fill. This can be harder to mandate if it is not available. Chris will call around and look for it and then provide to contractors. In Butte County USFS works with quarry to certify it—Chris does this. Other provisions include mandating that they remove Italian thistle within 30 feet of the road.

Wendy: There is a good source on the Center for Invasive Plant Management (www.weedcenter.org) on steps to certify gravel and fill material suppliers. This is a non-regulatory approach.

Peter: In working with procurement department, is anyone aware of general guidelines to contract management above and beyond BMPs? Caltrans has very extensive guidelines for fill, saying do not take across counties lines.

Wendy: Huge need as a community for procurement departments to have appropriate language in the contracts. Need to pull this together.

Chris: LOPs for rare plants. Used this for Scotch Broom control. Cut in the fall to get a better kill. Assigning controlled areas can work well for isolating units with high infestations. Problem is to get areas delineated and keeping them delineated.

All provisions go into a big table that consolidates environmental concerns and LOPs.

Q: How is equipment actually cleaned?

Chris: High-pressure washers at wash stations. We use a digging bar to remove loose soil. If something is grease-laden, we're not as concerned. Caltrans cannot put water to soil. Must drive rumble strips.

Q: In conducting an inventory for new route or trail, how far out do you look?

A: Decide what is the window of disturbance? Site specific.

Monitoring

Need to get funding on the front end. Get through reforestation—can go out after the work. Can go back and check on the replanting for noxious weeds. Can't say what are the effects of the logging.

Chris spoke with other groups like Rob Hill at Butte Co. Ag. Office. Internally, they can review site. Inform landowner that weed exists and ask landowner to follow a noxious weed plan and sign off on mitigation measures. What does county do? Nothing. No resources.

Wendy: RCD had opportunity to review permits at the county level.

Peter: Are there basic BMPs that work but don't impact the work?

Chris: I try to tie fire fuels reduction to fighting noxious weeds

Cal Dept. of Forestry and Fire Protection plays a role. CDFG has to demonstrate a significant impact on the environment before noxious weeds can be codified into contracts. So having the research to show is helpful.

Chris spoke with Paul Kirk of the Sacramento River Partners in Chico. Convert agricultural land to riparian. After planting they spray early with herbicides to suppress noxious weeds. They have also found that some natives out-compete the weeds, like Gredila, Artemesia, native grasses.

Monica Finn of CalTrans: is concerned about inconsistencies of seed mixes for revegetation. She thinks better communication is needed what needs to be done. Caltrans is big on composting and it's important to ensure no weed seeds. There is no clean compost yet in California. Texas is leading this due to all the cattle. Idaho DOT did 1:1 slope with composting. Worked great. Expensive. Someone said pine needles have been used as mulch. Could have weeds.

Chris: On the last point made by Monica—enforcement is a big challenge. CalTrans- BMPs are in contract language. Stormwater BMPs is the big ticket now.

Q: How much of the time are contractors trained?

A: All the time. If you want a promotion you must have "certification." Caltrans uses training module that employees sign off on. Two languages.

Chris also spoke with Jim Dempsey in State Parks in Chico. Jim's big thing—if creating an opening, need to plant natives immediately because something else will come in.

Q: Where is everyone else with BMPs?

Issue for one organization is that BMPs are not actually followed. Are there inspectors? Only the big projects. Is there a review process for performance? Yes, but only for large-scale projects. From Caltrans experience, you must hit the contractors with the dollar or it won't happen. There needs to be some hammer in the contract language.

Situation where Arundo is growing on the banks and the city bulldozes the channel and arundo is spreading all over San Diego. What permits are needed? Could you put BMPs in the

permit? Spray afterwards. Should be part of the Army Corps of Engineers permit. Suggestion to communicate with PM about the problem. There is good science on how arundo clogs the flood channel. Need to get the right information to the right people.

Through Caltrans, the stormwater permit drives what is going to happen.

How to get buy-in at upper level to conduct training.

Staffing is an issue for one organization. At the very least have a support truck that washes the equipment.

Suggestion to have rental companies take some measures to keep equipment clean.

Sources of BMP language: the Center for Invasive Plant Management has it broken down for specific audiences. "Invasive plant prevention guidelines" at www.weedcenter.org. They have a ton of resources. This also includes the sand and gravel certification, and sources for weed-free lists.

There was a conference on developing bid specifications for controlling weeds.

Wendy wants to pull together language from multiple sources. Cal-IPC may start doing this with Wendy's help.

Weed Mapping Developments

Leaders/Facilitators: Jason Giessow, John Knapp, Deanne DiPietro, Jason Casanova

Notetaker: Doug Gibson

Current Cal-IPC Mapping Efforts

An overview of the field course was given and Jason Giessow briefly discussed three key map-based projects that Cal-IPC is currently undertaking:

1. Arundo Mapping From Tijuana Estuary to Salinas
2. Predictive Modeling – Climex model
3. CalHIP

Data Management and Storage Issues

Deanne DiPietro from the Sonoma Ecology Center and Team Arundo Del Norte gave a brief overview of the Department of Fish and Game BIOS web-based mapping application. The Sonoma Ecology Center recently submitted a Northern California-based Arundo dataset to BIOS that they had been aggregating from a variety of data sources. While discussing the dataset Deanne also described the metadata development process (multiple sources using varying mapping methodologies) and the link that is made from BIOS through to the CERES catalog, the State's online clearinghouse for metadata. Deanne also touched on the importance of using NAWMA standards that will streamline merging shared data into one comprehensive dataset. Other web-based mapping systems that were touched on include the national level NBII CRISIS Maps.

Jason Casanova gave a demo of BIOS (http://bios.dfg.ca.gov).

Key Points

- metadata is needed for all layers in BIOS
- BIOS will accept any feature type (point, line, or polygon)

Question and Answer

Can you have time layers or multi year records?

A: Yes, but you cannot customize the symbology within the program interface.

Can DFG symbolize multiyear layers if requested?

A: Most likely (contact BIOS point person, Kristina White, with specific questions)

Is anyone using Google Earth? Anyone uploading data?

A: Not really (problems include: no one simple method, time constraints, no direction)

Is there an interest in metadata workshops?

A: Follow-up with Deanne regarding the potential for hosting workshops

Who can you contact regarding BIOS help?

A: http://bios.dfg.ca.gov - Look for the button that says HELP

General concern was raised about issues to data sharing, mainly in regards to the usability/ applicability of disparate data sets created using different methodologies. What constitutes good data?

Discussion on Different Mapping Protocols

John Knapp discussed a variety of methodologies based on overarching goals, size of area, geography, etc.

What is a patch? How do you determine this?

A: 1. Distance apart
2. Type of vegetation
3. Dispersal
4. Determine a protocol and stick with it

What feature type (point, line, polygon) is best when collecting data? Are there best practices for mapping?

- Good to have area mapped with polygons rather than point data if possible (high accuracy for acreage estimates); but ultimately it depends on project area size. Points are more realistic for larger areas with large species lists.
- Create a chloropleth map with spatial tags – size classification
- For determining rough area of extent – use road, mile markers, P/S Blocks & roads surveyed looking for leading edges
- Use a GPS track log to track absence of information
- Important to determine confidence in data layer (e.g. walking vs. driving, map scale)
- Resolution is important

Another resource for doing pre-mapping (in-house) of larger species before entering the field: Microsoft's Maps Live http://maps.live.com. The site contains fairly recent high-resolution vertical and oblique imagery that can be used to identify larger species.

Jason Casanova presented a short demo Microsoft Maps Live.

Weed Control Techniques

Topic leaders: Joe DiTomaso, UC Davis, and Mike Kelly, Kelly and Associates

Facilitator: Mona Robison, California Botany Surveys and Tours

Notetaker: Cindy Burrascano

Introduction

Discussion

Joe DiTomaso (JD) on burning for Medusahead: Literature says that sometimes burning works and sometimes it doesn't work. In four areas where JD has burned he has had some good results and some bad results. The correlation between successful burns is having thatch on the ground (R2 = 0.98). Having a large amount of thatch gave good kill with fire and having little thatch results in poor kill of Medusahead after a fire. Areas with low thatch levels tend to correlate with snow so burning of Medusahead in high elevations is unlikely to be successful for providing control.

The Saltcedar biocontrol works well in Nevada but not Southern California. New taxa have been collected and a different variety or species (taxonomy not published yet) from Greece was tested in Cache Creek. The insect is defoliating *T. parviflora*, although it actually prefers *T. ramossisima*. There is no T. *ramossisima* in the Cache Creek drainage. There was a long lag but now a 16-20 mile band of river has been defoliated. They are not spraying anymore in Cache Creek.

Mark Newhouser (MN) explained his hook for use with small to medium patches of Arundo. He used electrical pvc pieces to create and curve hook in combination with plumbing joints and an 8-foot wooden handle. The wooden handle is carved down at the connection with the pvc piping to allow a better fit and the pvc is screwed into the handle with a large bolt. Wood works better than aluminum. The hook allows one to reach up into the patch of Arundo, twist with a turn and catch up about 10 canes to pull towards you. You can spray the leaves as you walk and pull the canes down allowing you to spray the tips and leaves while minimizing overspray.

MN explained the bend and spray technique for Arundo used by Team Arundo. Bending the cane and snapping it to allow spraying on the ground had the same efficacy as foliar spraying on Arundo. The canes are bent but left intact. The technique works well with 3 people. Two people bend the Arundo creating a layer and move onto a different area while a third person sprays the just-bent layer. The benders then return to the area that have been sprayed and bend down another layer. The biomass is left in place but is likely to be a fire hazard and drift is reduced. The technique is very labor intensive.

JD described a drizzle gun that delivers 4-5 gal/acre for use on woody vegetation such as Scotch broom and tree tobacco. They tested on 5-foot plants and found this technique to be the least expensive. It takes about one second to spray a plant in a W spray pattern. Roundup cost 14-15 cents/plant to kill with foliar whereas it cost 5 cents/plant with the drizzle technique. You use a higher concentration of herbicide but less area of the plant is covered (10-20%). Garlon use gave a similar type of savings costing 8 cents/plant. The drizzle gun can be attached to a backpack sprayer. It is from Spring Systems Company and is called a drizzle tip. This technique has been tested on Himalayan blackberry and worked on it. 10% Roundup gave 85% control when applied in the fall and 100% control when applied in the spring. Roundup was 100% effective in spring or fall when applied at 20%. Garlon was 100% effective at 10% in both spring and fall. This technique does not work for pampas grass since you need to hit every tiller to kill a plant.

Mike Kelly (MK) described using dethatching prior to restoration to get better weed control afterwards. One is partially removing seed with dethatching. Some company actually vacuumed their sites but it is generally too labor intensive for most. Dethatching can be accomplished by hand or tractor. Dethatching rakes with long tines are available from Home Depot and can be used to pull material off site or to create brush piles. It was suggested to include dethatching as an experimental element to see if it helps on your work site. Grassland dethatching was reported to be very helpful for natives.

MK described using a drill for killing eucalyptus and palm trees. He uses a 16" long drill bit for palm trees to drill into the center of the palm. Herbicide is then added to the hole. The plant slumps down on itself after a year or more. He is running an experiment to test how many holes and how much herbicide is needed to kill the palms. Fan palms die with 1 hole and somewhere between 0.25 and 0.5 mL Roundup. Phoenix canariensis are harder to kill and he is still collecting data. He is also comparing results with Roundup and Garlon. Defining "dead" may be not when the tree is all brown but when the terminal bundle is dead. JD said that palms have segregated bundles throughout and trying different depths might result in a completely dead palm. The herbicide is introduced into the tree using a rigid plastic tube from Consolidated Plastics (http://www.consolidatedplastics.com/index.aspx) and a plastic syringe. The tube is pulled out slowly to allow the herbicide to exit the tube. Palm oil is very corrosive so chain saws should be broken down and the chain, bar, and housing cleaned after being used on a palm tree. Killing in place can maintain the tree as habitat at least for a while.

Drilling works on Pittosporum, Ailanthus, Brazilian pepper, and hybrid walnuts. You can

get a pack from a veterinary supply house that comes with a syringe to deliver the herbicide according to information previously obtained from Jim Dempsey.

Carl Bell was reported to use something called a Boominator for hand held spraying of large areas. There is an easy adaptor for a hand hold. You get a good spray to wet in large swaths where a truck sprayer cannot be used. They are available from Target Specialty (http://www.target-specialty.com/).

MK suggested we consider use of herbicides besides Roundup and Garlon. Telar over the top of native marsh species was effective at killing *Lepidium latifolium* while not affecting the native species. Milestone (*aminopyralid*) and Transline (*clopyralid*) provide pre-emergent and post-emergence activity with Artichoke thistle. Habitat (*imazapyr*) in the aquatic formulation has been very effective with invasive *Spartina* control.

Discussion

Robert Snyder (City Davis Open Space) described injecting Arundo with glyphosate (30%) for control. A K-Gun was mentioned. Mark Hanson uses an injection technique with Japanese knotweed. He needed to get every node and the technique is useful for small clumps. 5mL undiluted/stem.

Pre-emergents. Don't use Landmark (Oust/Telar) if you want to plant right away. They are good for bare ground, and they will mix up the amount needed to do your specific acreage. You can plant perennial grasses one year after treatment. Arizolin and Resalin must be watered in within 21 days. They don't do so well on mustard. Milestone is effective with Marestail.

Granular vs. dry flowable? Ken Moore is testing granular Snapasolva (Isothyocynate).

Mary Ann (Palo Alto) has a 13 acre site where they are hand pulling curly dock, *Dittrichia*, radish, *Hirshfeldia*. She wanted to know how much of the root could be left. The annuals can have root left in the ground but curly dock would need substantial amount of the root in the ground removed for hand pulling to be effective.

Dittrichia is a heavy metal accumulator. It causes a skin reaction when hand pulled so wear gloves. Knock Knock joke: Knock Knock, who's there? *Dittrichia, Dittrichia* who? *Dittrichia* into thinking I'm *Hemizonia*. *Dittrichia* looks like *Hemizonia* from a distance.

James Pyor asked about leaving dead palms. It was pointed out that there are large debris piles from fronds with either fan palms or Phoenix canariensis. They do not degrade rapidly. The fibrous nature of the trees tends to have them slump in place with death by drilling. They don't seem to fall over in the time frames they have been watched after drilling (1 year). They are easier to cut down after they have desiccated than when they are alive. Cheryl (Carmel) described Senegalese date palms as becoming brittle after a couple of years if left standing.

John Chapman (Santa Clara) asked about basal bark treatment. 12-18" spray of Pathfinder II on Ailanthus. Technique doesn't work with species with older separated bark as the bark doesn't let the herbicide move into the tree. Jesse Vinje (CNLM) asked if basal bark would work on Chamal Ash. No one had tried it. Doesn't work on eucalyptus. Drilling might be better.

Hybrid grape treatment? ¼-3" stems on plants that go 200 feet into the canopy. Cut stems and treat, drill into base and add herbicide, and girdle cuts were recommended.

Rare species potential may require more monitoring or a change in methods.

Waipuna effective (hot foam)? Janet Klein has done a lot of work but wasn't present to discuss. It was felt that this was not very cost effective, can't be used in many places, and takes a lot of time. If you have the right circumstances this can be an effective herbicide free method. The TNC website has a review (http://tncweeds.ucdavis.edu/tools/hotfoam.html).

New Western Society of Weed Science journal is featuring a Phragmites control article. WSWS will be held in Anaheim in March. There will be an Arundo/Phragmites Biology, Ecology, and Control Symposium coming up. The problem of keys for native versus invasive phragmites was discussed. JD said if in high salt area you most likely have the invasive strain.

Proposed Wildland Weed Licensing through the Department of Pesticide Regulation

Topic leader: David Chang, Santa Barbara County Agriculture Commissioner's Office

Facilitator: Joel Trumbo, California Department of Fish and Game

Notetaker: Mark Heath, Shelterbelt Builders

Joel – introduction to pesticide application licensing requirements, currently no category for wildland weeds and the quals do not necessarily reflect the needs for wildland weeds. Is there a need for specialized categories for wildland weeds?

Current Pest Control Advisor license requires pest control/production agriculture college coursework that doesn't necessarily reflect what's available at Universities/community colleges today.

ACTION ITEM: Create a dialogue

Discussion

Stan: Wildland category important to deal with issues relating to wildland sensitivities, endangered species and lack of specification of current tests

Bill: Changes in requirements would require UC to write a new test, new test prep materials, IPM manual etc requiring much work on their part which may be another issue.

Bill: Right of Way category and work closely matches the real work done in wildland pest control but it doesn't necessarily ever occur along a right of way. Written recommendations not necessary for much of wildland weed control. Writing multiple recommendations may be unnecessary or redundant for multiple parks with the same invasive plants/vegetation.

Dale: Uses right-of-way category for pest control in LA Water/Power but often sprays in a helicopter, large expanses of land, in and around homes

Joel: Public applicators don't need all categories because they don't actually need the QAC to spray own land with non-restricted materials. A much greater risk for private applicators who are legally required to operate in the correct category. This becomes a big issue when each county interprets categories differently and the regulations defining categories define wildland weed control unclearly.

Mac: DPR realigned State categories to be mirror Federal classifications. That is where the categories come from. Very cumbersome to break out detailed categories and so unlikely to happen soon. Each category takes ~$80-$100K funding plus legislation. Subcategories can be developed by regulation with much less expense/ effort.

Joel: Cal-IPC could possibly write DPR study guides for wildland weeds to help facilitate a wildland weeds subcategory

_____: Legislation could be an option as there is likely to be little opposition

Joel: Some regulatory benefit for wildand weeders who work directly in endangered species habitat other specialized needs.

_____: More credibility from regulators in developing and implementing projects in sensitive wildlands.

Mac: How are other States dealing with this issue? Potentially Florida already has an example?

David: North American Weed Management Association has a professional weed management certification that ~ 20 people in the US hold currently.

Options: Can we modify the definition for categories with DPR to include wildland category definitions more inline with current practices instead of creating a whole new category.

Mark: How does this affect private operators such as a Land Trust implementing pest control on their own lands?

Joel: Separate issues for ag use of private and public lands.

Mac: To justify a new subcategory, DPR needs the current number of people needing the new subcategory; a clear definition of why other categories do not apply and new study materials to support the exam.

Stan: PPE compliance difficult in wildlands as well such as eye washing stations in the backcountry.

David: What about Invasive Species Control category? Could build a constituency with other invasive species organizations to justify the number of people needed for the new category.

Mark: What about a Cal-IPC private certification for wildland weed workers?

Joel: Does not solve any legal issues. In summary new subcategory is the easiest mechanism to solve this issue. Plus study materials would have to be identified or created to support such a classification.

_____: Pesticide manufacturers have already done a cost-benefit analysis for habitat restoration sections of their labels therefore there should be a good impetus to justify a new category.

Mac: We need a number of people who want to take this test to have this subcategory. ~1000 people would need to want to take this test.

Joel: No lawsuits have occurred to justify better definitions.

Mark: Should we ask DPR for a list of compliance actions for working out of category in wildlands?

Joel: Probably little info would be available from DPR

Anna: A Statewide interpretation from DPR could clarify how enforcement actions resolve wildland category compliance.

_____: The categories must truly represent the actions so truly qualified people are doing the work

ACTION ITEM: Ask CAL-IPC to request a new subcatagory from DPR and attempt to justify the need

Bill: What is the action item?

Mac: Justification of numbers of people who will take that test PLUS justification of uniqueness of the category.

Joel: Definition of PCA issue

Mac: Proposed packet of regulation changes to PCA education requirements. Expansion will now include Pest Management experience and higher degrees in natural sciences supplement current educational requirements for the pest control advisors license.

Under "Pending Regulations" for Pest Control Advisory Licensing Requirements - March 2008 – Lead for comments Linda Iriqanda

Southern California Issues Meeting

Facilitator and Notetaker: John Knapp, Catalina Island Conservancy

Nearly 50 Attendees

Two main issues were discussed at the one-hour lunch meeting: a regional invasive plant inventory for southern California, and regional outreach campaigns.

Regional Invasive Plant Inventory

A regional invasive plant inventory would be useful to document the invasive plant distribution and abundance throughout the region, and also include new species currently on the Cal-IPC Invasive Plant Inventory (Statewide). The regional inventory would be a refinement of the existing Statewide inventory with impact, range, distribution and abundance records updated.

Outreach Campaign

It was discussed that there is a need for further outreach regarding invasive plant issues in many parts of the region. Outreach efforts in San Diego County which have been very effective could be used as a model for other counties. The support of existing outreach campaigns such as the Plant Right campaign, or starting new ones such as billboards, radio spots, etc. was discussed. The need to coordinate annual outreach campaigns seemed attractive to attendees.

Related Issues

Plant lists developed by non-weed related organizations such as: county fire, landscaping firms, water districts and utility companies were discussed as a way that invasive plants are promoted for landscaping. A regional inventory and an outreach campaign to these organizations, agencies, and industries would help curb the promotion of invasive plants for landscaping, and would support the Plant Right Campaign.

2007 Cal-IPC Symposium Attendees

Last Name	First Name	Organization	City	State
Acree	Lisa	National Park Service Yosemite	El Portal	CA
Acree	Martin	National Park Service	El Portal	CA
Adams	Sherry	Audubon Canyon Ranch	Glen Ellen	CA
Adams-Morden	Andrea	Carpinteria Salt Marsh Friends	Carpinteria	CA
Albertson	Joy	San Francisco Bay NWRC	Newark	CA
Alford	Christine	Yolo County	Woodland	CA
Allen	Jason William	City of San Diego Parks and Recreation	San Diego	CA
Archer	Gregory	National Park Service	Yosemite	CA
Athan	Tara	Mendocino Coast WMA	Redwood Valley	CA
Atik	Raquel	RECON Environmental	San Diego	CA
Auer	Sasha	Center for Natural Lands Management	Riverside	CA
Aulgur	Frank	Dupont Vegetation Mgmt.	Roseville	CA
Austin	Rick	Santa Clara Valley Water District	San Jose	CA
Ball	Regina		Lompoc	CA
Bankosh	Michael	Midpeninsula Regional Open Space District	Los Altos	CA
Barney	Jacob	University of California	Davis	CA
Beesley	Peter	PG&E	Grass Valley	CA
Bell	Carole	The Nature Conservancy	Murrieta	CA
Bennet	Anna	SERG	San Diego	CA
Bentley	Jacob	California State Parks	Soquel	CA
Bieber	Deborah	MCB Camp Pendleton	Camp Pendleton	CA
Biscieglia	Michael	Nufarm	La Center	WA
Bishop	Skyler	San Elijo Lagoon Conservancy	Del Mar	CA
Black	Bethallyn	UC Cooperative Extension	Pleasant Hill	CA
Blair	Charles	California Native Plant Society	Lompoc	CA
Boland	John	Tijuana River Valley Invasive Plant Control Program	San Diego	CA
Brady	Heather		Carmel	CA
Bramkamp	Jack	UAP Timberland LLC	San Dimas	CA
Brastow	Peter	Nature in the City	San Francisco	CA
Brawley	Shannon	Cache Creek Conservancy	Woodland	CA
Brusati	Elizabeth	Cal-IPC	Berkeley	CA
Buckley	Mark	Environmental Incentives	Lake Tahoe	CA
Burkhart	Brad	ECORP	San Diego	CA
Burrascano	Cindy	California Native Plant Society	San Diego	CA
Burt	Jennifer	University of California	Davis	CA
Butler	Cori	USDA-NRCS	Escondido	CA
Cabanting	Noreen	Ventura County RCD	Ventura	CA
Cantlon	John	DuPont Vegetation Mgmt.	Lakewood	CO
Carlock	Marcia	Cal Dept. of Boating & Waterways	Sacramento	CA
Carr	Colleen	San Diego Co. Dept. of Agriculture	San Diego	CA
Cartwright	Nicole	Tahoe RCD/LTBWCG	South Lake Tahoe	CA
Caruana	Michelle	Natures Image, Inc.	Lake Forest	CA
Casanova	Jason	Los Angeles & San Gabriel Rivers Watershed Council	Los Angeles	CA
Case	Robert	Alameda/Contra Costa WMA	Concord	CA
Cecena	Ian	CA Department of Fish & Game	San Diego	CA
Chaney	Sarah	Channel Islands Nat'l Park	Ventura CA	CA
Chang	David	Ag Comm - Santa Barbara Co	Santa Barbara	CA

Chapman	John	Santa Clara Valley Water District	San Jose	CA
Chavez	Enrique	Cal-Native Plants, LLC	Menifee	CA
Christman	Dolores	Tule Indian Reservation	Porterville	CA
Christofferson	Chris	USFS Plumas National Forest	Oroville	CA
Chu	Peter	University of California	Berkeley	CA
Clines	Joanna	USDA Forest Service Sierra National Forest	North Fork	CA
Codianne	Jennifer	Santa Clara Valley Water District	San Jose	CA
Corbett	Jim	Habitat West, Inc	Escondido	CA
Cory	Coleen	The Nature Conservancy	Ventura	CA
Cox	Michelle	Lassen Volcanic National Park	Mineral	CA
Crain	Jeff	BonTerra Consulting	Portola Hills	CA
Cummings	Gretchen	Cummings and Associates	Ramona	CA
Dalin	Peter	University of California	Santa Barbara	CA
Davison	Steve	MROSD	Los Altos	CA
Dedon	Mark	PG&E	San Ramon	CA
Delevoryas	Penelope	Athena Biological	San Jose	CA
Delfino	Kim	Defenders of Wildlife	Sacramento	CA
Delgado	Bruce	BLM - Fort Ord	Marina	CA
Dempsey	James	California Department of Parks & Recreation	Oroville	CA
DeSimone	Sandra	Audubon CA Starr Ranch Sanctuary	Trabuco Canyon	CA
Dickens	Sara Jo	University of California	Riverside	CA
Dinkins	Megan	CEMML	Camp Pendleton	CA
Dinn	Tom	NUFARM AMERICAS	Queen Creek	AZ
DiPietro	Deanne	Sonoma Ecology Center	Eldridge	CA
DiTomaso	Joe	UC Davis, Dept Plant Sciences	Davis	CA
Dowd	Frank	CDFA	Sacramento	CA
Dunn	Jonathan	CRES SD ZOO	San Diego	CA
East Bay Chapter	California Native Plant Society		Berkeley	CA
Eddy	Ben	Wildscape Restoration	Ventura	CA
Ekhoff	John	California Department of Fish and Game	Long Beach	CA
Ely	Terri	CA Dept of Boating and Waterways	Sacramento	CA
Eng	Ron	CDFA	Sacramento	CA
Erskine Ogden	Jennifer	University of California, Davis	San Francisco	CA
Etra	Julie	Western Botanical Services, Inc.	Reno	NV
Even	Greg	Padre Dam Municipal Water District	Santee	CA
Fallscheer	Robin	California Dept. of Fish & Game	Redding	CA
Farrell	Sharon	Golden Gate National Parks Conservancy	San Francisco	CA
Firestone	Jeffrey	UC Davis Plant Science Dept.	Davis	CA
Flietner	David		San Diego	CA
Francis	Jenny	Tahoe RCD/LTBWCG	South Lake Tahoe	CA
Gardner	Sue	Golden Gate National Parks Conservancy	San Francisco	CA
Gibson	Doug	San Elijo Lagoon Conservancy	Encinitas	CA
Giessow	Jason	DENDRA, Inc.	Encinitas	CA
Giessow	Jesse	DENDRA, Inc.	Encinitas	CA
Gluesenkamp	Daniel	Audubon Canyon Ranch	Glen Ellen	CA
Godfrey	Sarah	Big Sur Land Trust	Carmen	CA
Gonzales	Henry	Monterey County Ag Comm	Salinas	CA
Good	Deborah	USFWS Tijuana Slough	Imperial Beach	CA
Grayshock	Mark	Cal-Native Plants, LLC	Menifee	CA
Gregory	Quinn	Sacramento Local Conservation Corps	Sacramento	CA

Grove	Sara	National Park Service, Yosemite	El Portal	CA
Haines	Jennifer	County of San Diego, Department of Parks and Recreation	San Diego	CA
Halbert	Portia	California State Parks	Santa Cruz	CA
Hamel	Linda	Caltrans	Sacramento	CA
Hanley	Maeve	County of San Diego, Department of Parks and Recreation	San Diego	CA
Hansen	Mark P.	UAP Distribution	Seaside	OR
Hanson	Bruce	EDAW	San Diego	CA
Hanson	Linnea	Plumas National Forest	Chico	CA
Harrison	Jim	California Native Plant Society	San Diego	CA
Hawkes	Mary Ann	San Diego Natural History Museum	San Diego	CA
Haworth	Keith	CNLM	Wildomar	CA
Hayes	Kim	Elkhorn Slough Foundation	Moss Landing	CA
Heath	Mark	Shelterbelt Builders Inc.	Berkeley	CA
Heintz	Jonathan	CDFA	Roseville	CA
Hessing	Mark	Fort Irwin	Barstow	CA
Hibbert	Bryan	Land Conservancy of San Luis Obispo County	San Luis Obispo	CA
Hobbs	Robert	EcoSystems Restoration Assoc.	San Diego	CA
Hogle	Ingrid	Invasive Spartina Project	Berkeley	CA
Holbrook	Shannon	US Fish and Wildlife Service	Sacramento	CA
Holloran	Pete	University of California	Santa Cruz	CA
Holmes	Katherine	University of California	Davis	CA
Hooper	Stan	Midpeninsula Regional Open Space District	Los Altos	CA
Horenstein	Julie	Dept. of Fish & Game Habitat Conservation Planning Branch	Sacramento	CA
Howald	Ann	Garcia and Associates	Sonoma	CA
Huber	Anna	Wildscape Restoration	Ventura	CA
Humphrey	Jonathan	National Park Service Sequoia / Kings Canyon	Three Rivers	CA
Hunt	Thaddeus	University of California	Davis	CA
Hurst	Gigi	Habitat West, Inc.	Escondido	CA
Hutchinson	Rachel	UC Davis Information Center for the Environment	Davis	CA
Hyland	Tim	California State Parks	Felton	CA
Infante	Lisa	Midpeninsula Regional Open Space District	Los Altos	CA
Innecken	Shirley	RECON	San Diego	CA
Johanson	Arne	City of San Diego Parks & Openspace; Poway Blue Sky Reserve	San Diego	CA
Johnson	Doug	Cal-IPC	Berkeley	CA
Johnson	Judy	Coarsegold Resource Conservation District	Bass Lake	CA
Johnson	Brent	National Park Service, Yosemite	Midpines	CA
Johnson	Polly	University of California	Riverside	CA
Jones	Christopher	University of Arizona	Globe	AZ
Jordan	Jennifer	National Park Service Sequoia / Kings Canyon	Kings Canyon	CA
Jorgenson	Amanda	California Native Plant Society	Sacramento	CA
Karlton	Joanne	California State Parks	Gustine	CA
Kassebaum	JoEllen	MCAS Miramar	San Diego	CA
Kedziora	Matt	Zoological Society of San Diego	San Diego	CA

Keer	Beth		Oakland	CA
Kelly	Mike	Friends of Penasquitos Canyon Pres	San Diego	CA
Kelly	David	Garcia and Associates	Auburn	CA
Kidd	Bruce	Dow AgroSciences	Murrieta	CA
Klaasen	Larry	Sierra Club	San Diego	CA
Knapp	John	Santa Catalina Island Conservancy	Avalon	CA
Knight	Marla	US Forest Service	Fort Jones	CA
Kodama	Diane	US Fish and Wildlife Service	Newark	CA
Kozak	Chuck	Go Native Nursery, LLC	Montara	CA
Krebsbach	Michael	Monsanto Company	Atascadero	CA
Lambrechtsen	Benjamin	Intelli-Spray, Inc.	Central Point	OR
LaMond	Lisa	Natures Image, Inc	Lake Forest	CA
Lamoreux	Cara	Epsilon Systems Solutions, Inc.	Ridgecrest	CA
Lardiere	Benjamin	CEMML- Camp Pendleton	Camp Pendleton	CA
Lavallee	Janice	Mission Trails Regional Park	San Diego	CA
Law	James	Santa Ana Watershed Association	Redlands	CA
Lawson	Dawn	NAVFAC Southwest	San Diego	CA
Lea	Marc	Ag Dept - San Luis Obispo	San Luis Obispo	CA
Leonard	John	National Park Service, Yosemite	El Portal	CA
Lopez	Liana	Upper Merced Watershed Council	Mariposa	CA
Lwenya	Roselynn	Tule River Natural Resource Department	Porterville	CA
Maher	Eliza	Center for Natural Lands Management	Riverside	CA
Maly	Florence	CA Dept. of Food and Agriculture	Fresno	CA
Marchant	Tito	EcoSystems Restoration Assoc.	San Diego	CA
Marchant	Julie Simonsen	EcoSystems Restoration Assoc.	San Diego	CA
Marie	Jean-Philippe	University of California	Davis	CA
Markovchick-Nicholls	Lisa	US Navy	San Diego	CA
Martin	John	USFWS San Diego NWR	San Diego	CA
Martus	Carolyn	California Native Plant Society	Carlsbad	CA
Marushia	Robin	University of California Botany and Plant Sciences	Riverside	CA
Mason	Susan	Friends of Bidwell Park	Chico	CA
Mattson	Michelle	Aspen Environmental Group	Carlsbad	CA
May	Loran	May & Associates, Inc	San Francisco	CA
McConnell	Patrick	Center for Natural Lands Management	Fallbrook	CA
McCormick	Cheryl	Santa Lucia Conservancy	Carmel	CA
McCullough	Shani	Riverside-Corona RCD	Riverside	CA
McGiffen	Milt	University of California	Riverside	CA
McKinley	Bertha	California Native Plant Society	El Cerrito	CA
McMichael	David	Orange County Water District	Corona	CA
McStay	Sean	UC Santa Cruz, Environmental Studies	Santa Cruz	CA
Medina	Michael	NAVFAC Southwest	San Diego	CA
Meyer	Tanya	Yolo County RCD	Davis	CA
Miller	Alice	Joshua Tree National Park	Twentynine Palms	CA
Mills	Amanda	Mid Peninsula Regional Open Space District	Los Altos	CA
Molinari	Nicole	University of California	Santa Barbara	CA
Montalvo	Arlee	Riverside-Corona RCD	Riverside	CA
Moore	Ken	Wildlands Restoration Team	Santa Cruz	CA
Moreno	Polo	CA Dept of Pesticide Regulation		CA
Murphy-Vierra	Colleen	CDFA	Sacramento	CA
Naegele	Jennifer	County of Orange - Harbors, Beaches & Parks	Newport Beach	CA

Nazarchyk	Carrie	National Park Service, Lake Mead NRA	Boulder City	NV
Neill	Bill	Riparian Repairs	North Hollywood	CA
Newhouser	Mark	Sonoma Ecology Center	Eldridge	CA
Newman	Geoff	CA Dept of Boating and Waterways	Sacramento	CA
Nielsen	Dawn	County of San Diego, AWM	San Diego	CA
Nolan	Kathleen	The Land Studio	Ojai	CA
O'Brien	Jon	University of California	Davis	CA
O'Keefe	Shea	USDA- Nat'l Resources Cons. Service	Escondido	CA
Omori	Gary	Agri Chemical & Supply	Oceanside	CA
Omori	Greg	Agri Chemical & Supply	Oceanside	CA
Oulton	Mark	DeAngelo Brothers, Inc.	Hazleton	PA
Overtree	Lynn	Monterey Peninsula Regional Park District	Royal Oaks	CA
Palenscar	Kai	University of California, Riverside	Claremont	CA
Pederson	Todd	US Department of the Interior Bureau of Reclamation	Sacramento	CA
Peters	Mike	Fallbrook Land Conservancy	Fallbrook	CA
Peterson	Betsy	California State Floral Association	Sacramento	CA
Pitcairn	Mike	CDFA	Sacramento	CA
Poteet	Andrea	California Conservation Corps	Fortuna	CA
Principe	Bethany	Mission Resource Conservation District	Fallbrook	CA
Prud'homme	Emily	Mono Lake Committee	Lee Vining	CA
Puliatch	Cora	Cal-IPC	Berkeley	CA
Ratay	Sarah	Catalina Conservancy	Avalon	CA
Ready	Drew	Los Angeles & San Gabriel Rivers Watershed Council	Los Angeles	CA
Rebman	Jon	San Diego Natural History Museum	San Diego	CA
Records	Rich	Target Specialty Products	Santa Fe Spings	CA
Reilly	Tim	California State Parks	Soquel	CA
Reza	Greg	Marin County Open Space District	San Rafael	CA
Richardson	Brianna		Mountain View	CA
Ridley	Caroline	University of California	Riverside	CA
Robinson	Lori	Natures Image, Inc.	Lake Forest	CA
Robison	Ramona	University of California, Davis	Sacramento	CA
Roessler	Cindy	Midpen Regional OSD	Los Altos	CA
Rogers	Chris	Environmental Science Assoc.	Oakland	CA
Roma	Robert	County of San Diego, AWM	San Diego	CA
Romo	Tim	Santa Ana Watershed Association	Redlands	CA
Ross	Jeannine	RECON Environmental	San Diego	CA
Roth	Brad	Cottonwood Creek Conservancy	Cardiff by-the-Sea	CA
Rothbard	Heather		Tempe	AZ
Roullard	Phillip	California State Parks	San Diego	CA
Royall	Margaret	University of California	Irvine	CA
Russell	Kerwin	Riverside-Corona RCD	Riverside	CA
Ruyle	Gary	RLA	San Diego	CA
Ryan	Paul	CA Dept. of Boating and Waterways	Sacramento	CA
Sachs MartÃ¬n	Miriam	Acterra	San Jose	CA
Saito	Bruce	Los Angeles Conservation Corps	Long Beach	CA
Saunders	Hillary	Golden Gate Parks Conservancy	San Francisco	CA
Savage	Bo	Los Angeles Conservation Corps	Los Angeles	CA
Schafer	Brad	Jones & Stokes	Sacramento	CA
Schmidt	Dale	Los Angeles Dept. of Water and Power	Bishop	CA
Schneider	Heather		Riverside	CA
Seiley	Paul	Mission Trails Regional Park	San Diego	CA

Setty	Asha	Golden Gate National Parks Conservancy- Native Nursery	San Francisco	CA
Shook	Alyssa	Tahoe RCD/LTBWCG	South Lake Tahoe	CA
Shriner	Jan	Santa Clara County Parks	Santa Cruz	CA
Simpson	Bobbi	National Park Service	Point Reyes	CA
Skinner	Mark	Land Conservancy of SLO	San Luis Obispo	CA
Slimm	Reynaldo	County of Orange	Dana Point	CA
Smith	Lincoln	USDA ARS	Albany	CA
Smith	Trish	The Nature Conservancy	Newport Beach	CA
Smith	Scott	DeAngelo Brothers, Inc.	Katy	TX
Smith	Geoffrey	California Native Plant Society		CA
Smith	Darren	California State Parks	San Diego	CA
Snyder	Robert	City of Davis	Davis	CA
Songster	Daniel	California Native Plant Society	El Toro	CA
Speith	Elizabeth	Golden Gate National Parks Conservancy	Sausalito	CA
Spencer	Jessica	University of NV, Las Vegas	Boulder City	NV
Spiegelberg	Markus	Center for Natural Lands Management	Fallbrook	CA
Stafford	Cara	Catalina Island Conservancy	Avalon	CA
Stanton	Alison		South Lake Tahoe	CA
Steers	Robert	University of California	Riverside	CA
Sterman	Nan	Plant Soup, INC	Encinitas	CA
Strand	Jiri George	URS	Sacramento	CA
Stupar	Catherine	Santa Rosa Junior College	Guerneville	CA
Sweet	Sara	Restoration Resources	Rocklin	CA
Tamagawa	Yoshi	UCSB: RIVR Lab	Goleta	CA
Terp	Jill	USFWS San Diego NWR	Jamul	CA
Thiel	Richard	National Park Service Sequoia/Kings Canyon	Three Rivers	CA
Thomas	Don	San Francisco Public Utilities Commision	Danville	CA
Tomsovic	Peter J	RECON Environmental Consultants	San Diego	CA
Torralba	Jocelyn	Santa Clara Valley Water District	San Jose	CA
Torres	Carlos	USDA Forest Service	South Lake Tahoe	CA
Trotta	Peter	Habitat Restoration Sciences	Escondido	CA
Trujillo	Amy	San Elijo Lagoon Conservancy	Encinitas	CA
Trumbo	Joel	California Department of Fish and Game	Rancho Cordova	CA
Tu	Mandy	The Nature Conservancy	Portland	OR
Tuitele-Lewis	Jamison	USDA Forest Service/ Sierra NF	Prather	CA
van Warmerdam	Jason	Joshua Tree National Park	Twentynine Palms	CA
Vander Mey	Bryan	Mission Resource Conservation District	Fallbrook	CA
Vanderhoof	Melanie	Environmental Science Associates	Oakland	CA
Vinje	Jessie	Center for Natural Lands Management	Escondido	CA
Vona	Andrea	Palos Verdes Peninsula Land Conservancy	Rolling Hills Estates	CA
Vourlitis	George	California State University	San Marcos	CA
Waegell	Rebecca		Sacramento	CA
Walsh	Paul	Dudek	Encinitas	CA
Warner	Holly	Upper Merced River Watershed Council	Mariposa	CA
Warner	Peter	California Native Plant Society	Mendocino	CA
Washburn	Kyle	Washburn Grove Management Inc.	Hemet	CA
West	Wendy	UCCE - El Dorado County	Placerville	CA
West	Ryan	RECON Native Plants, Inc.	San Diego	CA
Weybright	Teague	Los Angeles Conservation Corps	Los Angeles	CA

Weyler	Jaime	Cal-Native Plants, LLC	Menifee	CA
Wihbey	Lynn	University of California	Riverside	CA
Williams	Andrea	National Park Service	Sausalito	CA
Winans	Bill	San Diego County Agriculture	San Diego	CA
Woerly	Rhett	UCD-NRS McLaughlin Reserve	Lower Lake	CA
Woiderski	Brittany		El Portal	CA
Wong	Frank	University of California	Riverside	CA
Wylde	Eric	Santa Clara County Agriculture	San Jose	CA
Yep	Valerie	Soil Ecology and Restoration Group	San Diego	CA
Young	Steve	University of California	Davis	CA
Zembal	Dick	Orange County Water District	Fountain Valley	CA