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Volume 9: 2005

Prevention Reinvention:

Protocols, Information, and Partnerships to Stop the Spread of Invasive Plants

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Edited by

Gina Skurka
California Invasive Plant Council

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Session 1: Protocols and Practices for Stoppping Weed Movement

Prevention of Weed Spread on Site-Disturbing Projects: Working with Landowners, Contractors and Local Agencies

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There are two ways to work at the local level with landowners, contractors and agencies to prevent weed spread during site-disturbing projects: 1) utilizing "the carrot" e.g. education, highlighting added value, showing how prevention saves money and 2) regulatory – ordinances, county General Plan, hydro project relicensing, etc. In many instances, a combination of the two methods will yield the most effective campaign to encourage the use of best management practices (BMP) to prevent weed spread. Site-disturbing projects can include: housing developments and general construction, road construction and improvements, construction and maintenance of fire breaks and fire evacuation routes, fuels reduction projects on private land, hydro project and water delivery systems and planting of agricultural crops.

One of the best ways to educate landowners and contractors is through the preparation and distribution of BMP guidelines for your local area. When preparing guidelines always:

- Remember the audience – how much knowledge do they have about the issue? Is the educational piece clear and concise and usable?
- Always include basic information – why should they care?
- Produce separate educational pieces for landowner, land manager, local agency or official to really target your audience; each piece can include similar information but tailored to each user.

Some examples of best management prevention guidelines to include:

1. Incorporate a strategy of integrated weed management into construction layout and design.
2. Remove or treat seed sources and other viable reproducing plant parts that could be spread by construction disturbance.
3. Avoid moving weed-infested materials (gravel, rock and other fill materials) to weed-free locations.
4. Identify existing noxious weeds along access roads and control them before construction equipment moves in.
5. Clean off-road equipment (power or high-pressure cleaning) of all mud, dirt, and plant parts before moving into relatively weed-free areas.
6. Minimize the removal of vegetation during construction and maintenance
7. Use only certified weed-free straw and mulch for erosion control projects. Consider the use of weed-free fiber roll barriers or sediment logs.
8. Road maintenance programs should include monitoring and treatment for noxious weeds.
9. Provide training to management and workers on the identification of noxious weeds, the importance of noxious weed control and measures to minimize their spread.

10. Quickly treat individual plants or small infestations before they become established, produce seed or are able to spread.

Resources for other BMP guidelines that may be applicable for your area:

"Measures to Prevent the Spread of Noxious and Invasive Weeds during Construction Activities" University of Nevada Reno Cooperative Extension, Fact Sheet FS-03-59, www.unce.unr.edu/publications/FS03/FS0359.pdf

"Invasive Plant Prevention Guidelines" – Center for Invasive Plant Management September 2003, www.weedcenter.org/products_pub/prod_pub_new.html

"Best Management Practices for Land Managers" Published by Long Island Weed Management Area, tncweeds.ucdavis.edu/products/wma/li-managers.pdf

Examples of ways to work with local agencies to improve weed prevention information dissemination and efforts include:

- Weed identification training for agency officials and on-the-ground crews including road crews, conservation crews, water district crews, utility companies; good identification training and tool use are the only ways they will be able to understand BMP and identify problem areas and weed spread;
- BMP as part of the easement permit process for local utilities (i.e. USFS permit); by understanding invasive problems through the permit process a utility district may extrapolate good BMP to all the lands that they manage and recognize that prevention saves money in the long term;
- Federal Energy Regulatory Commission (FERC) hydro project (dam) relicensing – it is important to get prevention guidelines into the licensing and long term management processes;
- Gravel and materials inspections, e.g. Greater Yellowstone Area Weed Group – sharing inspection forms, Weed Management Areas working to educate materials suppliers at the local level;
- Get invasive weed prevention language into your county General Plan;
- Work with local agencies to develop ordinances that support the prevention of weed spread;
- Is there an annual contractor BMP workshop or manual in your area? If not, working with other agencies, such as your local Resource Conservation District, to put information together. Other areas to interject weed spread prevention information are in erosion review and building permit processes;
- Is there an annual landscaper or nursery workshop in your area? If not, consider putting one together with your County Agriculture Department (with pest exclusion, herbicide use and permits information, etc.)

Here's an example of how the building industry has engaged in promoting the prevention of weed spread:

A developer in Gardenerville, Nevada understands the "added value" of stopping the spread of invasive weeds. The company has treated an area that will be sold as "ranchettes", to prevent further spread of diffuse knapweed. The company has also offered part of the acreage as a demonstration site for the local Weed Management Area (WMA) to conduct educational workshops.

In working with landowners, it is important to include prevention information in all invasive weed materials. Remember to make prevention guidelines very specific for each audience, so they know we are speaking to THEM. Use phrases like: "How to stop the spread of invasive weeds when….improving my road;…starting construction on my house;…making my property fire safe." If a title jumps out to a reader as specific to THEM, they may read the information!

Consider interjecting prevention information into a variety of materials and processes including erosion control and grading review processes and fire safe information. Always remember to emphasize that prevention can save money in the long term. Try to have reference information readily available for the general public including revegetation seed sources, weed-free erosion control materials sources, etc. Be creative!

Communicating the Need for Prevention

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Wildland weed workers need effective techniques for communicating the importance of weed prevention to a wide range of audiences. Once people understand that prevention is worth the extra time, labor, and money; that it is an integral part of any weed management program, and that healthy plant communities are the best defense against invasive plants, they often become more supportive and willing to participate in prevention efforts. People tend to be motivated to take action when they learn why invasive plants are such a serious problem, how watersheds commonly become permanently degraded, how rapidly weeds are spreading, and how they are spread by and negatively impact almost all people using wildlands. This underscores the need to tailor messages, using relevant examples, pictures and tours, to specific audiences ensuring that any particular group can see that they are not being singled out as the culprit. The challenges of motivating people to engage in invasive plant prevention will be addressed so those obstacles can be overcome. While it is important to consider a comprehensive list of possible prevention strategies, efforts usually need to be focused on those prevention activities that will be most effective for the specific area needing protection. While invasive plant priorities, rules and requirements are essential, perhaps success will be best achieved through the personal approach of working with the people who can make a difference in keeping relatively uninfested lands and waters from becoming seriously infested.

Protecting Public Lands: Progress in Incorporating Prevention Practices into Agency Policy

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California's public land management agencies are formulating weed prevention policy at all levels: individual parks and forests, regional, and agency-wide. In 2004, the superintendent of Sequoia and Kings Canyon National Parks issued a directive to prevent the introduction of weeds into the park, and the spread of weeds from infested front-country areas to weed-free backcountry areas. In 2005, Yosemite National Park began work on an Invasive Plant Management Plan that will incorporate significant weed prevention practices. The Pacific West Region of the National Park Service is creating an education resource kit to assist parks with informing the public of weed prevention practices, and with the compliance necessary to implement a weed free feed policy. Finally, a national-level NPS directive is planned for issue in 2006. The U.S. Forest Service issued a Guide to Noxious Weed Prevention Practices in 2001, and National Forests are required to complete noxious weed risk assessments for new projects. The Bureau of Land Management has been a leader at the national and local level for years with their prevention emphasis. At all agencies, educating staff and varied user groups about weed impacts and prevention practices is becoming a primary goal. Weed prevention practices also address fire management, construction, maintenance activities, landscaping, grazing and pack stock use, recreation, and agency-specific special uses. The challenges of implementing these policies will be discussed.

Preventing Weed Spread via Contaminated Hay and Straw

Joanna Clines, USDA Forest Service, Sierra National Forest, jclines@fs.fed.us

INTRODUCTION

Hay or straw that is grown, baled, or stored in areas infested with noxious or invasive weeds can contribute to the proliferation of weeds when contaminated bales are transported to clean areas. In most western states, some type of program or process exists to certify hay and mulch and to regulate its movement. Often, these programs are initiated by public agencies prohibiting feed or mulch that has not been certified as noxious-weed free. In California, key agencies have been working together to coordinate a certification process, but have faced several hurdles. A current renewal of the California effort involves the US Forest Service, National Park Service, Bureau of Land Management, State of California, and County Agricultural Commissioners collaborating on a Memorandum of Understanding formalizing their intent to move toward the goal of having a process to readily certify weed free feed and mulch products. This effort will involve stakeholders such as equestrians, growers, balers, and many others. Recently a new set of inspection procedures was approved by the counties and the State, and several land management agencies are preparing closure orders. Agencies will begin closing their lands to entry of non-certified products in phases to allow the market to adjust to demand once the orders are in place. Education of the public, stakeholders, and agency personnel will be crucial to the success of this effort.

EVIDENCE FOR WEED SPREAD VIA HAY AND STRAW

A critical component of a successful prevention program is having a clear basis for imposing new rules and requirements on people. The issue of whether or not hay and mulch truly spread weeds has been brought up repeatedly by certain stakeholders. For weed biologists, it is intuitive, but it is useful to consider the evidence for weed spread via hay and straw in three categories:

1. Scientific studies specifically focused on hay and straw as vectors. There is a paucity of studies on this topic. However, the National Park Service and the Dominican University of California are currently collaborating on a literature search focused on non-native, invasive plants found in field grown forage products, straw, and mulch; as well as pathways of spread. Draft documents for peer-review are expected by the end of 2005.

In addition, a set of empirical experiments began in 2005 to ascertain the presence of viable weed seeds in manure collected from pastures and stables in the San Francisco Bay Area. Preliminary results are displayed in a poster presented at this symposium by the National Park Service and Dominican University of California (Ghosh, 2005). Further research is planned on a larger scale in California National Park Service Units.

2. Documented instances where hay or straw contained weeds that started new infestations (observational and anecdotal evidence). Pest Detection Records maintained by the California Department of Food and Agriculture - Pest Exclusion Branch reveal that contaminated hay is a source of regular introduction of noxious weeds into California. Russian knapweed (*Acroptilon repens*) is the most frequently detected weed found in hay entering the State (Hrusa, 2005). This B-rated weed is extremely difficult to eradicate once established due to the extensive, deep, root system. Hoary cress (*Cardaria chalepensis* and *C. draba*) are B-rated weeds that can devastate wetlands and other wildlands, these species are also detected periodically in hay entering California from Nevada. It is a valid assumption that some contaminated hay escapes detection, and is sold and transported in California.

Table 1. Examples of hay or straw as the vector for introduction of invasive weeds.

Weed Species	Circumstances	Locality	Observer
Lens-podded hoary cress (*Cardaria chalepensis*)	Less than ¼ acre discovered at Dinkey Creek Pack Station	Sierra National Forest, Fresno County.	Joanna Clines, Sierra National Forest.
Yellow starthistle (*Centaurea solstitialis*)	Observed growing in and adjacent to a field of freshly baled hay in June 2005. Hay was being sold soon thereafter.	Near Highway 140, Merced County.	Brent Johnson, Yosemite National Park.
Yellow starthistle (*Centaurea solstitialis*)	Appeared in bales of straw used for erosion control along a county road near Bass Lake.	County Road 222, Madera County.	Joanna Clines, Sierra National Forest
Dyer's woad (*Isatis tinctoria*)	Apparently introduced by hay at pack stations, has spread to surrounding lands.	Klamath National Forest, Humboldt County.	Marla Knight, Ann Yost, Klamath National Forest
Canada thistle (*Cirsium arvense*)	Appeared directly after mulching with straw along Highway 36 in Humboldt County.	Six-Rivers National Forest, Humboldt County	Fred Hrusa, California Department of Food and Agriculture

The experiences of field personnel in land management agencies are a valuable source of information. A sampling of botanists from federal land management agencies were queried prior to the 2005 Cal-IPC symposium, requesting reports of instances where they knew that hay or straw was clearly implicated in the introduction of a new noxious weed infestation. Table 1 shows a sampling of these cases.

3. Logical inference. Knowing that hay and straw fields are sometimes infested, and that contaminated hay does enter California, it is logical to assume that weed seeds are moved to new sites via this material. E.g., see Figure 1.

AGENCY POLICY AND REGULATIONS

All major land-management agencies in California have national policy directing or strongly suggesting that hay or straw that is not certified as weed free be prohibited. An example is the following excerpt from US Forest Service National Policy:

• *Make every effort to ensure that all seed, feed, hay, and straw used on National Forest System lands is free of noxious weed seeds (Forest Service Manual 2080).*

• *Where States have enacted legislation and have an active program to make weed-free forage available, Forest Officers shall issue orders restricting the transport of feed, hay, straw, or mulch which is not declared as weed-free, as provided in 36 CFR 261.50(a) and 261.58(t).*

The Forest Service issued a set of prevention practices entitled "USDA Forest Service Guide to Noxious Weed Prevention Practices" (Version 1.0, Dated July 5, 2001). One such practice follows:

• *Practice 16. ... Use certified weed-free or weed-seed-free hay or straw where certified materials are required and/or are reasonably available. Always use certified materials in areas closed by administrative order; refer to Appendix 3 for a sample closure order.* (The entire text of the Guide including the example closure order can be viewed at: www.fs.fed.us/rangelands/ftp/invasives/documents/GuidetoNoxWeedPrevPractices_07052001.pdf)

The North American Weed Management Association (NAWMA) has a uniform process for certifying hay and straw as free of noxious weeds. A wealth of information is available at www.nawma.org, under the heading of "weed free forage". The list of noxious weeds agreed upon by NAWMA to meet minimum acceptable standards does not include all of California's noxious weeds, thus at this point California has not signed on to the NAWMA Weed Free Forage Memorandum of Understanding.

RECENT DEVELOPMENTS IN CALIFORNIA

The effort that began in 1998 to institute requirements for weed free hay and straw on public lands has been slowed by attempts to resolve problems such as: details of certification (field vs. bale inspections), who should perform the inspections and certify the products, how the products will be identified (e.g., twine, tags), and concerns over availability and cost. In 2005, major agencies involved in the weed free forage and mulch issue drafted up a new Memorandum of Understanding among the following entities: Bureau of Land Management, California Agricultural Commissioners and Sealers Association, California Department of Food and Agriculture, National Park Service, and U.S. Forest Service, Region 5.

The MOU is still undergoing changes, but the general commitments will be as follows:

The role of the US Forest Service, Bureau of Land Management, and National Park Service will be to:

- Implement a program and formal policies to prohibit or restrict possession, storage, and movement of non-weed free certified products on their lands.

- Work together in a coordinated manner so that there is consistency in the requirements each agency develops for possession, storage, and movement of certified weed free products.

- Move together in a coordinated manner to implement such programs.

- Share information as needed and necessary for development of environmental documents, regulations and rules.

- Accept the certification procedures developed by the California Department of Food and Agriculture.

- Allow a 3-year phase-in period to allow the market to adjust.

Role of California Agricultural Commissioners and Sealers:

Encourage agricultural commissioners to inspect and certify products as weed free. A Certificate of Quarantine Compliance will be issued to document bales or shipments of hay or straw that have been certified. Copies of the CQC must accompany portions of shipments as necessary.

California Department of Food and Agriculture's Role:

Develop and distribute procedures for certification of weed free products in compliance with California law and regulation. (Q.C. Circular 210, dated 2-22-05).

CONCLUSIONS

The objective of preventing or minimizing weed spread via hay and straw is an ambitious, but ultimately worthwhile one. California is a populous state with complex demographics relative to states like Montana or Colorado where weed free forage requirements have been in place for years. To bring about a sustainable program in California that prevents weed spread without causing undue inconvenience or cost increases to end users and producers will require persistence and flexibility on all sides.

Figure 1. Yellow starthistle growing throughout field of freshly baled hay in Merced County, 2005. Photo by Brent Johnson.

Session 2-A: IPM Laws and Regulations

Efficacy and Safety of New Herbicides on the Horizon

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Within the next year or two, California is expected to register two new herbicides and expand the label on a third herbicide for use against invasive plants. These new registrations include imazapyr (Habitat®), imazapic (Plateau®) and aminopyralid (trade name pending). All of these compounds have an excellent environmental and toxicology profile and will carry a Caution label, which is the least toxic category for herbicides. Habitat® is an expansion of the imazapyr label, currently registered in the state as Arsenal®, Chopper®, and Stalker®. This product expansion will allow control of emergent and floating aquatic vegetation in and around standing or flowing water, including estuarine and marine sites. With this compound, applications can be made to wetland, riparian, and terrestrial vegetation growing in and around surface water. This will offer an excellent opportunity to manage such species as *Phragmites australis*, *Tamarix* spp., *Spartina* spp., *Conium maculatum*, *Elaeagnus angustifolius*, *Polygonum cuspidatum*, *Lythrum salicaria*, *Cardaria* spp., and *Lepidium latifolium*. Plateau® will be registered for rangelands, pastures and non-crop areas. It has the same mode of action as imazapyr (amino acid inhibitor) and has been targeted for release and establishment of native perennial grasses and members of the legume and sunflower family. The main species it controls include noxious annual grasses, such as *Bromus* spp., *Taeniatherum caput-medusae*, and *Aegilops triuncialis*. It has also been shown to be effective on *Linaria* spp. and *Cynoglossum officinale*. The two drawbacks we have seen with this compound are that it has a narrow window of selectivity on native perennial grasses, such that injury can occur with rates just slightly above recommended. Also, the herbicide binds to plant litter, which makes it difficult to know the correct rate to apply. The third compound is aminopyralid, which is closely related to clopyralid (Transline®) and has the same growth regulator mode of action. However, aminopyralid appear to be about three times more active than clopyralid on *Centaurea solstitialis* and is much more effective at controlling other noxious thistles and some other problematic invasive perennials than currently available products. It will be registered for use on rangeland, permanent grass pastures, Conservation Reserve Program (CRP) acres, non-cropland areas, natural areas, and grazed areas. Trials so far show that this product will have an excellent fit in many invasive weed control programs within the state.

Regulatory Concerns with Herbicide Use in Invasive Plant Projects

Richard Price, Butte County Agricultural Commissioner

With the attention being paid to the use of herbicides today, it behooves us all to ensure that herbicides are being used properly, according to the regulations, and with the least impact on the environment. Despite the improvements in pesticide safety and an increase in pesticide regulatory oversight, more and more jurisdictions and not just the agriculture departments are restricting the use of herbicides or outright banning the use of synthetic pesticides on their property. What are the impacts of local policy on your compliance with the California Code of Regulations or Food and Agriculture Code?

Misuse or overuse of herbicides can have impacts to the weed control industry beyond the impact to the non-compliant pest control business. True integrated pest management technique benefits by having the tools, chemical and

non-chemical, available as options to prevent resistance, protect the environment, protect the public health, and increase efficacy. Misuse of herbicides will only reduce the alternatives when backlash results from the damage that could potentially be caused. How can you best ensure that you are using pesticides properly?

It isn't easy being green. Or is it? Your relationship with regulatory agencies doesn't have to be adversarial. Regulatory agencies need to enforce the rules and yet still be accessible. How can you ensure that your communication with the agriculture department remains open and amicable?

Control of Invasive Plants Through Biological Mitigation for Transportation Projects

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The California Department of Transportation (Caltrans), through the development of biological mitigation, has contributed to the control and removal of invasive plant species in San Diego and Imperial Counties. Over the past twenty years, Caltrans has implemented over fifty mitigation sites in these counties, totaling more than 5,200 acres, at a cost of more than $130,000,000. These mitigation sites include salt marsh, coastal sage scrub, chaparral, grassland, vernal pools, riparian woodland, alkali marsh, and freshwater marsh, and combine preservation in place, restoration and creation. At many of the sites, the major effort was directed towards the removal and control of invasive species on the Cal-IPC A&B list, as well as the establishment of native plant communities in their place.

In November 2004, San Diego County voters approved a forty-year, one-half cent sales tax extension for local transportation projects. This tax measure has $880,000,000 dedicated for the "Environmental Mitigation Program" (EMP). The EMP was developed by the San Diego Association of Governments (SANDAG), in coordination with Caltrans, the resource agencies and local environmental groups. The goal of the EMP is to provide streamlined project approvals through advanced mitigation. The EMP will fund acquisition, maintenance and monitoring, in addition to helping implement the Region's Habitat Conservation Programs. The EMP will be a major factor in the control and removal of invasive plant species in San Diego County.

Balancing Pest Management Needs and Water Quality

Parry Klassen, Coalition for Urban/Rural Environmental Stewardship (CURES)

Throughout California, detections of farm inputs in surface waters, especially of pesticides, have prompted the adoption of regulatory programs. Pesticide users are faced with the challenge of balancing pest management realities while responding to public and regulatory pressure to protect public health and the environment.

The regulatory approaches taken to solve these problems have the potential to impact how pests are managed across vast areas of the state, including where impacts are non-existent or impacted areas are remote.

Can regulations be fine tuned to respond to the current or potential environmental impacts without burdening all pesticide users with wasteful or unneeded regulations that add costs but might negligibly improve water quality? Programs such as the Irrigated Lands Conditional Waiver are being implemented to meet this challenge that pesticide users in all segments of pest management must face. The agricultural coalitions formed as a result of waiver requirements and have been tracking the identification and mitigation of problems in surface water. Working together we can reduce the impact of weed management tools on the environment.

California's New NPDES Permit for Aquatic Herbicide Use

Michael Blankinship,
Blankinship & Associates, Inc.

After the 2001 Talent decision, California began regulating the use of aquatic pesticides in virtually all waters in the state. During the initial emergency permit put in place in 2002, and in spite of data suggesting that no adverse impact has been caused by these uses, aquatic weed specialists working for drinking water, flood control, irrigation interests continue to be regulated under a new permit created in 2004. The presentation covered the significant changes since the last permit, compliance requirements, and the unique issues related to the use of copper and acrolein.

Session 2-B: Riparian and Wetland Invasives

Are We Creating the Ideal Conditions for *Arundo donax* Invasion in California?

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The rapid invasion of the nonindigenous plant giant reed (*Arundo donax*) has been well documented in riparian ecosystems in Mediterranean-climate regions. Millions of dollars have been spent over the past 10 years in attempts to remove this noxious plant from rivers systems in California. Although successful in removing small areas of this weed, we still know very little about the ecological conditions that promote continued growth and invasion of *A. donax*. Ever expanding development in watersheds of coastal California has led to increased water import and discharge into rivers from water treatment facilities and urban runoff; decreased in-stream and groundwater water quality from adjacent land use; and loss of healthy, mature riparian forests. We hypothesize in this study that factors such as quantity of water, nutrients, and light currently abundant in riparian ecosystems of mediterranean-type climate regions increase the competitive ability of *A. donax*. In 2002, a large-scale field experiment was established on the riparian terrace of the Santa Clara River to test this hypothesis. This experiment investigates the effects of nutrient additions, amount of light, and quantity of water on growth and competition between *A. donax* and three dominant native riparian plants: red willow (*Salix laevigata*), black cottonwood (*Populus balsamifera* ssp. *trichocarpa*), and mule fat (*Bacharris salicifolia*). Results indicate that *A. donax* outcompetes all three species under most conditions tested except under a simulated mature riparian forest canopy with the highest soil moisture. This finding indicates that mature riparian forests may be important for control of giant reed and loss of these habitats encourages *A. donax* invasion. In addition, increased water availability in riparian ecosystems in Mediterranean-climate regions is also promoting invasion of *A. donax*.

Control of Water Primrose (*Ludwigia hexapetala*) in a Freshwater Wetland

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The aquatic weed *Ludwigia hexapetala* is an increasing threat in California's freshwater wetlands. Its ability to spread rapidly and produce thick mats of woody perennial stems may have cascading effects on wetland ecosystems.

Among these are reduced biodiversity, depressed dissolved oxygen levels and changes to flooding regimes. Because the dense mats sharply inhibit mosquito control efforts, *L. hexapetala* also presents a public health threat related to West Nile Virus. Despite these issues, little is known about its basic ecology and there are few well documented control efforts. In Sonoma County, *L. hexapetala* has invaded significant portions of the Laguna de Santa Rosa, the second largest freshwater wetland in coastal California. The invasion is symptomatic of large scale perturbations throughout the watershed including channel modifications, increased nutrient and sediment loads, and removal of riparian vegetation. The Laguna de Santa Rosa Foundation has set a long-term goal of restoring these ecosystem components to make the Laguna more resilient to invasion. In the short term, however, the immediate threats have prompted a three-year *L. hexapetala* control plan that targets the worst infested areas using a combination of herbicide and mechanical removal. I discuss the challenges faced by the Laguna Foundation, logistical planning, and initial results of control.

Comparison of Removal Methods for *Spartina densiflora* in Humboldt Bay

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Introduction

Invasive *Spartina densiflora* (dense-flowered cordgrass) is the dominant salt marsh plant in Humboldt Bay, covering 330 ha (814 ac), or 94%, of the current salt marsh. It is believed to have been introduced from Chile in the 1850s in ship ballast during the active lumber trade. Dense-flowered cordgrass is a perennial that reproduces both by seed and by vegetative spread via underground tillers. Dense-flowered cordgrass out-competes native salt marsh plants in several ways: unlike native plants, it lacks a complete dormancy period in the winter, thus producing tillers throughout the year, it quickly colonizes bare ground, and it produces large quantities of wrack (dead stems), which smothers natives (Kittelson and Boyd 1997). Originally thought to be restricted to mid-elevation salt marsh, recent research has shown it to be spreading into the high-elevation salt marsh (Pickart 2001). The high-elevation salt marsh is the most diverse of the salt marsh vegetation types, with 22 plant species including 2 rare plants, Humboldt Bay owl's clover (*Castilleja ambigua* spp. *humboldtiensis*) and Point Reyes bird's beak (*Cordylanthus maritimus* spp. *palustris*) (Eicher 1997). Dense-flowered cordgrass is threatening to invade the remaining 6% of uninvaded salt marsh, and to increase in density in the 38% of invaded salt marsh where it is still sparse to moderate in cover. The spread of *Spartina densiflora* poses a major threat to the biodiversity of Humboldt Bay.

Experimental Design and Methods

In 2004 an experiment was designed to examine the effectiveness of mowing and digging methods for removing localized dense-flowered cordgrass from high-elevation salt marsh on Humboldt Bay National Wildlife Refuge (HBNWR), and to determine the scale of feasibility for these removal methods. Cover of dense-flowered cordgrass was mapped on a 1.6-ha (4-ac) island in Mad River Slough, and stratified into six cover classes: High 75-95%, Medium-High 50-74%, Medium 25-49%, Medium-Low 5-24%, Low 1-4%, and Not Present 0%. Within each stratum (except Not Present) eight treatment and eight control plots were established (see Figure 1). In July 2004, prior to any treatment, the plots were monitored for density of dense-flowered cordgrass culms and cover of native species. Monitoring was conducted again in July 2005, and

will be repeated in July 2006. Mowing with a weed eater was conducted in the High, Medium-High, and Medium plots, and hand-digging with a trowel was conducted in the Medium-Low and Low plots. A 0.25 m^2 buffer was treated the same as the plot. The mowing treatment was initially applied in August 2004 (mowing the plot to the ground), and was repeated monthly March-October and every other month in the winter.

For Medium-High and Medium plots the retreatment mowing is only done to the level of the native vegetation, so the natives avoid remowing. The digging treatment was also first applied in August 2004 (removing all dense-flowered cordgrass plants by digging them out individually, including the relatively short rhizomes), and was repeated monthly March-October and every other month in the winter.

Results

Effectiveness of Removal Methods

Preliminary, qualitative results show that density of dense-flowered cordgrass is lower in the treatment plots compared to control plots. In the High, Medium-High, and Medium plots, dense-flowered cordgrass density is about half that of the control plots, while in the Medium-Low and Low treatment plots there is now almost no dense-flowered cordgrass. Native plants are recovering more quickly than dense-flowered cordgrass in the treatment plots, including the two rare plants, Humboldt Bay owl's clover and Point Reyes bird's beak.

Feasibility of Scale

The mowing treatment is effective at reducing the density of dense-flowered cordgrass after multiple hits, and is relatively time efficient (approximately 6m^2 treated/person hour). For high-elevation salt marsh on HBNWR property, the mowing treatment could probably be maintained by staff. The hand-digging treatment is highly effective after only 1 to 2 hits, however it is very time consuming (approximately 0.6m^2 treated/person hour). In order to maintain this treatment on HBNWR property, hired crew or volunteer efforts would be needed. Considered over the long term, however, the digging treatment may be more efficient, given that it only needs 1 to 2 hits to be effective. The experiment is scheduled to continue until July 2006.

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Figure 1. Cover classes and experimental plots.

Dry Creek Watershed Red Sesbania Control Project - Initial Successes and Challenges

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The Sacramento Area Flood Control Agency (SAFCA) is conducting a three-year project to remove the invasive riparian weed red sesbania (*Sesbania punicea*, a Cal-IPC "red alert" species) from Dry Creek and its tributaries in Placer and Sacramento Counties. This project is funded by the California Department of Water Resources Flood Protection Corridor Program. Of approximately 44 linear miles of creek, 26 linear miles (60%) of creek bank were infested with sparse to dense areas of red sesbania. During Year 1 (2004), 80 percent of mature red sesbania plants were removed. The "cut-and-paint" method proved most successful, which involved cutting the shrub near the base and immediately painting the stump with herbicide (generally Aquamaster™). In Year 2 (2005), the remaining mature plants were removed and follow-up treatments were initiated for resprouting stumps and emerging seedlings. The primary treatment method for resprouts and seedlings has been herbicide application (generally Aquamaster™), with initial success observed at treatment locations. A trial treatment of "flaming" (i.e. applying heat to burn or boil the new growth) had mixed results. Flamed seedlings responded well, while flamed resprouting stumps subsequently resprouted, but mostly in areas with a higher water table.

The largest initial challenge to successful eradication is treatment timing, which is necessary in several phases, since cut stumps begin resprouting in late spring, while seedlings emerge along the waterline as soon as water levels drop. These seedlings can grow to more than 6 feet tall and produce flowers and young seed pods within 2-3 months. Post-project maintenance, monitoring, and surveying will be critical to guaranteeing the success of this watershed-wide eradication project.

Suppressing Exotic Weeds on Restoration Projects Using an Aggressive Herbaceous Understory

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River Partners is using a combination of weed control, herbaceous native understory species, and adaptive management to control invasives, including perennial pepperweed (*Lepidium latifolium*) and yellow starthistle (*Centaurea solstitialis*), and improve wildlife habitat on over 800 acres of restored riparian vegetation on the San Joaquin River National Wildlife Refuge. In December 2003, River Partners planted about 53 acres each of mugwort (*Artemisia douglasiana*) and gumplant (*Grindelia camporum* var. *camporum*) throughout 2-year-old restored fields as a measure of weed control. Cover of gumplant remained stable from August 2004 (40-50%; mature) to March 2005 (30 to 50%; just bolting) and cover of mugwort increased (16-43% to 37-66%). Weed cover in gumplant areas remained relatively stable while it dramatically decreased from 70% in 2004 to 22% 2005 in mugwort areas. We expect native species cover to continue to increase and weed cover to decrease as these perennials become more established. The concept of replacing non-native species with aggressive native species shows promise for the field of restoration and long-term land management.

Session 5-A: Comparing Control Methods

A test of repeat flaming as a control for poison hemlock (*Conium maculatum*), Cape ivy (*Delairia odorata*), and periwinkle (*Vinca major*)

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Introduction

Green flaming is a technique in which a heat source (typically a propane torch) is passed quickly over the top of plants, changing the plants color to a slightly darker green and causing the above ground plant tissue to wilt within a day. Green flaming, has been used in agriculture as an alternative to herbicides for some years. It was recently found effective for eradication of French broom (*Genista monspessulana*) seedlings in wildlands (Moore, Bossard and Fillipini, Cal-IPC Symposium 2004). In this experiment we wanted to examine the effectiveness of green flaming as a method of control for adult invasive weed species. We chose three invasive plant species, poison hemlock (*Conium maculatum*), Cape ivy (*Delairia odorata*) and periwinkle (*Vinca major*), that use their capacity for underground starch storage as a mechanism to enable re-growth after herbicide applications or manual removal of above ground biomass. Since flaming is done only in the rainy season which is also the seasonally lowest sunlight season in California we hypothesized that repeated flaming would cause the adult plants to deplete their starch reserves because they would have to repeatedly re-grow shoot mass. Once the starch reserves were depleted, one more green flaming treatment, we theorized, would eradicate the pest species from the area. If eradication was unable to be accomplished in one rainy season we realized this technique would not work as a control method because over the late spring and summer when flaming was not advisable, the target plants would re-supply their starch reserves.

Procedures

Three random block design experiments were set up; poison hemlock and periwinkle sites were at Elkhorn Slough National Estuarine Research Reserve and the Cape ivy site at Sunset Beach State Park. The poison hemlock and periwinkle experiments each consisted of eight, five meter by five meter blocks, four randomly designated for treatments and four as controls. Within each block were four, one meter by one meter randomly designated plots which were harvested at the end of the experiment to assess dry weight biomass.

The Cape ivy site consisted of ten blocks that were four meters by four meters. Five were randomly designated treatment blocks and five were control blocks. Two of the blocks were heavily shaded by tree canopy and three of the blocks had access to direct sunlight at least one third of every day. Within each block were four, one meter by one meter randomly designated plots which were harvested at the beginning of the experiment and four which were harvested at the end of the experiment to assess the dry weight biomass of the treated and control blocks.

Initial sampling of the blocks revealed no significant differences between treatment and

control blocks for any of the species: poison hemlock, F= 1.01; periwinkle, F=0.67; Cape ivy, F=0.89]. A 750,000 BTU Manchester Powerjet torch was used for this experiment. Harvested biomass was dried in an agricultural oven for five days then weighed. Initial treatments were done November 21, 2004, final treatment May 12, 2005. The poison hemlock and periwinkle plots were harvested in June 12, 2005 and Cape ivy plots were harvested July 19, 2005. Initial treatments on blocks took 25 to 30 minutes. Re-treatments took about five minutes per 5 m x 5 m block and were reapplied when re-growing plants had leaves at least 80% of full size, typically about every 3-5 weeks depending on the species. Poison hemlock was treated a total of six times, periwinkle five times and Cape ivy six times. An F test was done for each species on the final harvest dry weight biomass to assess statistical significance of the results (Zar, 1986).

Results

Repeat green flaming proved very successful in eradicating the poison hemlock from the treatment blocks with only two small <15 cm) poison hemlock seedlings remaining at time of harvest, while the control blocks contained 100% cover of 7-8 foot tall poison hemlock plants. The treatment blocks and plots were very significantly different from the controls ($F=149.7$ $p<.0001$). Seedlings stopped germinating in early May so the last treatment killed the seedlings that had germinated in the spring of 2005.

This technique was not as effective in removing periwinkle. It reduced the periwinkle density about 40% on treated compared to control blocks. The treatment blocks were significantly different from controls ($F=31.28$, $p< 0.001$). However, the periwinkle was not eradicated from the treated blocks.

Results of repeat green flaming on Cape ivy were mixed. Overall there was a significant difference between the treated and control blocks ($F= 113.86$, $p<0.0001$). However, this removal technique was more effective on Cape ivy in shaded or partially shaded, treated blocks than in sunny, treated blocks. There was eradication of Cape ivy in all three plots of the most shaded block and two plots of the other heavily shaded block. In treated blocks that had direct sunlight at much of the day the Cape ivy was not eradicated by the end of the flaming season, although it was much reduced in density.

Conclusions

Repeated green flaming of poison hemlock was effective in eradicating this species locally. Poison hemlock seeds undoubtedly remain in the seedbank and will have to be treated when they germinate next rainy season. We did not start treating the poison hemlock until it was about 40 cm high. This meant we had to spend far more time in the initial treatment than we would have if we would have started the treatment when the plants were approximately 15 cm in height, the typical height of the vegetation at re-treatment.

Since periwinkle density was reduced but the plants were not eradicated in any of the blocks in one season, we do not recommend repeat green flaming for control of periwinkle.

In areas with little or no direct sunlight exposure, flaming can be used for eradicating this Cape ivy. Where adequate direct sunlight was available, we were unable to eradicate this species locally in one season. Since many Cape ivy infestations have sufficient direct sunlight, repeat green flaming may have limited efficacy for removal of this species. An experiment this coming rainy season will examine if hand removing as much above ground biomass as possible and then flaming any re-growth, would reduce the number of flaming treatments required to achieve eradication.

Large Scale Pampas Grass Control Program

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The Peninsula Open Space Trust (POST) is a not for profit land trust operating on the San Francisco Peninsula for over 25 years. POST purchased the 6,400-acre Cloverdale Coastal Ranches in San Mateo County in 1997, which includes over 2,500 acres of grasslands. Some of the most destructive invasive species identified were pampas grass (*Cortaderia selloana*) and jubata grass (*Cortaderia jubata*), two closely related plants that are commonly grouped together under the single name "pampas grass." (For presentation purposes, both species are referred to as pampas grass). Pampas grass is an opportunistic colonizer of disturbed areas that can spread rapidly into native grasslands, out-competing native vegetation and dramatically degrading wildlife habitat. Infestations are especially dense near the ocean where the coastal micro-climate helps the plants thrive and spread. Since 2002, POST has used volunteers and contractors testing a variety of methods to control pampas grass on the 2,500 acres of grasslands. POST worked with UC Davis and weed-management consultants to develop appropriate strategies for this project. The Coastal Conservancy and Bella Vista Foundation have funded the on-going control efforts and at the end of 2005 over 1.4 million plants will have been treated. The results of this multi-year program will be presented with information regarding different treatment methods.

Invasive Annual Grasses in a Coastal Dune Ecosystem

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Coastal dune ecosystems are susceptible to invasions due to their open vegetation, natural disturbance regimes, and human-influenced disturbances. Historically, *Ammophila arenaria*, *Lupinus arboreus*, and *Carpobrotus* spp. have been planted to stabilize the dune systems. On the north coast of California these species have become invasive and much of the dune restoration efforts have centered on their removal. However, over the past several decades exotic annual grasses have become increasingly invasive in the coastal California dunes systems.

On the North Spit of the Humboldt Bay Dunes, land managers began to notice invasions of exotic annual grasses in the 1980s. Initially, the annual grasses were limited to stable mesic areas or sites already invaded by yellow bush lupine. Yellow hair grass (*Aira praecox*), native to southern Europe, was noted in transitional swales. Rabbit-foot grass (*Polypogon monspeliensis*), native to Europe, and Mediterranean beardgrass (*Polypogon maritimus*), native to Europe and the Mediterranean, were invading seasonally flooded swales. Ripgut grass (*Bromus diandrus*), native to Europe, and quaking grass (*Briza maxima*), native to southern Europe, were noticed invading upland dunes in which the invasive, nitrogen fixing *Lupinus arboreaus* was present or had been removed.

Yellow bush lupine (*Lupinus arboreaus*) is a bushy shrub, native to California south of Sonoma County. It is an invasive species in the northern California coastal sand dunes. *Lupinus* was introduced to the north spit of Humboldt Bay in the early 1900s. Initially the *Lupinus* occurrences were in the southern part of the North Spit. By the 1980s there were dense occurrences of *Lupinus* throughout the spit (Fig. 1). *Lupinus* facilitates the invasion of exotic annual grasses through nitrogen enrichment of the soil (Maron

and Connors 1996; Pickart et al. 1998).

In the 1990s land managers observed *Bromus diandrus*, *Briza maxima*, and brome fescue, (*Vulpia Bromoides*) spreading into previously undisturbed upland dune areas.

In 1996 an experimental removal of *Briza* was begun at the Lanphere Dunes Unit, Humboldt Bay National Wildlife Refuge. Plants were hand pulled by the roots, before they set seed, and removed in garbage bags. There was a marked reduction in the population after three years of the treatment (USFWS 1999).

In 1998 annual grasses were inventoried spit-wide to determine the extent of the invasion (USFWS unpublished data). Five species occurred over 221 ha in various densities (*Aira*, 162 ha, *Bromus* 154 ha, *Vulpia* 138 ha, *Briza* 74 ha, and *Polypogon monspeliensis* 8 ha) (Fig. 2).

Also in 1998, an experimental trial was initiated to test four methods of annual grass removal at the Lanphere and Manila Dunes: hand pulling, weed-eating, "black flaming" (incinerating target species), and duff removal (USFWS Unpublished data). All four methods were effective after two years of treatment, resulting in significant reductions in the densities of the grasses. There was no significant difference in the cover of native species except for a decrease in the weed-eating plots. The treatments did not differ significantly in effectiveness. However the duff removal was the most labor intensive, while flaming and weed-eating were much less labor intensive. We concluded there is not a single best treatment for removing annual grass on the North Spit. The presence of endangered plant species, the density of the grass occurrence, and the proximity to the coastal dune forest should dictate the treatment type.

In 2002 a management strategy was developed that called for mapping the percent cover of the invasive annual grasses at the Lanphere Dunes Unit and using a treatment of handpulling *Bromus* followed by the flaming of *Vulpia* and *Aira*. An experiment was designed in 2003 to test the effects of flaming on native and invasive species at a large scale and to determine the most effective time for flaming for each species. Subsequently the handpulling followed by flaming treatment was expanded over a larger area (Fig 3a & b). This method has been very successful in reducing all upland species of invasive annual grasses and restoring native vegetation.

However, flaming of annual grasses cannot be used near the forested dunes and swales due to the risk of the fire carrying. In addition, this treatment has unintended impacts to cryptogamic mat and invertebrates (of particular concern are ground-nesting solitary bees critical to the maintenance of native vegetation). While the role of cryptogamic mat in the succession of coastal dune ecosystems is not fully understood, the availability of cryptogamic mat is one of the most common factors limiting the population and distribution of bee species (Gordon 1984). Changes in the distribution and health of cryptogamic mats within dune systems are of concern.

In 2005 we established a new series of experimental plots designed to compare the use of the propane flamer to a radiant heater (for which the risk of igniting a fire is negligible) in terms of effectiveness on removing *Aira* and *Vulpia* and impacts on cryptogamic species. The radiant heater uses infrared radiation, reaching temperatures up to 1000° C, penetrating 1-2 mm into the soil. In 2007, we will compare the results of the first year's treatments.

Next year, a graduate student at Humboldt State University will begin a thesis on the effects of flaming and radiant heat on solitary bees. Until these studies are completed, we are restricting our flaming to areas without cryptogams and outside of bee nesting habitat. Previous studies have demonstrated a strong correlation between bee nesting, cryptogams, and the non-native *Aira*

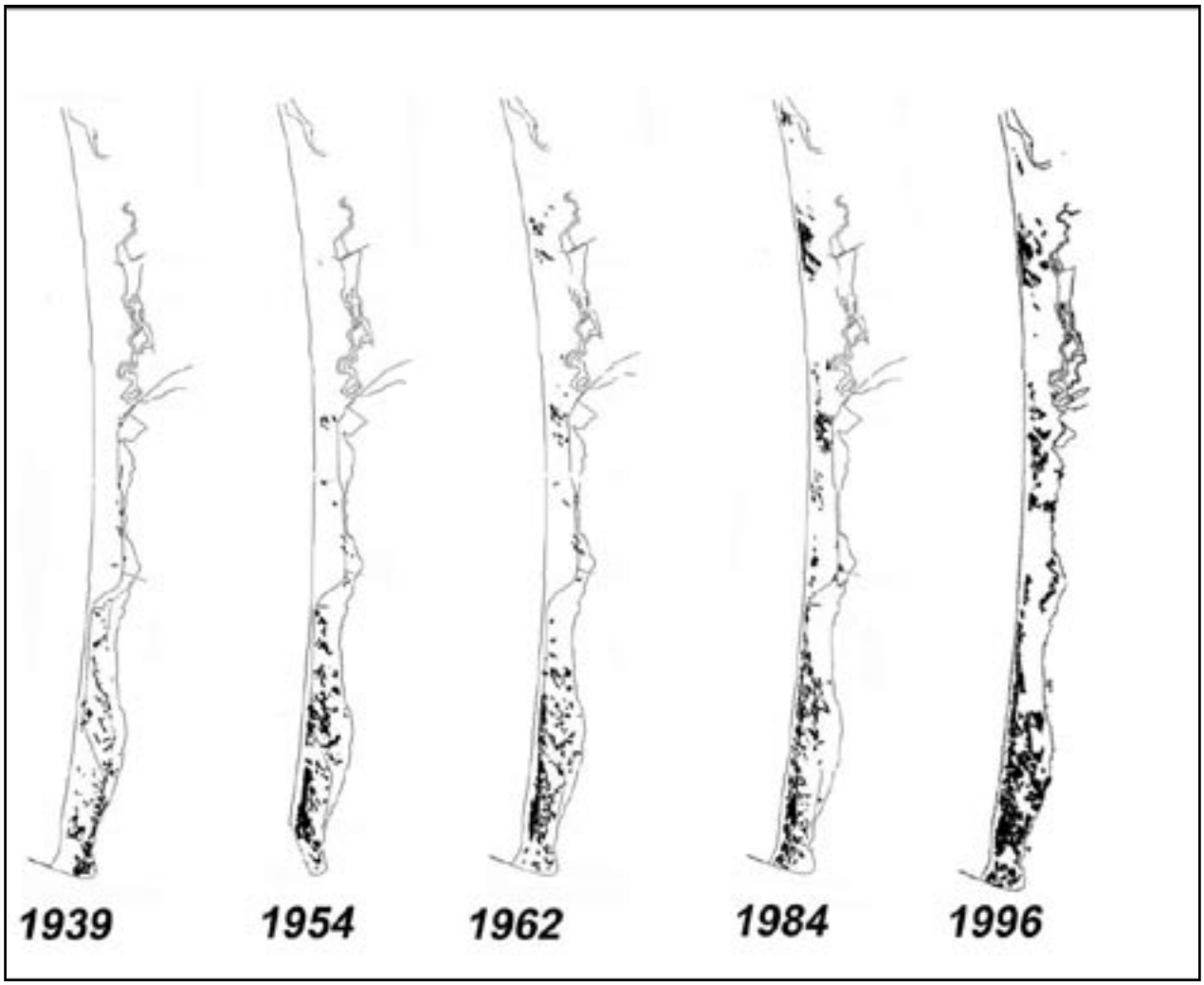

Figure 1. Spread of Lupinus arboreus on the North Spit of Humboldt Bay.

praecox. More research is needed to understand the synergistic roles of these native and non-native components of the ecosystem.

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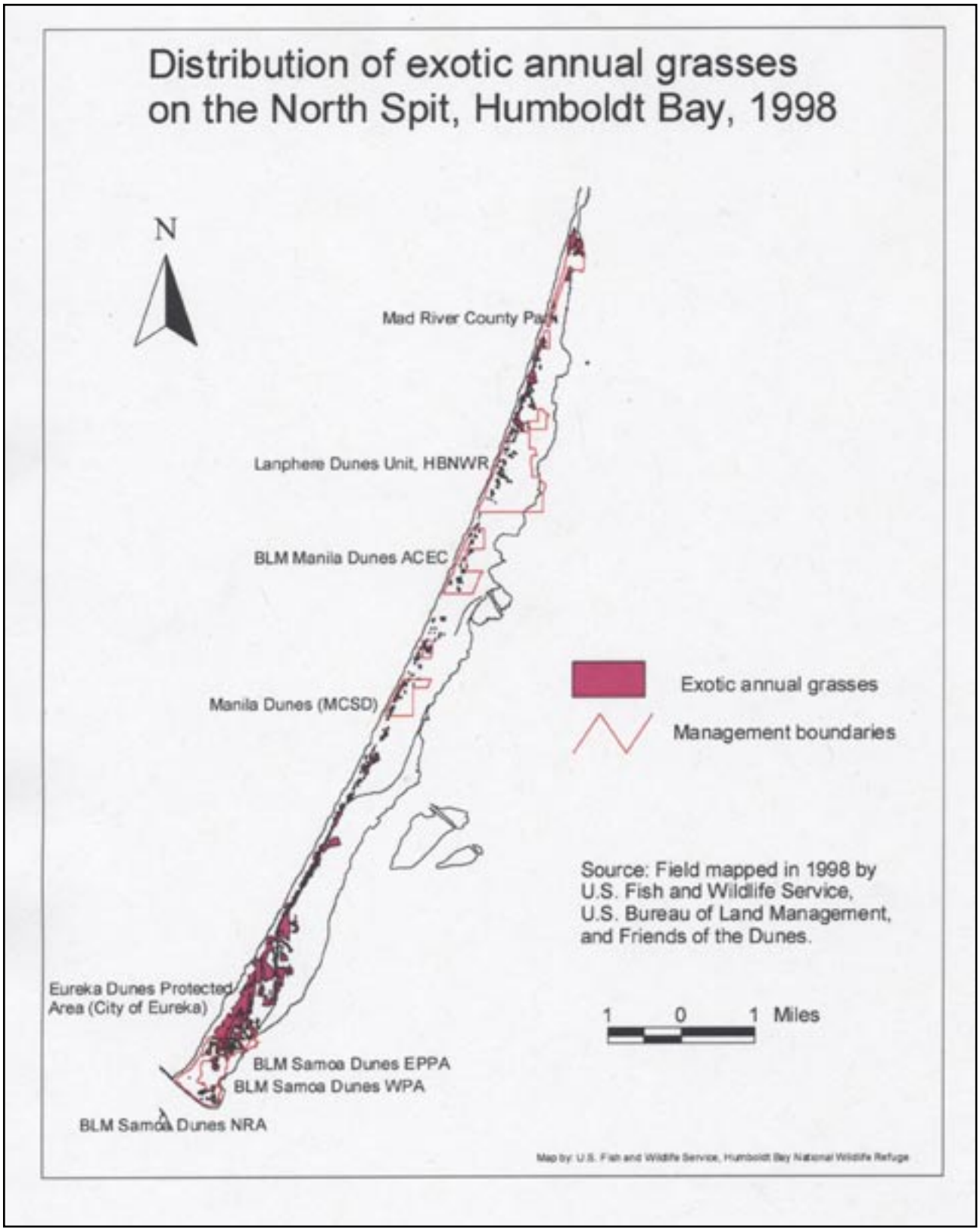

Figure 2. Invasive annual grass distribution.

Figure 3a. Before any treatment.

Figure 3b. After two years pulling and flaming.

Balancing Act: Managing Non-Native Plants of Historic Landscapes within the Natural Landscapes of Channel Islands National Park

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Many species of non-native trees were introduced to the California Channel islands in the late 1800s through the mid 1900s, for wood or fruit production, wind shelter, and aesthetics. We are in the process of comparatively evaluating each species' demonstrated and potential invasiveness and ecosystem effects. While some species appear to be benign or readily controllable, several others have proven to be highly invasive, expanding their ranges and numbers exponentially, with potentially enormous detrimental ecosystem effects. The National Park Service's dual mission includes preservation of both cultural and natural features of parks. Therefore, this Park is seeking to restore native ecosystems while maintaining- in some areas - a landscape reminiscent of the 19th – early 20th Century ranching era. In attempting to accomplish these seemingly conflicting missions, we are seeking a middle ground somewhere between the two extremes of committing large scale, and under current climates, perhaps unattainable resources to contain the more invasive species in their current numbers and locations, or to remove them entirely to protect native ecosystems. Our recent work on Santa Cruz Island on control of feral domestic olive (*Olea europaea*) will be presented as an example of seeking this difficult but potentially rewarding balance.

Management of Domestic Olives on Santa Cruz Island in the Channel Islands National Park: Preventing Development of an Olive-Dominated Chaparral

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The ecological conditions on east Santa Cruz Island are conducive to the spread of domestic olive, *Olea europea*, originating from grove plantings circa 1900. Their distribution and population demography, and the progress of eradicating feral olive populations, have been documented utilizing a varied set of field methods and instrumentation. In collaboration with the National Park Service, and Santa Cruz Island Native Plant Restoration Project, we surveyed approximately 6500 acres of the island, primarily on the east end, and eradicated at least 7000 juvenile and mature feral olive trees. Control techniques included both hand digging and herbicide cut-stump treatments depending on the size of plants. Data collected for all plants/populations included GPS locations, photo-documentation, burl diameter and total stem height, and herbicide amounts and concentrations. Data were analyzed using GIS techniques and delineated into categories that provide evidence for rate of spread, probable parent plants, seed bank properties, size/age distribution of populations, and probable vectors for seed dispersal. Project results include data on characteristics of all treated plants, and maps showing size/age classes, density and location of populations. From this information we hope to predict both rate and direction of further spread of olive, and to forecast the long-term cost of maintaining this historic grove in the landscape.

Session 5-B: DNA to GIS: New Techniques and Ideas

Identification of Cultivated Pampas Grass (*Cortaderia selloana*) Escaping Ornamental Plantings

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Molecular markers (microsatellites) were used to identify cultivars or genotypes of ornamental pampas grass that escaped cultivation and invaded wildlands of California. DNA was obtained from leaf tissue and each plant was genotyped at 10 microsatellite loci for 33 wild populations, 25 named cutivars, and 108 unnamed, or unidentified, plants from nurseries, botanical gardens, and landscape plantings. Three major groups were identified among the cultivated pampas grass based on microsatellite data. One of these cultivated groups accounted for 86 % of the gene pool of the wild plants sampled in California. Three out of the 25 named cultivars were found in this group. Landscape plantings were a major component of this group as 95 % of landscape plantings that we sampled in California belonged to this cultivated group. Further, this cultivated group was the only one to contain pampas grass sold as unnamed, generic pampas grass from nurseries Whether the identified cultivar group is genetically superior over other genotypes in the ability to escape cultivation needs further study. Alternatively, plantings might have fostered the establishment of escapes in California.

Biodiversity Risks from Atmospheric Nitrogen Deposition in California

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Atmospheric nitrogen deposition is an insidious, cumulative process that alters ecosystems. A GIS-based N-deposition risk screening for California included: 1) a 36 x 36 km map of total N-deposition for 2002, from the CMAQ model; 2) identification of sensitive habitat types; 3) overlay of the FRAP vegetation map; 4) overlay of the CNDDB; and 5) life-history and habitat for each species.

55,000 km^2 of California (total area 405,205 km^2) are exposed to >5 kg-N ha-1 year-1 and 10,000 km^2 are exposed to >10 kg-N ha-1 year-1. Deposition hotspots include coastal urban areas, the Central Valley, and Sierra Nevada foothills. N-deposition increases growth of invasive annual grasses in low biomass ecosystems, such as coastal sage scrub, serpentine grassland, desert scrub, and vernal pools. Of 225 listed "Threatened" and "Endangered" plant taxa, 101 are exposed on average to >5 kg-N ha-1 year-1. Of 1022 plant taxa considered "rare," 288 are exposed to >5 kg-N ha-1 year-1. Many of these taxa are associated with sensitive habitat types. This initial, broad-scale screening provides a basis for finer-scale analyses using a new 4 x 4 km CMAQ deposition map, more complete local data on species occurrences, and connections to weed invasions beyond annual grasses.

Status of New Agents for Biological Control of Yellow Starthistle and Russian Thistle

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Yellow starthistle

Yellow starthistle (*Centaurea solstitialis*, Asteraceae, YST) is an invasive alien weed, originating from the Mediterranean Region, that is the target of classical biological control (Turner et al. 1995, Pitcairn et al. 2004). Six species of insects attack flower heads of yellow starthistle in California, and most of these are now widespread (Balciunas and Villegas 2001, Pitcairn et al. 2003). Two of these: the hairy weevil (*Eustenopus villosus*) and the false peacock fly (*Chaetorellia succinea*) are very abundant at many sites. During the past ten years, the density of yellow starthistle has decreased substantially at two out of three long-term study sites monitored by California Department of Food and Agriculture (CDFA) scientists (Woods et al. 2004, Pitcairn et al. 2005). Yellow starthistle has also decreased in many parts of Oregon, especially where there is good competition with other vegetation (E. Coombs, personal communication). This is heartening news in light of the 35 years that have passed since the first introduction of a biological control agent. Nevertheless, it appears that additional agents will be needed to provide adequate control of the weed throughout its geographic range.

The rust pathogen, *Puccinia jaceae* var. *solstitialis*, was approved for release in California in 2003 and was released at sites in 20 counties in 2004 (Woods and Villegas 2005). CDFA scientists and cooperators are continuing to multiply and release this agent; however, it is not yet known how much impact this rust will have on YST populations in the field. CDFA and ARS scientists are collaborating to determine when and how best to release the agent and to measure its impact on YST.

During the past five years, we have discovered many new prospective arthropod biological control agents that are likely to complement the effects of the flower head insects and the rust. We have focussed on discovering agents that attack the leaves roots and stems of the immature plant during the spring. Of these, we have begun to evaluate the safety and potential effectiveness of five species, often in collaboration with other foreign scientists (Table 1, Smith 2004). The root-crown weevil (*Ceratapion basicorne*) is the next agent likely to be approved for release. This insect is found throughout the range of YST in Eurasia and attacks a high percentage of plants in Greece and Turkey. Adults begin to lay eggs in the early spring, larvae develop in the roots and can cause extensive damage. Adults emerge from the plants in late May to early June and then hide until the following spring. Host specificity tests conducted in the USDA-ARS quarantine laboratory in Albany, CA indicate that the insect is highly host-specific and does not attack native North American Cardueae species (thistles) nor commercial species such as artichoke. Field experiments conducted near Erzurum, Turkey confirmed that this insect does not attack safflower. Bachelor's button (*Centaurea cyanus*), appears to be the only nontarget plant that may be at risk of being attacked by this insect. Although Bachelor's button is an ornamental plant, it is invasive in the western U.S. (Whitson et al. 2000). A petition is being submitted to

Table 1. Status of prospective biological control agents for yellow starthistle.

Taxonomic name	Common name	Current Information
Aceria solstitialis (Acari: Eriophyidae)	blister mite	The mite attacks developing flowers. Basic life history and ecological studies are being conducted in Italy by E. DeLillo.
Ceratapion basicorne (Coleoptera: Apionidae)	root-crown weevil	Larvae attack root crown of rosettes. Host specificity studies in laboratory and field have been completed. Petition to release is being submitted to APHIS.
Larinus filiformis (Coleoptera: Curculionidae)	seedhead weevil	Larvae attack the seedheads. The insect if very abundant in eastern Turkey. Competition studies were conducted by L. Gultekin in Turkey to determine possible interference with Eustenopus villosus.
Psylliodes nr. *chalcomera* (Coleoptera: Chrysomelidae)	flea beetle	Larvae attack leaves and developing stems in spring. Individuals that attack YST are genetically distinct from those that attack Scotch thistle or musk thistle. Host specificity testing conducted in Russia, Italy and Albany is nearly complete.
Tingis grisea (Heteroptera: Tingidae)	lacebug	Adults and larvae feed on plant sap during the summer. Life history and initial host specificity tests are being conducted in Italy

the Technical Advisory Group (TAG) which is a review committee with representatives from all the U.S. federal departments, Canada and Mexico. If TAG recommends approval, then a permit request will be submitted to USDA-APHIS, which must write an Environmental Assessment (EA) and a Finding of No Significant Impact (FONSI) before the agent can be released. Each state must also approve before the agent can be released within its territory.

The next agent most likely to be approved is the flea beetle (*Psylliodes nr. chalcomera*). This insect also attacks YST in the spring, but larvae tunnel in the leaves and stems, causing extensive damage. This species was previously known to attack musk thistle (*Carduus nutans*), and was introduced to the eastern and central U.S. in 1997 (Andres and Rees 1995, Littlefield et al. 2004). However, discovery of a population on YST in southern Russia suggested the existence of a host-specific subspecies or biotype (Cristofaro et al. 2004). Further experiments by our team have shown that the Russian population is very host specific.

These two beetles greatly improve the likelihood of achieving successful biological control of this weed. The other prospective agents being evaluated will provide additional tools, should they be needed, to help ensure control of the weed throughout its range in North America.

Russian thistle

Russian thistle (tumbleweed, *Salsola tragus*, Chenopodiaceae) is an invasive alien weed, originating from Central Asia, that is the target of classical biological control (Goeden and Pemberton 1995, Pitcairn 2004). This plant has also been called *S. australis*, *S. iberica*, *S. kali*, and *S. pestifer* (Mosyakin 1996). Similar species include *S. paulsenii* and *S. collina*. Two species of moths (*Coleophora klimeschiella* and *C. parthenica*) were introduced in the 1970s. These became widespread, but predators and parasites prevent them from being abundant enough to control the weed. Foreign exploration in the Mediterranean Region led to the discovery of

Table 2. Status of prospective biological control agents of Russian thistle.

Taxonomic name	Common name	Current Information
Evaluated Species		
Aceria salsolae (Acari: Eriophyidae)	blister mite	The mite attacks developing tips. Petition approved by TAG, permit submitted to APHIS.
Gymnancyla canella (Lepidoptera: Pyralidae)	seed and stem moth	Caterpillar feeds on seeds and young branch tips. Host specificity testing almost completed.
Lixus incanescens [=salsolae] (Coleoptera: Curculionidae)	stem weevil	Adults feed on many plants in choice test at Montpellier, France (Sobhian et al. 2003). Rejected.
Piesma salsolae (Hemiptera: Piesmatidae)	plant bug	Develops on beets in no choice lab test at Montpellier, France (R, Sobhian pers. com.). Rejected.
Colletotrichum gloeosporioides	rust	More damaging to Russian thistle type A than to type B (Bruckart et al. 2004). Being evaluated by W. Bruckart USDA-ARS, Maryland.
Uromyces salsolae	rust	Damages Russian thistle type A (Hasan et al. 2001). Being evaluated by W. Bruckart USDA-ARS, Maryland.
New Species		
Anthypurinus biimpressus (Col.: Curculionidae)	jumping weevil	Found in Tunisia in 2004. Larvae and adults feed on leaves. Biology is unknown.
Baris przewalskyi (Col.: Curculionidae)	weevil	Abundant on Salsola in Kazakhstan in 2004. Biology is unknown.
Salsolia morgei (Col.: Curculionidae)	weevil	Found in Kazakhstan in 2004. Reported to be monophagous.

several prospective new biological control agents (Table 2). Evaluations conducted by R. Sobhian (USDA-ARS, European Biological Control Laboratory) demonstrated that two of these are specific enough to warrant further evaluation, and that two should be eliminated from further consideration.

The blister mite destroys young growing tips, stunting the plant and preventing development of flowers. The blister mite has been evaluated for host plant specificity and its ability to damage the plant in quarantine experiments at the USDA-ARS quarantine laboratory in Albany, CA. These studies demonstrated that the mite attacks only a few closely related species of *Salsola*, all of which are invasive alien weeds. A petition was submitted to TAG in Dec. 2004 (Smith 2005), and TAG recommended approval of release in Aug. 2005. A permit to release has been submitted to USDA-APHIS.

Larvae of the moth, *Gymnancyla canella*, feed on developing seeds and stems, causing extensive damage. Host specificity tests are being conducted in the Albany quarantine laboratory and are expected to be finished in another year. Foreign cooperators have begun travelling to Central Asia and have discovered many species of beetles attacking Russian thistle. Several of these are thought likely to be host-specific (Table 2). Initial experiments to evaluate host plant specificity are beginning conducted by cooperators in Russia. Access to this region greatly

improves our chances of finding safe, effective biological control agents.

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Reinventing the Language of Invasion Biology

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This presentation examines the language that invasion biologists use to refer to invasive species. Since invasion biologists have to communicate the problem of invasive species to others, including both non-biologists and non-scientists, they need to continuously reflect upon the rhetorical and ethical dimensions of their language. In particular, is current language likely to promote social cohesion and consequently, effective and appropriate action towards invasive species? I review recent discussions of these issues, focusing on prevalent militaristic metaphors within invasion biology. I argue that these metaphors are problematic because (i) they lead to a misleading perception of invasive species; (ii) they contribute to social misunderstanding, charges of xenophobia, and loss of scientific credibility; and (iii) they reinforce militaristic patterns of thought that are counter-productive for conservation. Consequently, while these metaphors may have been effective in motivating conservation action in the short-term, this may not translate into long-term efficacy. Militaristic language may be warranted in some instances, but I conclude with alternatives that better promote management and conservation goals in a multicultural context.

Please see Larson, B.M.H. 2005. The war of the roses: Demilitarizing invasion biology. Frontiers in Ecology and Environment. 3:495-500

Tracking Weed Population Dynamics Using Geodatabase Technology

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Discussion among weed mappers at Cal-IPC meetings frequently focuses on the difficulty of tracking weed patches over time. The difficulty arises from the fact that patches can grow, shrink, merge, divide or disappear. Such changes create a major challenge if one attempts to track numbered patches as permanent entities. As initial entities merge and dissolve, formerly distinct patches lose their definition. We have developed an ArcGIS 9.0 geodatabase which stores patch location and associated field data, and allows assessment of patch dynamics over time using a spatial approach rather than a numeric patch ID to track patch behavior over time. Our approach relies on identification

of patches by polygon location, as determined in the field. Analysis of patch dynamics from year to year takes place in a GIS environment, which allows use of topology rules for data quality control and patch reclassification. These methods enable tracking of changes in creation, disappearance, expansion and contraction of vegetation patches over multiple years. Analyses of these population data are performed both within ArcGIS and through export of data to statistical programs.

Session 6: Inventory and Prediction for Stopping Weed Spread

Nostradamus, Palantirs, and the Pros and Cons of Predictive Modelling for Invasive Species Management

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The importance of developing predictive models that aid in the management of invasive species and sites vulnerable to invasion has long been recognized. However, early attempts by invasion biologists to develop models predicting which species were most likely to become invasive were not very successful. This resulted in suspicion of just how much confidence could be placed in model predictions. Although these suspicions still persist, there has been notable progress over the last decade in our understanding of characteristics that contribute to higher rates of invasiveness in some species and factors that contribute to increased invasiveness into sites. There has also been substantial development of statistical methods and GIS technology that can be integrated to develop spatially explicit models. These advances have resulted in greater success with predictive modelling efforts, and there is little doubt that the application of these models will only continue to increase. While this trend has many potential scientific and management benefits, there are also a number of issues that can impede the effectiveness of predictive modelling. Some of the more significant ones include: (1) an emphasis on the statistical and technological parts of the models at the cost of the ecological parts; (2) the appropriateness and resolution of the predictor variables used in model development; (3) single-species versus multiple-species models; (4) the use of data collected at one point in time versus data collected over several years; (5) how models are validated; and (6) how long the ecological context of both the model and real system it represents can be expected to persist. These issues are not unique to the invasive species field but are held in common with modelling efforts from other branches in ecology and conservation. Several case studies are briefly examined to highlight the implications of these issues and to offer suggestions on how they can be worked with or mitigated. Ultimately, the effectiveness of predictive modelling will depend on three factors: (1) a specific definition of which part of the invasion process is being modeled; (2) the degree to which any given the model can adequately integrate and represent site characteristics with species distribution and abundance patterns; and (3) the resources available to validate and monitor the models performance.

Developing Predictive Models of Invasive Plants

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A central challenge to invasive species management is to identify locations that are most likely to have undetected populations of particular invaders, as well as the unoccupied sites that are at most risk of invasion. One approach is to develop predictive models that use data from

documented occurrence and absence locations to infer a statistical "environmental envelope" for the species, then examine the rest the landscape for other locations falling within the same envelope. A variety of statistical tools, including regressions, decision trees, neural nets, and co-Kriging have been advanced for this purpose, however an understanding of how well competing models perform under real-world conditions and what data is required to generate useful predictions, is still developing. We review recent developments in modeling tools. Validated models would be valuable to managers for inferring populations in unsurveyed locations, directing field crews to locations where infestations are most likely to become established and spread, and to estimate the risk of new invasions.

Weed Mapping in California - Where Are We?

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California is home to appoximately 1200 established naturalized plants. Of this group around 250 have been prioritized as particularily invasive, noxious and harmful. In sharp contrast, the list of invasive plants that we have comprehensive, statewide geographic data for is extremely small. For most species, published data exists only at the coarsest level of presence/absence over large ecoregions and this data is based on incomplete sampling and spotty herbarium records. The development of GIS technology and internet databases provides promising avenues for collecting, sharing and presenting location data, however the underlying lack of systematic field surveys and reporting will limit the usefulness of any electronic delivery system that is developed. The successful path out of this situaltion is systematic field surveys and coordinated on-the-ground mapping campaigns. This will demand funding, coordination, prioritization, training of volunteers and profesionals, further development of technology, and leadership at the local and statwide levels. We must actively pursue this effort because successful weed control, and especiall prevention, relies on a solid understanding the geospatial distribution of these invasive plants.

Designing Invasive Plant Early Detection and Rapid Response Networks

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In the management of harmful invasive plants, a stitch in time saves nine. By proactively treating incipient weed populations before they grow to become intractable we dramatically reduce the cost of treatment, are able to eradicate weeds before they develop persistent seedbanks, and can prevent damage to the sensitive natural systems we steward. This realization has driven a large body of research that seeks to predict which plant species are likely to become invasive. This work has identified several approaches that can successfully predict invasibility, ranging from life history modeling, climate matching, and expert assessment. However, these methods require resources, expertise, and funding that are not available to land managers, and so have not seen application to the pragmatic identification of likely sleeper weeds.

In this talk, I present a new method for identifying sleeper weeds that applies a principle well-supported by the literature: the best predictor of whether a plant will become invasive is whether it has invaded elsewhere. I demonstrate this technique by analyzing occurrence data for non-native plants within the Marin-Sonoma Weed Management Area. My technique successfully identifies sleeper weeds by analyzing aggregate data derived from worldwide invasive plant lists (readily available off the World Wide Web), and correlating taxon-specific citation rankings with easily obtained local incidence values. This approach is simple and requires very little time or

expertise. More importantly, it offers a powerful technique by which any land manager with access to the internet can identify the introduced plant taxa already sparsely present at a given site that are likely to become tomorrow's widespread harmful invaders.

Session 8-A: Safe and Effective Use of Chemical Control

Controlling European Beachgrass (*Ammophila arenaria*) Using Prescribed Burns and Herbicide

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Experiments on European beachgrass during the last decade have demonstrated successful control using manual or mechanical methods, but such methods remain relatively costly on a per-acre basis. At Sunset State Beach, where European beachgrass is dominant in the foredunes, serious funding constraints led the California Department of Parks and Recreation (DPR) to experiment with less costly methods. DPR staff relied on its in-house expertise with prescribed burning and herbicide use to substantially reduce control costs. Recognizing that fire reduces thatch and stimulates regrowth, DPR staff conducted prescribed burns in the fall, allowed native annuals to grow and set seed, and then treated the resprouting European beachgrass with glyphosate several times, beginning approximately 1 year after the burn. Volunteers also dug up resprouts by hand, particularly in areas where native plants rapidly reclaimed the foredune habitat. In certain conditions—easy site access, in-house expertise with prescribed burns and herbicide use, and remnant native plant communities or seedbanks to facilitate regeneration—this integrated approach may be an effective way to substantially reduce the per-acre cost of European beachgrass control.

An Assessment of the Hazard of a Mixture of the Herbicide Rodeo® and the Non-Ionic Surfactant R-11® to Aquatic Invertebrates and Larval Amphibians

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This study was conducted to determine whether the aquatic herbicide Rodeo® (active ingredient: glyphosate) and the non-ionic surfactant R-11® (active ingredient nonylphenol polyethoxylate or NPE) adversely affect aquatic species including invertebrates and larval amphibians. A Rodeo®/R-11® mixture was applied directly to the surface of a pond in a manner that would produce atypically high concentrations of these compounds in water. Water samples were collected from the treated pond for chemical analyses and toxicity tests with the aquatic invertebrate *Ceriodaphnia dubia*. A toxicity test with the Rodeo®/R-11® mixture was also conducted to determine the LC50 value for the larval life stage of the northern leopard frog, *Rana pipiens*. Water samples collected one hour after application contained the following mean concentrations: glyphosate, 1.83 mg/L; NPE, 1.10 mg/L; and 0.02 mg/L of the NPE breakdown product nonylphenol (NP). Concentrations of glyphosate's primary breakdown product, amino methyl phosphonic acid (AMPA), were below the laboratory detection limit of 0.020 mg/L. Water samples collected from the treated pond were not acutely lethal to *Ceriodaphnia dubia*. The 96-h toxicity

test with the Rodeo®/R-11® mixture using *Rana pipiens* produced LC50 values of 6.5 mg/L for glyphosate and 1.7 mg/L for NPE, indicating that the mixture is moderately toxic to the amphibian. A comparison of toxic units for the herbicide and surfactant in the mixture indicated that the toxicity to larval frogs was likely due to R-11® and not Rodeo®.

Aminopyralid: A New Reduced Risk Active Ingredient for Control of Broadleaf Invasive and Noxious Weeds

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Aminopyralid is a new systemic herbicide developed by Dow AgroSciences specifically for use on rangeland, pasture, rights-of-way, such as roadsides for vegetation management, Conservation Reserve Program acres, non-cropland, and natural areas in the United States and Canada. The herbicide is formulated as a liquid containing, 2 lb ae/gallon of aminopyralid as a salt. The herbicide has postemergence activity on established broadleaf plants and provides residual control of germinating seeds of susceptible plants. Field research has shown aminopyralid to be effective at rates between 0.05 and 0.1 lb ae/A, which is about 1/4 to 1/20 less than use rates of currently registered rangeland and pasture herbicides with the same mode of action including, clopyralid, 2,4-D, dicamba, picloram, and triclopyr. Aminopyralid controls over 40 species of annual, biennial, and perennial broadleaf weeds including Russian knapweed (*Acroptilon repens*), absinth wormwood (*Artemisia absinthium*), plumeless thistle (*Carduus acanthoides*), musk thistle (*Carduus nutans*), diffuse knapweed (*Centaurea diffusa*), spotted knapweed (*Centaurea maculosa*), yellow starthistle (*Centaurea solstitialis*), oxeye daisy (*Chrysanthemum leucantheum*), Canada thistle (*Cirsium arvense*), bull thistle (*Cirsium vulgare*), henbit (*Lamium amplexicaule*), *Matricaria inodora*, bulbous buttercup (*Ranunculus bulbosus*), curly dock (*Rumex crispus*), horsenettle (*Solanum carolinense*), *Solanum viarum*, and common cocklebur (*Xanthium strumarium*).

Most warm- and cool-season rangeland and pasture grasses are tolerant of aminopyralid applications at proposed rates. Research continues to determine the efficacy of aminopyralid on other key invasive weeds and on the role of aminopyralid in facilitating plant community improvement in land management programs.

Control of Scotch Broom *(Cytisus scoparius)*

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Scotch broom is a native of Central and Southern Europe and North Africa. It is a deciduous shrub, 1-3 meters high with bright yellow flowers from April to June. Scotch broom was introduced into California in the 1850's as an ornamental and for roadside erosion control. It is highly competitive with natives and forms dense monotypic stands that are inaccessible and unpalatable to wildlife. As the plants age, the inner stems dieback increasing fuel loads. In fall 2003 and spring 2004 two identical trials were established in El Dorado County, California, to test mechanical techniques and several herbicides using different application techniques. The herbicides tested were Chopper® (imazapyr), Garlon 4® (triclopyr ester), and Roundup Max® (glyphosate). Application methods included foliar, drizzle, and cut stump. The two mechanical treatments included a weed wrench and lopping. Each treatment was replicated 10 times in a randomized block design with an individual shrub serving as a replicate. Results showed that Roundup Max®, and Gar-

lon 4®, both gave excellent control as a foliar spray or drizzle application in the fall or spring, whereas Chopper® was most effective in the fall. As a cut stump application, both Chopper® and Garlon 4® were effective in the fall, whereas Garlon 4® was most effective in the spring. In the mechanical treatments, the weed wrench was very effective as a fall or spring treatment, whereas the lopping was most effective in the spring.

The Fennel Battle on MCB Camp Pendleton: Partnerships and Techniques in Combating the Invasion

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Abstract

MCB Camp Pendleton (Base) has been treating *Foeniculum vulgare* (fennel) since the 1990s and has collaborated with various partners to provide efficient and effective techniques. Since then, over 1,000 acres of fennel-infested areas have been treated on Base. Yet, fennel is dominating many more acres of grassland; often forming monotypic stands, and has even moved into areas of coastal scrub. Several different treatment techniques have been used for different areas on base through the late 1990's and early 2000's. Some areas had different types of terrain and vegetation, which affected the cost per acre. UC Cooperative Extension research on fennel control began in 2004 on Base and will continue into 2006. Techniques, which included broadcast versus spot spraying in addition to 1-2% of glyphosate and triclopyr were applied in different combinations to fennel dominated plots. Results indicate a mixture of glyphosate and triclopyr to be the most effective herbicide treatment when compared to using these two active ingredients alone. This paper focuses on past and current techniques used to treat upland weeds, primarily fennel.

Introduction / Background

With the increased movement of humans, exotic invasive plants have spread throughout southern California's natural landscapes including Marine Corps Base Camp Pendleton (Base). Invasive non-native plant species have been documented to cause direct, indirect, and cumulative impacts to natural vegetation communities (Bossard et. al. 2000). Impacts to the ecosystem include altering ecosystem processes and displacement of native species. Upland weeds have appeared to impact the integrity of the ecosystems on Base. The Base has since developed an upland invasive weed control program. For fennel, "Control" means, as appropriate, the suppression, reduction, or management of invasive species populations; the prevention of invasive species introductions and their spread from already infested areas (Executive Order 13112).

There have been collaborative efforts in treating fennel, artichoke thistle and other upland weeds. Partnering with researchers has proven to be important when determining cost-effectiveness in weed control strategies. Large-scale weed control can also require expertise from different disciplines including wildlife biologists (e.g., bird monitor). Artichoke thistle treatments began in 1984, and now can be considered under control throughout most of the Base. Today, fennel appears to be the most treatable widespread weed on Base. Over 18,000 acres of fennel occupied habitat was mapped on Base from 2004-2005. This survey did not include most impact/live fire or dude-producing areas. It is estimated that over 25,000 acres of fennel occupied areas occur on the Base. This paper will discuss some of the research, partnerships, fennel biology, and control techniques on Base.

Biology / Ecology

Fennel (*Foeniculum vulgare*) is a perennial herb in the Apiaceae family from southern Europe and the Mediterranean. It was introduced to the west for its edible root and seeds for cooking. The California Invasive Plant Council determined fennel to have a high ecological impact and an expansive distribution. In the United States, fennel occurs in 38 states, including much of California (USDA 2005). Fennel has the capability

to reproduce by rhizome or seed, allowing many dispersal strategies including, but not limited to: water transport, wind, traffic, and wildlife. Disturbance (e.g., vehicles) can encourage dispersal and establishment. Additionally, germinating potential and the number of individuals may increase during high rainfall years. Yet, research in areas such as population biology is needed on fennel. "Data on germination rates, seed production, survival, longevity, density, and viability of the seedbank would be useful for developing management programs" (Bossard et al. 2000).

Baseline research

The first major publications came from studies performed by Brenton, Klinger, Dash and Gleissman at Santa Cruz Island in 1994. Results indicated that wet season herbicide applications were significantly more effective than dry season applications (Brenton and Klinger 2002, 1994). Triclopyr (Garlon) applied in early spring had a 95-100% effectiveness, where as Glyphosate (Roundup) applied in early spring had a 75-80% effectiveness (Dash and Gliessman 1994 in Bossard et al. 2000). The Base funded study by SDSU showed that fennel density and height was significantly lower in annually burned vs. unburned areas before treatment, but there was not a significant difference between burned and unburned areas 1 year after treatment. This indicates that herbicide (i.e., Garlon) treatments on fennel are more effective than burning alone. Yet, this does not discount that burning or mowing is effective before herbicide treatments. Burning or mowing will remove the dead fennel biomass to allow efficient herbicide translocation into the rhizomes. Brenton and Klinger found the timing of these fennel treatment methods to be very important.

The University of California Cooperative Extension has been studying fennel on Base since 2004 to determine if Glyphosate, Triclopyr or some combination of both is more effective. This study, led by Carl Bell, has also used different types of herbicide application. Four replications of nine different treatments and one untreated control were set up in plots of 15'x2'. Results indicated that Triclopyr and a mix of Glyphosate/Triclopyr were more effective on fennel than Glyphosate alone at 1 & 2 lbs/A. The percent cover and biomass for the Glyphosate/Triclopyr (1+2 lbs/A) treatment was 0. It was also found that Triclopyr did not appear to affect purple needle grass (*Nassella pulchra*). This may depend on the time of year that the treatment took place, which was in March, but also gives hope that native perennial grasses can recover and flourish in areas that are now dominated by fennel on Base.

Fennel Projects & Techniques

Research findings were generally used throughout upland weed and fennel control projects on Base since the late 1990s. Herbicides were usually applied in the wet season or spring through early summer, depending on the year (i.e., weather), location and funding available. A mix of Glyphosate and Triclopyr applied at 1+2 lbs/Acre was used on fennel this year and has appeared to be very effective. A combination of boom, backpack, and hose sprayers were used depending on terrain and vegetation type/density. Mowing occurred in flatter areas with high fennel cover, and was treated after 1-month of re-growth. Some of the equipment used included: SP1 backpack, 100-foot hose, and six-foot boom sprayers, 4x4 ATV. Multiple year treatments have later become the standard (e.g., three years), as well as documenting the methods and other relevant efforts annually.

Fennel treatment methods (e.g., spraying or mowing and spraying in combination) have been conducted at many different sites on Base which include: Mass 3, Romeo 2/Tango, Case Springs, Juliett, 41 Area, 22 Area, Pio Pico, Bravo 1 and ASP site. The current upland weed management contracts treat fennel and other associated invasive upland weeds for three years. The 2004-2007 contract for $199,591 is treating 193.5 acres for three years, which includes 123.5

acres of medium to low density and 70 acres of high density fennel. The 2005-2008 contract for $155,884 will treat 163 acres of fennel dominated habitat (i.e., high density) for three years. The main factors affecting the cost/acre are usually the type of habitat and terrain. Prioritizing areas for treatment depends on a variety of factors including (but not limited to): cost, ease of access, habitat type, federally listed species and land use.

A variety of upland weed control efforts have occurred on Base in the past, including treatments following fires. The majority of these treatments were performed by Agrichemical and Supply. In 2004, weed control efforts began in the Cocklebur Mesa Sensitive Area and will continue through 2007. For control of exotic annual grasses and fennel treatment, efforts included mowing, hand pulling, and herbicide treatment. A retreatment occurred in Cocklebur in the spring of 2005. Treatments following a fire are occurring in Chappo (22 area) from 2004-2006. All weed treatment will have on-going monitoring.

Management Implications

Large-scale weed treatment strategies and management implications stem from research. Base-wide weed mapping is a basic requirement for developing a large-scale treatment strategy. Mapping is also necessary in understanding the extent and density of the infestation because it will give data on weed species and their distribution on Base. An upland weed geodatabase, which is pending completion by 2006, has helped to standardize data collection methods and management. Mapping and research will also allow the base to prioritize areas for treatment using a ranking system and GIS modeling. Factors such as ease of access, habitat type, wildlife occuring and land use can go into the ranking system to determine the highest priority areas to treat. The long-term goals are to keep fennel and other invasive upland weeds under control, while allowing the natives to become re-established and flourish. For fennel, additional long-term monitoring and data is needed to determine the success of the treatments or native succession and to standardize a management plan.

Conclusions

Cooperation and vast efforts are required for large-scale weed control, such as for fennel control on Base. It will typically take monitoring over time (five years +) to gather adequate data and to determine the success of the ecosystem recovery in each area of treatment. Short-term results will be apparent (i.e., fennel decline), but it is uncertain if native vegetation will become established over time. There is current research available through the Base and other organizations treating and performing research on fennel (e.g., UC extension). There is also online, published and helpful unpublished literature available. Partnerships and keeping open communication are very important to large-scale weed control. In conclusion, it has taken adaptive management through partnering with other firms and organizations, and adjusting to the best treatment techniques to take control of fennel one area at a time on Base.

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Session 8-B: Building Effective Programs and Partnerships

Montana Weed Prevention Areas: Partnerships for Rangeland Protection

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Introduction

Invasive weeds are considered the single greatest threat to rangeland ecosystem health and stability (USDI 1996) and one of the most serious problems facing western region land managers. Invasive weeds alter wildlife habitat suitability (Trammell and Butler 1995), threaten native biodiversity (Wilcove 1998), and permanently damage the structure and function of biological communities and ecosystems (Kolar and Lodge 2001). Invasive weeds can have devastating economic impacts. Weeds in rangeland reduce forage yield and quality and increase the costs of producing livestock. This causes an estimated loss of $2 billion annually in the United States (Quimby et al. 1991).

Invasive weeds continue to invade natural communities up to 14 percent annually (USGAO 2001). The rapid spread of invasive weeds occurs in spite of management efforts (USDI 1996). Existing approaches to the challenges presented by species invasions are typically reactive in nature (Peterson and Vieglais 2001). A proactive approach focused on the protection of healthy ecosystems from weed spread would be cost-effective and highly improved over the existing reactive approach (Hobbs and Humphries 1995). The Office of Technology Assessment (1993) reports targeted expenditures on prevention and early control provide solid economic returns where, on average, every dollar spent on early intervention prevented $17 in later expenses. We aim to maximize efforts and resources by protecting healthy rangeland ecosystems and critical zones in eastern Montana from weed spread through the widespread development of weed prevention areas (WPAs). These special management areas are effectively weed-free and comprised of unified stakeholders that share common goals to protect native plant resources and livelihoods from weed invasion and associated impacts. Weed prevention areas work as coordinated, local-level, early detection and rapid response mechanisms that are necessary to permit timely response to invasions (USGAO 2001).

Objectives

Our first objective is to promote the urgency of early weed control, which is not widely understood (USDI 1996), and the tools available to curb spread and restrict ecologic and economic impacts (Mack et al. 2000). This is attained through regional and local-level awareness campaigns and programs using a social marketing approach. Collective implementation of rancher-designed plans promotes the adoption of preventative measures through a “learn by doing” approach.

Our second objective is to identify and delineate highest priority areas (USDI 1996) and prioritize protection from weed spread through WPA development. County weed leadership and key producers identify and prioritize areas and formulate site-specific strategies for protection from weed spread to meet this objective. Weed prevention areas facilitate protection of healthy rangeland ecosystems predominately comprised of northern mixed-grass prairie [Bluebunch wheatgrass – western wheatgrass mixedgrass (*Pseudoroegneria spicata – Pascopyrum smithii* herbaceous vegetation)].

Our third objective is to maintain the current healthy, weed-free ecologic state of the WPA

through collective rancher implementation of WPA-specific, integrated plans of ecosystem management, prevention, and early intervention. Plans are formulated through a "knowledge network" approach (Jordan et al. 2003) where quality collective inquiry of ranchers is gathered for an effective plan. Proper ecosystem management maximizes the persistence of native species and reduces weed invasion. This is accomplished with proper cattle grazing techniques (Sheley et al. 1999) and discussions related to the reintroduction of natural disturbance regimes, such as fire, to slow or prevent invasions (Stohlgren et al. 1999). Prevention strategies are considered the first line of defense. Strategies are specific to each WPA to minimize weed movement into the WPA, especially where humans are the spread vector. Early detection and rapid response strategies are considered the second line of defense. Mapping strategies using GPS technology support systematic sampling methods across WPAs where monitoring frequency is based on invasion probability. Seasonal range riders / weed scouts and Montana Conservation Corps crews provide monitoring assistance to ranchers, confirm and map weed-free status across WPAs, and eradicate new invasions. Rapid management response to small populations is crucial to preclude spread. Rapid response efforts, however, have been significantly hindered by the lack of effective early detection systems (USGAO 2001). Ground inventories remain the best method to detect new weeds when periodically repeated at the highest level of detection confidence practicable, but are not always reasonable based on the challenge and expense in finding new invasions across large areas when density is very low. Complete ground inventories performed strategically and with adequate frequency and improved efficacy will improve the detection of new weeds to increase the chances of eradication success, prevent reinvasion, and stop spread. Such inventories may become practical when augmented with the use of specially trained, invasive weed detector dogs.

Canine detection has been recognized as an effective method to cover more area than by human searches (Lorenzo et al. 2003) and domestic dogs (Canis familiaris L.) may be effective at locating invasive weeds in low density because of their high sensitivity to a target (Waggoner et al. 1998). Experts have provided formal support for the usefulness of canines as an effective detection technology (Williams and Johnston 2002) based on advantages in sampling efficiency, sensitivity, target noise discrimination, and gradient detection (Waggoner et al. 1998).

Investigation of a novel method to detect an invasive weed using specially-trained canines Spotted knapweed (*Centaurea biebersteinii* DC.) currently infests over 1.6 million ha in Montana. This weed impacts the livestock industry and has been associated with increased soil erosion and changes in wildlife habitat suitability. Spotted knapweed has the ability to invade and dominate a variety of healthy and relatively undisturbed plant communities (Rutledge and McLendon 1998), increasing the probability it will continue to spread. Effective early detection of spotted knapweed is crucial to preclude spread throughout Montana and the western region. The purpose of this study, as an early detection component to improve rapid response in WPAs, was to evaluate the potential of canine detection as a novel sampling method to locate new invasions of spotted knapweed across rangelands. Our objective was to quantify and compare the accuracy, search duration, and detection distance of canines and human surveyors to detect spotted knapweed incursions through a series of field trials.

Methods

Three canines with previous experience in field setting detection work were selected to participate in this study. Two German shepherds and one Rocky Mountain shepherd were trained to detect spotted knapweed based on standard narcotics detection training protocol and techniques frequently used in tracking. Three humans were

selected based on strong experience in surveying plant communities for spotted knapweed.

We conducted field trials during September 2005 in Gallatin County, Montana. Seven, 0.5-ha field trial sites were delineated in a grazed dryland pasture dominated by crested wheatgrass [*Agropyron cristatum* (L.) Gaertn.]. Total search area was calculated as 3.5 ha. Thirteen spotted knapweed targets were available for detection across the sites as isolated plants or small patches. Mean density of targets was calculated as 1.9 targets per site (SD 0.69). Canine / handler teams and human surveyors performed an open grid search across each field trial to ensure each site was covered evenly. Accuracy was calculated as the number of targets located out of the total number of targets present across each trial. Search duration was calculated as the difference between the start and end time of each trial. Detection distances of each target were calculated as the distance from the target to the canine or surveyor upon detection. All statistical analyses were carried out using ANOVA (SAS Version 9.1; SAS Institute, Cary NC, USA). The model included replication (3), survey treatment (canine or human), and site (7).

Results

Compared across sites, canines were more accurate in detecting spotted knapweed targets compared to humans ($P = 0.0007$). Mean accuracy of canines was calculated as 85.7 percent (SD 23.1) and mean accuracy of humans was calculated as 63.5 percent (SD 38.2). The interaction of survey method (i.e., canines compared to humans) and site ($P = 0.0666$) suggests canines may be more accurate at detecting targets that are difficult for humans to visually discriminate. The two sites driving this interaction contained targets as juvenile and obscure adult plants. Mean accuracy of canines across these two sites was calculated as 66.7 percent (SD 0) and mean accuracy of humans was calculated as 16.7 percent (SD 23.5). Canines searched the sites faster compared to humans ($P = 0.011$). Mean search duration of canines was calculated as 30.2 minutes (SD 8.81) and mean search duration of human surveyors was calculated as 38.1 minutes (SD 11.1). Canines detected targets from greater distances compared to humans, but results were not significant ($P = 0.157$). Mean detection distance of canines was calculated as 8.1 meters (SD 13.2) and mean detection distance of humans was calculated as 4.1 meters (SD 6.58).

Discussion

Our findings demonstrate canines are significantly more accurate in detecting early spotted knapweed invasions compared to human surveyors. Our findings also demonstrate canines are able to search sites faster and with possibly greater detection distances compared to humans. The strategic use of highly effective invasive weed detector dog teams may work to improve ground inventories and fill broad survey needs, such as to cover large areas, increase sampling accuracy and thoroughness, decrease search time and expense, and locate early age class and early season weed targets. Detector dog teams may work to stop spread at population fronts and increase the chances of eradication success, potentially affecting ecological and economic

savings. The development of improved early detection methods using detector dogs may increase rapid response efforts in prioritized ecosystems and address the recognized need for more early detection systems (USGAO 2001). Non-infested rangeland ecosystems are prioritized for prevention in Montana through the development of weed prevention areas. These special management areas maximize efforts and resources by preventing the development of complex and costly weed problems through exclusion, detection, and eradication. Weed prevention areas protect non-infested rangelands from weed spread through collective, local-level efforts that are designed and implemented by ranchers. Since 2003, over 1.8 million ha have been protected through WPA development across 11 eastern Montana counties. This project was funded by the Center for Invasive Plant Management and USDA – Natural Resources Conservation Service.

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Early Detection Protocol Development in the National Parks: Integrating All the Pieces

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Invasive plant species management is a national priority for the National Park Service (NPS). The NPS and other land management agencies have limited resources available for invasive plant control and, therefore, must optimize control efforts. Following the introduction of invasive plants, the most effective management strategy is to detect and respond to invasive species before they become so well established that control is not economically or logistically feasible. At this early stage, predictive capabilities and monitoring strategies that efficiently cover large areas are necessary. Natural resource managers require species prioritization tools, spatially-explicit models, non-spatial models, risk analyses, adaptive sampling designs, and incidental reporting to accomplish these tasks. Many of these components have been applied in other contexts or exist in isolation, but no effort has been made to combine these components into a comprehensive protocol for early detection of invasive plants. We discuss NPS-USGS collaborative efforts to integrate these diverse approaches and apply them in National Parks. Our goal is to produce a tool for natural resource managers that has broad application yet is sufficiently detailed to be practical. An overview of the individual and collective efforts, their status, and opportunities for sharing these products also will be discussed.

Ecosystem Protection through Watershed-Level Prioritization on Catalina Island

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Introduction

Successful management of wildlands requires a thorough knowledge of the resources being protected as well as the forces that threaten them. Like doctors, it is our job as land managers to treat the patient (the land) and not just the disease (invasive plants). The Catalina Island Conservancy, which owns and manages 88% of a 19,425 ha. (48,000 acre) island, has developed a watershed-level ranking system utilizing extensive rare plant, animal, and habitat data. Each watershed throughout the entire island ecosystem is treated as a Habitat Management Unit (HMU) and ranked for priority of protection based on the natural resources found within it.

There are two general approaches to managing invasive plant species: species management and site management (Owen 1998). Thus far, the Conservancy has utilized the species management approach, by identifying 76 of the most invasive plant species, mapping over 37,000 populations of those species by conducting extensive transects throughout the island, and ranking them for priority of control (J. Knapp 2003). Many highly invasive species of limited abundance have been identified for eradication on the island through this process. But with almost 17,000 ha. (42,000 acres) to manage, it is difficult to determine where to focus management efforts for those invasive plants which are so widespread on the island that eradication is not an option. This paper focuses on the site-management portion of our comprehensive invasive plant management plan.

Site Description

Catalina Island is the third largest of the eight California Channel Islands, and lies approximately 20 miles south of the Los Angeles County Coast. It has at least 22 endemic taxa which are found only on Catalina. Catalina is the only Channel Island with an incorporated city; a year-around population of 5,500 increases to over 10,000 during the summer months. Since the late 1800s, Catalina has been a popular tourist destination, and currently receives approximately 1 million visitors each year. Due to Catalina's high visitation, it has long endured the impact of humans, including numerous invasive plant and animal species introductions. These invasions have contributed to 98 taxa being listed as natural heritage species in need of protection. In recent years the Conservancy has accomplished the eradication of feral goats (*Capra hircus*) and pigs (*Sus scrofa*) while reducing bison (*Bison bison*) and mule deer (*Odocoileus hemonius*) populations. With the release of grazing and browsing pressures, it is a crucial time to substantially increase efforts toward the eradication and control of invasive plants on Catalina Island.

Methods

In order to develop a site-based management plan, we first divided the island into Habitat Management Units (HMUs). HMUs are generally defined by watershed boundaries, with very large watersheds subdivided using features such as ridges and roads in order to make them a more manageable size (for the purposes of this paper, they will all be referred to as watersheds). The mean size of the resulting 76 HMUs is 255 ha. (631 acres, Figure 1). The HMUs were given names for easy recognition using historical island maps as a reference.

A ranking system was then developed to prioritize those units. The ranking of the HMUs incorporates data for three components: rare plant taxa, island habitats, and rare animal taxa; each is discussed below.

Rare Plants

Four elements were chosen for the rare plant ranking component: endemism, listed status, frequency on the island, and frequency trend. Catalina is fortunate enough to have two historical floras for the island (Millspaugh & Nuttall 1923, Thorne 1967, 1969) and a future volume for which the fieldwork has been completed. From a list of over 460 native species, those species and subspecies were highlighted which are: a) restricted to Catalina, the California Channel Islands, or the California Islands including Baja, California, b) listed by the U.S. Fish and Wildlife Service, California Department of Fish and Game, NatureServe, California Native Plant Society, or the Jepson Manual, or c) assigned a frequency of rare (found in three or fewer locations on the island) in Thorne's flora. This resulted in a list of over 200 taxa. Population numbers from the 1923 and 1967 floras were then examined, and those species and subspecies which have exhibited a downward trend in frequency were identified. One to three points were awarded for these components in the first iteration of the ranking (where a species was listed by multiple organizations, only the highest score was used). Species totaling fewer than three points were then eliminated from the list.

Location data for the selected taxa was then compiled. Nine years worth of field notes beginning in 1995 were obtained from Steve Junak, the lead author of the upcoming Catalina Island flora. The notes were searched for any mention of the selected species. A data layer of location points was created in our Geographic Information System (GIS) using a combination of the recorded road mileage, elevation, aspect, and UTM bearings. Interestingly, the UTM bearings, which were not differentially corrected, proved to be the least accurate of those four sources. This process resulted in 868 additional plant locations in the Conservancy's existing GIS layer, for a total of 1,843 rare plant locations.

Using this new layer, the number of existing populations for each species was calculated and a new frequency rating assigned. Plants within one quarter mile of each other were considered one population (Bittman 2001). Trend in frequency was re-assessed using the new population numbers. Some species were more frequent than previously thought, and were dropped from the list; this resulted in a final tally of 179 species and subspecies included in the watershed prioritization.

Island Habitats

A vegetation map produced from aerial photographs taken in the year 2000 was used for the habitat ranking component (D. Knapp 2005). A minimum mapping unit of 0.04 ha. (0.1 acre) and average polygon size of 3.6 ha. (9 acres) provides a level of detail which is relevant to wildlife use and able to capture both remnant habitats and limited communities such as coastal marsh and dunes. Island habitats were classified and mapped at the community level, which is based on the physiognomy of the dominant plants, species composition, and other habitat characteristics. One community, island woodland, was also mapped at the floristic level (alliance) due to the rare status of each of those alliances and their dominant species. A total of 16 native habitat types were evaluated in the ranking effort. Six elements were chosen to rank each of these habitats for protection priority: % of the island, listed status, geographic limit, endemism, total ranking of dominant species, and special importance to wildlife. These are discussed below. One to three points were given for each element in the first iteration of the ranking.

Percentage of the island reflects the rarity of the habitat on the island itself, while *listed status* reflects rarity in the state and/or nation. *Geographic limit* refers to those habitats for which Catalina represents the farthest extent of its range. Where a plant community is only found on Catalina or the other California Islands, it is given points under the category of *endemism*. However, while some habitats are not considered rare or endemic at the community level, they are dominated by rare and endemic plants and will undoubtedly be recognized as a unique plant assemblage at the alliance level once properly described. To capture this uniqueness, points given to any of the *dominant species* in the rare plants component of this ranking were tallied; those totals were divided into three groups for which points were awarded.

Riparian habitat supports a greater variety of wildlife, particularly avian species, than any other California habitat type (Smith 1980). The final element, *special importance to wildlife*, was designed with riparian habitat in mind, although this category could be enhanced as more wildlife habitat data becomes available. Riparian woodland was given more points than riparian scrub, herbaceous, or bare streambed for its more highly developed and complex structure, as well as its greater available water.

Rare Wildlife

Although the Conservancy maintains resident mammal, bird, reptile, and amphibian lists, few of these species except the rarest have been assigned a frequency for the island. In addition, the majority of the wildlife surveys conducted on the island have been distributed primarily along roadsides in the interest of time and accessibility. This uneven coverage of the island proved to be a complication when assessing the faunal resources within each of the island watersheds.

First, a list was compiled of those species and subspecies in three categories: a) endemic to Catalina or the Channel Islands, b) listed by the U.S. Fish and Wildlife Service, California Department of Fish and Game, and NatureServe, or c) rare on the island. This resulted in a list of 21 taxa, for which one to three points were (in the first iteration) given for each category. Location information for the selected taxa was then

compiled using data from land bird, pitfall, fox, bat, butterfly, and shrew survey and monitoring projects conducted primarily within the last seven years, rounding this out with observation data (from the authors) when necessary.

Synthesis

For each HMU, occurrences of rare plants, island habitats, and rare animals were assessed and the corresponding points awarded for each. HMUs were given points for plant and animal species and island habitats on a presence/absence system; regardless of how many populations of a rare plant or animal species or how much of a habitat is found within that watershed, points were awarded once for that element. This simplified the process and saved time.

Because each of the three ranking components contributes unique ecological values, we chose to weigh rare plants, island habitats, and rare wildlife equally. To accomplish this, we calculated the mean watershed score for each of the three elements, and applied a correction factor to those with lower means (e.g. wildlife scores were all multiplied by 4.5) to make the means equal. The total points for each watershed were then tallied, and the HMUs ranked. The final model is a comprehensive index of rarity and biodiversity.

Results and Adjustments

The five highest ranking watersheds came as no surprise. They include the two wettest drainages on the island (upper and lower Cottonwood and Middle Canyons), and an area of exceptional diversity in all three categories (Toyon Canyon). What was surprising, however, was the low ranking of the Wild Boar Gully watershed, an area on the south side of the island which contains two Federally Endangered plant species (Catalina Island mountain-mahogany [*Cercocarpus traskiae*] and Santa Cruz Island rock cress [*Sibara filifolia*]) and the Federally Threatened Island rush-rose (*Helianthemum greenei*). The Catalina Island mountain-mahogany, which is endemic to Catalina and found in only one naturally occurring population on the island, is of particularly special importance to the Conservancy. Although these three species received some of the highest rankings of all of the rare plants, their scores were not enough when combined with the rest of the data to elevate this watershed to the top tier.

The relatively low ranking of an important watershed such as Wild Boar Gully was helpful in pointing out several shortcomings of the first ranking iteration. Firstly, because there are so many rare plant taxa, the points for rarity dwarfed those points given for endemism or listed status when combined in a watershed. To rectify this, the point system was raised for listed status and lowered for plants with three or fewer populations on the island (but remained the same for endemism and trend). Endangered and Threatened points were raised significantly, to 20 and 10, respectively; the remaining listing categories were unchanged. Points given to species with a frequency of rare were lowered to 1; this gave more separation between those (relatively few) species which are endemic or listed as well as rare on the island, and those (many) species which are rare on the island but more common elsewhere. The listed portion of the wildlife ranking system was then adjusted to more closely match that of the rare plant system. The final three ranking systems are presented in Tables 1-3.

It became apparent that the southern watersheds of the island were underrepresented for wildlife data due to their steep terrain, remoteness, and lack of access during wet months. Several common species, such as the Santa Catalina Island deer mouse (*Peromyscus maniculatus catalinae*) and Santa Catalina Island fox (*Urocyon littoralis catalinae*), appear to be found throughout the island, yet data is biased by the selection of roadside plots in more accessible areas of the island.

For such species, we gave points to all watersheds of the island to more accurately reflect their distribution.

These adjustments raised Wild Boar Gully to the twelfth ranked watershed on the island. Because of its limited habitat composition and lack of the more rare wildlife species, it rightfully did not emerge at the very top of the list. The rest of the watershed ranking did not change appreciably.

Because the watersheds range between 19 and 1,060 ha. (46 and 2,618 acres), we speculated that biodiversity would be overrepresented in the larger HMUs. To address this perceived problem, the total score for each watershed was divided by the watershed acreage. The result, however, favored small watersheds and did not appear to reflect biodiversity as well as the original ranking. Noting that the rare resources tend to occur in clusters apparently unrelated to the size of the HMUs, we chose to keep the original scores.

Table 1
Rare Plant Ranking System

Element	Categories and Points
Endemism	Catalina = 3 Channel Islands = 2 California & Baja Islands = 1
Listing[1]	USFWS or CDFG Endangered = 20 USFWS or CDFG Threatened (or candidate for) = 10 NatureServe G1/T1, CNPS 1A = 3 CDFG Species of Special Concern, NatureServe G2/T2, CNPS 1B, Jepson RARE = 2 Other (NatureServe G3/T3, CNPS List 2) = 1
Frequency on Island[2]	Very Rare, Rare = 1
Trend	Declining = 1

Table 1. [1]Listing Key

NatureServe (2005):
G1= Critically Imperiled G2= Imperiled G3= Vulnerable
T1-3 = Status of subspecies or variety

California Native Plant Society (2005):
1A = Presumed extinct in California. Not seen or collected within California for many years.
1B = Considered by CNPS to be rare, threatened, or endangered in California and elsewhere in their range.
2 = Considered b CNPS to be rare, threatened, or endangered in California but more common elsewhere.

Jepson Manual (Hickman 1993):
RARE = generally, those taxa included in or proposed for inclusion on CNPS List 1B; however, flux in taxonomic assessments and legal statuses, concurrent publication dates, and contrasting views led to some discrepancies between designations in the Jepson Manual and the CNPS Inventory (CNPS 2005).

Table 2 **Island Habitats Ranking System**	
Element	**Categories and Points**
% of Island	<1% = 3 1-18% = 2 18+% = 1
Listed Status: NatureServe Series Types[1] / CNDDB Rare Habitat	G1 or CNDDB Rare = 3 G2, G3 or CNDDB Partial Rank = 2 Recognized, Not Yet Ranked = 1
At Limit of Geographic Range (non-endemic)?	Yes = 1 No = 0
Endemic Habitats	Catalina = 2 Channel Islands = 1
Total Ranking of Dominants	30+ = 3 11-30 = 2 0-10 = 1
Special Importance to Wildlife (Riparian)	Riparian woodland = 2 Riparian scrub, herbaceous, or bare = 1

Table 2. [1] NatureServe Series Type Listing (NatureServe 2005)
G1=Critically imperiled G2=Imperiled G3=Vulnerable GNR=Not yet ranked

Table 3 **Rare Wildlife Ranking System**	
Element	**Categories and Points**
Endemism	Catalina = 3 Channel Islands = 2 California & Baja Islands = 1
Listing[1]	USFWS or CDFG Endangered (or candidate for) = 20 USFWS or CDFG Threatened = 10 NatureServe G1/T1 = 3 CDFG Species of Special Concern, NatureServe G2/T2 = 2 Other (NatureServe G3) = 1
Frequency on Island[2]	Very Rare, Rare = 1
Trend	Rare = 3 Infrequent = 2

Table 3. [1]Listing Key

NatureServe (2005):
G1= Critically Imperiled G2= Imperiled
G3= Vulnerable
T1-3 = Status of subspecies or variety

Discussion

This is the Conservancy's first attempt at organizing a large amount of data into a ranking system; it will continue to be refined and improved as new information is gathered. Possibilities for refinement are discussed below.

As discussed previously, points for each taxon or habitat were awarded to a watershed based on presence/absence rather than incorporating multiple occurrences, area occupied, or densities. A system where the latter features are recognized may better represent each watershed's true biodiversity, however this approach would be significantly more resource- and time-intensive.

For this first attempt at watershed ranking, we treated each category (rare plants, rare animals, island habitats) as equal. However, with additional data and knowledge we may decide that one or the other element should be weighted more heavily. In addition, our arithmetic treatment of the points' calculations may need further refinement upon examination by a statistician; suggestions and comments from readers are welcomed.

An important benefit of this ranking exercise is that, in the systematic review of an area's natural resources, gaps in knowledge become more apparent. In this case, wildlife data emerged as the weakest link in the Conservancy's database. This exercise will help us to prioritize future research projects and improve their designs, consequently enhancing this portion of the ranking.

The point system that was developed was customized to Catalina Island based on its natural resources and the Conservancy's conservation values of biodiversity, rarity, and endemism. Although this process could be repeated for any other geographical area, refinements in the points system would undoubtedly need to be made.

The uses of this project do not stop at invasive plant management. The ranking described here will provide a biological basis for sound decision making by the Conservancy in all of its practices. Additional resource values, such as archaeological and historical sites, as well as other disturbance factors, such as roads, waterways, recreation, wildfire, fence lines, utilities, and urban development, should be incorporated into the model to make it more robust and useful for additional management levels.

Summary and Conclusions

In order to protect its natural resources through site-based invasive plant management, the Catalina Island Conservancy has developed a ranking system for island watersheds utilizing extensive rare plant, animal, and habitat data. Points allocated to rare species for endemism, listed status, and rarity on the island were refined in order to reflect the Conservancy's conservation values. Prioritizing management areas enables a more systematic approach to controlling widespread invasive plant species. A site-based management plan is also an invaluable tool for decision making, when seeking program support, or when communicating with other partners and the public.

Acknowledgements

We are very grateful to Steve Junak for graciously allowing us to access his extensive field notes, without which this ranking would be incomplete. Frank Starkey assisted greatly with the naming of the HMUs. We would also like to thank Carlos de la Rosa, Jenny McCune, Jon Fox, and Darcee Guttilla for providing helpful comments and edits to this paper.

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Beyond the Plantae: Commonalities in Combating *Phytophthora ramorum*, Cause of Sudden Oak Death, and Other Plant Diseases

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The recent appearance of a devastating and exotic pathogen in California's forests has prompted enormous public interest, as well as regulatory and educational efforts to limit its distribution. The similarities in addressing the invasions of wildland weeds and of *Phytophthora ramorum*, cause of Sudden Oak Death and other plant diseases, are great. In regards to *P. ramorum*, as with many weeds, State and federal regulations attempt to limit spread; educational programs focus on personal responsibility and proper sanitation; and coordination and cooperation with the nursery industry has become crucial. The overlap in tactics and techniques when dealing with this pathogen and other invasive species highlights an opportunity to join forces in educating regulators, the nursery industry, and the general public of the hazards of global movement of species. The California Oak Mortality Task Force is excited about the prospect of working with Cal-IPC to stop the spread of both plants and pathogens damaging to California's wildlands and would like to open a dialogue about how best to work together.

Incorporating Applied Research into an Ongoing Watershed-Based, Programmatic Approach to *Arundo donax* Removal

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Since 1997, we have engaged in a programmatic approach to *Arundo donax* eradication in the Russian River watershed – one that integrates

ongoing invasive species mapping, GIS development, giant reed removal, riparian vegetation restoration, landowner outreach, community education, volunteer opportunities, and applied research. Using a question-driven approach to *Arundo* removal and the restoration of invaded sites, we have focused on a range of research needs with our program. Current research elements include descriptive assessments of landscape-level characteristics, experimental evaluations of *Arundo* physiology, and community-level impacts. Future research includes landscape scale modeling of *Arundo* population expansion, site-specific responses to removal and habitat restoration, and evaluation of ecosystem level effects of *Arundo* invasion. Our research program is iterative - developing new questions in response to the needs of local and regional efforts to remove *Arundo* and restore invaded sites.

Session 9: Partnerships for Early Detection and Rapid Response

Noxious Weed Early Detection & Rapid Response: California's Been There and is Doing Just That

Mary Pfeiffer, Shasta County Agricultural Commissioner

Recently the terms "Early Detection" & "Rapid Response" have appeared with greater frequency in organizational mission statements, in news articles, and in power point presentations throughout the state. The terms describe what should be done to prevent and/or address the continuous invasion of problematic plants into California and the rest of the nation.

What may not be well understood is that California has had an "Early Detection & Rapid Response" team in place for decades. County agriculture departments statewide and the California Department of Food and Agriculture have worked together to implement the state's Pest Prevention System. The system is designed to detect pests early, and then, if necessary, to implement eradication or management programs. The system, even with its limitations, has provided the state with a well-established line of defense.

In recent years that line of defense has faced greater challenges ranging from inadequate funding to regulatory barriers. But there has also been a wider recognition than ever before of the serious threat posed by noxious and invasive weeds, a development which is creating broader support for the county and state programs as well as other community based programs.

Early Detection & Rapid Response: a Western Regional Approach?

Eric Lane, Colorado Dept. of Agriculture

Local, watershed, and statewide efforts are underway throughout the West to detect and eradicate recent invasions of selected noxious weed species. Examples are many of local efforts to raise awareness of targeted species, improve communication among weed management professionals, and coordinate effective responses to discovered populations. However, these efforts rarely exceed state boundaries, leaving communities near their boundaries exposed to rapid invasion with little forewarning. The development of a western regional, cooperative effort to raise awareness and coordinate eradication efforts targeting common species across a larger landscape offers greater opportunities for success and more cost-effective solutions to shared problems.

The Power of Partnerships: Weed Program Management with a Limited Budget

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Funding for noxious weed programs has historically been scarce for National Forests in the California Region (Region 5). While a comprehensive noxious weed program ideally includes prevention, education, cooperation, planning and treatment; funding has been tied strictly to the number of acres treated per year. This has limited available funds and created a situation where innovation, collaboration and commitment at the field level is how much of the noxious weed work is accomplished. The Klamath National Forest and partners in the Siskiyou County Weed Management Area have been creative and aggressive when it comes to accomplishing noxious weed work. Limited funds have been leveraged with partnerships, grants and agreements, contributing labor from multiple resource functions such as fire and recreation and a strong community of volunteers to successfully fight the ongoing battle against invasive weeds. At the far northern end of California, Siskyou County is a critical pathway for weed introduction and spread into the state. This presentation will highlight the different groups that the Klamath National Forest weed program has partnered with to fight weeds.

6000 Volunteer Detection Partners: The Problem, Possibilities, and Potential

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Budget cuts and staff reductions at The California Department of Food and Agriculture (CDFA) and county agricultural commissioners means fewer trained detection professionals in the field. "Weed Tours" for field indentification of rated noxious weeds have been cut. Increased travel and the internet have opened new pathways for introduction of exotic seed and plant material. The net result is fewer eyes in the field, fewer detection surveys, and more undetected invaders.

As part of a Weed Summit a state "Weed Plan" was developed to deal with invasive plants. One of the cornerstones of the new California State Weed Plan is "Early Detection and Rapid Response". This is the most effective and economical way to deal with invasive plants. To accomplish this we need more trained observers in the field.

How can we meet this need? There is a vast untapped resource waiting to help. Government employees that are in the field, land stewards, park rangers, and utility district employees can be trained to be effective "Detection Partners." University and college staff, students, Cooperative extension volunteers and Master Gardeners are potential "Detection Partners". Non-governmental organizations such as the California Native Plant Society, Audubon Society, Sierra Club can help. Ranchers and land owners that can also be trained.

The California Invasive Weed Awareness Coalition (CALIWAC) and The California Interagency Noxious Weed Coordinating Committee (CINWCC) can network with member agencies and organizations to recruit partners. Cal-IPC can coordinate training workshops. Pilot programs have already shown success. Training materials have been developed and trainers are waiting. A system of positive reinforcement and modest rewards can create "6000 Detection Volunteers."

Posters Presented at the 2005 Cal-IPC Symposium

Analysis of Clonal Diversity in Giant Reed (*Arundo donax* L.) Using Molecular Markers

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Giant reed (*Arundo donax*) is an exotic perennial grass that has invaded riparian areas throughout California and many other regions of the world. Its success as an invasive species is at least partly attributable to its rapid clonal spread by rhizome extension and flood dispersal of plant fragments, since viable seed does not appear to be produced in the United States. To measure genetic diversity in this clonally propagated species, we genotyped 144 leaf samples of *Arundo* collected from California, Texas, Mississippi, Florida and France. For maximum genome coverage, we used two molecular marker systems: (1) ten SRAP (Sequence Related Amplification Polymorphism) markers, a gene-targeted marker system, and (2) fifteen transposon-based molecular markers, which primarily amplified non-coding regions of the genome. Our results indicate that, with the exception of a few minor differences, all tested samples are represented by a single clone despite the extreme geographical distance among the accessions. The lack of genotypic diversity in giant reed suggests biological control of the species could be successful.

Resource Kit for Management of Non-native Plants in National Parks

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Introduction of non-native plants is detrimental to ecosystems. Once established, invasive exotic plants alter native habitats and populations of indigenous species. Eradication is costly and often impossible. Thus, it is best to prevent invasions. Dominican University of California (DU of C) and National Park Service (NPS), along with other partners, have formed a team to investigate sources and dispersal methods of non-native plants into new habitats. The project team is synthesizing vast amounts of information available about the developing California Weed Free Feed and Mulch Program. As education is integral to this project, DU of C faculty and students are developing a resources kit for use in California's National Parks. The kit will serve as a basis for educating NPS employees and concessionaires as well as the public about use of best management practices to prevent invasion and spread of non-native species. Components of the kit will include: information about the NPS Units, a list of non-native plants for each park, and an explanation of how weeds spread and negatively impact natural habitats and landscapes. In addition effective practices and procedures to prevent infestations will be illustrated. The goal is to change existing practices, associated with stock feed, mulches, soils, and by human activities within and around California NPS Units that inadvertently result in establishment of non-native plants.

Tumbleweeds of California - Who, What, Where, and How?

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Salsola tragus has spread widely throughout the U. S. since its introduction in the 1800s. *Salsola paulsenii* has been known for decades from the transmontane regions. A third *Salsola* species, referred to here as 'B', was recently recognized as occurring widely throughout low elevation cismontane California. Two additional *Salsola*, termed 'C' and 'lax', were found in the southern San Joaquin Valley and western Mojave Desert. Our goals were to develop keys to identify these five taxa, to determine whether the groups were genetically distinct using DNA markers, to map the distribution of the four taxa that occur north of the Tehachapi, and to determine the relationships among the taxa using microsatellite DNA markers. A principle components analysis based on morphological traits distinguished the five taxa. Both RAPD and ISSR DNA markers clearly separated the 5 groups genetically. *S. tragus* and 'B' were widespread in the central valley and coast ranges, while 'lax' and 'C' were found primarily around Bakersfield and in the western Mojave. Microsatellite analyses suggested that 'C' is an interspecific hybrid between *S. tragus* and 'B', and that 'lax' is a complex hybrid involving *S. tragus*, 'B', and *S. paulsenii*.

Cape Ivy Removal at Golden Gate National Recreation Area and Point Reyes National Seashore

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Between 2004 and 2006 Golden Gate National Recreation Area and Point Reyes National Seashore are working to remove its most invasive plant, *Delairea odorata* (Cape Ivy). Under a federal grant, park staff are in the second year of eradicating the choking vine from riparian, coastal scrub and oak wood forests. Cape Ivy causes significant reduction in native plant species richness and reduces the abundance of insects in riparian habitat. This brittle vine spreads by readily breaking at the node to re-sprout new individual sprigs. The first phase of "initial" removal is conducted in the fall, outside the bird nesting season, and involves limbing and cutting back native vegetation to access and remove the infestation. Sites are raked to mineral soil to expose the shallow cape ivy roots and fragments. Cut vegetative material is covered in landscape fabric and left at the site for decomposition. The "follow-up" phase is the most time intensive process, involving hand picking re-sprouting cape ivy fragments 3 weeks after initial removal and subsequent visits over several years. The effort involves contracted restoration crews, Americorps members, interns, volunteers, and NPS and Park Partner staff. Removing cape ivy in contiguous watersheds has been successful. In 2004, the first year of the grant, Golden Gate NRA removed its target goal of 7.5 acres and Point Reyes NS removed 8.3 acres of Cape ivy infestations.

Evaluation of Non-Chemical Control Strategies for Common Aquatic Weeds in California

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Little of no quantitative data exists for the aquatic weed management professional to compare non-chemical control techniques to the use of aquatic pesticides. The efficacy, cost-effectiveness and impacts to water quality when non-chemical control techniques are employed was

studied and documented on aquatic emergent, floating and terrestrial weeds. Techniques evaluated were goats, mechanical removal, chemical treatment followed by mechanical removal, and manual removal by labor crews using power equipment. Water quality impacts including the presence of coliform and *E. coli* were noted. Significant differences in cost per acre treated and efficacy were noted in the study and may be useful for the practitioner evaluating the relative merits of chemical vs. non-chemical control techniques.

Perspectives of Nursery Professionals on Invasive Plants and the St. Louis Voluntary Codes of Conduct

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The St. Louis Voluntary Codes of Conduct have received much attention and optimism as a potentially effective tool to curb continued introduction of invasive plants via the horticulture trade. These Codes, drafted in 2001, emphasize industry cooperation and modification of nursery practices. We chose to examine the awareness, behavior, and attitudes of nursery professionals regarding invasive species and their willingness to change nursery practices to reduce invasive plant introductions. We conducted a telephone survey of nursery professionals from retail and wholesale nurseries and growers in the San Francisco Bay Area. Our survey results indicate that a very high level of awareness exists among nursery professionals regarding invasive plants and of the horticulture trade's role in invasive plant introductions. Furthermore, survey respondents indicated the nursery trade should be more responsible than non-industry groups (including consumers, government, policy makers, and scientists) for preventing the introduction of invasive plants. Although very few survey respondents had ever heard of the St. Louis Codes of Conduct (7%), approximately 28% of respondents said they have carried out a majority of activities suggested by the Codes. Our results provide insight into nursery professionals' perceptions that may facilitate the creation of partnerships to curb invasive plant introductions via the horticulture trade.

Noxious Weed Management on National Forests in California: Regulations, Tools and Tactics

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The US Forest Service has declared nonnative, invasive species a key threat to National Forests. Invading weeds can alter species diversity, hydrology, nutrient cycling, and natural disturbance patterns such as frequency and intensity of wildfires. Changing these patterns can lead to displacement of native plant species, eventually impacting wildlife and plant habitat, indigenous use, recreational opportunities, forage production and scenic beauty. The Forest Service has developed an integrated management strategy to address the problems associated with the introduction and spread of invasive plant species, noxious weeds. California National Forests total approximately 20 million acres. These areas provide drinking water and support a wealth of plant and animal diversity. They also support recreational activities and timber production. Fire exclusion and logging have created environmental conditions which favor replacing wildfires and subsequent weed invasion. As a result, land managers of these National Forests face a unique challenge to manage noxious weeds. Tools used to combat noxious weeds include: prevention of new introductions, mapping and identification, and treatment of sites with an array of techniques.

Invasive Plant Control at California State Parks in the Northern Sacramento Valley

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Along the lower Sacramento River, Woodson Bridge State Recreation Area (SRA), Bidwell-Sacramento River State Park, and Colusa-Sacramento River SRA have become refuges for ornamental and agricultural exotics that thrive where summer water is not limited. These exotics include *Ailanthus altissima* (tree of heaven), *Arundo donax*, *Catalpa* sp., *Celtis* sp. (hackberry), *Ficus carica* (edible fig), *Juglans* sp. (walnut), *Morus* sp. (mulberry), *Prunus* sp. (prune rootstock), *Rubus discolor* (Himalayan blackberry), *Vinca major* (periwinkle), and others. Field experience over several years has resulted in successful use of mechanical control methods, as well as frill-and-squirt, drill-injection, basal spray, and foliar spray techniques with glyphosate, triclopyr, and imazapyr. Where control of exotics creates openings for reinvasion, site-appropriate natives are planted and cultivated including *Carex barbarae* (white-root sedge), *Platanus occidentalis* (California sycamore), *Populus fremontii* (Fremont cottonwood), *Quercus lobata* (Valley oak), *Salix* sp (willow), and native grasses.

Invasive Plants of Western United States: Identification and Control CD-ROM

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The success of the Invasive Plants of the Eastern United States: Identification and Control CD-ROM (FHTET-2003-08) has encouraged us to initiate a similar project for the Western United States. The Invasive Plants of Eastern United States CD has proven to be a useful tool for land managers, educators, researchers, private citizens, or others dealing with the issue of invasive weed species. Over 15,000 copies of the Eastern CD-ROM have been pressed and distributed at no cost by the US Forest Service, Forest Health Technology Enterprise Team (USFS-FHTET). In collaboration with the USFS FHTET, USDA-APHIS PPQ and others, together with the experience gained from developing the Eastern CD, the Bugwood Network is initiating the "Invasive Plants of the Western United States CD-ROM" project.

The focus of this new CD-ROM will be providing identification, ecology, and control information for the worst invasive plants in the Western United States, including the Midwestern prairies and forests, Great Plains, western mountain ranges, deserts, and the Pacific coast. It will be available at no cost through the USFS-FHTET.

If you and your organization have publications, photographs and other information that would be useful to include in this upcoming CD-ROM and web information, please contact us.

Phragmites australis in the Humboldt Bay Region: Biology of an Invasive Species and Opportunities for Treatment

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Phragmites australis (common reed) is a pernicious invasive exotic that is widespread in distribution throughout the United States, and occurs in a handful of unique habitat types in the Humboldt Bay region. Although native forms of the species do occur, morphological analyses of Humboldt County plants has confirmed that local occurrences are exotic. The variety

of habitat types in the region supporting *Phragmites* include 1) Palustrine emergent wetland (freshwater drainage ditch); 2) Estuarine emergent intertidal (bay island); 3) Estuarine emergent with freshwater and muted tidal influences (marsh complex); and 4) Isolated Palustrine emergent wetland with relict saline soils. Due to various management limitations, each site poses a different opportunity for method of treatment and analysis of treatment success. Treatment and eradication of *Phragmites* at these locations can be a first step towards site enhancement and habitat restoration.

Perennial Pepperweed Control Experiment at the Cosumnes River Preserve

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We are using a full-scale experimental design to determine what method of perennial pepperweed control is most appropriate based on site conditions including existing vegetation, soil characteristics, and flooding regime. The Cosumnes River Preserve Perennial Pepperweed Control Project, a three-year, CALFED-funded project which began this summer, investigates weed control in seasonal floodplain habitats in Sacramento county. Our study contains the follow research components:

Control Experiment

- Herbicide (Telar, Aquamaster, Garlon) versus 2-year tarping treatment
- Cut stem versus mow + broadcast spray herbicide application
- Mow versus mow + disk tarp pre-treatment
- Soil Characterization
- Soil physical & chemical parameters tested for correlation with weed control/restoration success
- Bioassay testing to assess herbicide soil residue levels
- Passive Restoration Monitoring
- Vegetation monitoring pre- and post-treatment
- Seedbank analysis

The results of these experiments will be used to develop site-specific adaptive management guidelines for control of perennial pepperweed at the Cosumnes River Preserve. These guidelines and the research results on which they are based will be shared with the entire conservation community so as to better inform weed control efforts on similar lands throughout the CALFED Bay-Delta area and beyond.

Which Weed to Whack?:The Cal-IPC Invasive Plant Inventory

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Land managers, often faced with an overwhelming number of invasive species, need to know where to focus their control efforts. The California Invasive Plant Council (Cal-IPC)'s Invasive Plant Inventory (commonly called the "weed list") addresses this need in several ways. It provides a tool to help land managers choose priority species for control, alerts restoration workers to new problem species, identifies research gaps, and aids in commenting on environmental documents. It also serves as a resource for working with the horticultural community to identify problem plants still on the market.

The 2005 list updates and expands the 1999 version, which was based primarily on the knowledge and judgment of an expert panel. The 2005 list uses a new criteria system and includes detailed documentation on approximately 300 non-native species that invade wildlands in California. It is the most comprehensive summary available on these plants. Each species was categorized using a Plant Assessment Form (PAF) with 13 criteria divided into three sections:

ecological impacts, potential invasiveness, and habitats invaded. Scores from each section were combined into a total rating of High, Moderate, Limited, or Considered But Not Listed. Ratings represent the level of statewide ecological concern for that plant. Species with high scores on impacts, but limited current distribution, were designated "Alert" plants, indicating their high potential for spread. Plant Assessment Forms and the full criteria are available on the Cal-IPC website (www.cal-ipc.org).

In early 2006, the full list of ratings will be published in a summary that will include habitats of concern and geographic regions invaded (based on the Jepson Manual). Future plans include developing an on-line system where land managers can submit and view data on new invasions.

Effects of Single Pass Flaming on Previously Brush-cut *Genista monspessulana*

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Abstract

Propane flaming has been shown to be an effective tool in managing *Genista monspessulana* seedlings. The Marin Municipal Water District (MMWD), in conjunction with the Marin Conservation Corps (MCC) /Americorps Program, tested the efficacy of single-pass propane flaming on resprouting *G. monspessulana* plants that had been repeatedly mowed. We compared the mortality rates of single-pass flaming of resprouting *G. monspessulana* with that of a control treatment--brushcutting. We also examined the impact of stump size on survivorship. We found a statistically significant difference in the effects of propane flaming versus brushcutting, with propane flaming resulting in higher mortality rates and greater decreases in both percent cover and overall *G. monspessulana* growth post-treatment. Propane flaming resulted in a mortality rate of 80%, while the control treatment of brushcutting resulted in a 2% increase in the mean number of live stems per plot. Size had a statistically significant impact on survivorship (p-value < 0.01). Mean root crown diameter of surviving plants was 13.6 cm while the mean root crown diameter of killed plants was 7.8 cm. The largest individual to be killed by flaming had a root crown diameter of 31.5 centimeter. It should also be noted that the *G. monspessulana* mortality rate in the size effect trial was only 54%; we believe this is a direct result of our intentional selection of very large resprouts for inclusion in the trial.

Background

The Marin Municipal Water District owns and manages approximately 18,500 acres of watershed lands in the Mt. Tamalpais region of Marin County. While only 3% (700 acres) of district lands are infested with *G. monspessulana*, this invasive species poses a significant challenge. Because district policies prohibit the use of herbicide applications in close proximity to the reservoirs and upstream creeks, the District's approach to *G. monspessulana* management has been that of containment. Extensive stands of *G. monspessulana* are mowed annually to prevent seed production and reduce fuel loading. This method does not result in high levels of broom mortality and does not address the long-term maintenance costs or habitat degradation posed by *G. monspessulana* resprouts. Sites that have been previously treated by mowing are considered unsuitable for handpulling due to the high density of resprouting shrubs with extensive, hard-to-pull root masses. Handpulling, a lethal method that promotes the long-term recovery of invaded sites and over time reduces maintenance costs, is therefore restricted to unmowed sites.

MMWD recently adopted the use of propane flaming to kill *G. monspessulana* seedlings that emerge after handpulling or broadcast burning. In this study, we examine the potential of propane flaming to treat previously mowed, resprouting *G. monspessulana*.

Site description: The study site is located at Pine Point on the Bon Tempe Lake shoreline in the Mount Tamalpais Watershed in Marin County, California. The site was quarried during the construction of Bon Tempe Dam and is highly disturbed. Stem density in the area is approximately 71,000 stems per acre. *G. monspessulana* is well established on the remaining subsoil. For the past fifteen years, the site has been mowed at least annually. The site was burned in the summer of 2001 as part of a larger habitat restoration project. The study was conducted between March and June 2005. Unseasonably late rains occurred multiple times following the initial treatment.

Methods

In March 2005, all *G. monspessulana* in the site received the annual treatment of brushcutting to a height of 10 cm. For the treatment efficacy experiment, eight plots were set up for control and received no additional management. Sixteen plots were set up for treatment and were flamed until individuals became charred using a liquid-withdrawal torch propane system (Red Dragon Liquid torch kit: liquid torch 750,000 BTU). Flaming time varied with the size of individual plants with flame applied for as long as was required for all above-ground parts of target plants to appear charred. Treatment and control plots were ½ m by ½ m separated by 1 m buffers. Plot location was randomized to prevent topographical biases. Data were collected on stem height, number of resprouts and seedlings and percent cover. Data were collected immediately before flaming and again in June, 2005. For the size correlation experiment, fifty plants (25 larger individuals and 25 smaller individuals) in close proximity to each other were tagged. The diameter of each plant was recorded in four cross sections, according to cardinal directions. The mean diameter size of treated *G. monspessulana* stumps was 10 cm (+/- 2). The individuals were flamed until they appeared charred. After three months, data was collected on the survivorship of the individuals. The data were analyzed using one-tailed t-tests.

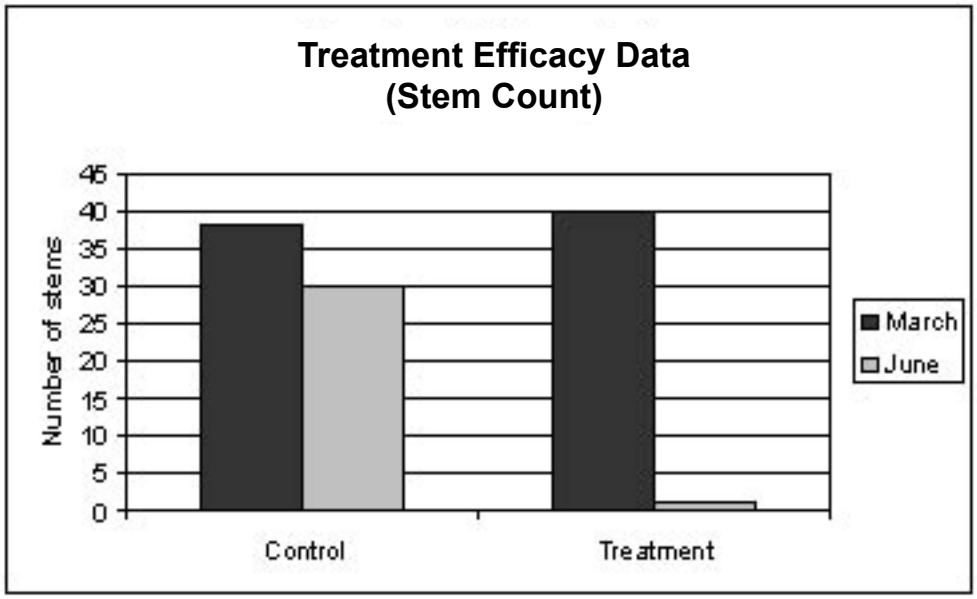
Results

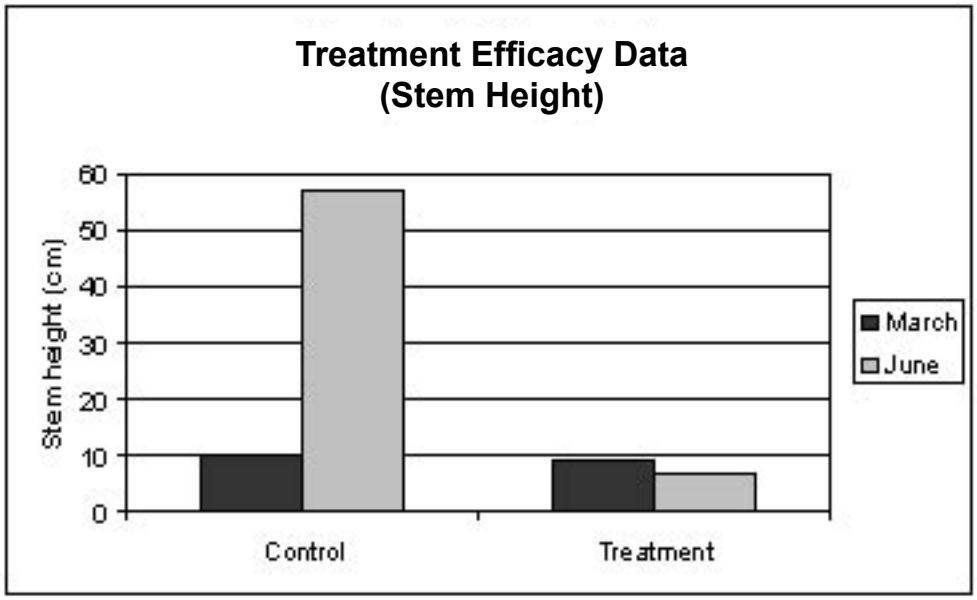
Treatment Effects

The treatment of brushcutting previously mowed *G. monspessulana* followed by propane flaming resulted in statistically significant decreases in live *G. monspessulana* stems per plot ($p < 0.001$) while the control of brushcutting alone resulted in no statistically significant change in live *G. monspessulana* stems per plot ($p = 0.44$). Treatment plots also experienced a statistically significant decrease in percent cover of *G. monspessulana* ($p < 0.002$) with mean percent cover per plot dropping from 4.4% to 1.4%. Control plots experience a statistically significant increase in percent cover of *G. monspessulana* ($p < 0.002$) with a mean percent cover per plot increasing from 5% to 51.6%. Propane flaming decreased the mean stem height per plot from 9.4 cm to 6.8 cm, although this was not statistically significant ($p < 0.15$). In control plots, the increase in mean stem height from 10 cm to 56.7 cm was statistically significant ($p< 0.001$).

Size Effects

The size of *G. monspessulana* individuals subjected to propane flaming was correlated with survivorship. There was a statistically significant difference in the mean root crown diameter of individuals that survived 3 months following treatment ($p < 0.005$), with surviving individuals having a mean root crown diameter of 13.6 and dead individuals having a mean root crown diameter of 7.8. Large individuals did succumb to treatment however; the largest plant to die following propane flaming was 31.5 centimeters in diameter.

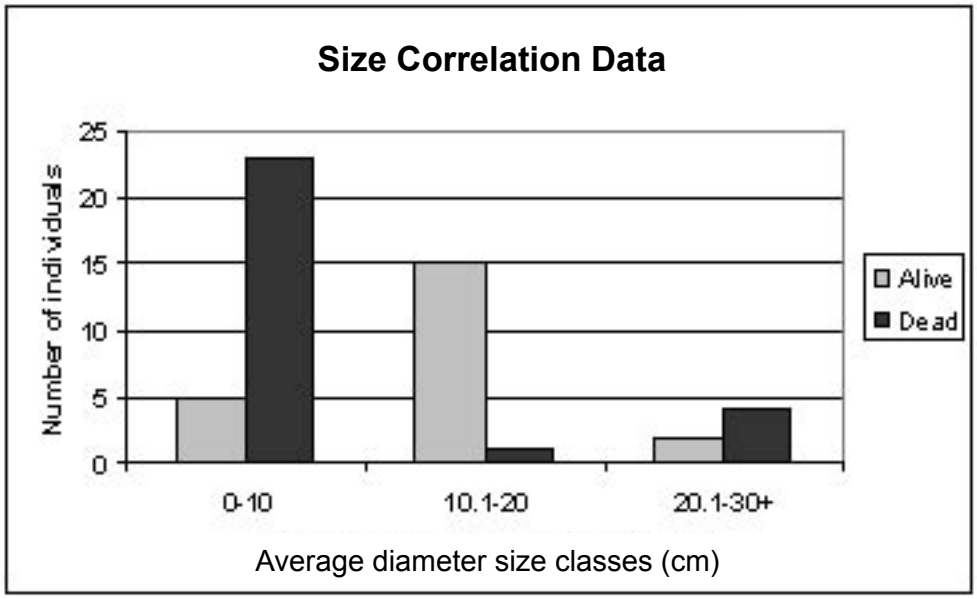




Discussion and Conclusions

Propane flaming is an effective method for killing previously brushcut *G. monspessulana*, although the size and age of the individual plants targeted for treatment impacts survivorship. We believe greater size results in greater survivorship because individual plants with larger root crown diameters have correspondingly higher nutrient reserves stored in their roots and are better able to recover from a flaming treatment. Propane flaming resulted in the death of some very large individuals, but we believe the torch operator applied flame to these individuals for longer periods of time than to smaller plants.

Our two trials, treatment effect and size effect, resulted in mortality rates of 80% and 54% respectively. We believe the difference in these mortality rates reflects the effect of size on survivorship. In choosing individuals for the size effect trial, we intentionally included individuals at the high end of the overall size distribution of *G. monspessulana* in the project area, thus selecting



a disproportionate number of likely survivors. Propane flaming appears to be a viable option for killing previously brushcut *G. monspessulana*. As expected, it is most efficient when used on younger, smaller *G. monspessulana* individuals. The method is slow and the equipment somewhat cumbersome, particularly on steep slopes. Its safe use is limited to the rainy season. Nonetheless, it offers a non-chemical alternative for effective *G. monspessulana* management.

Blurring Edges: A Test of Weed Control Methods Used Along Edges of Sage Scrub Patches to Encourage Shrub Colonization into Abandoned Agricultural Fields

Eliza Maher* and Edward Stanton, Center for Natural Lands Management, Western Riverside County Preserves, *emaher@cnlm.org

Applying techniques to encourage native plants to colonize disturbed areas may be an effective alternative when time is less limiting than funds. Johnson Ranch is a 1,400 acre Ecological Preserve in Southwestern Riverside County consisting of remnant patches of Riversidian sage scrub (RSS) in a matrix of abandoned agricultural fields. The agricultural fields are now converted to non-native annual grasslands (NNG) dominated by *Avena barbatus*, *Bromus* spp., *Brassica geniculata*, and *Raphanus sativus*.

To achieve our objective of increasing the total acres of RSS within the Preserve, we are testing three combinations of weed management techniques within NNG along sharply defined edges of RSS. Our goal is to determine what mix of chemical (grass specific herbicide, FusiladeII) and mechanical (mowing) treatments is most cost-effective in converting NNG to RSS near the interface between the two plant communities. We discuss our experimental design, treatment procedure, and vegetation monitoring method. After three to five years of treatment application and data collection, we will apply our results by implementing the most effective weed management technique on all ecotonal areas within the preserve.

Phenology of *Brassica tournefortii* in Comparison to *B. nigra*, *B. geniculata*, and Native Mojave Desert Annuals

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Brassica tournefortii, or Sahara mustard, is an exotic invasive mustard increasing in dominance throughout the southwestern deserts. It is rapidly invading the Mojave desert where only *Schismus* spp. and *Erodium cicutarium* were previously known to invade. Although it has been assumed that *B. tournefortii* is able to invade the Mojave because of its early germination and rapid development, the phenology of *B. tournefortii* has not been studied or measured against comparable native and exotic annuals. Furthermore, *B. tournefortii* is relatively new to the Mojave and selection may have played a role in its expansion. This study was conducted with two goals: first, to determine the phenological characteristics of desert and non-desert populations of *B. tournefortii* and compare this phenology with other invasive mustards not present in the Mojave. Second, this research compared the phenology of *B. tournefortii* with native annual species and observed the impacts of *B. tournefortii* density on native annual diversity, dominance, survival, and fecundity. Preliminary greenhouse results show that *B. tournefortii* has a faster development than *B. nigra* or *B. geniculata*. Preliminary results from the field suggest that sites beneficial for native annuals may also be most beneficial for *B. tournefortii*.

Experimental Herbaceous Restoration and Noxious Weed Mitigation at the California Department of Fish and Game's Butler Slough Ecological Reserve, Eastern Tehama County

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Experimental herbaceous restoration and noxious weed mitigation is being conducted at the California Department of Fish and Game's Butler Slough Ecological Reserve (BSER) in eastern Tehama County. The BSER consists of 54-acres of former plum orchards and remnant riparian forest located between shallow rangeland soils to the east and deeper orchard soils to the west.

The main components of this project are (1) seed collection and greenhouse propagation of a suite of native perennial grasses and forbs; (2) on-site reduction of noxious species with an emphasis on medusahead (*Taeniatherum caput-medusae*) using mechanical and chemical means; and (3) direct seeding of perennial grasses and forbs in experimental plots under four seeding conditions: grasses only, forbs only, grasses and forbs, and weed reduction only (controls).

The objectives of the BSER project are to examine methods for on site reduction of invasive winter annuals such as medusahead while increasing the species scope in herbaceous restoration. Propagation of a suite of herbaceous species is currently lending insight into the potential use of these species in grassland restoration and noxious weed mitigation projects.

Correlation Between Weed Control Techniques, Cost and Habitat Restoration Success: Two Case Studies

Dan Ryan and Andrea Vona. Palos Verdes Peninsula Land Conservancy, dryan@pvplc.org

The majority of undeveloped open space in Southern California contains degraded habitat and is commonly inundated with non-native weeds. The growing discipline of habitat restoration attempts to reverse this decline in the quality of habitat and to reestablish the flora that supports the ecology of the region. The primary

goal of restoration is to contain and eventually diminish the weed population, providing resources required to establish native habitat, generally through out-planting or seeding. To address this goal, various methods of weed control can be used. These techniques differ on many levels; equipment, cost of labor, methodology, and managerial oversight are all components that require attention in the development of a restoration project and budget planning. Two separate restoration projects on the Palos Verdes Peninsula consisting of coastal sage scrub and riparian habitat will be analyzed. A comparison of weed control techniques, cost of implementation, and success of habitat restoration will be conducted for two sample areas within each habitat type. An analysis of the results will reveal recommendations for weed control methods/restoration techniques in relationship with cost of the project in order to ensure success.

Effect of Fertilizer Additions on Yellow Starthistle Insect Biological Control Agents

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A number of studies indicate that adding fertilizer to plants influences growth, reproduction, and grazing by herbivores. We tested the hypothesis that adding fertilizer to yellow starthistle plants would increase population densities of insect biological control agents by adding combinations of N and P + S to grassland plots at two sites in northern California. We monitored insect abundance by direct counts, using sticky traps, and dissecting yellow starthistle flower heads collected at various times throughout the growing season. Plots that received N additions at Putah Creek had higher numbers of *Chaetorellia succinea*, but not *Urophora sirunaseva* and *Eustenopus villosus*. At Cache Creek, only the abundance of the *Eustenopus villosus* increased with N addition. The overall rate at which flower heads were attacked increased with N addition at Putah Creek. Although the mechanism underlying these increases is not known, these results indicate that it may be possible to enhance local densities of biological control agents and the rates at which yellow starthistle flower heads are attacked in some but not all habitats by adding N to the soil.

Exotic Annual Control and the Competitive Release of Native Forbs: An Example from the Northwest Sonoran Desert

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Exotic annual grasses and forbs have become increasingly dominant components of the Mojave and Sonoran Deserts. The purpose of this study was to evaluate the response of native forb species to the removal of exotic grasses and forbs. This experiment took place in a creosote bush scrub community located in the Coachella Valley, California. The exotic grasses *Schismus barbatus* and *S. arabicus* were removed from experimental plots using the grass-specific herbicide Fusilade II®. The exotic forb *Erodium cicutarium* was removed by hand pulling. Three treatments that included a control, herbicide, and herbicide plus hand-pulling of *E. cicutarium* were implemented in interspace and understory habitat. Removal of exotic grass species resulted in the increase of native forb % cover and biomass in both habitats. In interspace habitat, % cover of native forb species was only significantly greater in herbicide plus hand pulling of *E. cicutarium* plots, suggesting that exotic forbs can be strong competitors with native forbs.

These results also demonstrate that the control of both exotic grass and forb functional types may be necessary for optimal competitive release of native desert forbs.

Role of Large Herbivores in Spreading Non-native Invasive Plants into Natural Areas

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*Mietek_Kolipinski@nps.gov

Invasion of non-native plant species is a universal issue and of concern to land management agencies. Exotic plants alter ecological processes and lead to loss of biodiversity in protected areas. We looked into the role of large herbivores in spreading weeds into California's National Parks. Literature review indicated horses and other herbivores are associated with invasions of non-native plants. Evidence exists in USA and other countries that weeds spread by passage of seeds through the horse gut and subsequent sprouting from manure. Also, the literature points to numerous noxious plants arising from uncertified horse hay, including yellow starthistle, medusahead, perennial pepperweed, broom, and fennel. Further, weeds are introduced through use of animal feed, such as hay and alfalfa, containing seeds. A synthesis report on this topic is in preparation. Additionally, as part of this project the research team at Dominican University of California and the National Park Service are conducting a study to determine what plants grow from horse manure sampled at a variety of locations in California, including national parks. Findings from this project will be shared with park employees and concessionaires, and with the public.

2004 Invasive *Spartina* Project Monitoring Program

Katy Zaremba, San Francisco Estuary Invasive Spartina Project, California Coastal Conservancy, (510) 548-2461, kzaremba@spartina.org, www.spartina.org

The purpose of the 2004 survey was (1) to assess the current distribution of introduced *Spartina* species in the San Francisco Estuary, (2) to quantify net acreage for each of four non-native Spartina species, (3) to determine the spread since the 2001 Estuary-wide inventory, and (4) determine the control efficacy at sites treated in 2003. The mapping project was a field-based effort, utilizing GPS units to collect location and ecological data for each found population of invasive Spartina. In addition to detailed field mapping, aerial photos and ground truthing were utilized to map highly infested marshes. Genetic testing was conducted to confirm identification of *S. alterniflora* hybrids. In 2003, the *Spartina* invasion at a subset of 28 sites, stratified across the Estuary by latitude and marsh type, was examined. In 2003, the average percent increase in area since 2001 for *S. alterniflora hybrids* was 329%. According to average percent increase across the sampling sites of 2003, the net acreage of *S. alterniflora* hybrids bay-wide was estimated to be 2,012 acres. The more labor-intensive estuary-wide inventory of 2004 will be compared to the estimates calculated from the stratified sampling methods used in 2003.

Working and Discussion Group Notes

Horticulture/Landscaping Alternatives Working Group

Leader: Mark Newhouser
Facilitator: Kate Symonds
Notetaker: Christy Brigham

Attendees

Name	Organization	E-mail
Kathy Nolan	NWA and Associates	NWAkn@aol.com
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Kate Symonds	NRCS	kate.symonds@ca.usda.gov
Tanya Meyer	CLBL	tanyajmeyer@hotmail.com
Kelly Rose	Ballona Wetlands	ecorestoration@verizon.net

Terri Kempton and Mark Newhouser provided an introduction to the project of removing invasive species from nurseries highlighting:

- Work with the horticulture industry to reduce use of invasive plants in horticulture
- Goal of removing invasive plants from sale
- Goal of addressing a certain number of plants (not all species)
- Using Cal-IPC criteria for selecting plants to focus on
- 22 people are on the steering committee for the project including representatives from:
    - landscape architects
    - Home Depot
    - Growers
    - John Randall (TNC)
    - Sarah Reichart (University of Washington)
- Goal of transparent collaborative process
- Communicate results of project back to constituencies for consensus
- Achieve change from within the industry

Terri Kempton also mentioned that:

- Sustainable Conservation has a quarterly newsletter
- The plant list of focus species has been identified
- A toolkit and outreach materials are being developed for each species focusing on separate information for producers and consumers
- They hope to have the toolkits completed within a year
- They are currently working with Sunset magazine on an article
- In 2007 they will be working on predictive measures to use on potential new landscape plants to predict invasive potential
- The door opened to working with the nursery industry at the last symposium where Monrovia was represented

Mark Newhouser also gave a brief tour of the Cal-IPC webpage and the Don't Plant a Pest brochures.

Kate Symonds (facilitator) asked how many people in attendance had experience working with the nursery industry on the invasive species issue.

Nine people indicated past work with nursery industry. People described the following experiences:

Sue Fritske (Golden Gate National Recreation Area) commented on seeing over 20 nurseries in Marin county selling invasive plants near the GGNRA. She had the following suggestions:

- Get listings of local nurseries
- Assign people to work with local nurseries in each area
- Avoid duplication of contact
- Discuss having displays at nurseries
    - Provide brochures at nurseries with alternatives available for purchase on the spot
    - Help nurseries avoid being hit with an economic loss by promoting alternatives
    - Avoid the need for the consumer to search for alternatives

Kate Symonds added that we should help nurseries with a seamless transition away from invasives with no economic loss.

Sustainable Conservation is discussing nursery displays and approaches.

Sustainable Conservation is discussing certification for landscapers with invasive species training.

Mark Newhouser passed around a regional contact list for the Don't Plant a Pest brochures.

Linda Hillman described her personal interactions with nurseries (at Home Depot and elsewhere). There is a local nursery in Berkeley that sells a lot of native plants but also sells iceplant. When Linda questioned them about the iceplant they made excuses and justified their actions. Linda suggested that CNPS might be a good contact group for nurseries.

Terri Kempton mentioned designing promotional information for nurseries about the program and also for nurseries to provide to consumers. In addition, she mentioned developing the idea of sending pledge letters to nurseries – if they get rid of invasives and carry alternatives instead; we pledge to purchase the alternatives from that specific nursery.

Mark Newhouser mentioned that we would make information about this project and Sustainable Conservation available on the Cal-IPC webpage.

Mark Newhouser commented that resale outlets must demand the invasive alternatives from the wholesalers.

We should approach Horticulture and Landscape architecture departments in all colleges as a form of outreach.

Sam commented that there are lots of old school Horticulture teachers out there. It is vital to get invasive species issues into the curriculum.

Susan Mason mentioned addressing the issue of demand for these plants by contacting newspapers and garden editors and having them write articles addressing the garden escape issue.

Sam also commented that the brochure is an extra thing to pick up, what about incorporating issues of invasive plants into the Western Garden Book?

There was a brief discussion on what is currently in the Western Garden Book – currently a small disclaimer about some species but no symbol for invasive.

Jennifer Burt mentioned that UC Davis IGERT have made contact with the editors of the Western Garden Book and are looking into this issue.

Elaine Jackson is concerned about potential economic impacts to nurseries. One way to offset economic impacts would be to link alternatives to fire safe landscaping and market the list to nurseries and consumers living near open spaces prone to fire.

Several lists could be developed- an allergy-free list, a fries safe list, a drought tolerant list. Right now the Fire Safe Council's list of fire safe plants is full of invasive plants.

Mark Newhouser mentioned that it is important to get comments in early during the development of these plant lists so that they can be removed prior to printing. The Marin-Sonoma WMA lobbied for changes when their local fire safe list was being revised.

Daniel Songster mentioned that it is great to have nurseries at the table. He mentioned previous CNPS efforts with Jake Sigg to approach nurseries. Local people working with local nurseries had great success when the people involved had good outreach skills.

Daniel Songster – CNPS has an up and running Horticulture committee. Peggy Duvall is the contact. Daniel is on the committee. We need to strengthen the tie between CNPS and Cal-IPC.

Kate Symonds mentioned the need to make contact with Master Gardeners.

Bertha McKinley described approaching big chain stores and being bucked up the chain of command. The sales staff is often on board with not selling invasives but doesn't have any ability

to do anything.

Sue Fritske mentioned the need to approach not just growers but also seed companies. GGNRA was selling "native California wildflowers" in their visitor center that was full of non-natives and genetically inappropriate plants.

Terri Kempton mentioned that staff training is a big concern for nurseries.

Terri Kempton – Home Depot has a single buyer who purchases plants for all the Home Depots in the western half of the country. This buyer is very receptive to invasive plant concerns.

Jennifer Burt mentioned that plant purchasing can be at the level of the individual at small nurseries and grassroots efforts at education have their place.

Stephen Jones inspected plant materials coming in for the county Agricultural Commissioners office. He sees the impacts of invasive species on roadsides and flood control channels. He is also working on mitigation projects and sees consultants recommending inappropriate plants.

Stephen Jones mentioned contacting the California Association of Nurserymen, C.L.C.A. (Landscapers), PAPA (a pesticide training group), and designers of large building projects (condos, etc.). He also mentioned the up and coming problem of water gardens.

Mark Newhouser asked Stephen about regulating shipments.

Stephen said regulation was easy – they could destroy or return it to the place of origin – but only for listed noxious pests.

Jennifer Burt and Adrianna Muir, along with other UC Davis graduate students, did a project surveying nursery professionals in the Bay Area about their awareness of invasive species and the St. Louis Voluntary Codes of Conduct. They interviewed retailers, wholesalers, and growers in the Bay Area and asked to speak with people who had purchasing power (purchasing agent, manager, owner, etc). They asked about awareness and implementation of preventative measures regarding invasive species. They found that very few nursery-people were aware of the St. Louis codes. They have a poster at the Cal-IPC conference.

- 100% of people contacted had heard something about the invasive species issue.
- 81% were aware of the role that the nursery industry plays in introducing invasive plants.
- 28% had engaged in the majority of preventative measures that are listed in the St. Louis codes.
- The 28% taking action were more likely to be involved with some sort of nursery trade association and want to project a green business image.
- All respondents cited 'lack of information' as the greatest obstacle to engaging in The Codes. They need detailed information on the day to day implementation of preventative measures. Other discouraging factors cited by 'inactive nurseries' were lack of funds and lack of personnel.
- Many people (41% of respondents) were willing to engage in The Codes.
- There is a great potential for increasing involvement.
- 31% said they have not and would not engage in preventative measures.
- There was no correlation between cooperation and large versus small nursery.

Kate Symonds mentioned that this study could be used to structure efforts for a nursery outreach program.

Jennifer and Adrianna said they will pass on

their information to Sustainable Conservation and Cal-IPC.

The project was a side project. They hope to pass on the results and publish a journal article on the project.

Jennifer and Adrianna also asked the nursery-people what reference they used and do they make their own plant labels. Sunset Western Garden Book was the most commonly used reference.

Jennifer is interested in doing an internship with Sunset. They invited the garden editor to UC Davis through the UCD News Service. The editor is very interested in their project. In the past, other people have contacted Sunset and gotten nowhere. Jennifer is waiting to hear back from them. She thinks that we should use the existing pathways of information such as Sunset.

Bobbi Simpson has seen the survey results and sent them on to Cal-IPC.

There was then a short discussion of Jennifer and Adrianna's actual dissertation research and the IGERT program at UCD. Four other students did a study on the aquarium trade where they inventoried stores and looked at the biological requirements of the fish being sold with an eye to identifying potential invasive species.

Kelly Rose from Ballona Wetlands in L.A. has contact with many thousands of people every year. She wants to know what she can do in her contacts to educate and inspire people about this issue. We need local activism and local ordinance. Maybe we could repeat the Bay Area study in Southern California.

Drew Ready mentioned the L.A. W.M.A. project to create a wallet-sized version of the DPP brochure modeled after the Monterey Bay seafood card.

Kate Symonds asked about constructive measures being implemented in specific areas.

Mario Abreu, who works at the Mendocino Botanic Gardens, talked about the history at the garden of planting of non-native flora. Then visitors come and see these non-native plants and want to grow them at home. They assume that all plants that they see at the garden are approved/sanctioned by the garden as being good plants.

Mario Abreu brought the the St. Louis Codes to the garden for discussion. The garden has a retail nursery. They need a committee to review the invasive species list and compare it to what they are selling in their nursery. They need site specific invasion risks for their area. They also need guidance for future plantings in the garden and interpretation for visitors.

Mario also mentioned that there has been a great deal of resistance to these ideas at the garden. The resistance may be due to aesthetic concerns. Mario is responsible for the natural areas at the garden.

Mark Newhouser mentioned the Chicago garden and St. Louis Missouri Botanic Garden have protocols.

Mario Abreu mentioned that the Mendocino Botanic Gardens retail nursery is not funded by anyone and needs to make money. In prior years, many invasive plants have been sold including Jubata grass and brooms. Many species still not on the Cal-IPC list are invasive in the Mendocino area.

- Should they not sell plants that are not on the list but are invasive in their area?
- They need to talk about invasive qualities not just rely on the list.
- Focus on educating the public using gardening knowledge – does the plant reproduce quickly and migrate out of the planted area in your yard? Do you

have to do a lot of weeding to prevent it spreading?
- Focus on reproduction and local spread qualities.
- If the retail nursery isn't aren't willing to remove species, perhaps the nursery could develop a disclaimer.
- Mario also asked about outreaching to bookstores.

Drew Ready mentioned that the L.A. and San Gabriel watershed council has focused on landscaping issues and are starting outreach efforts to nurseries. They are looking forward to partnering with Cal-IPC, they are getting regional reports together. They want the St. Louis codes to be promulgated. They are worried about the nursery industry being self-regulating since growers supposedly at the table are marketing and promoting plants that "naturalize well" and "invade wild places". See Monrovia's website entry for *Cytisus x spachianus*.

Martha Berthelsen described a Bay Friendly gardening outreach to nurseries. They started with a group of four nurseries and asked them to post a list of Bay Area friendly plants. The plants were non-invasive and water conserving. They combined multiple messages into one list so people don't have to juggle lists.
- Nurseries are interested in doing what is right.
- They need incentives
- For bay friendly list the incentive is paid ads that promote bay friendly plants and list the four nurseries as places that they can be purchased.
- They are also doing nursery staff trainings.
- The staff like it but cites lack of contact time with customers as a constraint.
- They hold free workshops for the public and mention the four nurseries by name.

Martha Berthelsen suggested that we could mention to nurseries that their names would be mentioned to the Cal-IPC membership if they remove invasives and offer alternatives. More info. about this program can be found at Bayfriendly.org.

Educating volunteers who do weed work is also an outreach tool. These volunteers are consumers and see invasive plants being sold. We need to get information out to volunteers.

Kate Symonds mentioned that NRCS as an agency has spread weeds but now has a new group, Resource Conservation and Development that is looking for projects. They are going to do a nursery outreach program in Marin and Sonoma. Kate is in the information gathering stage. There is a lot of interest in trying to address the invasive species issue.
They are considering contacting larger nurseries with the DPP brochures.

Drew Ready asked if anyone is working with CDFA to get more wildland pests listed so we have regulatory power.

Mark Newhouser - Although this issue is being worked on, it will never be enough due to the political nature of the process. It took years to list 8 plants. It is a time consuming, long, painful process but should be on-going.

Stephen Jones – There is also the issue of insufficient funding for enforcement.

Kate Symonds asked what we can do as citizens and professors to address this issue.

Stephen Jones suggested linking the issue to agricultural applications to increase funding. He also suggested linking the Cal-IPC and CDFA websites.

Mark Newhouser mentioned the Marin-Sonoma WMA outreach to all listed nurseries and landscapers. They included a combined list

of bad plants in their mailing (combined from CNPS, Cal-IPC, and CDFA). There was no feedback mechanism so they don't know how effective the mailing was.

Terri Kempton agreed that we need regulations, but it is a long, difficult, reactive process; not a preventative process with collaboration. A collaborative process can address new threats on the horizon.

Mark Newhouser wrapped up the session by thanking people for coming and hopes that we all continue to interact.

Mapping Working Group

Leader: Steve Schoenig
Facilitator: Deanne DiPietro
Notetaker: Jon Hall

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Previous Weed Mapping Working Groups focused on the need for mapping, mapping techniques, and the importance of using standard forms of data collection. **This year the working group focused on how we are going to share and access our data by setting up a "California Weed Data Collaborative and Information System".** The working group discussion consisted of:

- Presentation of the plan for a California Weed Data Collaborative and Information System.
- An update on Team Arundo Del Norte's new NSDI grant.
- How to contribute spatial data.
- A brainstorming session about what we want and need out of our "information system"

California Weed Data Collaborative and Information System – We are the "California Weed Data Collaborative", a community of people interested in sharing data, co-developing the data products we need to enhance our weed work and cooperating to solve problems and remove the barriers to data sharing and development. We will accomplish this through our Cal-IPC Weed Information System. This system has three components.

1. Communication services – This is how we organize our communications (ex. Listservs with archives, Bulletin boards, News and event postings, a virtual meeting place for our information community).
2. Digital library – This is where we contribute and access our data. Think of it as a digital version of a conventional library where all

the data relates to weeds!

3. Map services – These are our map servers, facilitating the interface of how we want our data displayed, searched and shared.

Update on NSDI grant – Team Arundo Del Norte received an NSDI grant to get the "California Weed Data Collaborative" started. The NSDI grant was specifically meant for building datasharing communities. This grant will help us create a framework to build our Weed Information System around. Cal-IPC staff will provide Web design and programming. Cal-IPC Mapping Committee, UC Davis and CERES will provide guidance. There are many other grants we can go after to work on our network once we design it. **Everybody working on weed related issues in California are urged to join this "Weed Data Collaborative" and help us build and design our own information sharing network!**

Contributing Data – We can start sharing data now! We have a Cal-IPC Weed Data Catalog on CERES. To contribute data go to ceres.ca.gov/catalog and select 'Contribute Entries' from the left hand column. Our catalog name is 'Cal-IPC Weed Data Catalog' and our password is 'deth2weedz'. We can also use CERES to search for data by subject.

Brainstorming session – In the brainstorming session everybody had a chance to contribute ideas for the Information Sharing Network. It was emphasized that the information shared is not restricted to spatial data. Suggestions included;

- An automated Red Alert system
- ASPNET was suggested for the programming language used. This would help with the future viability of the system.
- Have a listing of known keywords used in listing data.
- Have links to other databases
- If generating metadata already be able to contribute data with this metadata and not have to fill out CERES form for metadata again.
- Make bulk loading of large GIS datasets possible.
- Assistance to weed programs that don't have GIS, a way to collect what they know.
- There's lots of data out there already, why isn't it incorporated in this system? Answer: Because the Weed Data Collaborative needs to decide which system we want to use so we can start dumping data in there.
- We need to dispel the "Build it and they will come" myth. We need a campaign to go along with it. We have to couple a sales and enticement component so people will use it. Must have someone to spend time calling people and collecting data.
- WMAs (Weed Management Areas) would be a good venue for tracking down local data and funneling it to the network.
- We need a system to overlay historical data so we can see rate of spread.
- Incorporate an observation capture system.

The working group concluded with the thought from Deanne: Programming is expensive, if all our energy goes into one product we are steps ahead. If we all adopt a system we will be able to have a large user community and be able to contribute and access data easily.

Education/Outreach Working Group

Leader: Wendy West
Facilitator: Dan Gluesenkamp
Note taker: David Chang

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Cal-IPC's outreach and education activities and committees were summarized:

- Educating legislators – National Invasive Weeds Awareness Week; California Invasive Weeds Awareness Week; Invasive Weeds Day at the Capitol.
- Educating the public – web development, events, conferences, field courses, Speaker's Bureau, publications

A show of hands was conducted on how many people were interested in public outreach? (most); government outreach? (some); Speaker's Bureau/ volunteer? (some)

Speaker's Bureau:

A suggestion was made to create regional coordinators for a Cal-IPC Speaker's Bureau. It was noted that quality control is important since Cal-IPC has a reputation to maintain. The Nature Conservancy has a PowerPoint presentation available; Wendy West will check and see how

the implementation and utilization has gone and if lessons have been learned. Participants encouraged Cal-IPC to get the general PowerPoint presentation out and available as soon as possible and not wait to make it "perfect".

Who is the target? General public, gardeners, landscapers, contractors, architects, academics/ students elementary to university level. Separate presentations will be available to target each specific audience Where is the audience? Homeowner's associations, Lion's Clubs, garden clubs, schools, etc. There is a huge need for educational materials (video, handouts, PowerPoint, etc.) for contractors, landscapers, builders and "on-the-ground" crews. Presentations at pest control continuing education seminars are another good educational opportunity.

How to get invasive weed education into schools:
Ways to reach out to educators include contact the teacher's union, use email, contact education coalitions. It was suggested to conduct a pre-conference workshop for teachers. Teachers are often busy. Teacher interest may be a problem. If a program is complete, teachers will be more receptive. Support by work group attendees for student gardens was mixed. Getting kids out of the class is attractive to teachers. Teacher training can build capacity. Provide manuals, computer based materials. Link with current groups already doing environmental education including local coalitions. Any courses developed for schools would need to be linked to California state curriculum standards. Need to look at getting invasive weed training into environmental education programs that are utilized to educate new teachers while in college. The bottom line question is --- are teachers ready to teach about invasive plants? Are they aware of the problem or do we need to do more basic education to get them there?

Expanding California Invasive Weeds Day at the Capitol (March) and Awareness Week (July):
Dan Gluesenkamp discussed his area's coordinated Weed Week outreach:

- They are making lists of all local restoration volunteer groups.
- WMA will do press releases for all groups with events that week to local media.
- Invite elected officials to attend these volunteer events.
- A participant from every district in their WMA will be asked to visit their supervisors at budget time and ask for funding for the WMA.

It was noted that California Trail Days has a successful "Day at the Capitol" event and could be used as a model to expand our event.

Other Education/Outreach Needs and Discussion:

- Conferences/events that Cal-IPC should have a presence at: Botany Society of America – California Conference 2006 (per Charles Blair), California Rare Fruit Growers (per Bethelyn Blade), California Garden Clubs, Inc., wine grape growers conferences, statewide mountain bike association (– do they have a conference?), special districts associations statewide conferences.
- Press releases should be increased; Cal-IPC should create news items for broad release and feed to local groups to distribute to local media; e.g. publicize volunteer opportunities; create a briefing statement with financial info for legislators; CSPAN website with a list of all media outlets; National Public Radio – audience may be more involved than general radio audience; consider press releases and information to regional/local group newsletters (i.e. Sierra Club, garden clubs).
- Conduct a mail campaign. Action item: Christina Sloop volunteered her assistance on a mail campaign; she has connections with the direct mail industry.
- Legislator outreach/education: Local content can be especially compelling to legislators. Dan Gluesenkamp and Pete Holloran volunteered to put together a

list of other (non-monetary) items to ask legislators to act on.

- It was suggested to create a video and/or public service announcement. The Nature Conversancy has a web based presentation that the public is allowed to use. Action item: Mietek Kalipinsky volunteered to contact Jerry Ashton about the presentation.
- It was suggested that some websites will pay for continuing education programs, with fees paid to the organization (i.e. Cal-IPC) providing curriculum.
- Find out what other groups are doing. Build on experience, do not reinvent the wheel!
- A suggestion was made to create ambassadors for Cal-IPC outreach.
- "Leave No Trace" organization was pointed out as a target audience. Currently without a stance on invasive species but are working on it. Action item: Aaron Morehouse volunteered to keep track of progress.
- Cal-IPC was suggested as a repository for content, such as photos and success stories. Jerry Asher's photos and stories were good; ask him to contribute. Action item: Pete Holloran and Wendy West volunteered to gather success stories and get compiled into a professional format. Action item: Dan Gluesenkamp volunteered to research an upload site for pictures and stories.
- The internet was acknowledged as an important resource. Items that could be placed on a website include: photo clearinghouse (high quality for reproduction); info clearinghouse; digital library of publications available; bibliography; speaking points; fast facts; should integrate strongly with info that is already out there; no dead links; early detection notices with photos; documentation of actual costs of weed control; Best Management Practices (BMP)

Invasive Plant Inventory ("Weed List") Working Group

Leader: Joe DiTomaso
Facilitator: Alison Stanton
Notetaker: Elizabeth Brusati

Attendees

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Joe and Alison explained the process for the new weed list, using the Cal-IPC website to show how to find PAFs and the summary spreadsheet as well as the full criteria (www.cal-ipc.org).

Outline of process:
The criteria file contains full explanation for each question, for instance, what severe vs. moderate impacts mean. There is a strong hierarchical weighting in Section 1, so that high impacts in that section will cause the overall score to be high. The score received depends on literature available, or observations available. Some questions: for example, is *Carpobrotus chilensis* a native? Received a B in impacts.

- A few species were not reviewed due to lack of information.
- Documentation comes from all over, not just California. The committee had to make a judgment call on impact information, because it varies so much by climate. If systems were similar, we definitely used the information.
- One weakness in the list is the way it deals with plants that have different effects in different regions of California. For example, *Eucalyptus* is a big problem on the coast, but not Central Valley. Need to include that in comments somehow. Species distributions are problematic. It was a problem in writing the criteria to apply to CA, AZ, and NV. The three states agreed not to change criteria without consulting the others.
- Is a statewide list useful for land managers that have to convince their local supervisor to spend money on a particular plant? Statewide list does have value for overlap with CDFA, but regional is more appropriate for on the ground management. Weed Management Area scale would be good.

Discussion:
Joe: High, Moderate, Low categories debated. People think low means "no problem", which isn't true. Low species can be regionally problematic.
Ann Howald: Doesn't like H, M, L. No matter how you define the terms, supervisors will misinterpret them. Old list used "A-1", "B", etc. List needs to say it doesn't tell you how to map, survey, etc. Don't want to make people ignore the lows. Low and Mediums might be more appropriate for management because they're easy to work on.
Peter: Need better definition of each category and what they mean, especially Low. Need to specify that Low means little documentation for some species.
Marla K.: Liked the old (1999 Weed List) system because made regional more specific.
Peter: Don't want to overpopulate High (or old A-1) list because could lose credibility. Trying to address the concerns of broad audience, from practitioners to policy makers.
Sara Chaney: Could we get rid of judgmental words, and instead add comments on where it's a problem and whether it's widespread and really strong impacts, or not?
Emma U.: Did we discuss local/regional H, M, L?
Joe: We hope WMAs can make own list based on our criteria, regionally high, etc.
Example: scarlet pimpernel widespread but low impacts, so shouldn't be a priority compared to other species. Maybe the Low list should be split into low - lacking info and low - lesser impacts.

One possibility would be to create a double rating for everything. Part 1 - statewide. Part 2 - regional. Second high is significant impacts on a local level. For example, *E. globulus* mod-high would mean moderate impacts on a statewide level, but high impacts regionally on the coast. Keep all highs just high. Others could be mod-high, or mod-mod, low-high, etc.
Other examples - Gorse: bad north of Monterey,

iceplant, Ammophila - high-low (only a problem on foredunes). But the problem is quantifying it and making it transparent. The point of this criteria is to keep the process transparent rather than relying on a few people sitting in a room.

For example, look at the ecological types table (question 3.2) for *E. globulus*
We know how bad things are in specific habitats.

These changes may be made on a future list. Joe is worried about having list destroy management programs because of L, M, H designations.

Who in the working group volunteers to develop the regional list for their area? (No answer)
One person commented that something from Cal-IPC has more authority than a list from a local group. *(Notetaker's comment: Cal-IPC is 1000 members, including those who know about the impacts of specific species in their local area. We can't do everything from Berkeley.)*

Peter agrees that H, M, L needs to be changed. Alphabetized list with other information can include everything without the subjective interpretation. Could encourage people to give information.
Joe: Would that be more helpful for managers? (No answer from participants.)

Question: What if this becomes more citable for official purposes, more accepted by the state?

Ann H.: Keeping everything on one list makes it more usable, keeps credible. What about indicating local differences in a comments column or print in bold, etc.?

Extra designation needs to be very obvious, not buried in comments.

Peter: What about using quantitative scores from each section rather than H, M, L.

Comment: Using Jepson regions overlaid with counties as a map with different colors… Some day.

CNPS has two lists: high and low. But still works.

Ann: Many of these species are not in Jepson. Should this be indicated in comments?

Notetaker's comments: The weed list committee will finish the updated Invasive Plant Inventory at the end of 2005, at which time it will be published. We are working on improving the Cal-IPC website to make the plant assessment forms more user friendly and to add photographs and a method for weed workers to submit new observations, particularly for species that lack published documentation.

Riparian, Wetland and Sensitive Habitats Discussion Group

Leader: Joel Trumbo
Facilitator: Jason Giessow
Notetaker: Jan Boudart

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The initial discussion revolved around how to educate regulatory agencies and the public regarding the safety of the herbicides used to control invasive species and the necessity to use them economically and without unnecessary regulatory restrictions.

A. Buffer Zones for Herbicide Use Adjacent to Waterways:

Comment: *A contractor reported she was required to follow a 2500 ft. setback on salmonid streams.*

Responses: Applicators should be careful about accepting guidelines that seem unreasonable without asking the regulatory agency how the buffer distance was established. Determine if the restriction applies to foliar use only or if it applies to low volume or low drift methods (i.e., cut stump). Applicators need to remember that they can't violate label restrictions that prevent use *in* water, but that the hazard posed by use *adjacent* to water depends on the herbicide, application method and weather. Applicators should also become familiar with the current scientific literature on the toxicology and environmental fate of the herbicides they intend to use. A good source of this information is the EXTOXNET website extoxnet.orst.edu maintained by UC Davis and other universities.

Comment: *NOAA allows no herbicide of any concentration on the Russian River when the salmon are running*.

Response: It's important to verify *exactly* what restrictions the Agency is referring to. Does the restriction refer only to uses in water or adjacent uses as well? Does the restriction involve use or detectable concentrations in the water? This is an important distinction. Many application methods may not result in detectable residues in water even when used in close proximity (i.e, cut stump, basal bark, wick application). Sometimes the applicator needs to educate the regulators in the many different application methods that might be employed at any one site.

Comment: *The requirements for water quality testing and reporting are more expensive than the herbicide use itself.*

Responses: This is often the case. However, there may situations where existing environmental fate and toxicology information may be used to support the environmental appropriateness of your proposed herbicide use. Here again, don't just except regulatory requirements out of hand without asking questions.

B. The Necessity of Using Herbicides on Some Weed Species.

Comment: There is a dire need to use herbicides on some difficult to control species such as perennial pepperweed and spartina.

Response: Yes, some species have proven to be difficult to control with non-chemical methods. Some of these herbicides are legal for use on water (i.e, the recently approved imazapyr herbicide Habitat® and various glyphosate and triclopyr formulations). The question is, how can we re-educate the public that has concerns.

The CA Dept of Boating and Waterways water hyacinth control program has quite a bit of environmental monitoring data in published reports.

C. Surfactants. (R-11, Activator 90, Competitor, Cygnet, LI-77, Agridex, Silguard, No-Foam A, Liberate)

Comment: *Much of the recent concern has to do with surfactants used with herbicides and not the herbicides themselves. People often confuse this issue. Ventura County allows no use of R-11.*

Response: Some surfactants are more toxic in aquatic settings than the herbicides they are used with, but this is not always the case. Not all surfactants are the same. Even when the surfactant has higher toxicity, its concentration and/or its persistence in water may not be sufficient to cause any measurable impact to non-target aquatic organisms. For example a recent CA Dept of Fish and Game study showed that concentrations of both the glyphosate herbicide Rodeo® and the surfactant R-11® may be initially high but drop down significantly after the first 24 hours. The CA Dept of Fish and Game Pesticide Investigations Unit has no record of any fish or aquatic organism kills due to the use of Roundup.

D. Perennial Pepperweed

Comments: *When pepperweed is near water the new imazapyr herbicide Habitat® can be used in place of the chlorsulfuron herbicide Telar®. (Telar® can't be applied to water). On upper side of San Pablo Bay Caltrans wants to try Habitat®. They need advice from contractors as far as when they should switch from Telar® to Habitat®. What are some of the guidelines about when and where?*

Responses: Chlorsulfuron has very low toxicity to fish. However, the herbicide is very soluble and active at very low concentrations and can travel a long way in water. The worst situation

would be to have chlorsulfuron residues in water that will be used to irrigate crops…especially broad leaf crops. Remember that Telar is used in water at a concentration of about 2oz in 100 gals of water. This is very little use of the product and is safe if water is not going to be used for irrigation. The Telar® label does have a prohibition on use in tidal basins and estuaries. This probably has more to do with data gaps in environmental fate data in these types of sites rather than any toxicological issue. Right now, Telar® is the only thing that works on pepperweed. Also remember that the best current info available suggests that the ecological risk the weed poses to the habitat is much greater than the toxicological risk presented by herbicide.

Comment: *In Sebastopol, Sonoma County, citizens decided to get rid of pepperweed without herbicide. This involved using machetes around little kids and trampling down the surrounding vegetations. 200 people came out. This should be a good test to see the effectiveness of non-chemical attempts at control for this species. Convincing people that herbicides use for these purposes in ecologically appropriate takes patience and good, credible information. Attempting hand removal of Pepperweed can be a very bitter experience.*

Responses: Get documentation on control measures whether they are chemical or non-chemical. Cal-IPC is very interested in this type of information.

Experiments with *Pepperweed* showed that a small rhizome piece sprouts readily (and in the dark)! Pepperweed control requires something that will translocate to the rhizomes. Left unchecked, pepperweed produces a huge amount of biomass that is a significant resource drain and the quantity of biomass quickly outstrips resources. The goal is to reduce it to a manageable amount. However, herbicide is generally not thought of as a long-term solution. Other management activities need to be discovered to discourage future infestations and to maintain a stable native vegetation component.

Goats were tried in a comprehensive study; but the pepperweed came back. Mugwort can't compete with pepperweed nor can most other native species.

Salting works and it's cheap, but is it environmentally appropriate?

E. Parrotfeather

Parrotfeather will out-compete water primrose. Renovate® is effective but must be used at a low tank mix concentration. If the concentration is too high it will produce only top-kill and no translocation. With this species it's very important to be vigilant and get an early start on control efforts.

F. *Arundo* or Giant Cane.

Comments: *There was a discussion re: the merits of cut stump and foliar applications*.

Responses: Glyphosate can be effective. Many believe that non-cutting methods work best. Leaving the foliage intact will allow more herbicide to be translocated to the rhizomes. One person commented that most failed sites are cut stump sites.

Bill Bradbury likes "cut stump." If you want his methods, send him e-mail and he will tell you by return mail. In Ventura the willows and *Arundo* were cut to the ground and the *Arundo* sprayed. The willows came back within 3 years. He said you can't kill willow with Roundup.

F. What About Soil Organisms?

Responses: There are several studies on

glyphosate impacts on soil microbes. This has not proven to be a legitimate issue. (Busse, Matt and R. F. Powers. 2000. Progress Report on "Effects of repeated use of glyphosate on functional diversity and key processes of soil organisms". USDA Forest Service, Pacific Southwest Research Station.)

G. Anticipating Problems:

Comments: A highly experienced person may take a lax attitude about herbicide use. This can be transferred to less experienced workers and can result in bad practices. If workers see a careful supervisor, they'll be careful.

Good tools may have unexpected consequences, but this doesn't mean they should not be used. Some pesticides break down into toxic components. These should be matched against known toxicity values. Different chemicals in the same space may interact. These problems should be watched for, but they shouldn't prevent the use of a good tool.

Onionweed in San Diego area. A 10 acre stand on San Marcos UC preserve was treated with Aquamaster, which worked really well.

H. Preventing Drift.

Mechanical ways: trimming native, pushing and trimming, 10 trimmers to 1 sprayer, large garbage bags to create a shield, blow sprayer with the wind, basal treatments, wicking, can't come back and foliar treat seeded sites, hockey stick wick (use on mustard), CSS mustard – wicking when mustard is 6 in. tall, Pepperweed when bolting.

I. When Construction Spreads Weeds.

Try to build weed protection into specs. Make them sign off on it. Clean equipment and fill is cheap next to cleaning up spreading weeds. Have an inspections schedule – check! It's important to find infestations early. Star Thistle comes in on equipment, rip rap. Put the onus on the construction company. The contractor's guilt may be obvious if they brought in contaminated fill or spread mulch on erosion sites. Don't let them move into the next phase of contract if specs not met.

Suggestions:

Cal-IPC should work at regulatory level to educate regulators about the necessity and environmental appropriateness of herbicide use to control invasive weed species.

Fire, Fuels Treatments and Weeds Discussion Group

Leader: Joanna Clines
Facilitator: Janet Klein
Notetaker: Mischon Marin

Attendees

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The session opened with people briefly introducing themselves and stating their general area of interest. Two topics surfaced as being of greatest interest: 1) fuelbreaks/fuel treatments as sources of weed spread; and 2)fire as a tool for weed management.

Joanna reviewed the major themes that emerged from last year's fire working group:

- Fuelbreaks and the potential for spread of invasive plants
- Invasions caused or exacerbated by fire
- How to use fire to reduce invasives.

Discussion Then Continued as Follows:

Rolland Mathers of Shelterbelt Builders, Berkeley, wanted strategies for battling with local fire departments over the definition of fuelbreaks and fuelbreak designs; i.e. was it always necessary to go down to mineral soil or could unmowed, standing annual grass be left in pockets.

Similar concerns in San Diego where private land owners are getting vegetation information from fire departments and are even threaten with fines if landscaping/grounds maintenance does not meet fire department specifications.

Someone mentioned Maria Alvarez of Golden Gate National Recreation Area found perennial grass weed invasion into fuelbreaks was less severe where fire crews trimmed coastal sage brush to 8 cm, not all the way to the ground.

East Bay Regional Parks Comment: Repercussion from Oakland Hills Fire was the creation of assessment districts to reduce fuels and set species targets. Fuel reduction is the # 1 priority so only after this need is met can they take new and different steps.

One difficulty is current Wildland Urban Interface (WUI) fuelbreak design that doesn't plan for extreme fire conditions.

Joanna Clines: Central Sierra fuels crew actually work with her and want to know what vegetation she (botanist) wants in her fuelbreaks. Vegetation one of the characteristics considered when designing fuelbreak.

Rob Klinger: Helpful to break this issue into WUI and wildland situations. Some literature about planting in fuelbreaks is available in Forest Service documents. A lot of anecdotal informal available as well.

Bonnie Davis: erosion control straw can be an ignition source. Caltrans projects worrisome.

Jim Dempsey of Caltrans *(note: this should be either Jim Dempsey of state parks or Jim Hanson of Caltrans):* fuel management drives work in right of ways. How low can you mow without wiping out native populations? Interested in a planned fuel break.

Dale Schmidt: El Portal. Isn't enough literature to help you plan your fuelbreak system. So he focuses on highest flammable plants under normal fire conditions. You need to get on-the-ground fire guys to help you make fuelbreak decisions.

Various opinions expressed by group as to value of fire department vegetation knowledge. Agreed fire guys know what burns under what conditions but are less knowledgeable about what comes in after fire or fuelbreak construction.

Not all Fire Departments buy into the same beliefs. In many counties bare mineral soil is the preferred option because of Type I and II Engines (city vehicles) limitations.

Rob Klinger: large issue of trade offs: to what extent do you want to emphasize weeds vs. homes.

Rob Klinger: Write down these bigger issues and post them on a listserve so folks can continue the discussion.

Fuelbreaks as weed vectors vs. necessity of fuelbreaks. Can you protect communities while still dealing with invasive species? Issues differ in WUI and forest systems.

Does anyone know of a video for homeowners on why scotch broom is bad around their homes? with footage of flaming broom? Or literature that compares fire performance of natives vs invasive species?

Bill Baxter—gorse photos or fire footage?

Fire Safe councils provide landscaping info for homeowners. Should include information on invasive species.

Dale Schmidt: Fire fuel modeling problematic when dealing with invasives because existing models don't include weed species. El Portal is also trying to get video footage of fire in "under represented" fuel types.

PSW Redding—modeling masticated fuels

Perhaps Cal-IPC can disseminate more info regarding weeds and fuelbreaks.

Maintenance of fuelbreaks is a critical component of success.

Need to promote weed issues to fire departments and Firesafe Councils.

Topic Shifted to Fire as A Management Tool/ Fire for Weed Control

Question: after burning coastal scrub last fall, vicia and *Holcus lanatus* invaded. What should we do next?

- coastal scrub/fire interval information is available in the literature.
- frequent fire return intervals easily convert this habitat type to weedy grasslands.
- past history is important to know before embarking on fire management of existing community. might inform what to expect from seedbank.
- literature suggestion: Walter Wessman and John Oleery. coastal Sage Scrub structures and fire Impacts.

Question: Prescribed burning: Is it worth it to Manage Grasslands?

- Janet Klein: for managing woody weeds in savannah/woodlands, handcrews/ herbicides gave better results than prescribed burning;
- know the historic fire regime before embarking on burn program;
- have clear goals and objectives: what are you trying to accomplish?
- define terms correctly: prescribed burning/broadcast burning/ etc.

Question: can you manage *Phalaris aquatica* with fire?

- Denali Beard at State Parks has some information.
- 1 agency has burned it and sprayed the resprouts. Only in the 1st year so no results yet.

Rob Klinger: Cal-IPC could establish a database on what people are finding when they burn weeds. Quantitative data would be great but even qualitative data would be good to know. How do different species respond in different area?

- database vs listserve? most people agreed they are already on too many listserves. would prefer to go to database at their own convenience.

Closing thought from Kyle Merriam: using

fire to control invasives often promotes weed invasion.

Next big topic that should be discussed within Cal-IPC: using fire as a site prep for restoration.

Should have Integrated Vegetation Management, not just Integrated Pest Management.

Flip Chart Notes

- Fuelbreaks Potential to Spreak Weeds
    - Urban Interface
    - Forested Systems

- Need better information on what natives can be planted into fuelbreaks and where.
- Collaborate with Fire Safe Councils
- More Information needed for public
- Great to have video of scotch broom burning and threatening homes/
- Encourage fuel modeling for more common invasive species.
- Need to underscore the importance of fuelbreak maintenance.
- Establish a database for quantitative studies and observational reports of weed species response to fire and fuelbreak system performance. Put on Cal-IPC website.

Post-script

Rob Klinger is pursuing the database idea with input from Steve Schoenig. In a recent email, Steve made the following suggestion:

"I think compiling data on post-burn invasives response is a great idea. One simple way to utilize existing infrastructure is to have these fire reports put into the NRPI/CalWEED database at UCD-ICE and then make sure they are tagged as a group to allow a restricted display and search on a Cal-IPC webpage/portal.

Another way more powerful way to procede is a new database hosted on the Cal-IPC website. Probably could be done with a small but not insignificant amount of programming effort and the effort of someone knowledgable to set things up from a program side."

Grasses Discussion Group

Leader: Chris Rose
Facilitator: Cynthia Harrington

Attendees

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Goat grass control:

- Two successive fires in May/June recommended, but not conclusive.
- Feral pigs dug up grasses. Seeded *Danthonia californica*. *Danthonia* seeded into 1" hoe lines.

Brachypodium control:

- Mid-Peninsula Open Space used Round-up, hand pulling and tarping.

Can you seed perennial grasses post-fire? No.
Vulpia and *Bromus* control on coastal dunes at Moss Landing:

- 5 acre project.
- Planted Mockheather.
- Hand weeded grasses.

- Mockheather eventually shaded out new seedlings.

Tarping:
- Leave on for a few years.
- Can change soil structure.
- Seed with native forbs to prevent new weeds from invading.
- Can tarp for 6 weeks around August; pull off in October. Annual weed dieback is good; perennials may come back.
- Need stronger tarping if it will be on for a longer amount of time. Recommends landfill quality plastic.
- Can be used as greenhouse to germinate seeds. Must use clear plastic.
- Can remove tarp to germinate seedlings and flush out annual seed bank, and then replace tarp. Has been successful with *Oxalis* removal.
- Lew Stringer and Stuart Weiss volunteered to compile a history of tarping projects and advise on study design for collaborative research.

Lolium control:
- Fire.
- Grazing. Cattle recommended.
- Selective herbicide use. Hoelon is effective, but not yet registered?
- No biological controls known.

Herbicides:
- Puma. Used for *Lolium* control. Looking into getting a local need permit.
- Hoelon is not effective on *Lolium*.
- Round-up is not effective on perennial *Lolium*.
- Currently moving into poor sites as ammonia is pulled from the atmosphere?
- Can manage at a level at which it will not smother other species. Grazing is effective for this.

Medusahead control:
- Low-dose Round-up on Medusahead within 15 days of germination/rain.

Stu Weiss is pulling together observations of annual grasses moving into new places. Due to atmospheric nitrogen deposition. Cannot simply look at levels in the soil to determine availability. Currently creating maps of 4x4 km plots to see deposition levels. Is the addition of carbon a viable option? Sugar can be added; microbes will tie-up nitrogen. However, too much is needed to make it useful. Possibly valuable on a small scale. Woodchips or sawdust may make a good, longer-lasting carbon source. Corn gluten can be used as a suppressant, but it expensive and washes away. Regional precipitation plays a role on carbon options.

Mowing, swathing and haying can be used to control grasses and remove seed sources. Caltrans currently using it.

Annual grass seed bank is not always short-lived, but does have a stronger tendency to rot. Example: wild oats have a long seed viability.

Resources:
CNGA offers good resources for establishing grasslands, www.cnga.org.
Bring Farm Edges Back to Life. Published by the Yolo County RCD.

Velvet grass:
- Exploded in 1998, as it moved from dry to wet sites.
- Recently only seen in small populations.
- Why the change? What steps should be taken?

Trees and Shrubs Discussion Group

Leader: Mark Heath
Facilitator: Ken Moore
Note taker: Petra Unger

Attendees

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Which trees/shrub problems would you like to see addressed?

- *Ailanthus* (3)
- Black locust
- French and Portuguese broom (3)
- Gorse
- Eucalyptus
- Monterey Pine
- Tamarisk (4)
- Russian Olive
- Fig, pokeweed
- *Acacia*
- Hackberry
- Fruitless mulberry
- *Cotoneaster*
- *pyracantha*

What specific issues are of concern to you?

- Biomass leftover/slash management
- Educational purposes/how to manage volunteers
- How to mange data

What to do with all the debris?

- Stem treatment and leave tree in place.
- Will cost more if you change your mind later as wood hardens over time
- Good for ficus, *Acacia* so it won't cause re-sprouting;
- Makes it difficult to retreat in subsequent years;
- Vehicle removal causes compaction, changes soil;
- *Ailanthus* won't fall fast if left standing;
- Castor bean can stay in place and does not cause access problem;
- Scotts broom expands at level of person treating;
- Flaming of Scotch broom resprouts worked (Joanne Clines Poster); cost of planning comparable to herbicide labor is more intense

Herbicide Use

How many in group CANNOT use herbicide: 2
How many are limited to select herbicides? 3+
Who decides this? Regulators, pressure from constituents;
New formulation of Imazipyr very effective on *Ailanthus* per Jo di Tomaso's talk; long half life – remains viable after treatment until roots breach down; will leak into soil, could be picked up by other plants; depends on root levels of adjacent plants.

Public sentiment about Imazipyr: people are more comfortable with herbicides that are widely sold and have been around, i.e., glyphosate

Is it necessary to use herbicide on tamarisk?
- Have to dig up root crown;
- Cut stump and cover with black tarp ;
- Tap root may go down too;
- If you get the main stem you have done the job.

Eucalyptus – problem of scale. i.e., large scale removal.
- Pathfinder – Garlon 4 would be good or Roundup 100%;
- Cut stump treatment works IF applied within 1 minute;
- Is it possible to replant among eucalyptus; recent studies of eucalyptus forest show that understory of eucalyptus forest is more diverse than thought once duff removed it should be fine;
- Notify stakeholder, i.e., through CEQA people are upset about aesthetic impacts;
- Phasing might be a good option, i.e., remove hazards first;
- Publicly announce danger;
- Disposal.

What to do with debris?
- Give away as firewood (might be liability issue if people cut their own);
- If can't be near road for access, just pile them somewhere;
- Traditionally preference is to leave in place as minerals/biomass belongs on site;
- Leave piles for wildlife habitat;

Where do you put piles and how do you manage them?
- Best place on bare ground of areas you just cleaned, i.e., bare on unvegetated;
- Reduce volume by cutting up limps and leave isles to go in and retreat;
- If no room, find other off-site clear areas;
- If you want material to decompose quickly, put in moister areas (but do not tamanisk);
- Broom – coming up through piled up stacks - make piles where you can burn them later;
- Burn where seedlings are coming up will trigger seedbank around perimeter;
- If burns are planned, do linear piles and cover let dry up 1 year and leave in place, cover small area with tarp so it can stay dry and light up when ready to burn.

Privet – how to deal with ones you can't remove?
-beyond brush height requires annual pruning.

How to treat gorse?
Garlon 4 - high concentration on cut stump plus low on seedlings; add acidifier pH has big influence on how chemicals work.
If you have herbicide questions confer with Joe DiTomaso.

Other sources of information
Other weed managers are good resources too – contact list in Cal-IPC package.
Have Cal-IPC website list emails if people willing to "double" expertise – be willing to share knowledge.

Help on weed removal projects
Volunteers: break down into smaller projects; prison crews can be good labor to help weed removal; important to explain meaning of project to crew; and important to any contractor as well.

Success with Mulberry?
2% Garlon ester on leaves is successful;
Girdling and Garlon 4 does not work well;
Girdling – can't see cambium because chainsaw is narrow - if you miss a spot tree will survive;
Basal bark only works well on species less than 10" diameter; figs can be bigger;
Frilling may work on mulberry – works well on *Acacia*;
Have to get down all the way to the root crown;
Chipping – have to cut root and not get soil;
If you drag plants into clipper you get stones – high maintenance;
Watch for seed content and materials can take root, i.e., cape ivy pieces, palms; Machine is dangerous;
Materials have to be green, don't chip dry stuff;
CalTrans will take chips if made to specification.

2005 Cal-IPC Weed Alerts

New Invasions, Recent Expansions, and a Few Others to be on the Look-Out For…

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Weed Alerts represent either plants that are known to be invasive, but appear to be on the increase, or are potentially new species that appear to be escaping from cultivation and are becoming invasive in some areas of the state. It is critical that Cal-IPC members report potentially significant invasions of plants new to an area. Not only does this provide the society with an initial time frame for the invasion, but also alerts land managers in other regions of the state to the potential threat. Rapid action on a new invader can potentially save millions of dollars with preventative control or even eradication.

New reports should be made to the main office of Cal-IPC. This information will then be transferred to the individual presenting the Weed Alerts talk at the following symposium. The visual presentation of the talk will be included on the Cal-IPC website (www.cal-ipc.org) for future reference.

The 2005 Weed Alerts include:

- *Piptatherum miliaceum* (smilograss)
- *Saccharum ravennae* (ravennagrass)
- *Parentucellia viscosa* (yellow glandweed)
- *Centaurea debeauxii* (=*Centaurea* x *pratensis*) (meadow knapweed)
- *Allium triquetrum* (three-corner leek)
- *Geranium robertianum* (herb-robert)
- *Geranium lucidum* (shining geranium)
- *Scabiosa atropurpurea* (pincushion flower or mourningbride)
- *Nelumbo lutea* (American lotus)
- *Nassella tenuissima* (Mexican feathergrass)
- *Polygonum aubertii* (Chinese fleecevine, silverlace vine).

Piptatherum miliaceum **(smilograss)** is a widespread perennial bunchgrass in California. Although it is mainly found on the coast, it can also survive inland. Smilograss appears to be rapidly expanding its range in southern CA and in the Bay Area. It produces many viable seeds and is fairly drought resistant. Ideal climatic conditions in some years may account for rapid expansion.

Saccharum ravennae **(ravennagrass)** has been known to escape cultivation in southern California, but has recently been rapidly expanding its range in northern California along Cache Creek in the Capay Valley between Clear Lake and Woodland. It may actually be even more widespread, but perhaps has not been reported because of its similar appearance to the much more widely invasive species *Arundo donax*. It inhabits disturbed areas near creeks but has also moved into relatively undisturbed riparian areas, occupying much of the same habitat as both *Arundo donax* and *Tamarix parviflora*.

***Parentucellia viscosa* (yellow glandweed)** is widespread throughout the coastal areas of central and northern California, but reports indicate that it is spreading and becoming more of a threat in Humboldt County, and perhaps Del Norte County.

***Centaurea debeauxii* ssp. *thuillierii* (=*Centaurea* x *pratensis*) (meadow knapweed)** is a hybrid between *C. jacea* and *C. nigra*. It is more invasive in the western portions of Oregon and Washington, and was previously only sporadically found in northern California. However, it appears to be rapidly expanding its range in the northwestern corner of the state. Meadow knapweed was recently listed as an A-rated noxious weed by the California Department of Food and Agriculture.

***Allium triquestrum* (three-corner leek)** has only occasionally escaped outside of urban areas, but is becoming more prevalent along the northern coast, particularly in Humboldt County.

***Geranium robertianum* (herb-robert)** is a widespread garden escapee in the Bay Area, just beginning to establish itself away from urban areas.

***Geranium lucidum* (shining geranium)** was recently reported to be invasive in Eugene, OR, by the Bureau of Land Management. It was found escaping in oak woodlands in mesic/shaded areas, generally under the oaks and in monotypic stands. The Bureau of Land Management attempted to use handpulling to control it, but as a result the problem became worse. In California, it has not been reported to occur outside of the vicinity of the Berkeley Botanical Gardens, where it has commonly escaped cultivation, but appears to have the potential to move into adjacent wildlands.

***Scabiosa atropurpurea* (pincushion flower or mourningbride)** is a very common cultivar. It began to escape into wildlands four to five years ago and form near- monotypic stands in San Bruno grasslands. It is spreading along trails and fire roads between Claremont Canyon and Strawberry Canyon in Berkeley.

***Nelumbo lutea* (American lotus)** has taken over much of a 30-acre lake in Tehama County and has the potential to spread to other areas. It is invasive in the tropics and the seeds are very long lived, reportedly up to 400 years. This is the first report of this species having escaped in the state.

***Nassella tenuissima* (Mexican feathergrass),** also called *Stipa tenuissima,* finestream tussockgrass, or ponytails, is a fine textured clumping perennial grass native from Texas to New Mexico south through Central America to Chile. It is considered drought resistant and cold hardy. As a result, it has been widely planted throughout California as a landscape ornamental. Employees of various botanical gardens have anecdotally indicated that the plant quickly spreads within their gardens. They have predicted that it has the potential to move into wildland areas, although there are no reports of this yet in California. It has, however, escaped cultivation in urban environments in both Arizona and California and was placed on the California Department of Food and Agriculture Q-rated list in January 2004. Outside the United States, *Nassella tenuissima* has invaded Australia and New Zealand. The Auckland Regional Council considers *Nassella tenuissima* to have the same potential to invade pastures and has prohibited the sale, propagation and distribution of the plant. In California, this species should be watched carefully and any reports of its establishment in wildlands should be reported immediately.

***Polygonum aubertii* (Chinese fleecevine, silverlace vine)** is a perennial vine native to China. It is not widely grown as an ornamental, but is still available. It grows rapidly and forms dense cover—the *Sunset Western Garden Book* states that it can grow 100 square feet per season. It has become established in at least four locations on the banks of San Francisquito Creek in San Mateo and Santa Clara counties and appears to move downstream when the stream bank collapses due to high flow conditions. It produces a large number of seeds that also facilitate rapid spread.

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