

Predicting the Spread of Invasive Plants in the Sierra Nevada with Climate Change

Elizabeth Brusati, Cal-IPC

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Cynthia Powell, Suzanne Harmon, Tony Morosco**



Introduction

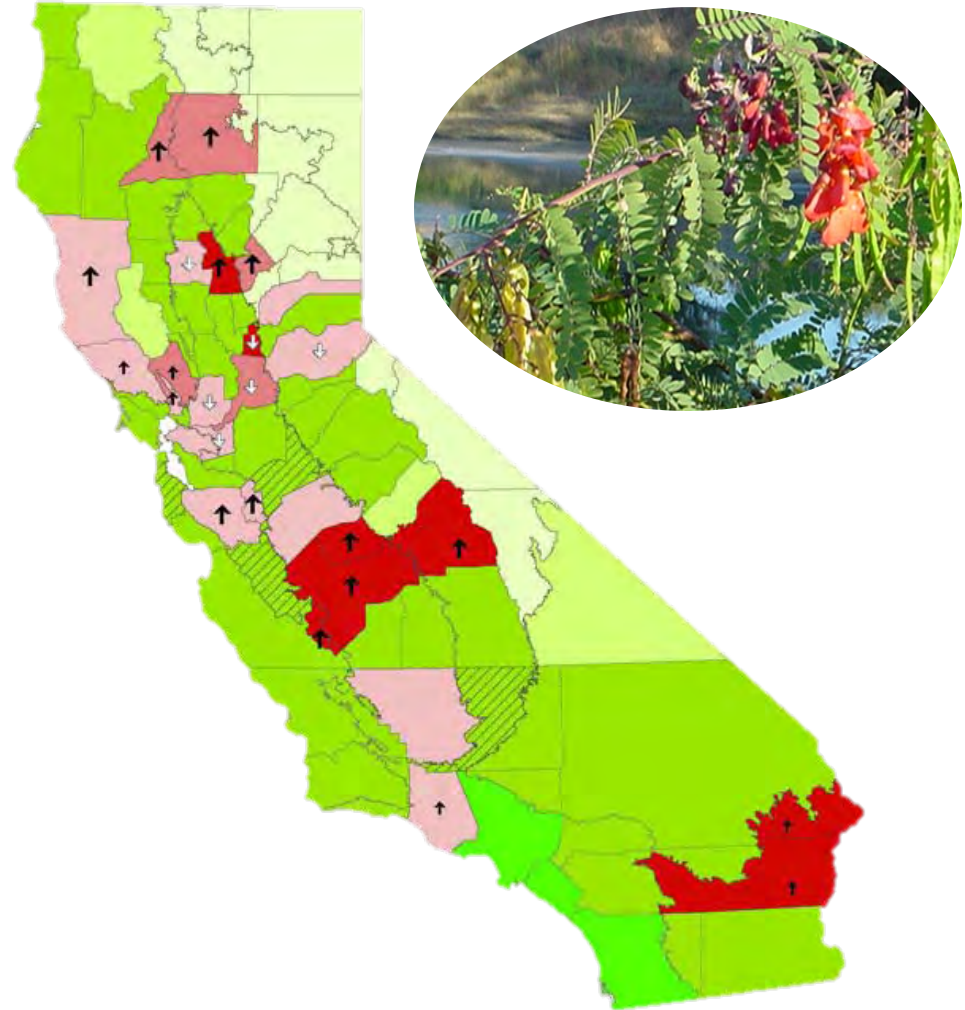
- **Goal:** Provide land managers with tools to improve effectiveness of invasive plant management
- Are there restoration opportunities if climate change decreases the competitiveness of some invasive plants? (Bradley et al. 2009)
- Potential for other projects similar to Yellow Starthistle Leading Edge?
- Sierra Nevada region is pilot for rest of state

Climate Change and the Sierra

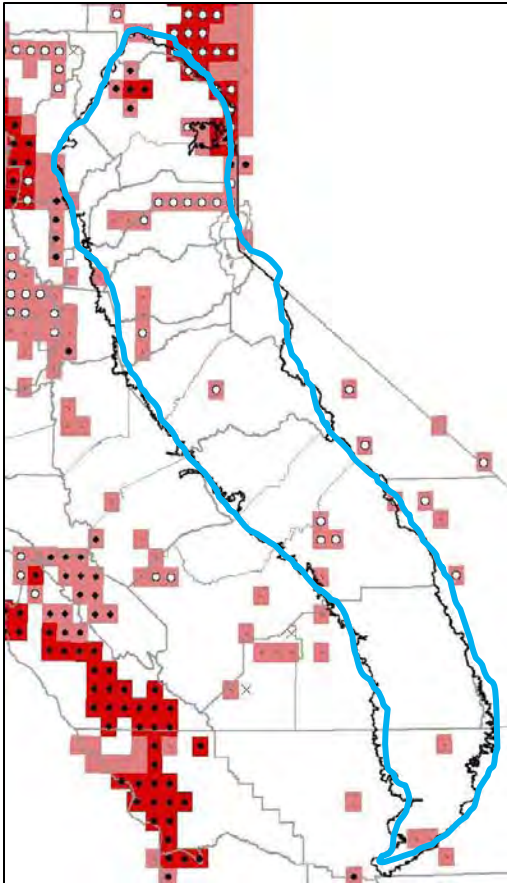
- Snow may shift to rain with more interannual variability (Coats 2010)
- Grassland likely to expand at the expense of woodland and shrubland (Lenihan et al. 2008)
- Changes likely constant north-south but will vary east-west, by elevation, and with topography (PRBO 2011)
- Invasive plants moving up in elevation in other ranges (Kelly and Gouldon 2008, Pauchard et al. 2009)

Previous Project (2006-08)

- Mapped 35 species by county and Jepson Floristic Region
- Modeled suitable range based on estimates of current range and environmental tolerances
- A good first estimate, but imprecise



Methods: Current Distribution



Cardaria draba & *C. chalepensis*

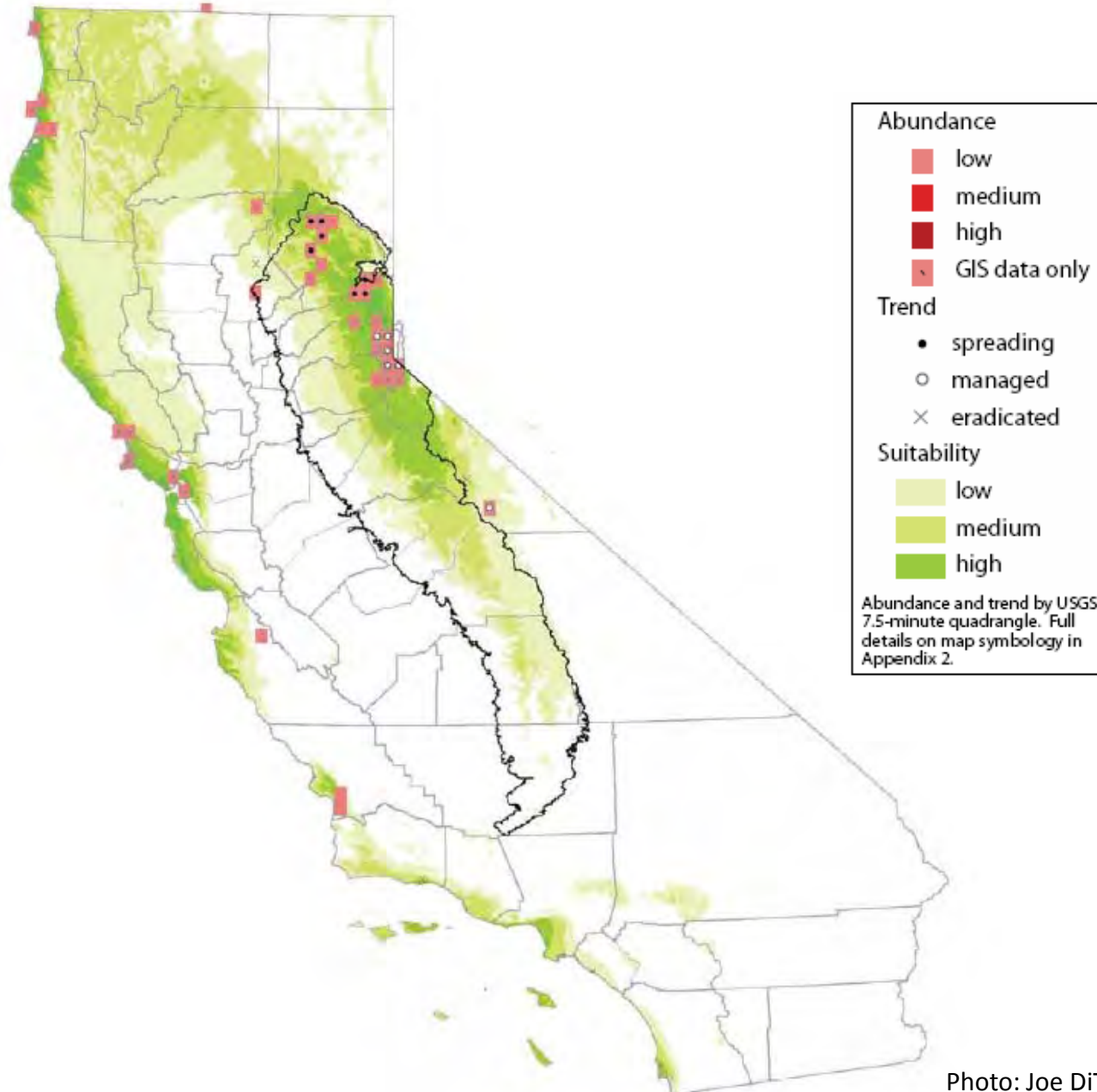
- Expert knowledge by USGS 7.5” quadrangles
 - Supplemented by compiled GIS datasets
 - 204 species for statewide project
 - ~100 spp. on Inventory are in the Sierra
- Recorded abundance in categories and whether eradicated, spreading, or under management
- Combined a few species due to taxonomy changes or identification problems

Methods: Suitable Range

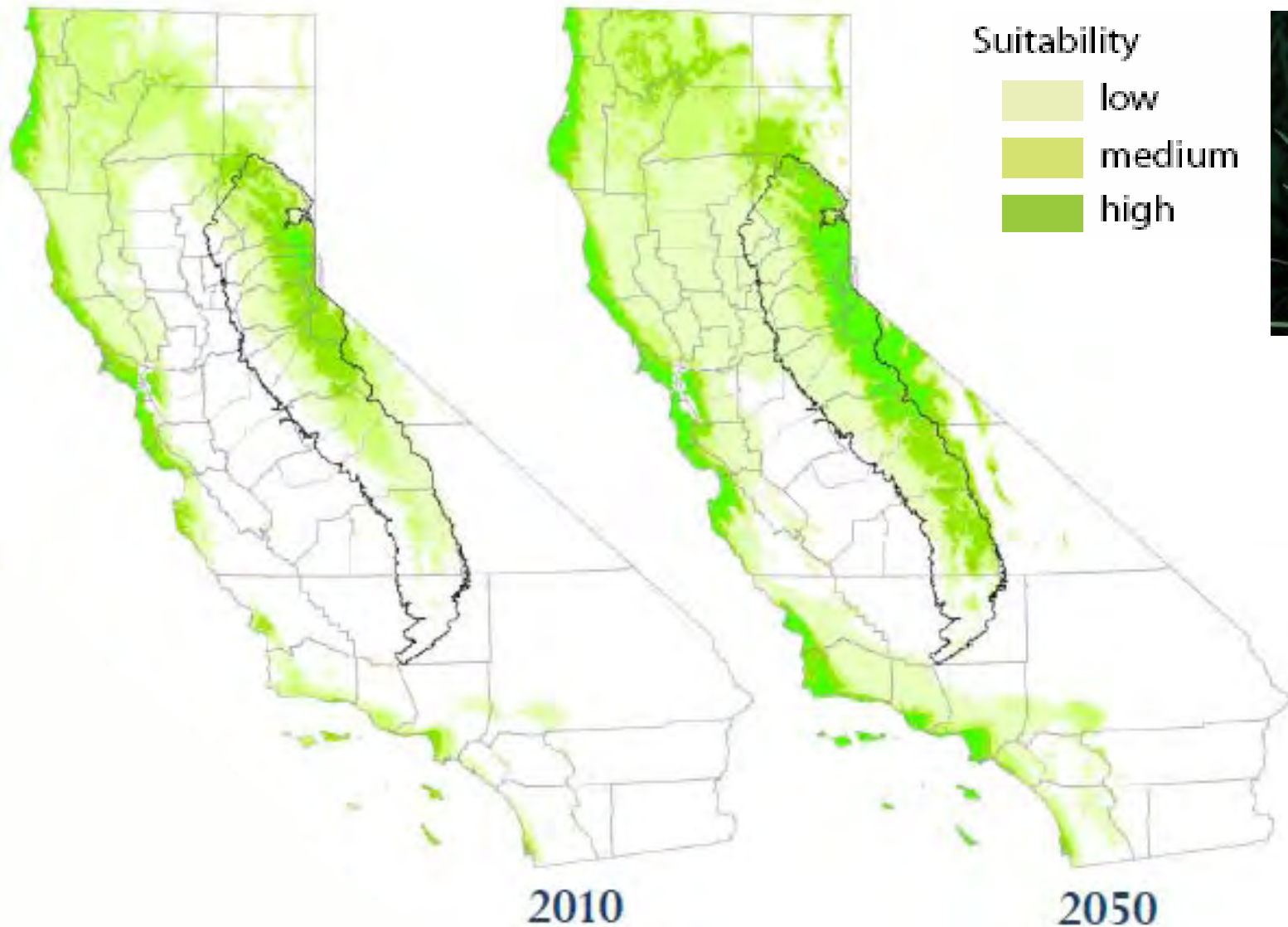
- 31 spp. modeled so far
- Ecological niche modeling (Maxent) predicts suitable range based on current locations and environmental data
- Results reviewed by invasive plant experts
- Data:
 - 25 datasets from California
 - 19 climate variables from Bioclim (temp. and precip).
 - Climate change: Downscaled CCCMA A2 scenario for 2050
- Caveats:
 - Depends upon good representative coverage in data points
 - Only one climate change scenario so far



yellow toadflax (*Linaria vulgaris*)

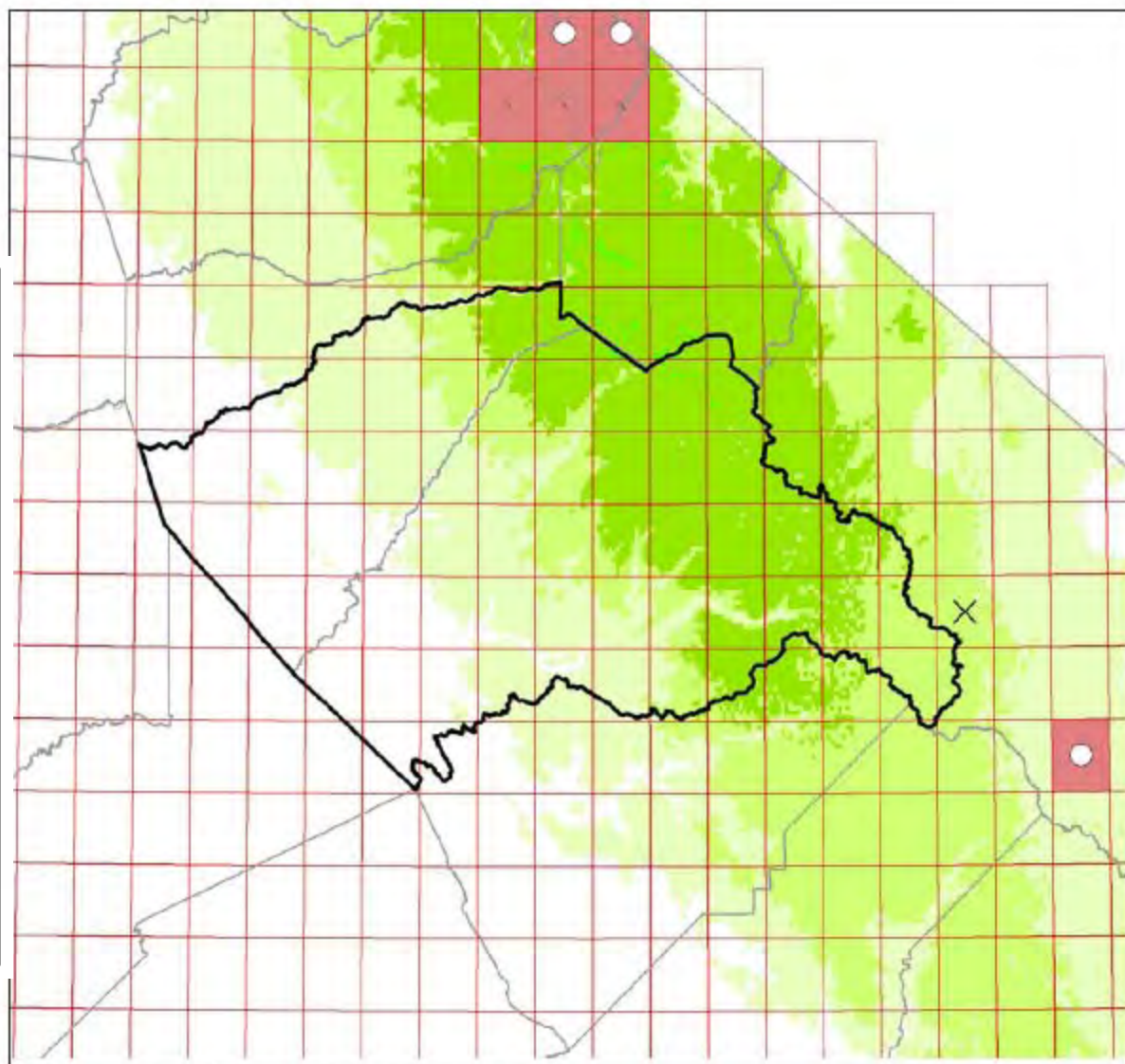


Suitable Range: yellow toadflax



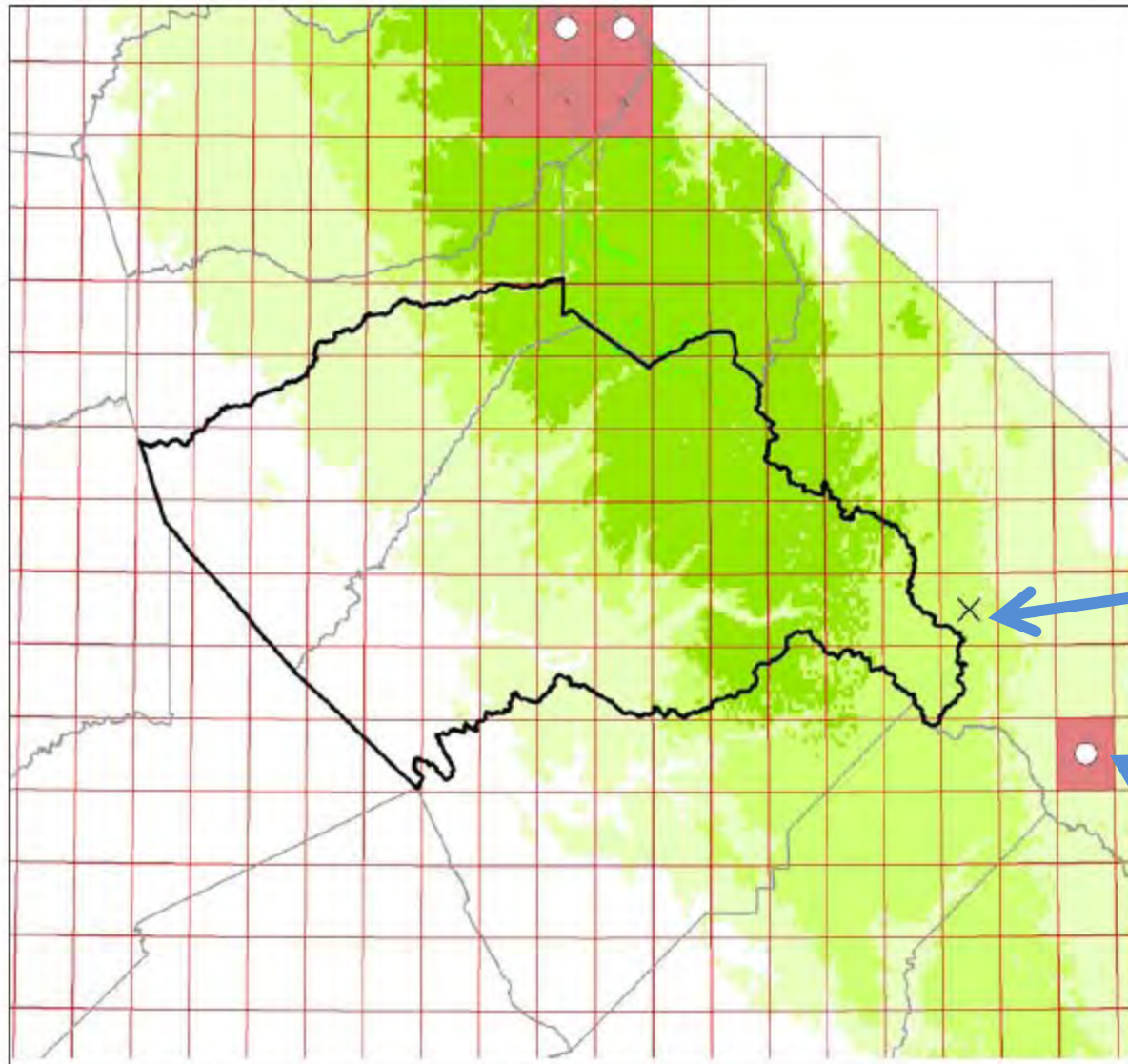
Central Sierra Partnership WMA

Calaveras and Tuolumne Counties



yellow toadflax (*Linaria vulgaris*)

Central Sierra Partnership WMA (Calaveras and Tuolumne Counties)

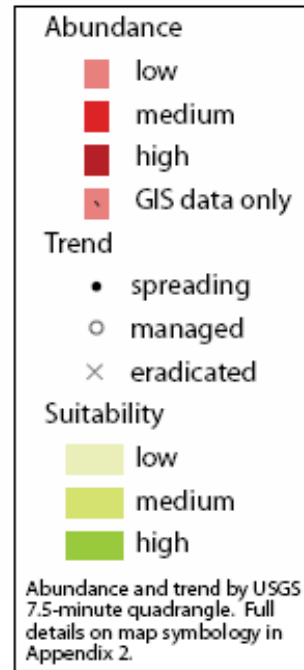
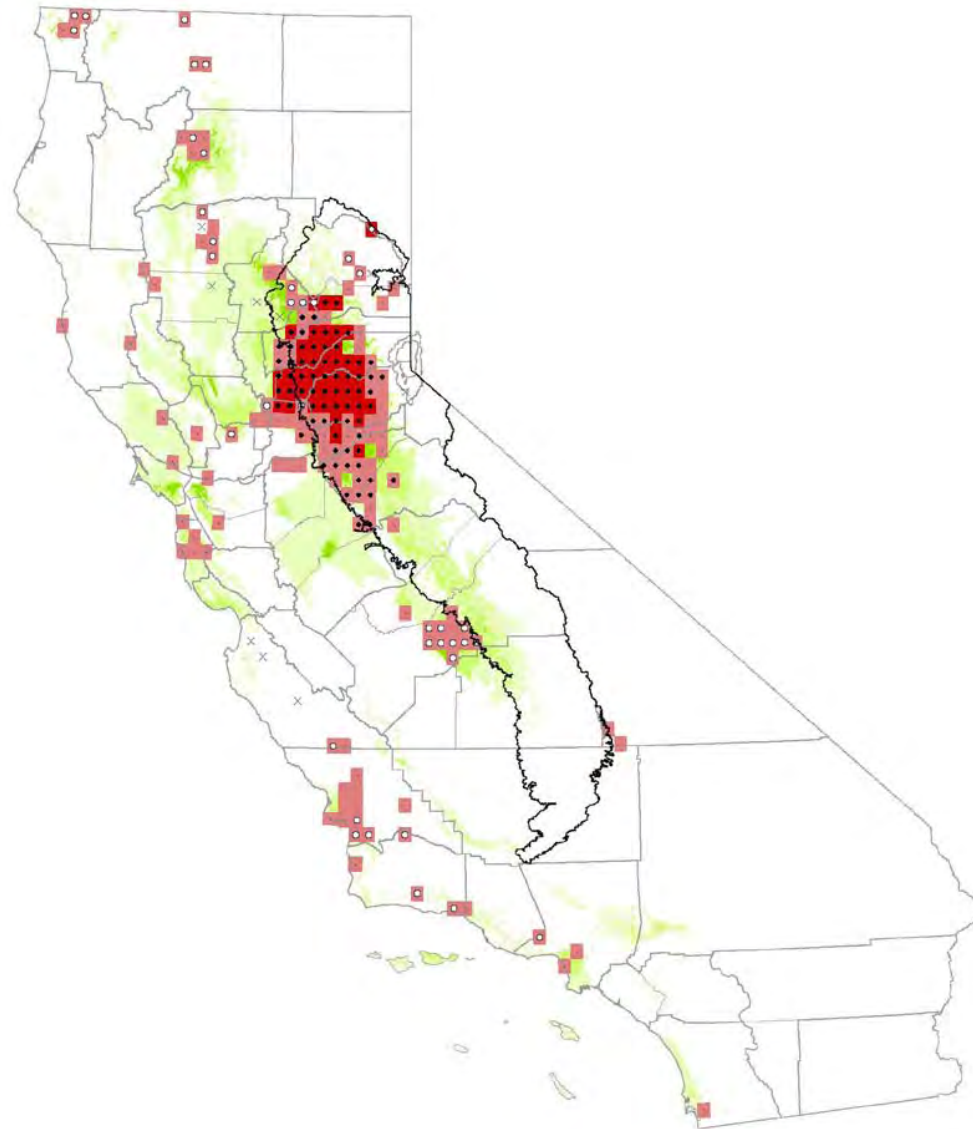


eradicated

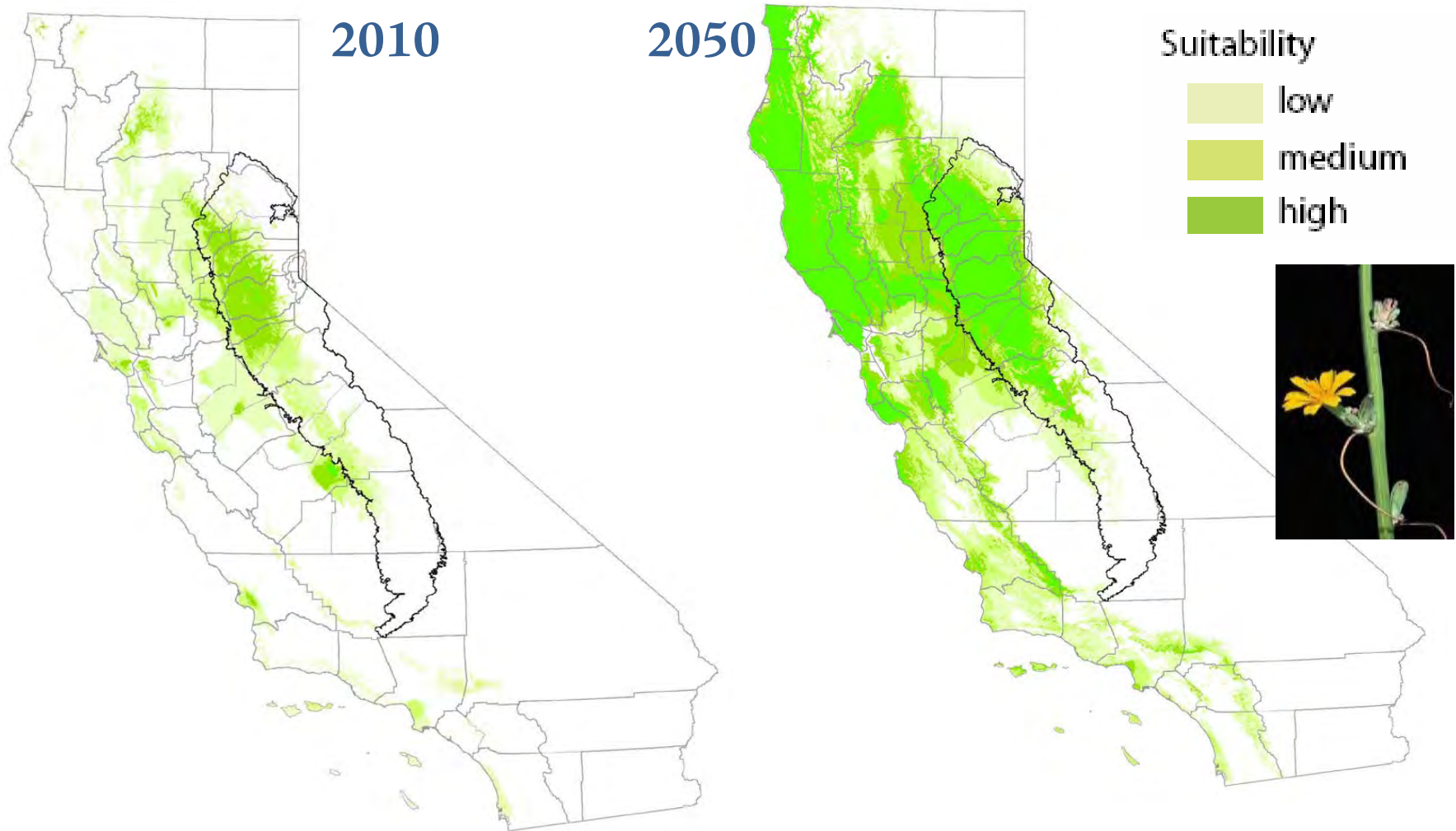
Under mgmt.

yellow toadflax (*Linaria vulgaris*)

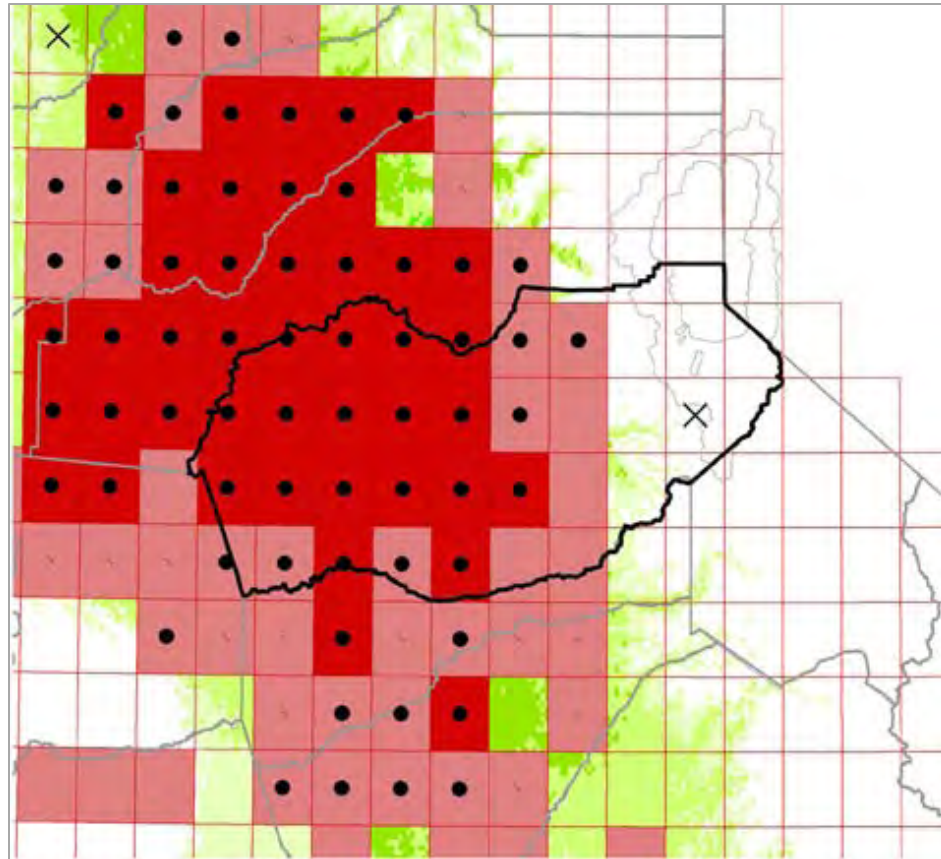
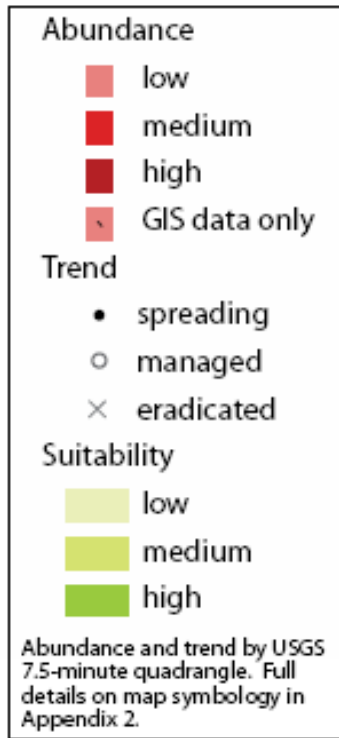
Rush skeletonweed (*Chondrilla juncea*)



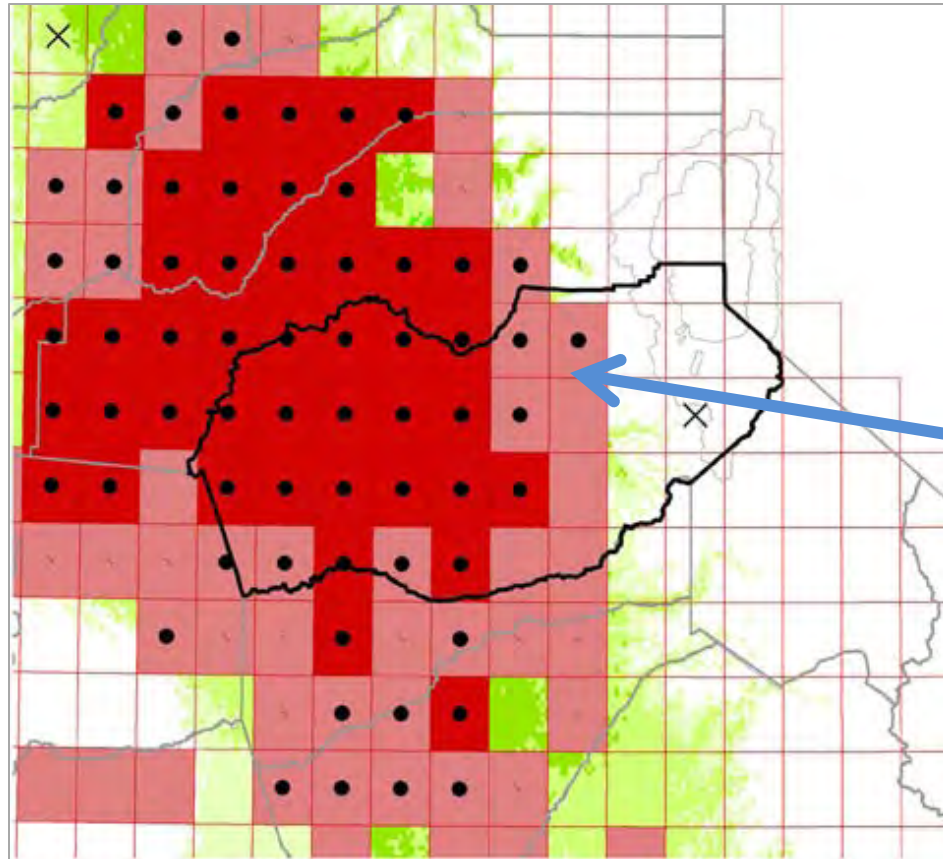
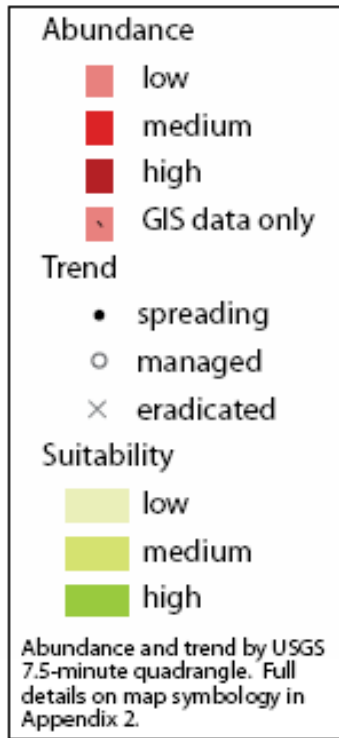
Suitable Range: Rush skeletonweed



El Dorado WMA

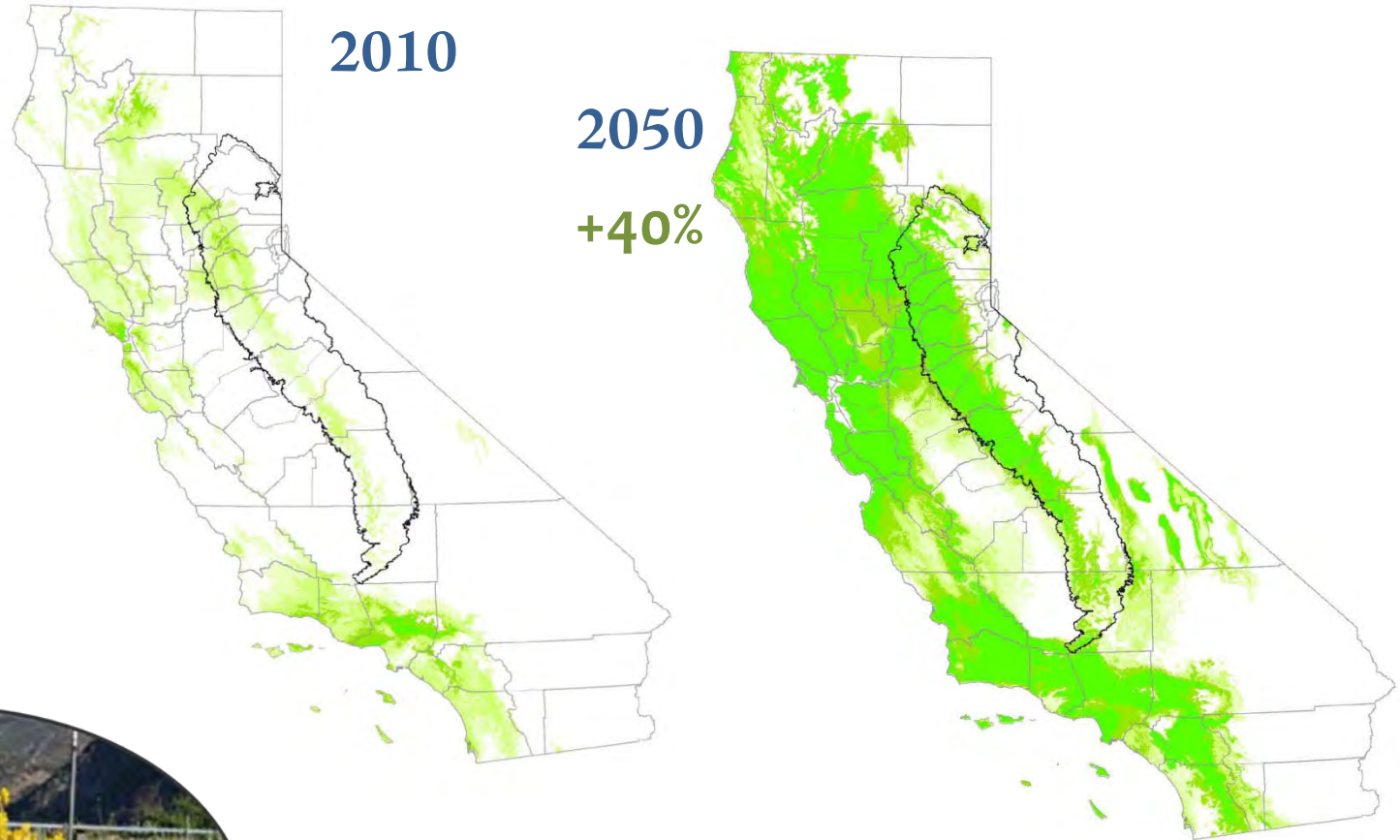


El Dorado WMA



spreading

Spanish broom's suitable range may increase...



... while dyer's woad's suitable range may contract slightly.

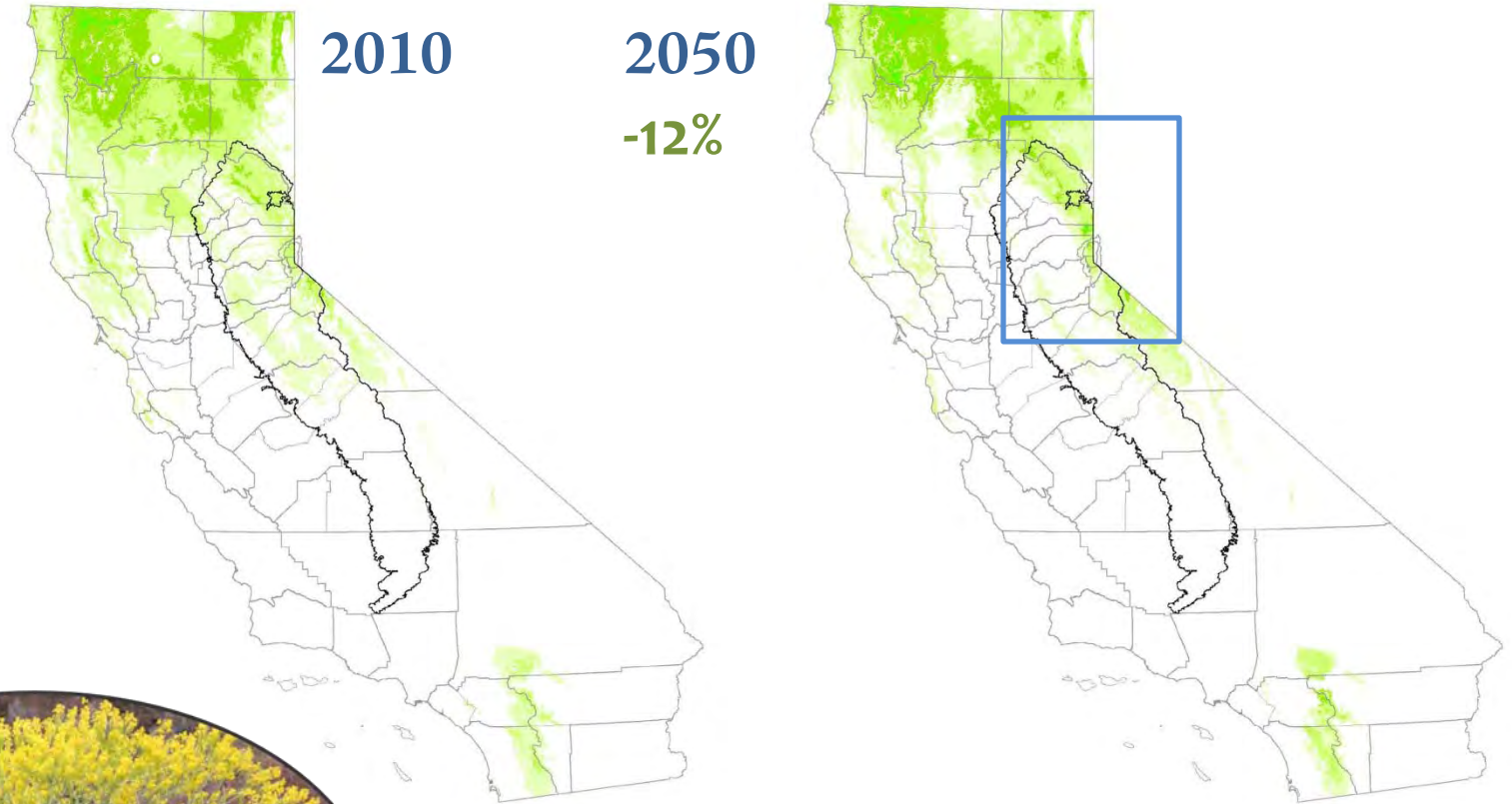
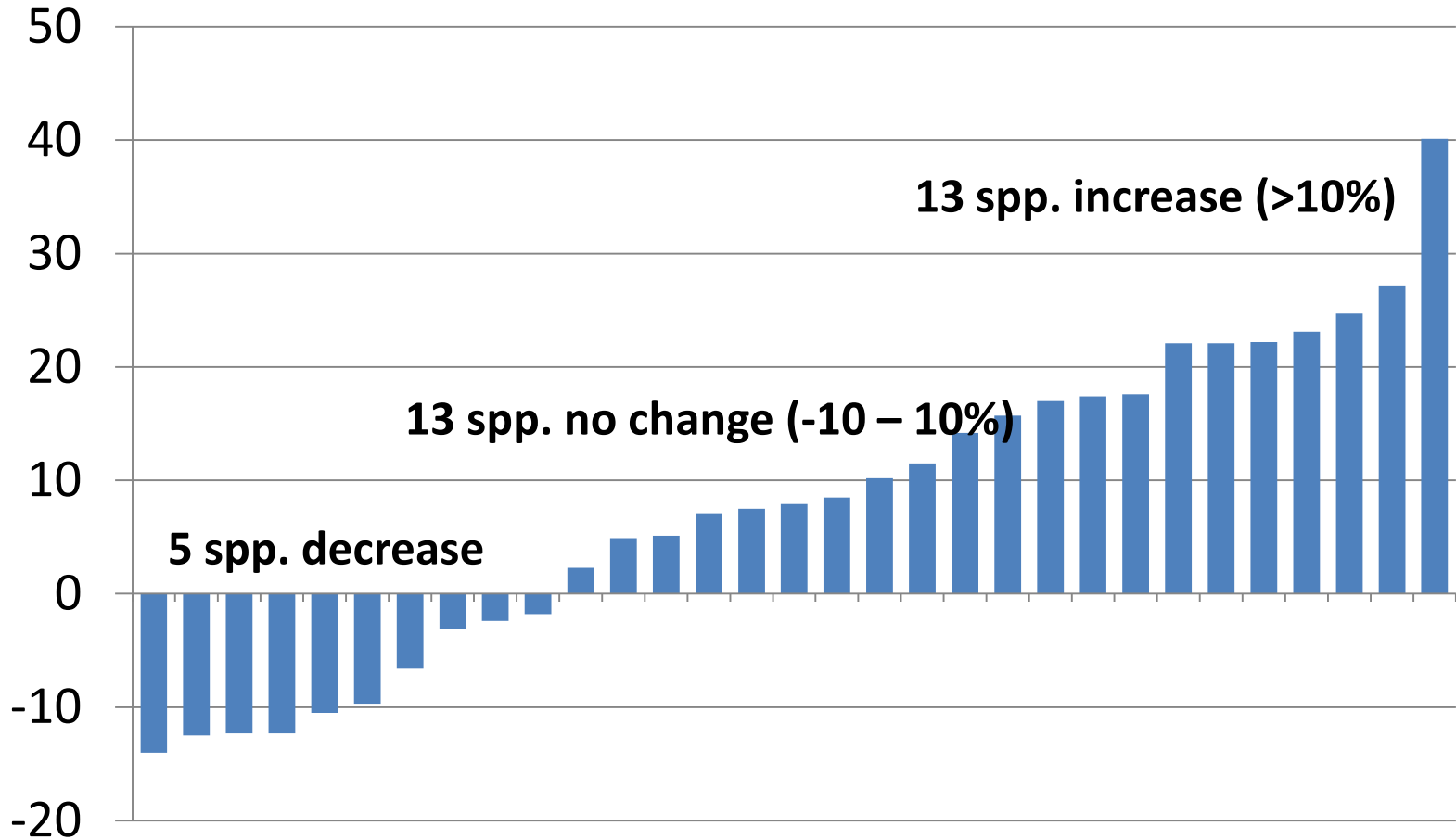


Photo: Bob Case

Change in amount of suitable range



Range Shifts

“The retreat of once intractable invasive species could create restoration opportunities across millions of hectares (acres).”
(Bradley et al. 2009)

What will happen as new
 (“no-analog”) communities
 form? (Strahlberg et al. 2009)



Management Opportunities

Intended to be used with existing local priorities and projects.
Based mostly on **current distribution** and prioritized by Cal-IPC **statewide rating**.

Surveillance: Survey to detect new infestations of species not yet present (may be nearby)

Eradication: Complete removal of infestations (isolated quads)

Containment: Limit spread from existing populations (larger areas)

What We Learned

- Land managers have a large amount of knowledge that isn't reflected in formal datasets.
 - However, they don't always identify plants to species
- Compiling GIS data is limiting factor for modeling.
 - Few large (agency) datasets
 - No standardization in collection
 - Incomplete data even for common species
- Expert opinion and GIS may not agree.
 - Currently working to vet data and fill in gaps



What's Next

- Model more species
 - Increase data from California
 - Incorporate data from outside California
 - Incorporate multiple climate scenarios
- Visit WMAs and agencies to discuss results
 - National Park Service, USFWS refuges, and State Parks interested in applying results on the ground
- Incorporate more information on habitat types and other conservation targets





Download the report:

www.cal-ipc.org/ip/mapping/sierra

Introducing CalWeedMapper!

- A partnership between Cal-IPC and Calflora, this new site contains data from Cal-IPC's statewide mapping effort and is hosted through Calflora.
- Cal-IPC's mapping effort compiled expert knowledge data and occurrence (GIS) data into one system.
- Currently in beta (testing) version. Send your comments!



Major increase in spatial data

- 204 species mapped in nearly 2700 quads
- GIS datasets nearly doubled the number of data points for invasive plants in Calflora
 - More than 50 datasets contributed (and more coming in!)

Before: 108,000



Now: 198,000





Map the Spread

CalWeedMapper provides a dynamic tool for mapping invasive plant distribution at the landscape level using expert knowledge. Learn more about how to use the maps >>

Submit Spatial Data

Contribute your GIS or observation data to Calflora for plant occurrences. Learn more about submitting spatial data and how our systems work together >>

News and Events

- » 20th Annual Cal-IPC Symposium
- » We're in Beta! Send us feedback.
- » Strategic Planning Meetings

CalWeedMapper enables natural resource managers, scientists and others to:

- ✓ Create maps and reports of invasive plant distribution
- ✓ Identify management opportunities in a county, WMA or region
- ✓ Update species distribution data



BASIC MODE: View maps and reports

CalWeedMapper

home | maps | how to | spatial data | plant profiles | about | contact

BETA

basic | advanced

CREATE A REPORT | LEGEND | ?

base map

Centaurea maculosa




Photo by: herbaria of the University of California

Centaurea maculosa
(spotted knapweed)

Cal-IPC Rating: High
Other Ratings: CDFA A, BAEDN

species description

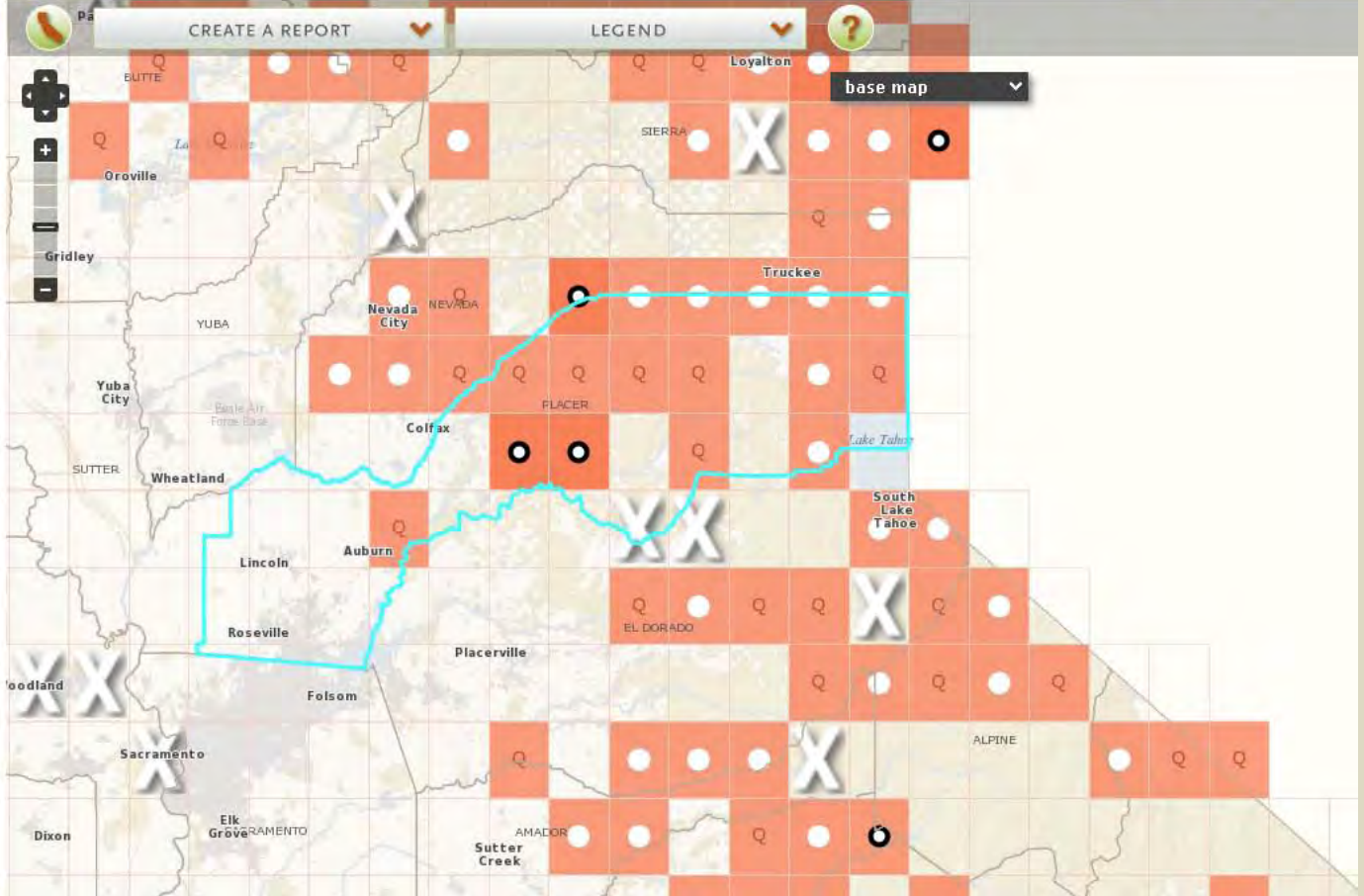
get species map report

Placer

Placer Management Opportunities

Surveillance: ?	36 species >>
Eradication: ?	4 species >>
Containment: ?	124 species >>
Managed: ?	32 species >>

get management opportunities report



Regional Species Map Report

Cal WeedMapper

Cal-IPC Rating: High

Other ratings: CDFA A, Bay Area (BAEDN) priority target

Species Description: *Centaurea maculosa* (spotted knapweed) is a biennial to short-lived perennial (family Asteraceae). It can be found in disturbed open sites, grasslands, overgrazed rangelands, roadsides and logged areas. It crowds out native species and forage for livestock, and can invade undisturbed native bunchgrass stands. An individual plant may produce as many as 40,000 seeds.

Additional information: See Cal-IPC's [Plant Profiles](#) or California's [Taxon Report](#)

REGIONAL SPECIES MAP REPORT: Map View

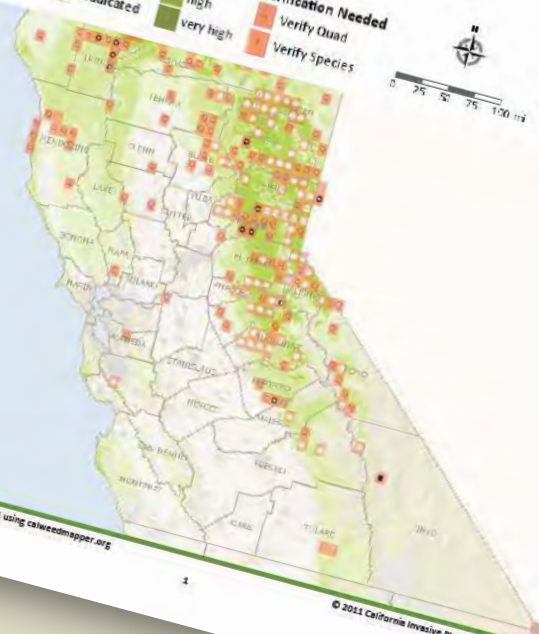
Centaurea maculosa (spotted knapweed)



Photo © Herbaria of the University of California



Abundance and trend by USGS 7.5-minute quadrangle. See ? on Maps for additional information on map legend.



This report was created on Sep 29, 2011 using calweedmapper.org

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Cal WeedMapper

REGIONAL SPECIES MAP REPORT: Map View

Centaurea maculosa (spotted knapweed)

How To Use This Report

This report provides distribution and suitability maps that can be used in conjunction with the Report on Management Opportunities as a starting place for setting regional priorities. The maps show the spatial factors that determine surveillance, eradication, and containment opportunities.

Suitability maps can be used to further assess the potential for an invasive plant species to spread into a new area. Predicted change in future suitability allow natural resource managers to prepare for new conditions, and may be used to elevate or demote the priority of a particular species in a particular area.

For current distribution, we interviewed local experts to determine abundance, spread and management by USGS 7.5-minute quadrangle (approximately 8 mi x 6 mi). We also incorporated occurrence data from California, the Consortium of California Herbaria, and other collected datasets. For suitable range, we used modeling software that combines the species' current distribution with environmental variables. Future suitable range is based on commonly used scenarios from the Intergovernmental Panel on Climate Change. Details about methods can be found at CalWeedMapper under About.

Suitable Range



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Regional Report

Cal WeedMapper
INVASIVE SPECIES MANAGEMENT OPPORTUNITIES IN Placer County


This report summarizes invasive plant management opportunities in Placer County. Opportunities are determined from maps of each species' current distribution and suitable range. Species are listed by three types of management opportunity:


- **Surveillance** – surveying to detect new infestations
- **Eradication** – complete removal of infestations
- **Containment** – limiting further spread of infestations


Below is a sample of top-ranked opportunities in Placer County. This information should be combined with local knowledge to set local priorities (see "Using the Report" at the end of this document.) click on a plant's name below to view a map of that species.


Top Opportunities:


Surveillance:


Photo courtesy of CalIPC
Brassica tournefortii
Saharan mustard, African mustard



Photo © Regents of the University of California
Cortaderia jubata
jubatagrass



Photo © Regents of the University of California
Euphorbia esula
leafy spurge



Photo © Regents of the University of California
Salvinia molesta
giant salvinia



Photo © Regents of the University of California
Acacia dealbata
silver wattle


Eradication:


Photo © Regents of the University of California
Erihorbia calycine
purple veedgrass



Photo © Regents of the University of California
Tamarix parviflora
smallflower tamarisk



Photo courtesy of Bob Cole
Halogeton glomeratus
halogeton



Photo © Regents of the University of California
Coniopus acanthoides
plumbeous thistle



Photo © Regents of the University of California
Lobularia maritima
sweet alyx


Containment:



Photo © Regents of the University of California
Aegilops triuncialis
barb goatgrass


Photo © Regents of the University of California
Arundo donax
giant reed


Photo © Regents of the University of California
Bromus madrirensis sp.
red brome


Photo © Regents of the University of California
Bromus tectorum
downy brome, cheatgrass


Photo ©



Cal WeedMapper
INVASIVE SPECIES MANAGEMENT OPPORTUNITIES IN Placer County

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Cal WeedMapper
INVASIVE SPECIES MANAGEMENT OPPORTUNITIES IN Placer County

Surveillance Opportunities, Continued

Plant Species	Suitable Range
Species near Washingtonville	2010 - 2050
Species near Washingtonville	2010 - 2050
Species near Washingtonville	2010 - 2050
Species near Washingtonville	2010 - 2050
Species near Washingtonville	2010 - 2050

Cal WeedMapper
INVASIVE SPECIES MANAGEMENT OPPORTUNITIES IN Placer County

Eradication Opportunities

Eradication entails complete removal of all infestations in the area. These opportunities result from a small number of isolated infestations. The strategic importance of an eradication opportunity can be further assessed based on the degree of isolation as well as the suitability of the surrounding area. Determining the feasibility of eradication requires surveying infestations in the field.

Cal WeedMapper
INVASIVE SPECIES MANAGEMENT OPPORTUNITIES IN Placer County

Containment Opportunities

Containment entails limiting the spread from existing infestations. These opportunities result from larger groups of infested quads. The strategic importance of a containment opportunity can be further assessed based on how distinct the boundaries of the infestation are, how isolated it is, and the suitability of the surrounding area. Determining the feasibility of containment requires surveying infestations in the field.

Plant Species	Current Species Distribution			Suitable Range	
	Isolated	Spreading	Managed	2010	2050
Wash					
Aegilops triuncialis	25	20	1	0	0
barb goatgrass	10	2	1	0	0
Arundo donax	30	2	1	0	0
giant reed	35	0	0	0	0
Bromus madrirensis	18	35	0	44	37%
red brome	36	3	0	30	100%
Bromus tectorum	17	19	10	0	0
downy brome, cheatgrass	24	0	34	2	69
glowey brome, cheatgrass	4	15	2	0	33%
Centurus maculosus	4	0	10	0	92
spotted knapweed	3	0	0	13	82%
Carduus arvensis	3	0	0	0	100%
yellow starthistle	14	0	0	37	63%
Cortaderia jubata	3	0	0	0	0
pampas grass	3	0	0	0	0
Cytisus scoparius	3	0	0	0	0
Scotch broom	3	0	0	0	0
Egeria densa	3	0	0	0	0
Brazilian tiger	3	0	0	0	0
Eichhornia crassipes	3	0	0	0	0
water hyacinth	3	0	0	0	0
hemlock	3	0	0	0	0
Genista monspeliensis	3	0	0	0	0
French broom	3	0	0	0	0
Redtop	3	0	0	0	0
Feederia hirsuta and H. canariensis	3	0	0	0	0

ADVANCED: View occurrence info

BETA

basic | advanced

Centaurea maculosa




Photo © Regents of the University of California

Centaurea maculosa
(spotted knapweed)

Cal-IPC Rating: High
Other Ratings: CDFA A, BAEDN

species description

get species map report

Counties

Placer

Placer
Management Opportunities

Surveillance: ?	36 species >>
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Managed: ?	32 species >>

get management opportunities report

CREATE A REPORT | MANAGE MAP LAYERS

base map

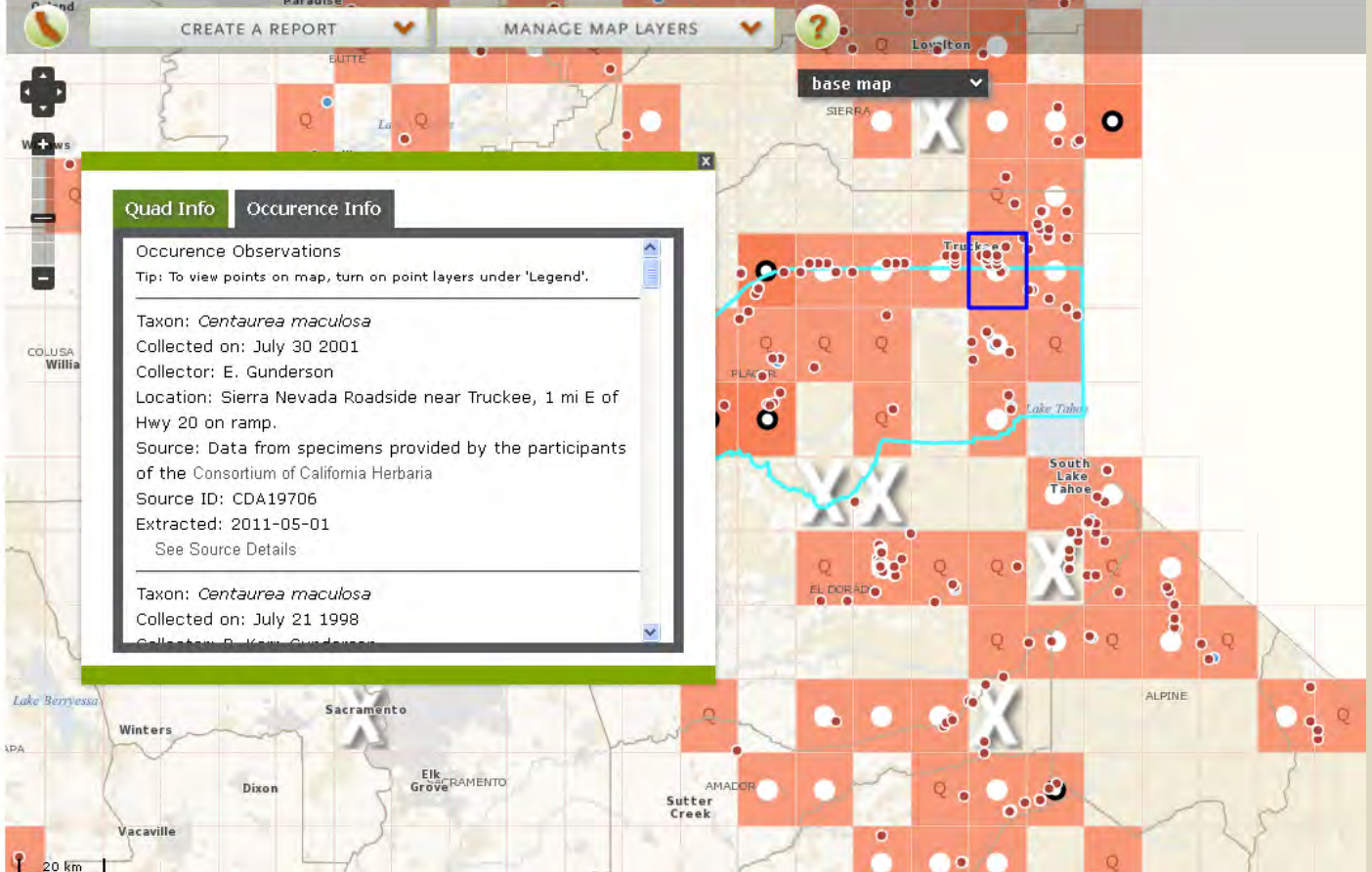
Quad Info | Occurrence Info

Occurrence Observations

Tip: To view points on map, turn on point layers under 'Legend'.

Taxon: *Centaurea maculosa*
Collected on: July 30 2001
Collector: E. Gunderson
Location: Sierra Nevada Roadside near Truckee, 1 mi E of Hwy 20 on ramp.
Source: Data from specimens provided by the participants of the Consortium of California Herbaria
Source ID: CDA19706
Extracted: 2011-05-01
See Source Details

Taxon: *Centaurea maculosa*
Collected on: July 21 1998
Collector: B. Kuhn-Gunderson





Thank you

...to everyone who provided data and participated in meetings!

Funding:

California Dept. of Food & Agriculture (ARRA funds)

National Fish & Wildlife Foundation

Resources Legacy Fund

Richard & Rhoda Goldman Fund

True North Foundation

USDA Forest Service State & Private Forestry

USDA Forest Service Special Technology Development Program

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