

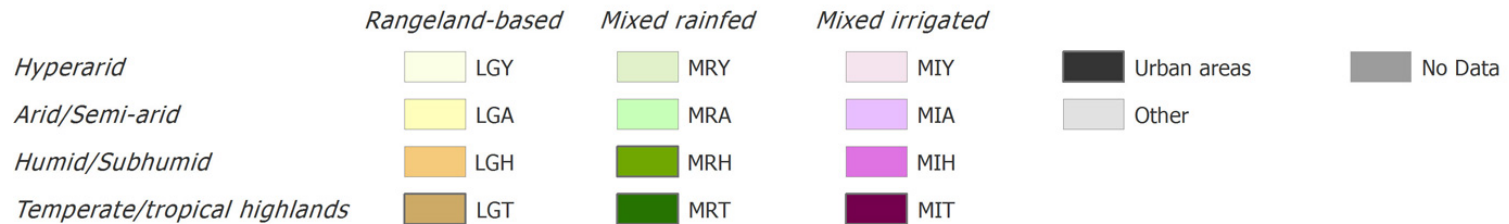
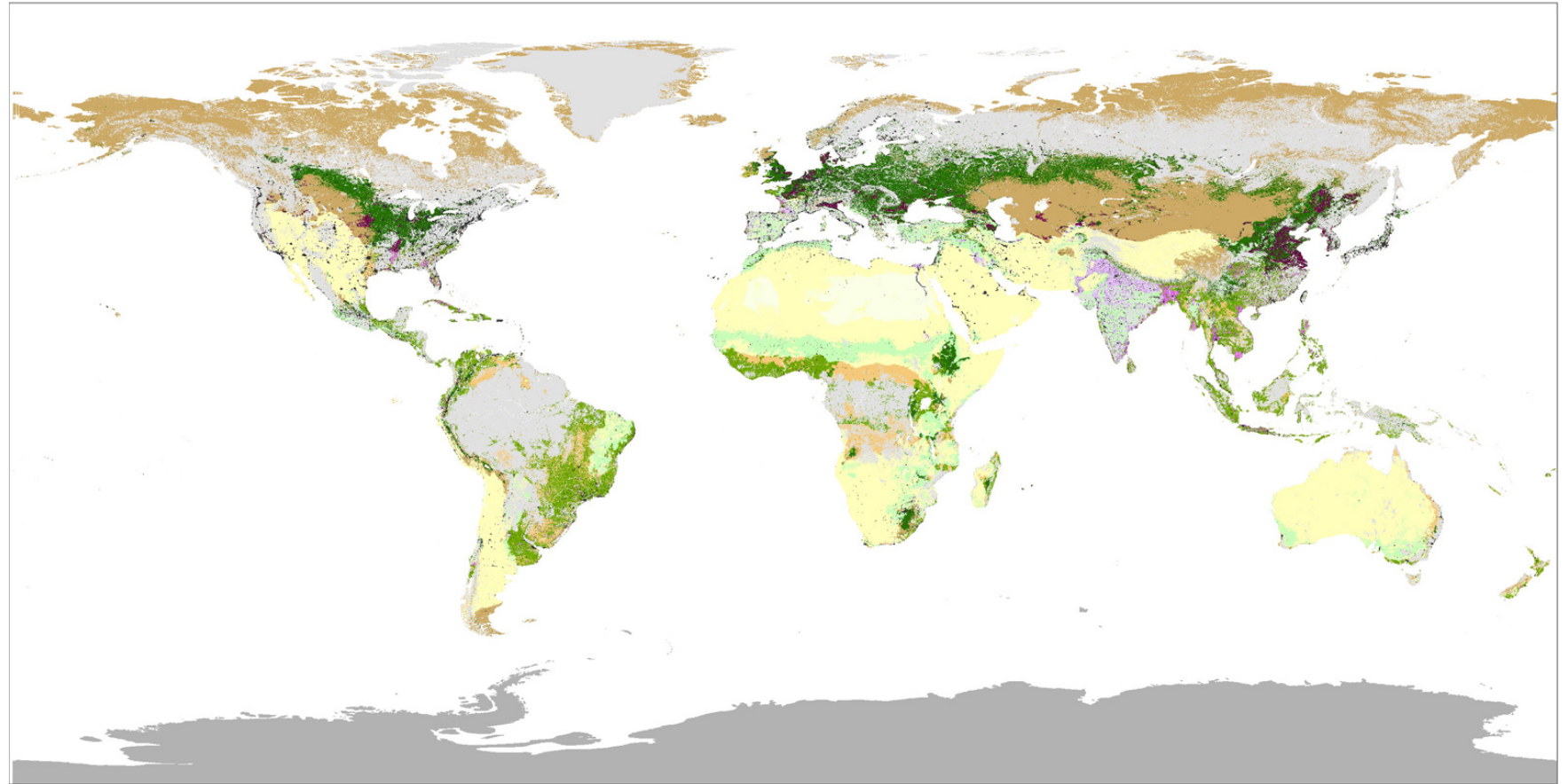


Weed Management

Lynn M. Sosnoskie
UCCE Merced and Madera

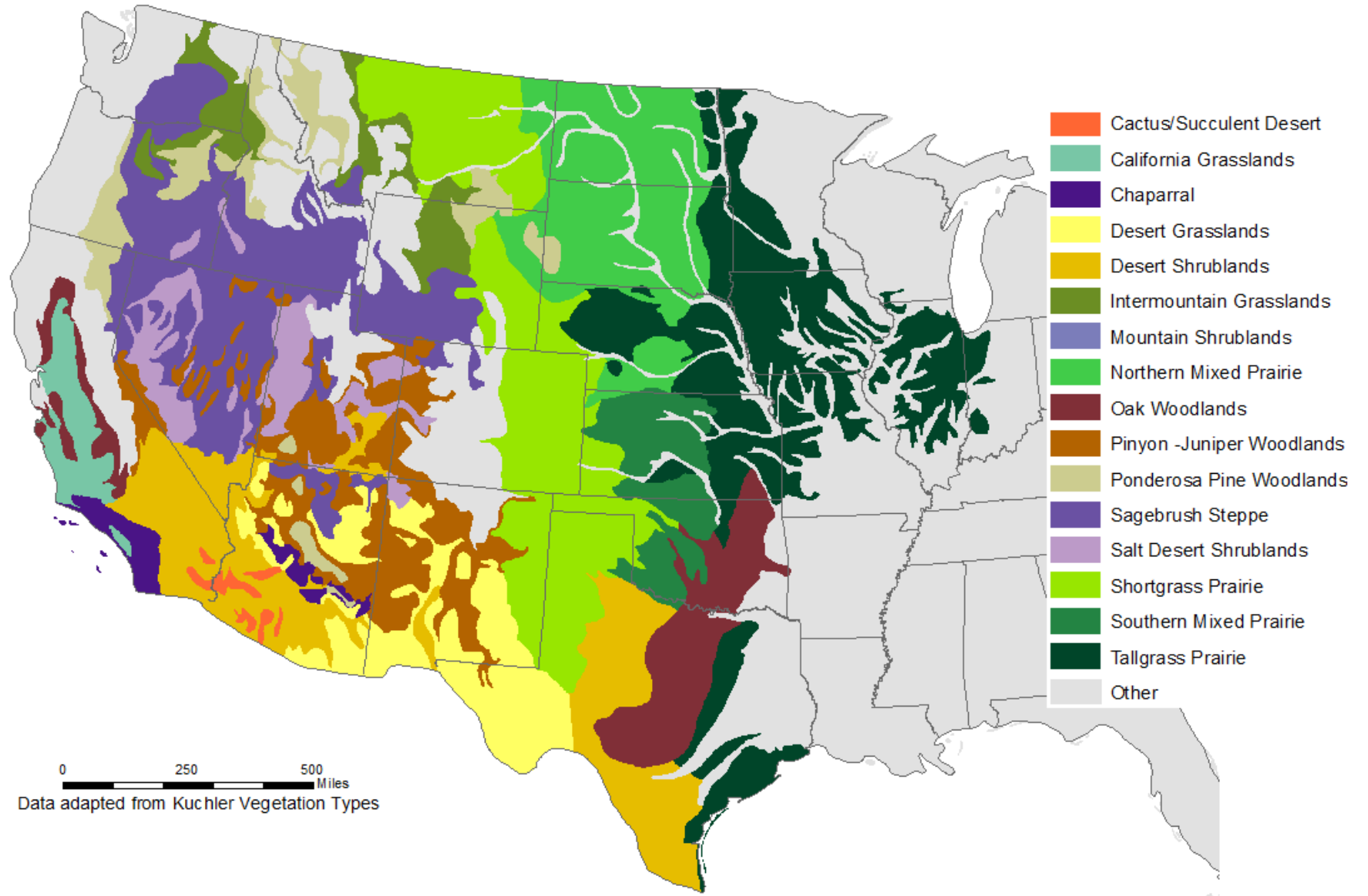
Global grazing lands occupy ~3.4 billion ha or almost 50% of the earth's terrestrial surface

Support the livelihoods of millions of people



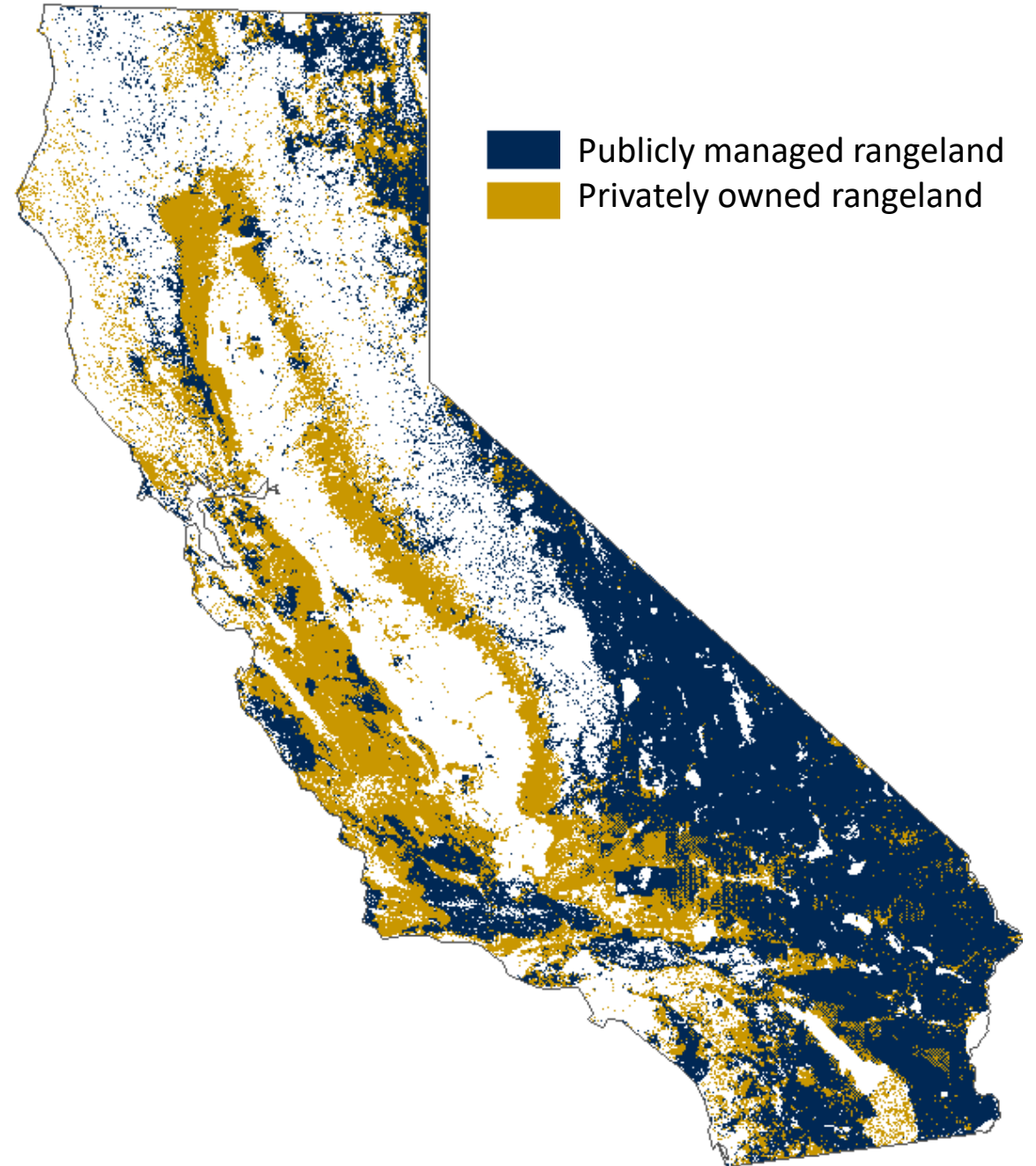
September 2011

In the continental US, rangelands occupy a diverse set of environments from arid deserts to shrublands to grasslands to woodlands and forested land

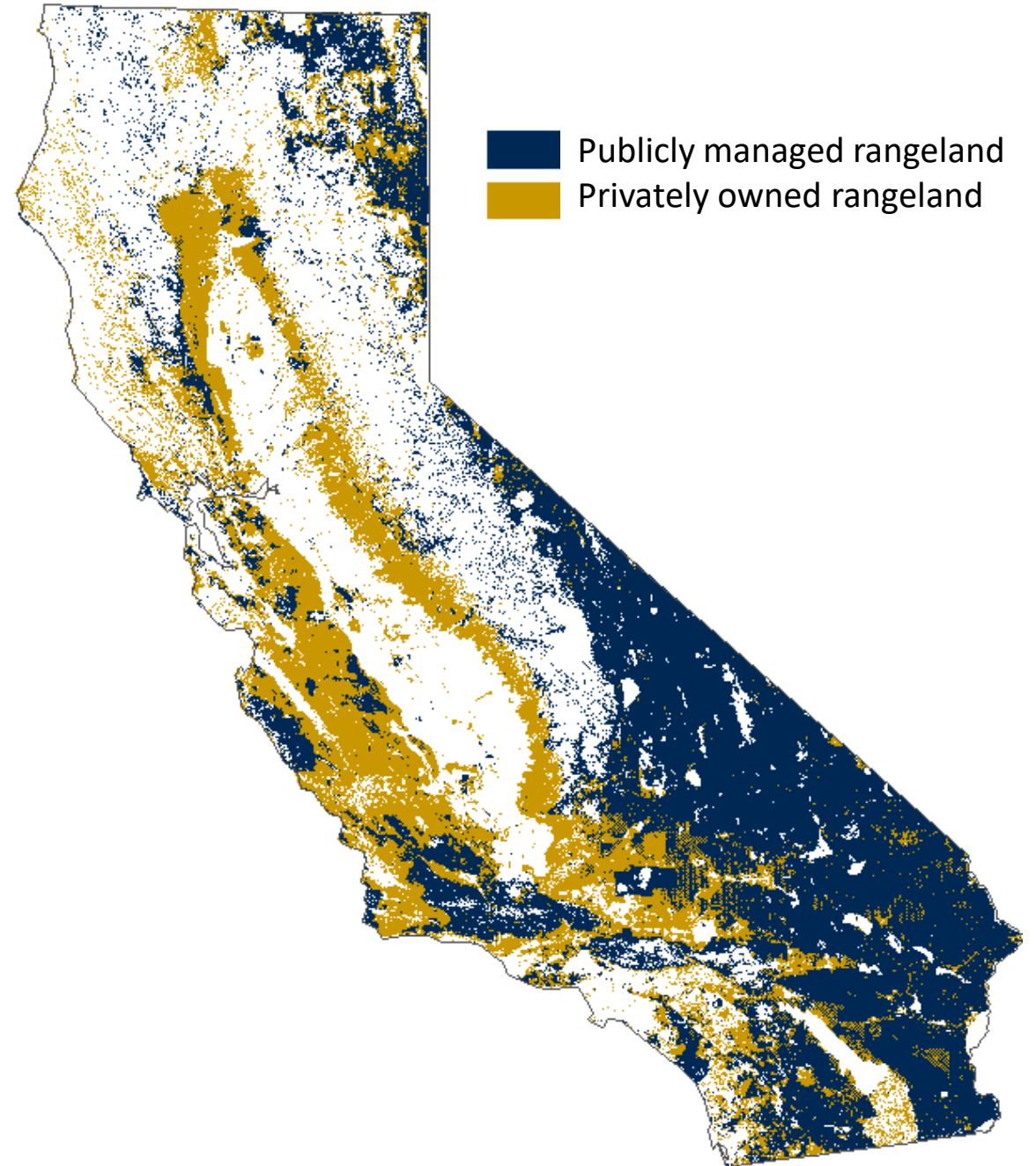


Slide provided by Dr. Leslie Roche

- 57 M acres of rangeland, of which ~34 M acres are grazed
- \$2.6 billion annual cattle and sheep industry
- >2/3 surface water supplies pass through or stored
- >300 vertebrate, 5000 invertebrate, and 2000 plant species



- ~50% of CA rangelands are publicly owned
- ~20% of ranches have public land leases
- Public lands fill an important summer forage gap – livestock move in summer from a lower elevation to a higher one to access high quality forage





**WHAT ABOUT
WEEDS?**

**WHY ARE THEY
PROBLEMATIC?**

WEEDS ARE A PAIN IN THE GRASS!

FOR MORE INFORMATION CALL: 509-422-7165

***DO YOUR PART!
Stop the spread
of noxious weeds***



Weeds are problems in more than just ag and hort systems...

- Beyond competition for water and nutrients...
- Reduced safety through obstructions
- Loss of aesthetic value
- Reduced biodiversity
- Adverse effects on ecosystem functions
- Hazards to human and animal health



Puncturevine seed head

An example of effects on ecosystem functions

Non-native species can impact fire cycles

Five things you probably never knew about California's wildfires

Patrick May

PUBLISHED: July 3, 2018 at 10:49 am | UPDATED: July 3, 2018 at 10:56 am

California News, Latest Headlines, News



A firefighter scrambles to stop the Pawnee fire as it spots across Highway 20 near Clearlake Oaks, Calif., on Sunday, July 1, 2018. (AP Photo/Noah Berger)

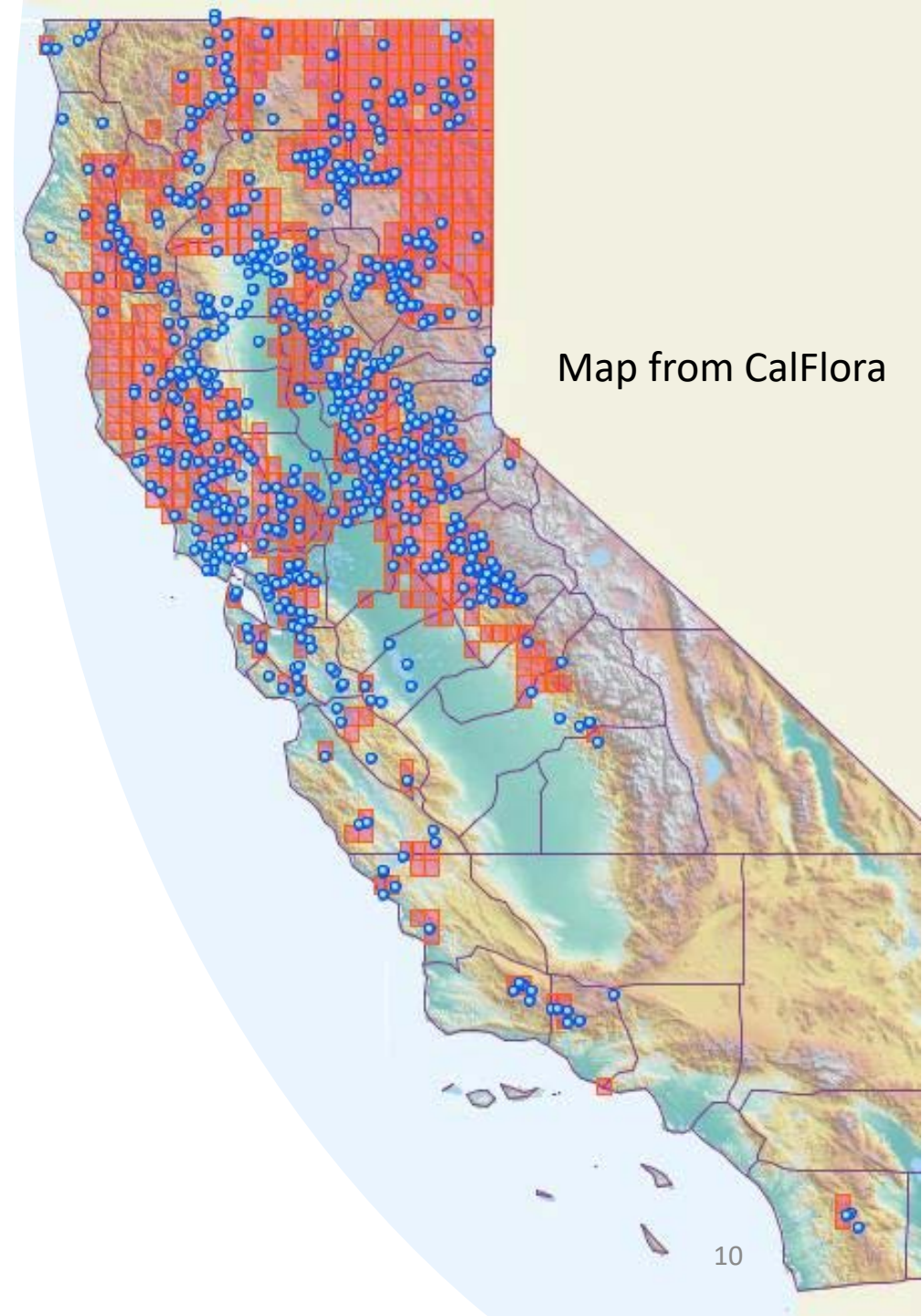
Non-native plants are helping California to burn, baby, burn

Travis Bean writes in UC Weed Science blog that despite all the news coverage of last year's wildfires, "almost no source has identified the actual fuels involved for this most recent fire season or any other. As a weed scientist, this is a particularly alarming omission, especially when it's highly likely that invasive plants may have been partially responsible for exacerbating the intensity and spatial scale of many, if not most, of 2017's fires." Bean writes that there's an apparent "tendency to lump fires into very broad categories (e.g., "forest" fire, "brush" fire, "wildfire") that tell managers, the public, and policy makers little about the actual fuel. Without letting the public and policy makers know that our wildfires are being dramatically worsened by fuels from invasive plants, it's difficult to build the political will and support for efforts to do a better job managing these fuels. As scientists and managers, simple data on the fuels involved and the antecedent weather would allow us to provide timely predictions on not just when and where these fires will strike, but also where and when we should be investing in fuel breaks, restoration, or other management actions that can save money, resources, and lives."

Medusahead

From: Medusahead Management Guide for the Western US

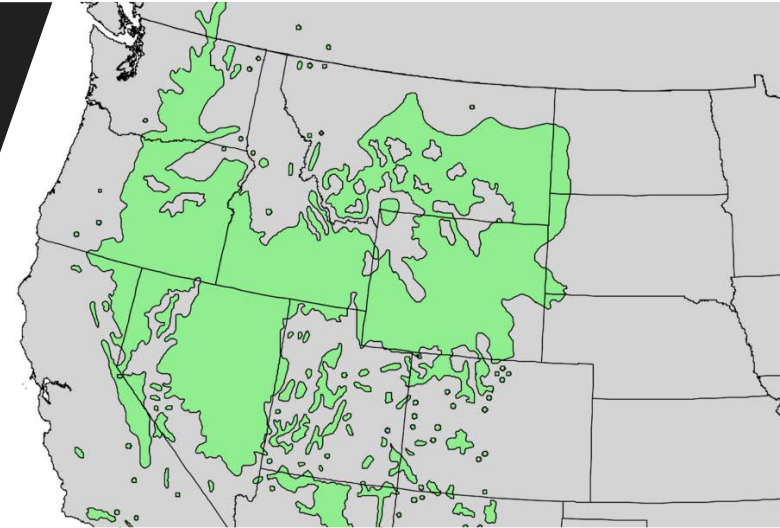
- Winter annual grass
- Native to Mediterranean
- First reported in OR in 1887
- Mainly infests rangelands
- Poor forage
 - Silica accumulator
 - Barbed seeds
- Displaces native species
- Disrupts wildlife habitat
- Alters fire regimes



Medusahead

From: Medusahead Management Guide for the Western US

- Acts as a fire promoter in the big sagebrush (*Artemisia tridentata*) steppe
- Fills in between sagebrush to create a continuous fuel corridor
- Many species of sagebrush are unable to regenerate from frequent fires





Fiddleneck



Hare Barley



Common Groundsel

Weeds can be injurious to livestock

Fiddleneck (*Amsinckia* spp.)

- Fireweed, tarweed
- Poisoning by pyrrolizidine alkaloids
- Horses
- Cattle
- Chronic, irreversible liver damage
- Symptom development 2-8 months
- Loss of appetite, weight loss
- Diarrhea
- Jaundice
- Head-pressing, awkward gait (horses)



Livestock Poisoning Plants of California

<https://anrcatalog.ucanr.edu/pdf/8398.pdf>

<http://anrcatalog.ucdavis.edu>

Publication 8398 | January 2011



Livestock-Poisoning Plants of California

LARRY FORERO, University of California Cooperative Extension Livestock Advisor, Shasta and Trinity Counties; **GLENN NADER**, University of California Cooperative Extension Livestock and Natural Resources Advisor, Sutter-Yuba and Butte Counties; **ARTHUR CRAIGMILL**, University of California Cooperative Extension Environmental Toxicology Specialist, Sierra Foothill Research and Extension Center; **JOSEPH M. DITOMASO**, University of California Cooperative Extension Weed Specialist, Department of Plant Sciences, UC Davis; **BIRGIT PUSCHNER**, Professor of Veterinary Toxicology, California Animal Health and Food Safety Laboratory; and **JOHN MAAS**, University of California Cooperative Extension Veterinarian, School of Veterinary Medicine, UC Davis.

Poisonous plants cause significant losses of livestock every year. A successful livestock operator must know which poisonous plants occur on a given range or pasture and how they can be controlled or avoided. This publication shows which plants are poisonous, tells how they affect stock, and suggests ways to reduce losses from poisoning.

Undesirable effects may result from a single ingestion of a large amount of a poisonous plant, but some plants are so toxic that very small amounts may result in severe disease or death. Other plants cause chronic poisoning only after ingestion over weeks or months. The later situation may result in clinical signs long after the exposure to the toxic plant material, and treatment may no longer be possible.

With few exceptions, livestock will not eat poisonous plants unless forced to by hunger. The single most important way to prevent poisoning is to use proper range and pasture management practices to provide ample forage, encouraging consumption of nontoxic plants. Areas infested with poisonous plants should be avoided when trailing, holding, or unloading animals. Supplemental feed may protect stock if these conditions cannot be avoided, but there are circumstances (for example, herbicide applications) that may change palatability or increase toxicity in some plants. If toxic weeds are embedded in alfalfa cubes or included in total mixed rations, animals may not be able to avoid ingestion of them.

Many poisonous plants may be controlled with herbicides. Often, however, the uneven distribution



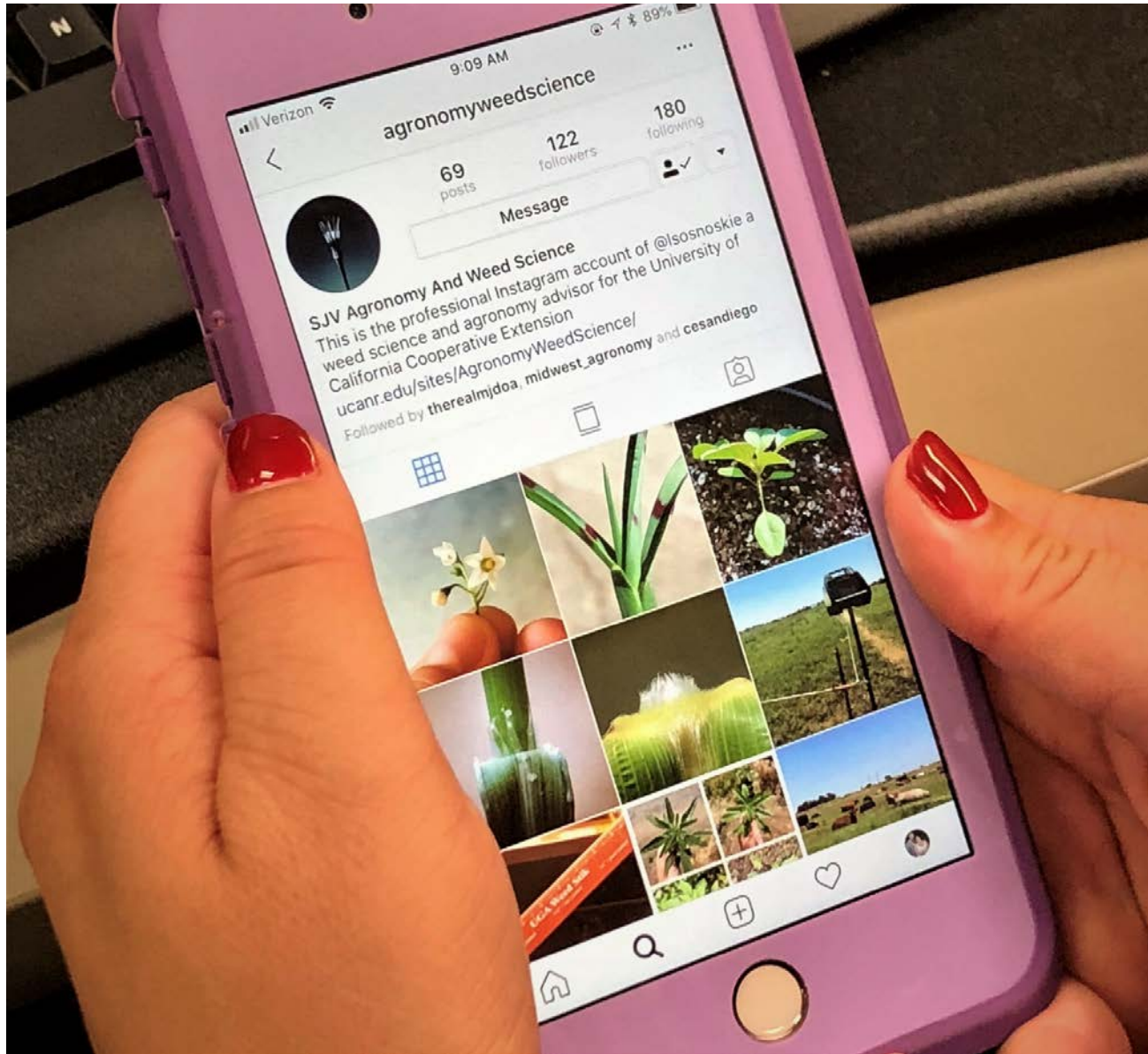
**THE FIRST STEP IN
DEVELOPING AN
EFFECTIVE WEED
MANAGEMENT
PROGRAM IS TO
IDENTIFY THE
SPECIES PROPERLY**

WHY IS WEED ID IMPORTANT?

- Because weed management strategies are not equally effective against all weeds
- Selectivity
 - Herbicides that target grasses vs broadleaf species
 - Mowing that can differentially affect erect vs prostrate plants
 - Cultivation that can control annuals but not perennials
 - Timing of operations to target summer vs winter annuals

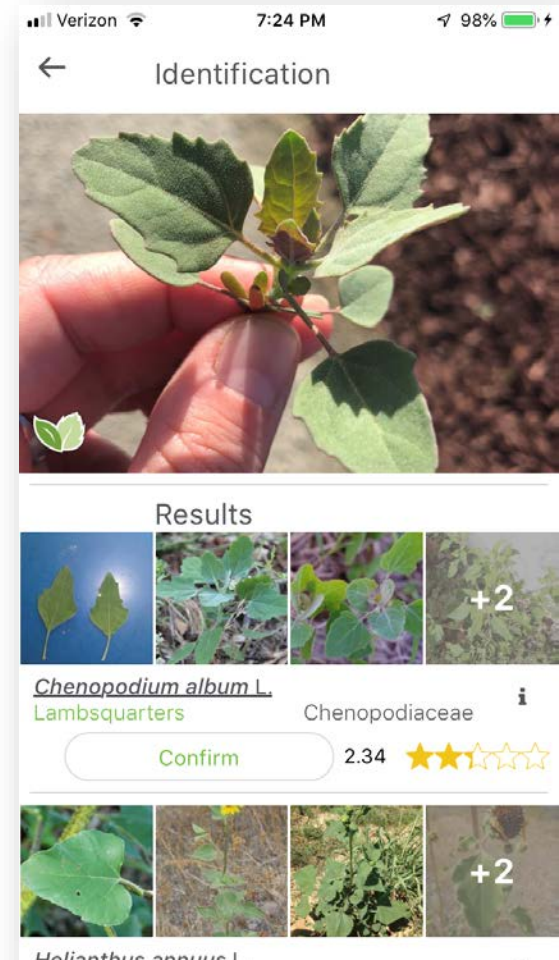
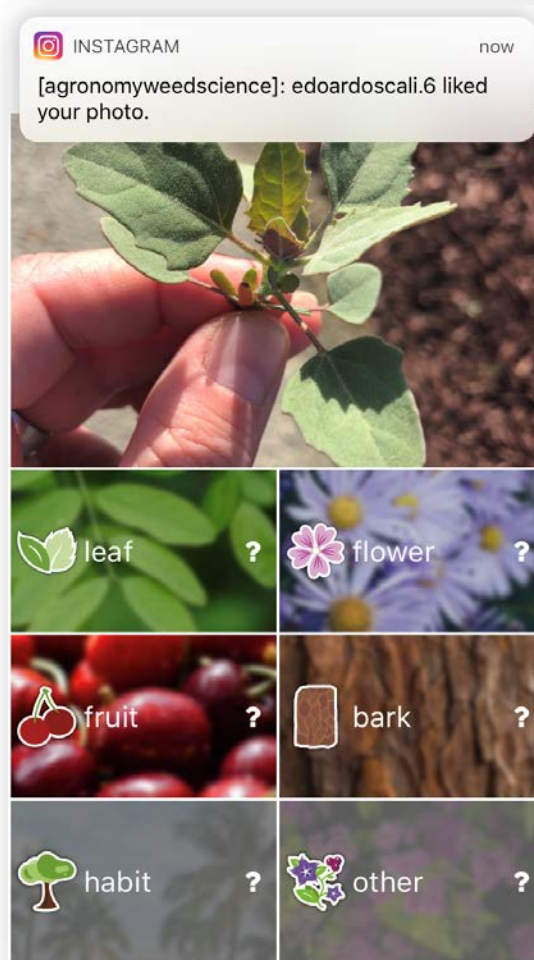
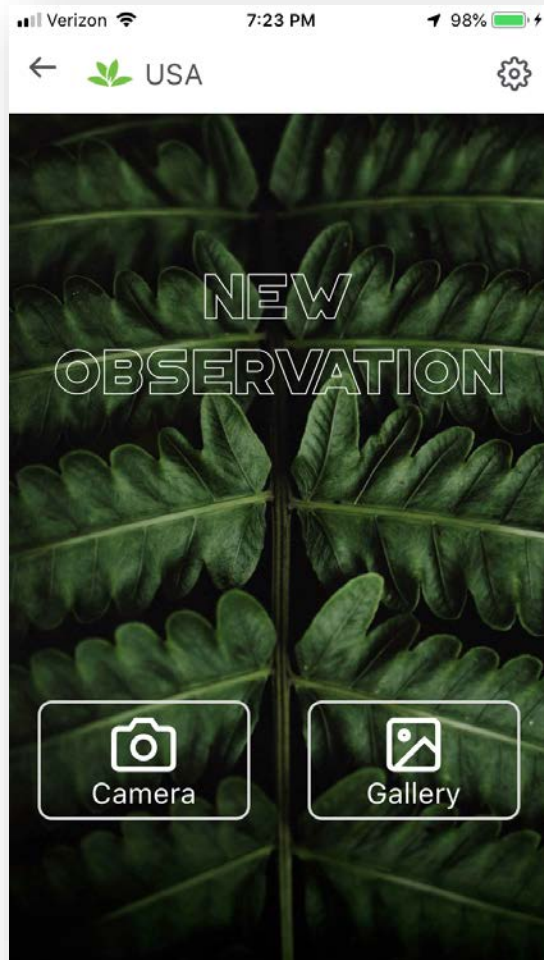
WEED ID GIVES YOU A STARTING POINT

- A successful identification provides you with the basic knowledge that you need to develop a successful management plan
- Ideally, control strategies will be adopted based on the sensitivity of a target species to control measures

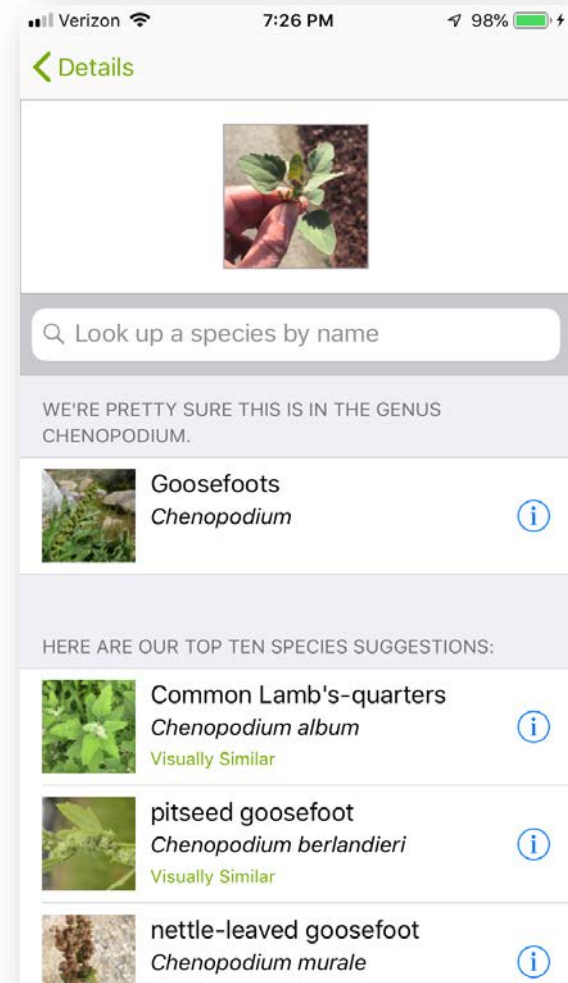
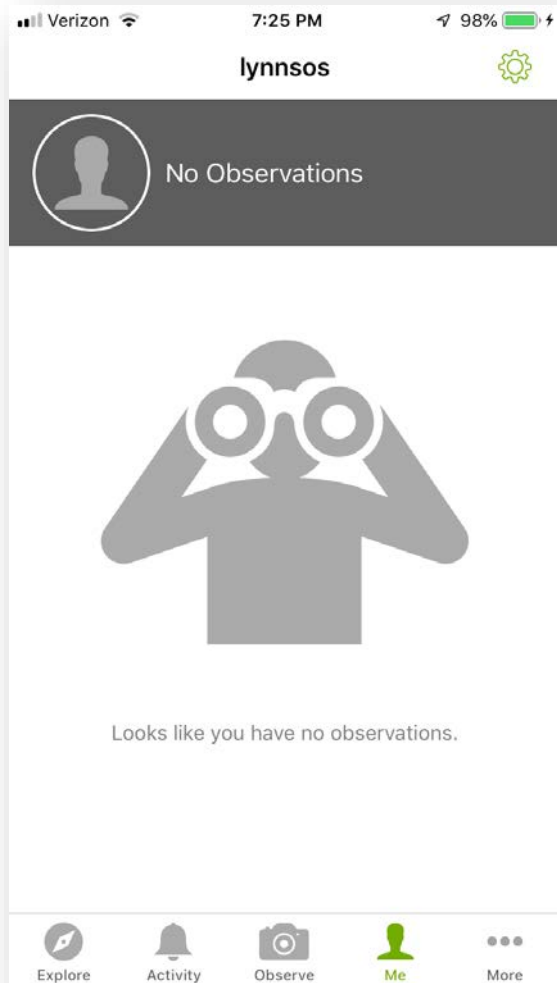


PHONE APPS

PL@NTNET



INATURALIST





WEED CONTROL: HERBICIDES

A top-down photograph of a large, green, leafy plant with deeply lobed, serrated leaves, growing in a black plastic tray. The plant is the central focus, with other smaller plants visible in the surrounding compartments of the tray. The word "GLYPHOSATE" is overlaid in large, white, bold, sans-serif capital letters across the center of the plant. The background is a dark, textured surface, likely the tray's material.

GLYPHOSATE

Land manager perspectives on rangeland weed control practices

L.M. Roche^{1,2}, T.K. Schohr², J.A. Shaw¹, K.W. Tate^{1,2}, E.S. Gornish³

University of California¹, Davis; UC Cooperative Extension²; University of Arizona Cooperative Extension³



UCRANGELANDS
Supporting Working Landscapes

UC DAVIS
DEPARTMENT OF PLANT SCIENCES
College of Agricultural and Environmental Sciences

California Environmental Protection Agency
dpr Department of
Pesticide Regulation

Purpose:

Leverage the largely untapped weed management knowledge of land managers via synergistic activities (workshops, surveys, interviews).

Goals:

1. Understand how practitioners make decisions about approaches.
2. Identify factors contributing to success/failure.
3. Understand how to strengthen links between academic research and field application.



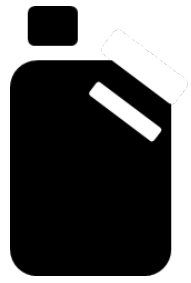


Deriving knowledge from managers...

“Knocking Out Noxious Weeds on Rangelands”

>350 participants, 7 workshops

- Ranchers, Private landowners
- Rangeland Professionals
- State and Federal Agencies
- Non-governmental Organizations



Which herbicides do you use most often?

	Eureka	Susanville	Woodland	Salinas	Fresno
#1	Glyphosate products	Glyphosate products	Glyphosate products	Glyphosate products	Glyphosate products
#2	Imazapyr	Telar/ Milestone	Telar/ Milestone	Milestone	Milestone (aminopyralid)
#3	2, 4-D	2, 4-D	Garlon	2, 4-D	Transline (clopyralid)

Herbicide Basic Information

Glyphosate

- WSSA Group 9
- EPSPS-inhibitor
- Systemic/translocated
- Non-selective
- Controls many annual and perennial broadleaf and grass weed species before renovating pastures
- Rates depend on weed species, stage of growth, and density
- Repeat treatments may be necessary to control weeds regenerating from underground tissue

Aminopyralid and Clorpyralid

- WSSA Group 4
- Synthetic auxins
- Systemic/translocated
- Selective against broadleaf weeds
- Aminopyralid - Controls a range of broadleaf weeds, including many in the sunflower and legume families
- Clopyralid - Apply to Canada thistle after most basal leaves have emerged but before bud stage

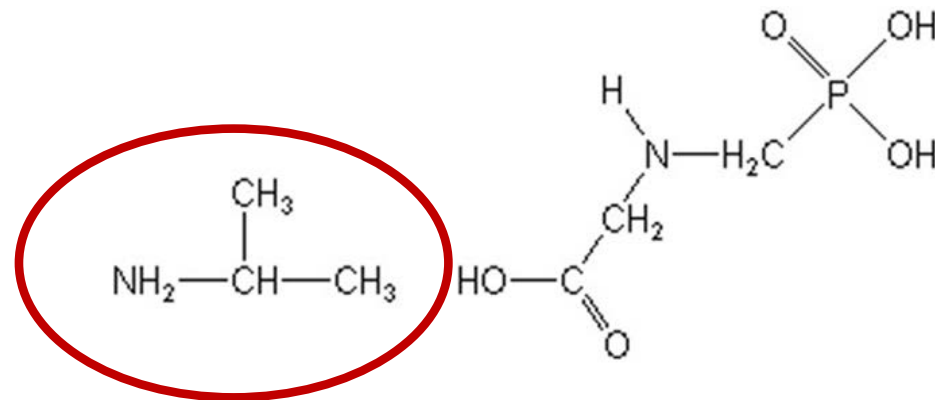
Glyphosate

- Originally synthesized in 1950 by the Swiss company Cilag
- In 1970, Monsanto Company evaluated the molecule as a herbicide
- Entered the commercial market under the trade name Roundup in 1974
- Monsanto's last commercially relevant patent for glyphosate expired in 2000
- Worldwide, there are hundreds (more?) of formulated glyphosate products

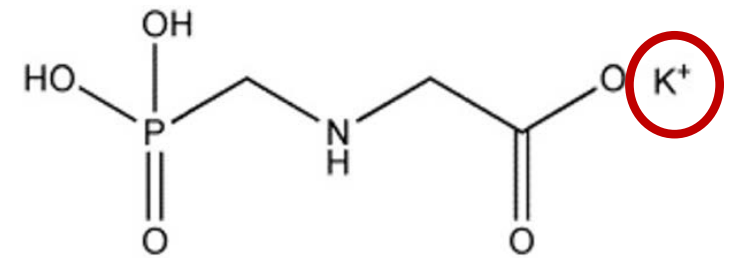
The glyphosate molecule is a weak acid

- In a formulated product, the parent molecule is bound to a salt

- Isopropylamine
- Dimethylamine
- Potassium
- others



Glyphosate-isopropylamine salt



Glyphosate-potassium salt

Formulation: Why Does This matter?

- This parent acid of glyphosate is effective as a herbicide BUT it doesn't make for a stable product so manufacturers combine it with a salt
- Salts differ in their solubility and weight and they can affect how concentrated glyphosate may be in the commercial formulation
- 32 oz/A of one formulated product is not necessarily the same as 32 oz/A of another formulated product

Some Glyphosate Formulations

Trade Name	Formulated Salt	Concentration		0.75 lb ae rate
		<u>lb ai/gal</u>	<u>lb ae/gal</u>	<u>(oz/acre)</u>
Roundup Original	IPA	4	3	32
Roundup WeatherMax	K	5.5	4.5	22
Durango	IPA	5.4	4	26

UC WEED SCIENCE

Weed control, management, ecology, and minutia

Glyphosate formulations - what's the diff (and what's a salt)?



Author: Brad Hanson

Published on: December 20, 2017

Glyphosate is one of the most widely used herbicides in the world and is extremely important in many of our orchard, vineyard, and annual crops as well as in non-crop and home situations. However, it can be confusing to understand some of the differences among various formulations of glyphosate herbicides.

I'll paraphrase a recurring extension question as "I'm trying to compare the rates and cost effectiveness of two glyphosate herbicides. One lists the active ingredient as '41% glyphosate isopropylamine salt' and the other as 48.7% glyphosate as the potassium salt'. How do these two herbicides?"

First important point, glyphosate is a weak acid herbicide. The various salt formulation impacts on how the herbicide behaves in the jug, and to some degree on how it gets into the plant. But once in the plant, it is the glyphosate acid that binds to the target enzyme in susceptible plants and causes the herbicidal effect.

What is a salt? From a chemistry perspective, a salt is simply a compound formed by ionic bonding of two ions of opposite charge. Glyphosate acid has a weak negative charge and the salt is formed when

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Tags

– orchards and vineyards (97)

– herbicide resistance (86)



WHY DOESN'T IT WORK?

**SPRAY WATER QUALITY, DUST, AND TEMPERATURE
(AMONG OTHERS)**

Why care about your spray water? Lets look at glyphosate

- Hard water

- Calcium (Ca^{++}), magnesium (Mg^{++}), and sodium (Na^+) are common in hard water
- These positive ions can bind to negatively charged herbicides, like glyphosate
- These ion-herbicide complexes do not bind as well to glyphosate's target enzyme
- **Result is reduced efficacy**

- Turbidity

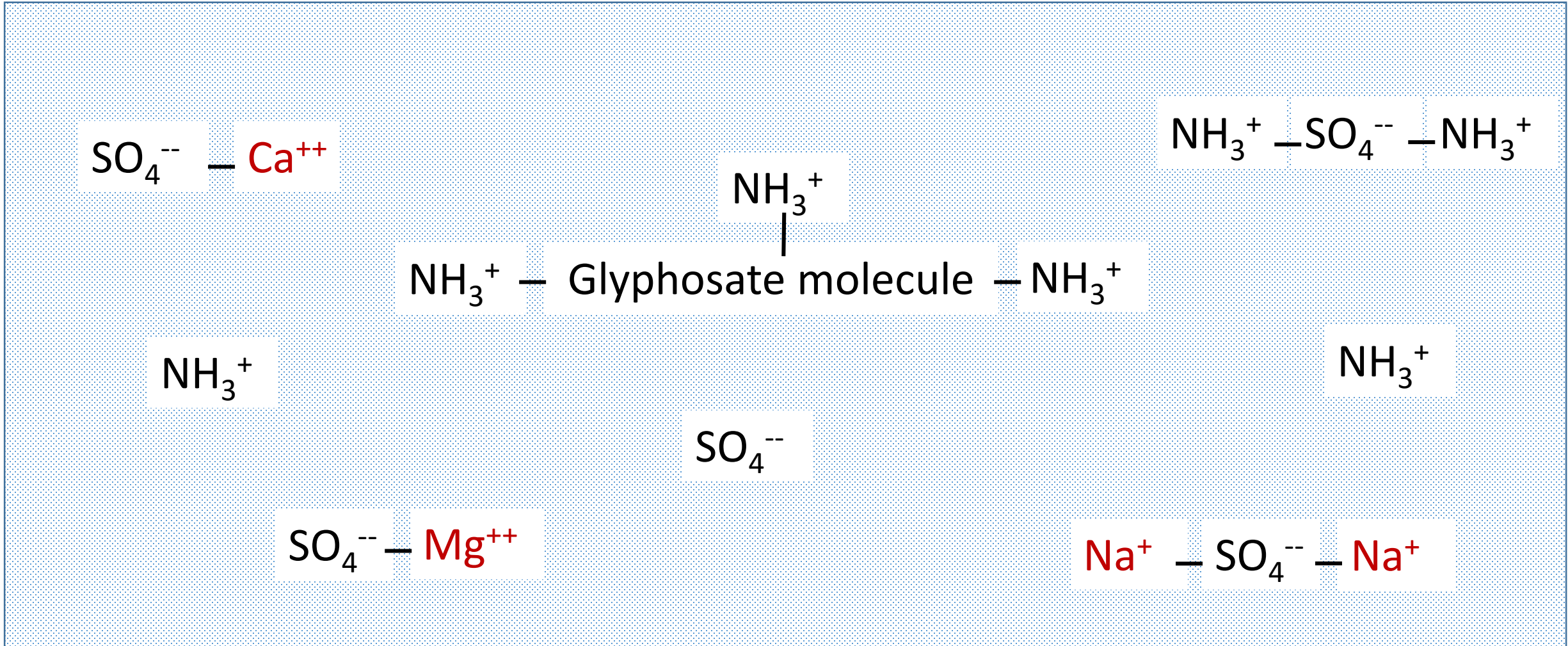
- Water containing OM or suspended soil particles can reduce glyphosate efficacy
- Glyphosate has a high soil organic carbon sorption coefficient (K_{oc})
- Glyphosate will bind to soil/OM in the water and will not be available to the plant
- **Result is reduced efficacy**

Ammonium sulfate and glyphosate: why it works

- Glyphosate is **antagonized by cations** in hard water such as calcium, magnesium, and sodium
 - These cations will preferentially bind to glyphosate (and reduce its ability to bind to target site)
- Both **ammonium** (NH_3^+) and **sulfate** (SO_4^{--}) active
 - Free **sulfate** binds with **Ca^{++} , Na^+ , Mg^{++} ions** in the spray water
 - Glyphosate binds to the **ammonium**
 - Glyphosate is **more readily absorbed** into foliage and bound to the target site and when combined with **ammonium** than when combined with **Ca^{++} , Na^+ , Mg^{++} ions**

Ammonium Sulfate and Glyphosate in Hard Water


(BTW...add AMS to the tank before glyphosate and don't forget to adjust pH down afterwards)




Best 'plain language' explanation of spray water and glyphosate efficacy

Google: glyphosate spray water quality Purdue

https://ag.purdue.edu/btny/weedscience/documents/water_quality.pdf



Created: 3/2/2012



www.btny.purdue.edu/weedscience

The Influence of Spray Water Quality on Herbicide Efficacy

What is Water Quality?

Water is a universal solvent, and it is used as a primary carrier for crop protection products applications, constituting more than 95% of the spray volume. The properties of water used for carrier in spray solutions can greatly influence the performance of herbicides including glyphosate, Ignite, Clarity, 2,4-D, Sharpen, Pursuit, Poast, Accent, and many other herbicides. Therefore, defining the role of water quality on herbicide efficacy is very important. Unlike pure water, water quality of groundwater is variable between sources. Water quality of groundwater is determined by several factors such as pH, hardness, alkalinity, turbidity, and temperature. Presence of dissolved cations like calcium, magnesium, iron, aluminum, zinc, manganese, sodium, potassium, cesium, and lithium can influence herbicide efficacy. The presence of calcium and magnesium carbonate makes water hard whereas carbonate and bicarbonate concentration determine the alkalinity of the water. The presence of soil and/or organic matter particulate leads to the turbidity in water.

Gurinderbir Chahal
Postdoctoral Research Associate

Jared Roskamp
Weed Science Masters Candidate

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Weed Science Program Specialist

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Professor of Weed Science
Purdue University
Extension Weed Science



Dust that accumulates on leaves can bind to glyphosate and prevent uptake

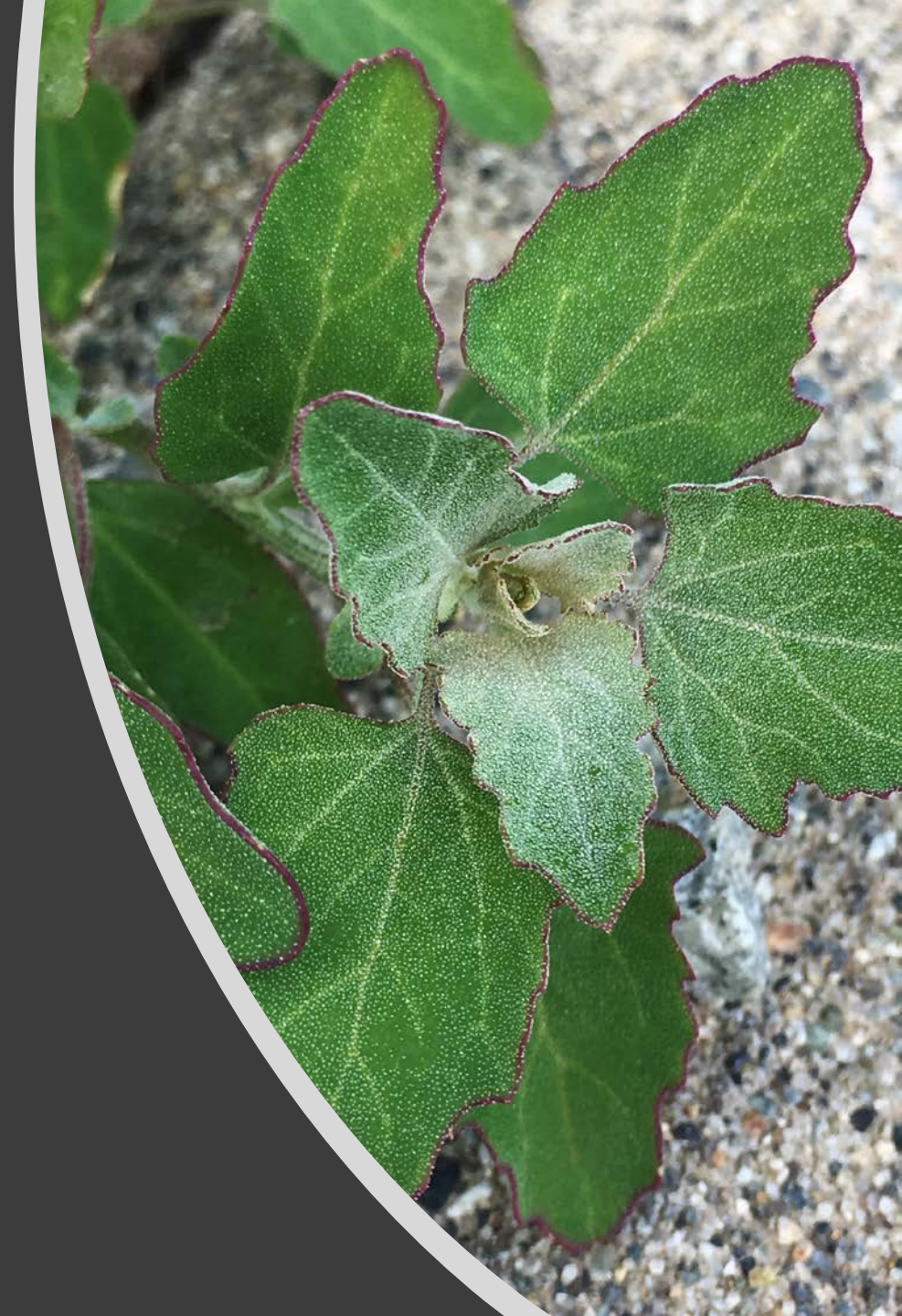
Dust that accumulates on leaves can bind to glyphosate and prevent uptake



Photo by Andrew Kniss PhD

Temperature effects on POST herbicide performance

- Herbicide efficacy can be adversely affected by very low and very high temperatures
- Plant growth, leaf area, leaf shape, and cuticle development can be impacted by temperature
- At temperature extremes, translocation and physiological activities in the weed may be reduced
- High temperatures can affect the deposition, volatility and breakdown of many herbicides, which affects activity



Examples of how temperature can affect POST herbicide efficacy

Frost can result in leaf damage and make those tissues poor targets of herbicides

Plants can develop thickened cuticles that can affect herbicide deposition and uptake

Plants grow slowly and do not produce sufficient amounts of foliage to capture herbicides

Slower uptake, translocation and activity of herbicides

High temperatures cause herbicides to dissipate and become removed from the target

Plants become stressed, physiological processes that herbicides disrupt are slowed down



Low Temp

High Temp

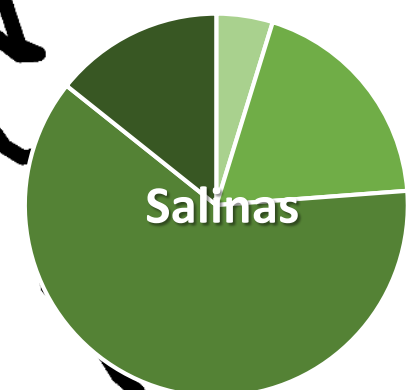


WEED CONTROL: OTHER STRATEGIES



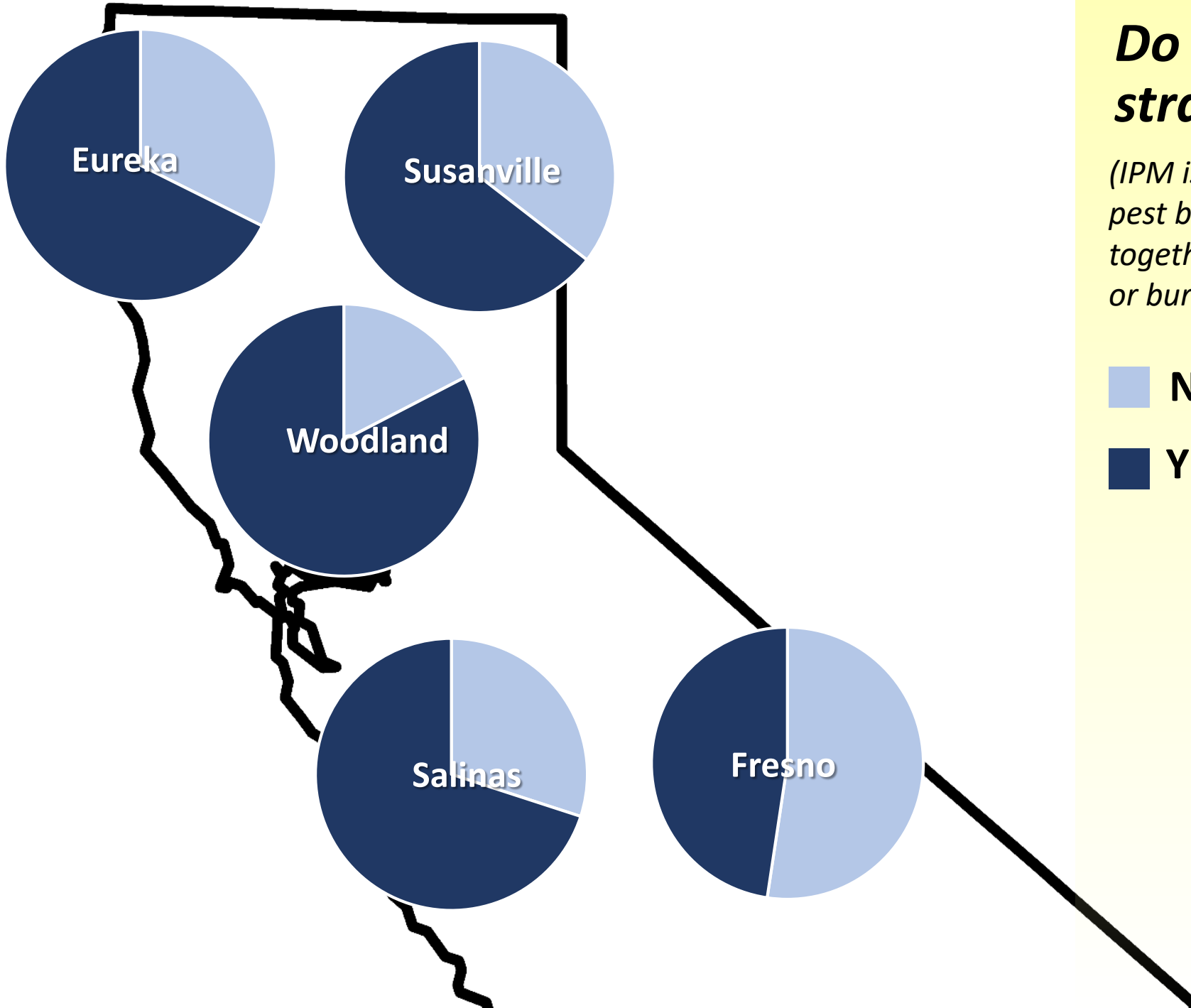
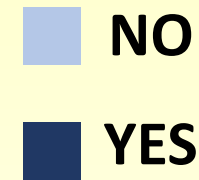
What is your success in controlling weeds with herbicide?

- Very poor
- Poor
- Fair
- Good
- Excellent



Do you practice any IPM strategies?

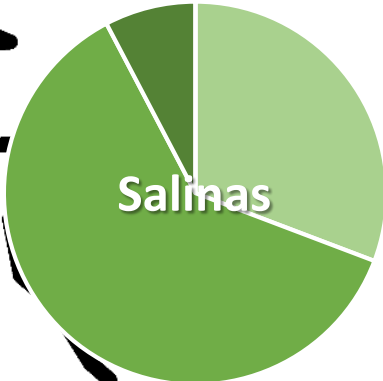
(IPM is a strategy of managing weeds and other pest by combining treatments that work together, such as grazing followed by reseeding, or burning followed by herbicides.)





What is your success in controlling weeds with fire?

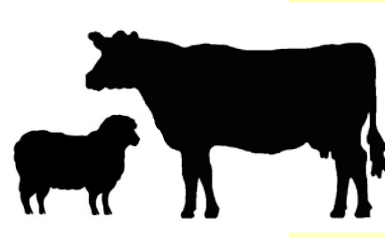
-  Very poor
-  Poor
-  Fair
-  Good
-  Excellent





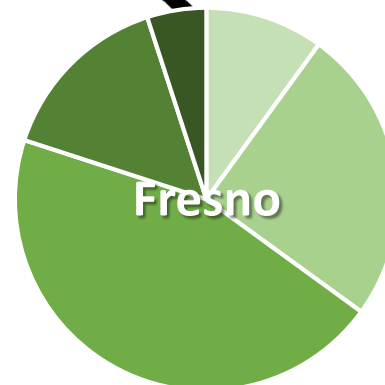
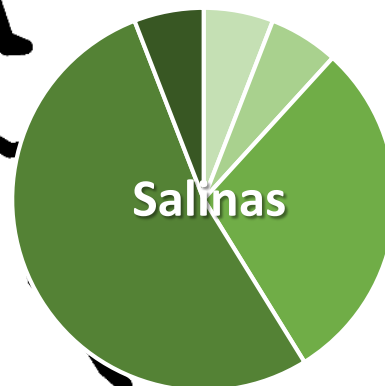
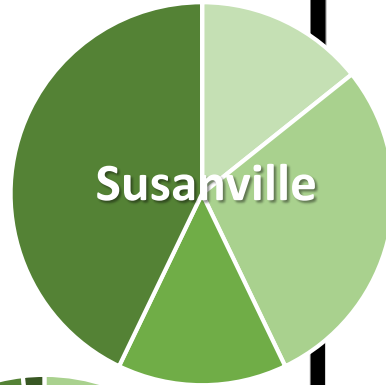
What are your main concerns about using prescribed fire to manage weeds?

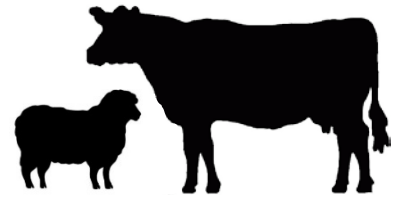
	Eureka	Susanville	Woodland	Salinas	Fresno
#1	Permitting	Loss of control	Permitting	Permitting	Permitting
#2	Public perception	Other	Loss of control/Public perception	Loss of control	Loss of control
#3	Loss of control	Weeds not adequately controlled	Lack of experience	Public perception	Public perception



What is your success in controlling weeds with grazing?

-  Very poor
-  Poor
-  Fair
-  Good
-  Excellent



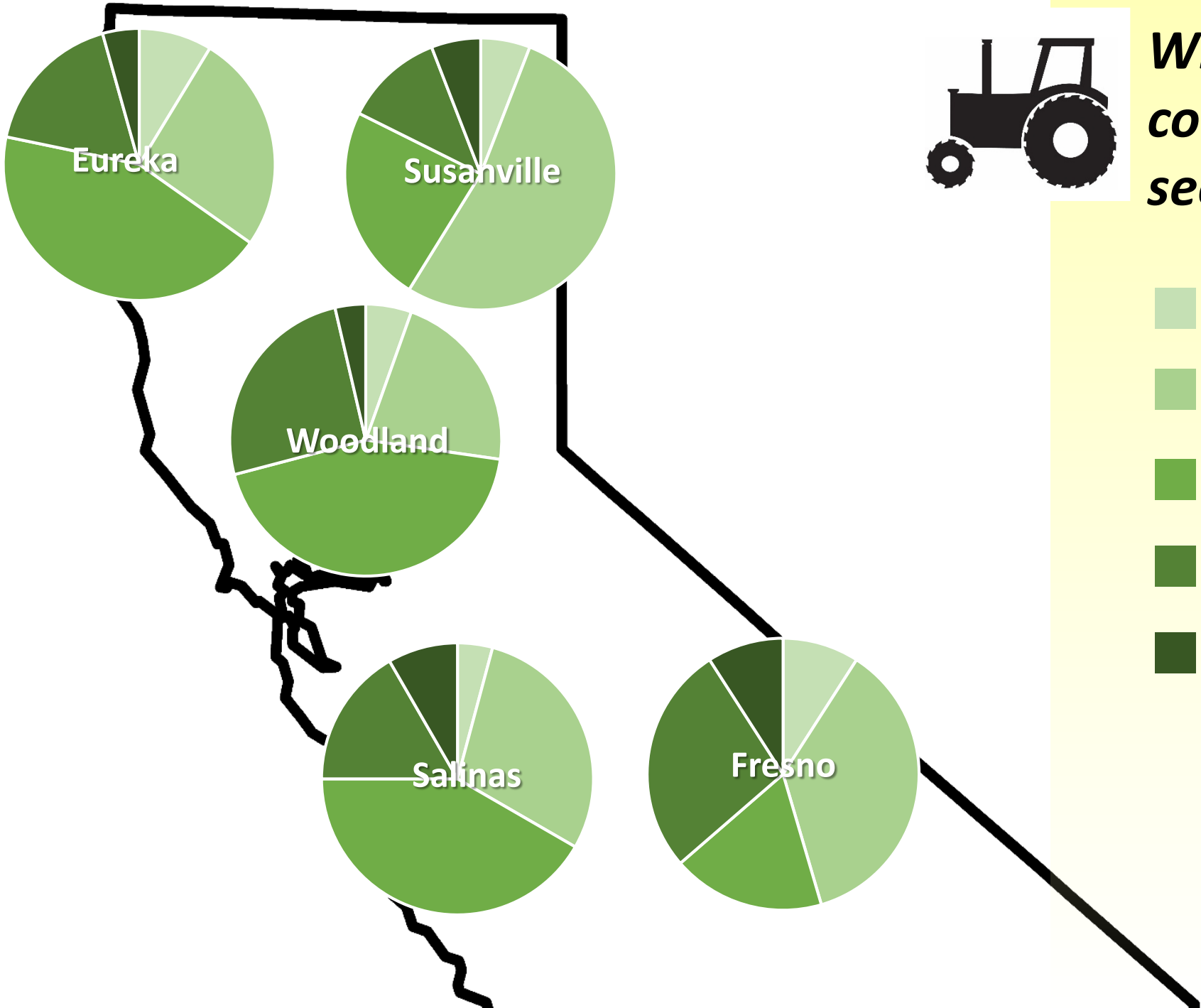


What are your main concerns about using grazing to manage weeds?

	Eureka	Susanville	Woodland	Salinas	Fresno
#1	Poor palatability-toxic weeds	Water availability	Weeds not adequately controlled	Poor palatability-toxic weeds	Weeds not adequately controlled
#2	Other	Weeds not adequately controlled	Poor palatability-toxic weeds	Weeds not adequately controlled	Poor palatability-toxic weeds
#3	Unintended effects/ Predators	Poor palatability-toxic weeds/ Forage quality	Water availability	Access to animals/Other	Water availability/ Other



What is your success in controlling weeds with seeding?



- Very poor
- Poor
- Fair
- Good
- Excellent



What are your main concerns about using seeding to manage weeds?

Reason	Eureka	Susanville	Woodland	Salinas	Fresno
#1	Cost	Cost	Establishment	Cost	Cost
#2	Establishment	Establishment	Cost	Establishment	Establishment
#3	Terrain	Availability of water/Terrain	Water availability	Water availability	Lack of experience

Control Methods - Grasses

Species	Mechanical	Rx fire	Grazing	Herbicide
Medusahead	Till/mow before seed set; may need to repeat	Late spring; follow with grazing/chem	Heavy grazing before seedhead formation (doesn't eradicate)	postemergent best on young plants
Barb Goatgrass	Mow after flower but before soft boot; otherwise not recommended	Late spring; follow with chem; limited success	Heavy grazing OK (doesn't eradicate)	Postemergent best on rapid growth stages
Foxtail and Hare Barley	Repeated tillage may work; mowing not recommended	Late spring; repeat or follow with grazing or chem	Heavy grazing before seedhead formation (variable results)	Postemergent best on rapid growth stages

Control Methods - Forbs

Species	Mechanical	Rx fire	Grazing	Herbicide
Spurges	Repeat for several years and throughout season	Ineffective, not recommended	TOXIC (only goats and sheep OK to graze)	Postemergent best at spring flowering
Skeletonweed	Frequent mowing/ tillage OK; otherwise not recommended	Ineffective, not recommended	Ineffective, not recommended	Postemergent best on rosette/young plants
Yellow Starthistle	Mow in early bloom OK; repeat tillage OK, threatens desired forage	Ineffective, not recommended	Goats best, pre- or early flower. All will graze rosettes	Postemergent best on rosette, rapid growth stages
Other thistles	Hand pull or cut to sever root; do before flower	Ineffective, not recommended	Goats eat flower heads; sheep will eat rosettes	Some preemergent; post- best on rosette, rapid growth
Puncturevine	Hand pulling or tillage before flowering OK	Impractical, not recommended	TOXIC	Postemergent best on seedlings, rapid growth

Control Methods – Woody Species

Species	Mechanical	Rx fire	Grazing	Herbicide
Klamathweed	Tillage OK; others ineffective	Ineffective, not recommended	TOXIC (except goats)	Postemergent best on young plants pre-bloom
Brooms	Hand-pull or “wrench” in first few years	Follow with mech/chem; repeat to deplete seedbank	TOXIC (except goats)	Postemergent, on rapid growth stages
Tree of Heaven	“Wrench” smaller plants, extract entire root	Ineffective, not recommended	Not recommended	Foliar or basal bark; best in summer-fall

Best Management Practices

- There is NO SINGLE best management practice or combination of practices
- Vegetation management programs will be dependent on the weeds present, the ecological system that they occur in, and the views and values of the land manager
- Understanding the identity and biology of the unwanted species is crucial for selecting the best tools or combination of tools to employ

THANK YOU



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