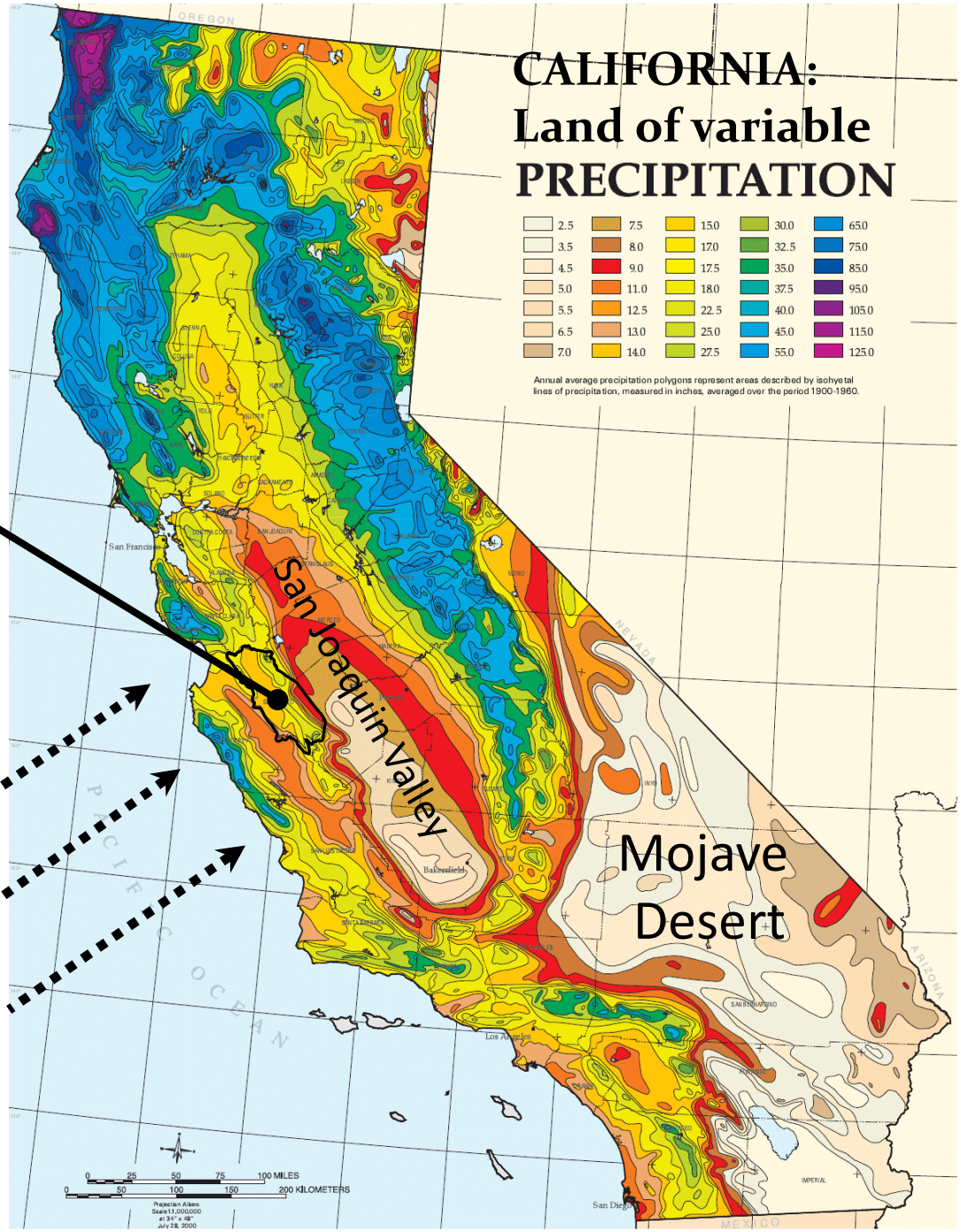
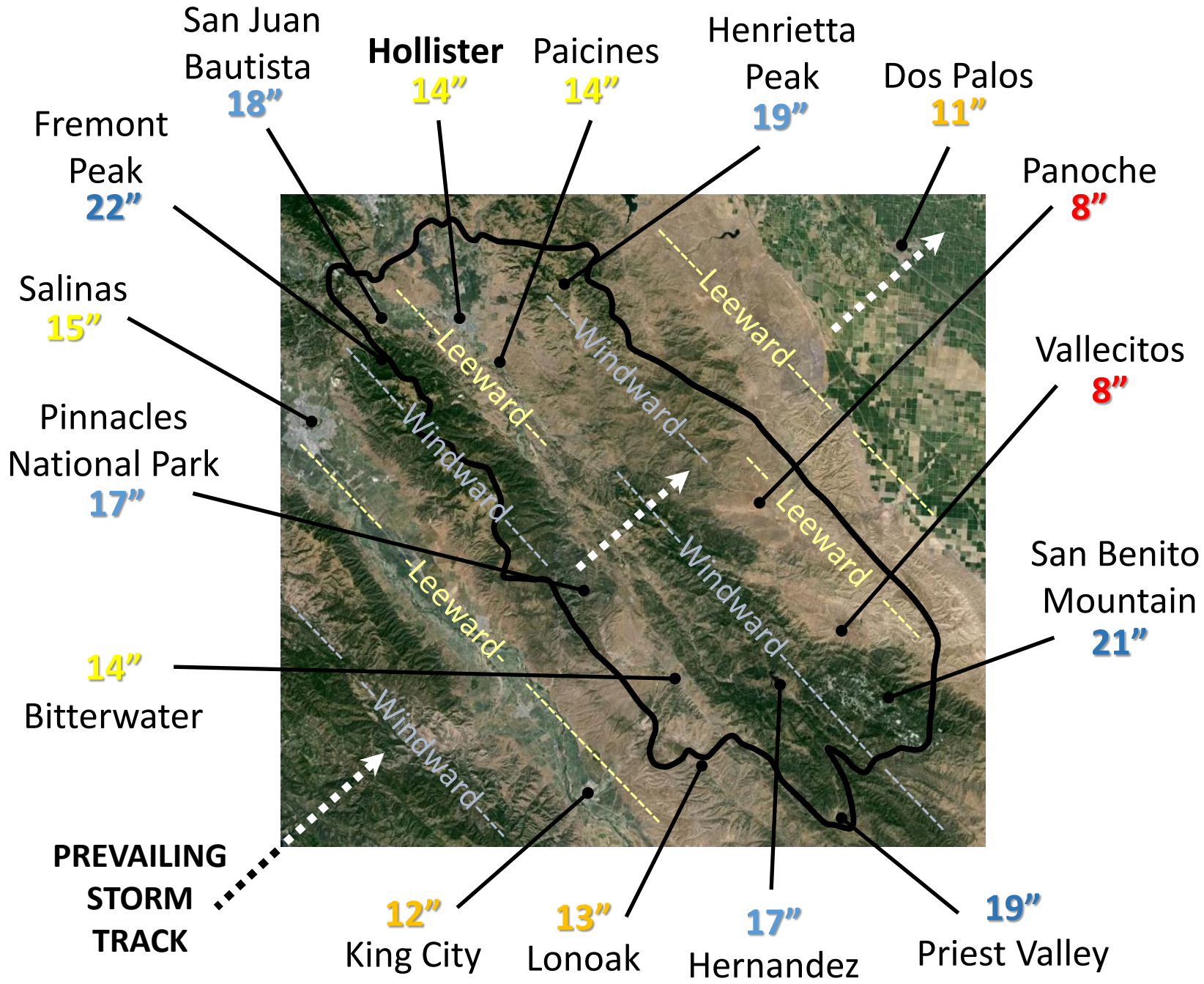
New weed invasion fronts – What are they, where are they, and what can we do to stop them?

Ryan O'Dell (BLM) and Amelia Ryan (NPS)



San Benito County **8” – 22”** average annual precipitation

PREVAILING STORM TRACK DIRECTION


San Juan Bautista
18”
Hollister
14”
Paicines
14”
Henrietta Peak
19”
Dos Palos
11”
Fremont Peak
22”
Panoche
8”
Salinas
15”
Vallecitos
8”
Pinnacles National Park
17”
San Benito Mountain
21”
14”
Bitterwater
PREVAILING STORM TRACK
12”
King City
13”
Lonoak
17”
Hernandez
19”
Priest Valley
Leeward
Windward
Leeward
Windward
Leeward
Windward
Leeward
Windward

Non-native mustards of San Benito County

New

Sahara mustard

Brassica tournefortii

- desert climate

Black mustard

Brassica nigra

- temperate climate

London rocket

Sisymbrium irio

- temperate climate

Summer mustard

Hirschfeldia incana

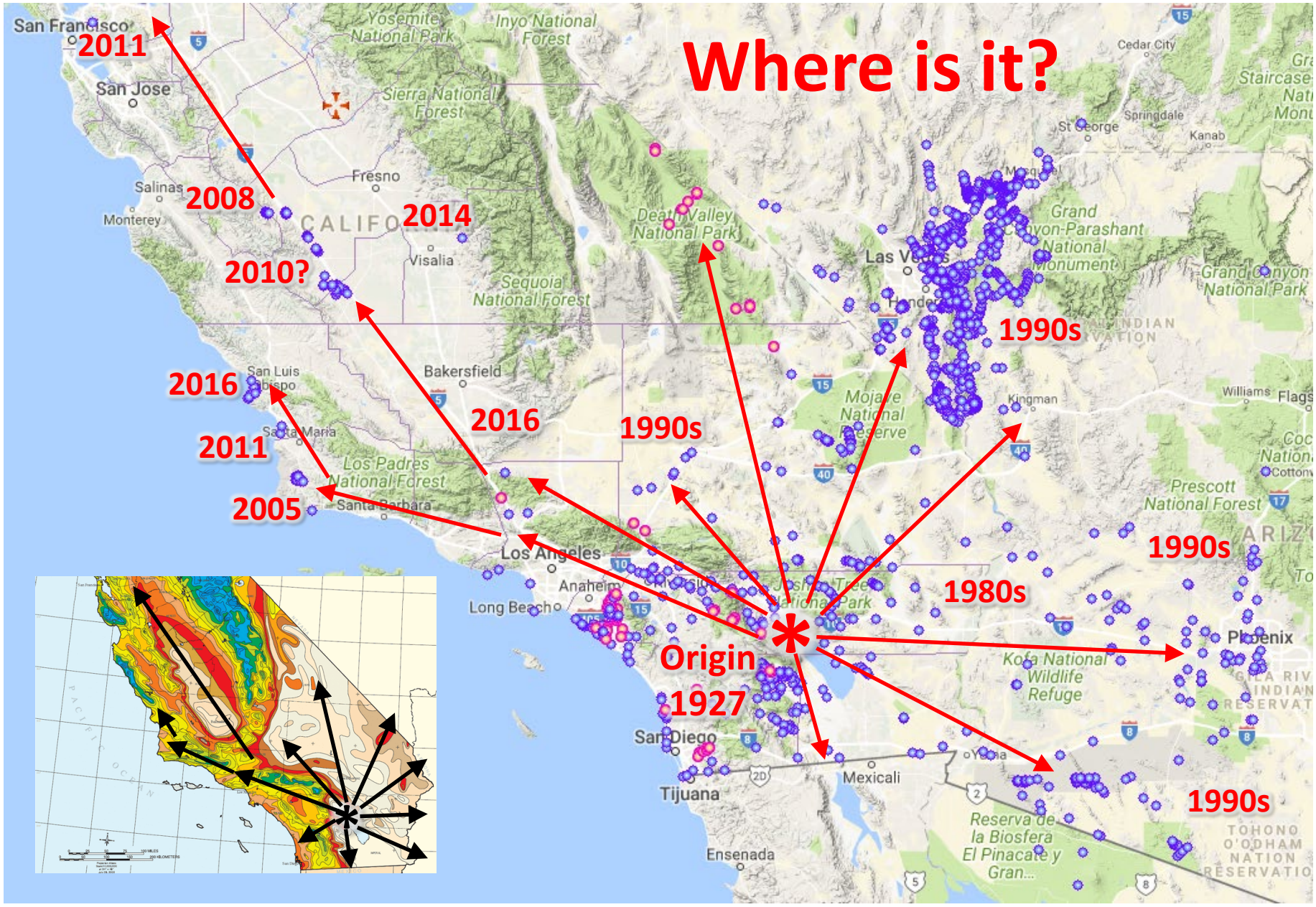
- mediterranean climate

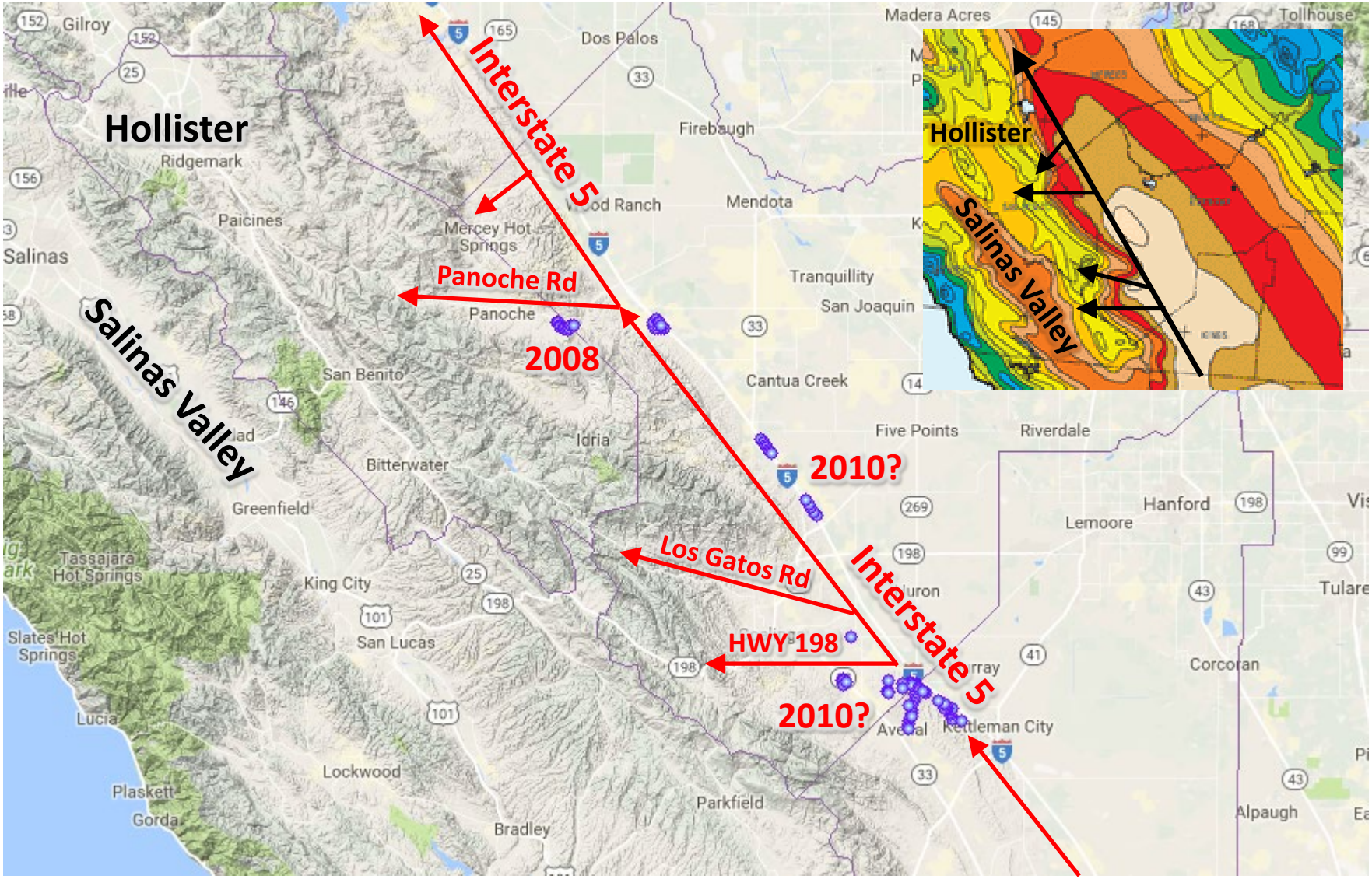
What is it?


Mojave Desert
Sahara mustard

Sahara mustard seeds

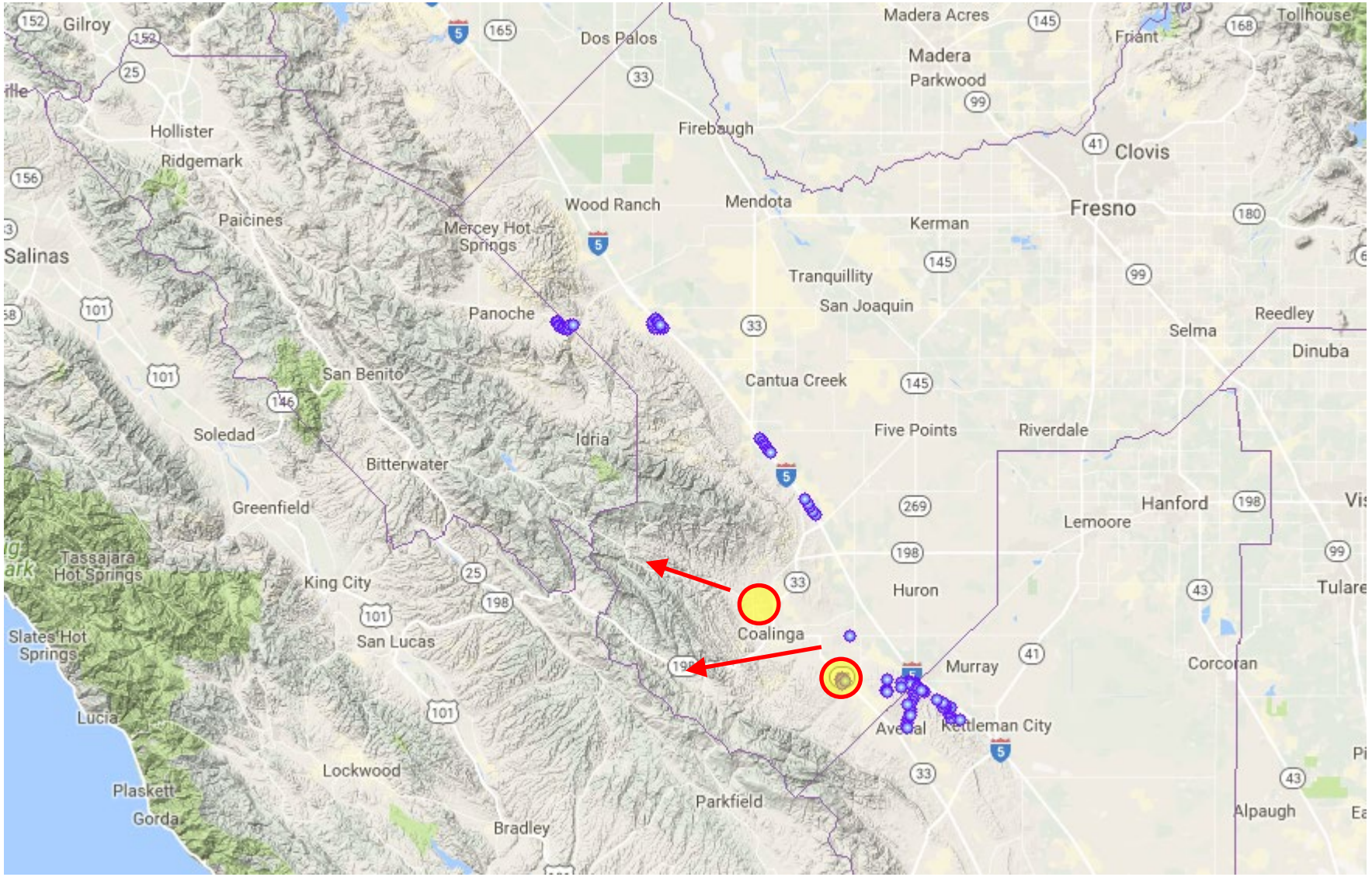
- produce thousands of tiny seeds
- plants break free and tumble with wind
- dispersed seeds are very sticky when wet
- seeds stick to tires and disperse further
- seed longevity > 50 years!


Where is it?
2011
2008
2014
2010?
2016
2011
2005
2016
1990s
1990s
1980s
1990s
1990s
Origin
1927
San Francisco
San Jose
Fresno
Salinas
Monterey
Visalia
Bakersfield
San Luis Obispo
Santa Maria
Santa Barbara
Los Angeles
Anaheim
Long Beach
San Diego
Tijuana
Ensenada
Mexicali
Las Vegas
Kingman
Cedar City
St George
Springdale
Kanab
Phoenix
Yosemite National Park
Inyo National Forest
Sierra National Forest
Sequoia National Forest
Death Valley National Park
Grand Canyon-Parashant National Monument
Grand Canyon National Park
Mojave National Preserve
Los Padres National Forest
Joshua Tree National Park
Kofa National Wildlife Refuge
Prescott National Forest
Reserva de la Biosfera El Pinacate y Gran...


Hollister
Ridgemark
Paicines
Salinas
Gilroy
Mercey Hot Springs
Dos Palos
Firebaugh
Mendota
Tranquillity
San Joaquin
Madera Acres
Tollhouse
Panoche Rd
Panoche
2008
Interstate 5
Salinas Valley
San Benito
Cantua Creek
Idria
Bitterwater
Greenfield
Five Points
Riverdale
2010?
Hanford
Lemoore
Los Gatos Rd
Tassajara Hot Springs
King City
San Lucas
Slates Hot Springs
HWY 198
Corcoran
Tulare
Lucia
Lockwood
Plaskett
Gorda
Bradley
Parkfield
Kettleman City
Alpaugh
Hollister
Salinas Valley

What can I do to stop it?

- Beware of aggregate quarries
- Limit soil movement



Non-native tamarisk of San Benito County

Tamarisk

Tamarix ramosissima

- very invasive

Athel

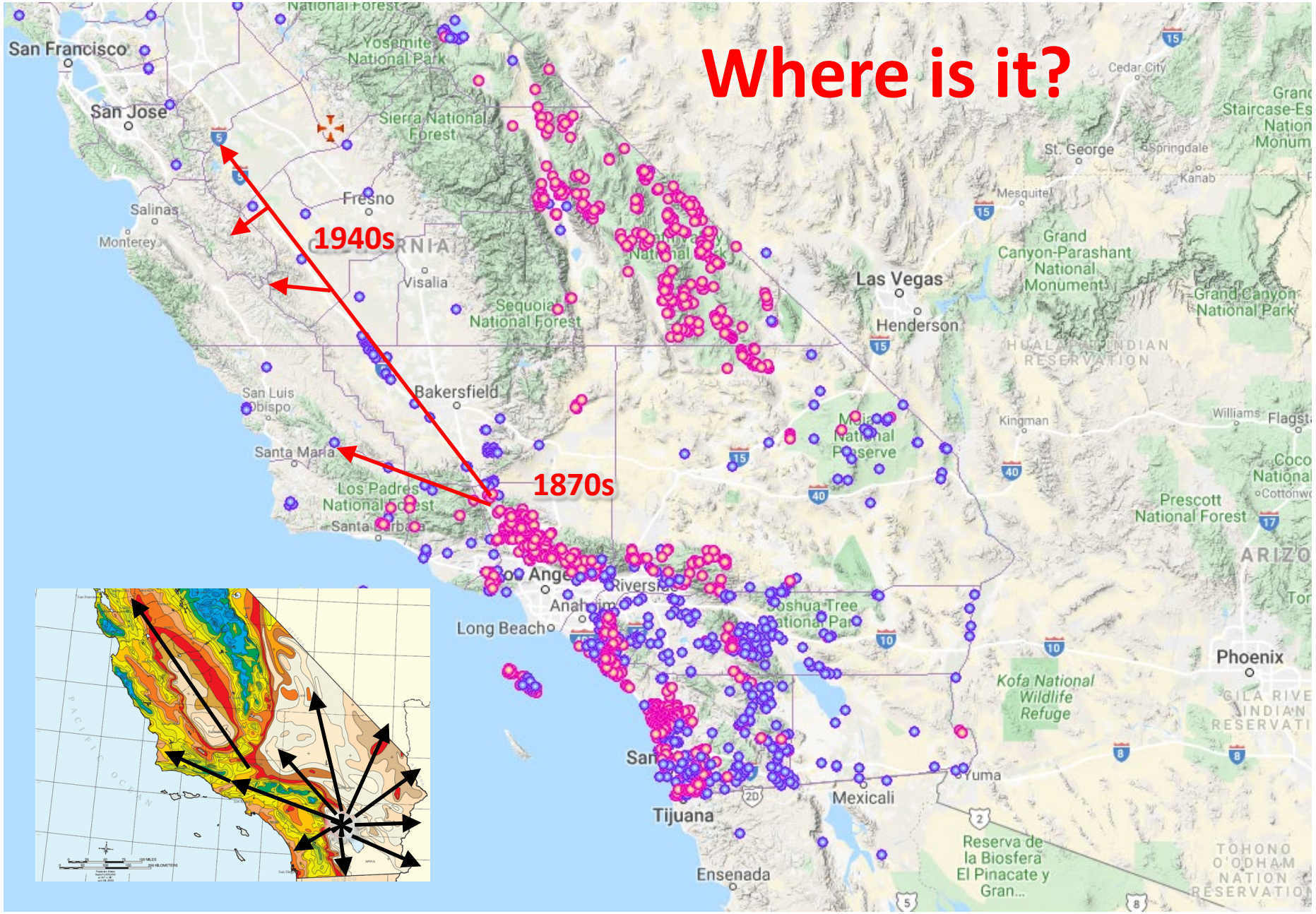
Tamarix aphylla

- generally not invasive

Tamarisk seeds

- produce hundreds of thousands of tiny plumed seeds
- seeds travel with the wind or float downstream
- short seed longevity (< 1 year)

Where is it?


1940s
1870s
San Francisco
San Jose
Fresno
Salinas
Monterey
Visalia
Bakersfield
San Luis Obispo
Santa Maria
Las Vegas
Henderson
Mesquite
St. George
Cedar City
Kingman
Williams
Prescott National Forest
Phoenix
Yuma
Mexicali
Tijuana
Ensenada
Long Beach
Anaheim
Riverside
Joshua Tree National Park
Sequoia National Forest
Sierra National Forest
Yosemite National Park
Los Padres National Forest
Grand Canyon-Parashant National Monument
Grand Canyon National Park
Kofa National Wildlife Refuge
Reserva de la Biosfera El Pinacate y Gran...
HUALAPAI INDIAN RESERVATION
GILA RIVER INDIAN RESERVATION
TOHONO O'ODHAM NATION RESERVATION

What can I do to stop it?

- Pull them out – work from upstream down

Weed wrench

Giant weed wrench

What is it? HWY 101 near HWY 25

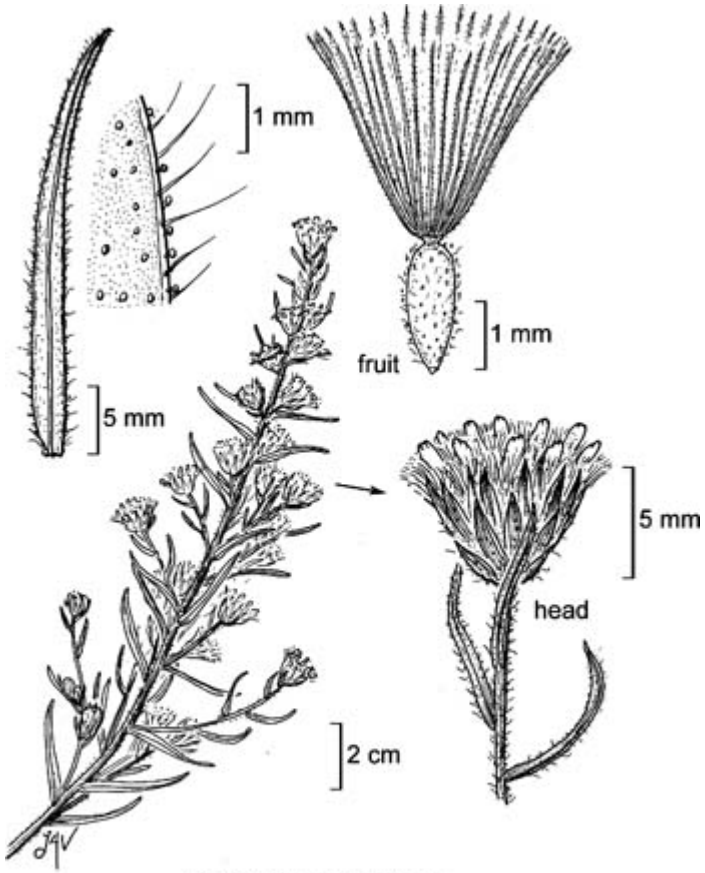

Dittrichia graveolens
(Stinkwort)
strong-smelling, glandular foliage
and abundant yellow flowers
prolific production of
wind-dispersed seeds
N. Chiariello

Stinkwort/Stinkweed
Dittrichia graveolens

- Annual
- Thousands of tiny, viable seeds
- More germination on good rain years
- Currently in disturbed sites, but major rangeland past in other countries
- Moving south of Paicines along Hwy 25, and along San Benito and Tres Pinos Creeks
- Covered in stinky oils, similar to a tarweed
- Flowers tiny, yellow, not showy
- Short “Christmas tree” appearance

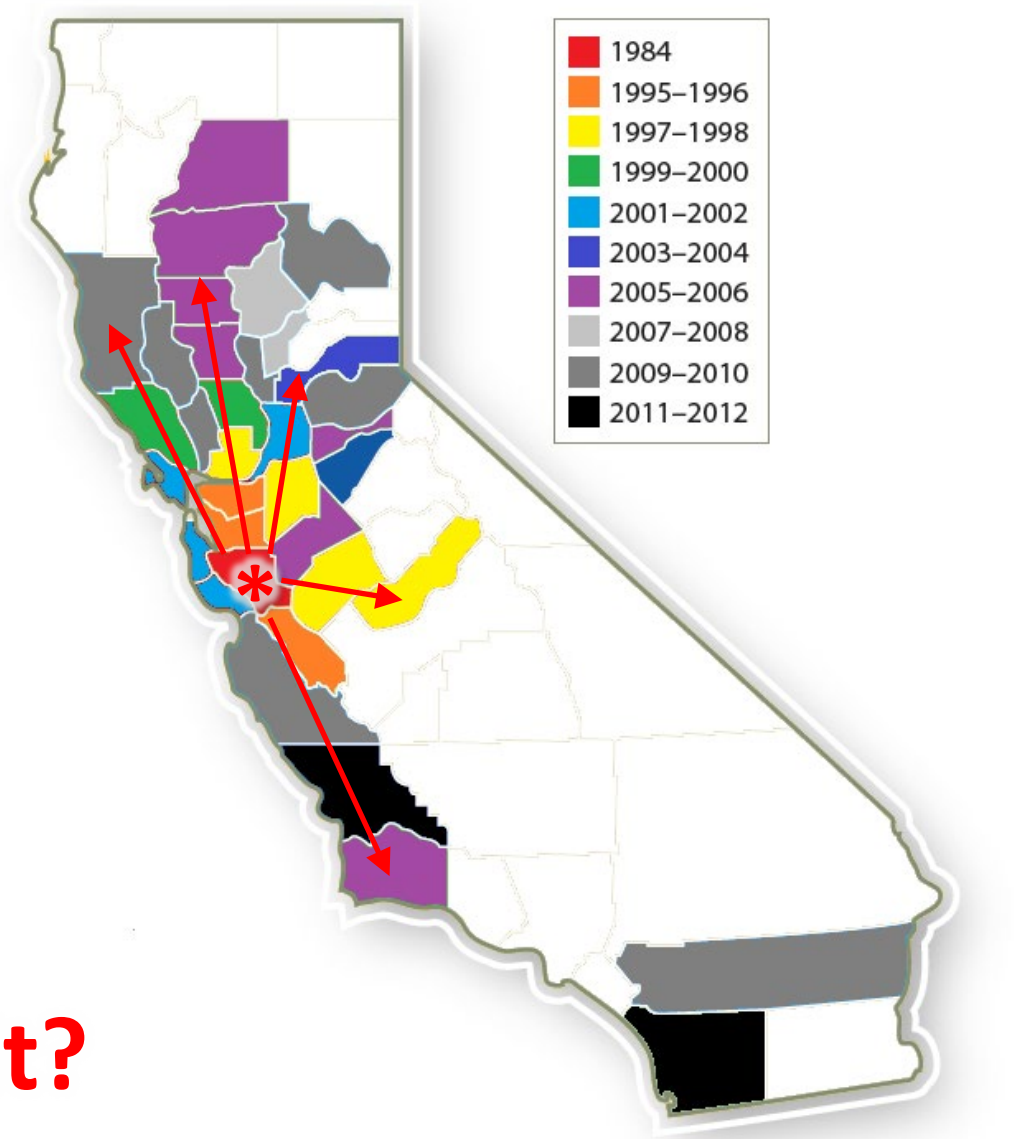
Problems

- Unpalatable to livestock
- Barbed seed leads enteritis/
  gastrointestinal disease
- Caused 20% mortality in sheep forced to eat it
- Oils taint milk and meat of animals that consume
- Can cause severe dermatitis and allergic reactions



Dittrichia graveolens

Spread of Stinkwort in California



Where is it?

Stinkwort is rapidly expanding its range in California

by Rachel Brownsey, Guy B. Kyser *and* Joseph M. DiTomaso

Stinkwort (Dittrichia graveolens) is a Mediterranean native that has become a weed in areas of Europe as well as in Australia. This strongly aromatic weed was first reported in California in 1984 in Santa Clara County, and it had spread to 36 of the 58 California counties by 2012. Stinkwort is not palatable to animals, and can be poisonous to livestock and cause contact allergic dermatitis in humans. In California, this weed is found primarily along roadsides. However, the biology of this annual plant suggests that it could also invade open riparian areas and overgrazed rangelands. Stinkwort has an unusual life cycle among annual plants: Unlike most summer or late-season winter annuals, stinkwort flowers and produces seeds from September to December. Such basic biological information is critical to developing timely and effective control strategies for this rapidly expanding weed.

Stinkwort is related to fleabanes and goldenasters and grows to about 2.5 feet tall. In California, this rapidly invading weed most often occurs in disturbed and wasteland sites.

Dittrichia graveolens (L.) Grueter, commonly known as stinkwort, is a member of the Asteraceae, or sunflower, family. This plant is native to the Mediterranean region of Europe, occurring as far east as Turkey, Afghanistan and Pakistan (Brullo and de Marco 2000; Qaiser and Abid 2005). Stinkwort is an erect, fall-flowering annual that can grow about 2.5 feet tall. Its foliage has sticky glandular hairs covered in resin. The resin emits a strong aromatic odor that resembles the smell of tarweeds. The flowerheads are 0.2 to 0.3 inch (5 to 7 millimeters) in diameter and consist of short yellow ray flowers on the outer edge and yellow to reddish disk flowers in the center. Stinkwort is closely related to fleabanes, horseweed (*Erigeron*; formerly *Conyza*), goldenasters and telegraphweed (*Heterotheca*), but it also closely resembles the tarweeds (*Centromadia* spp., *Hemizonia* spp. and *Holocarpha* spp.). From a distance, stinkwort can resemble Russian-thistle (*Salsola tragus* L.), also called tumbleweed. Because it is fairly unattractive and nondescript in appearance, stinkwort initially passed unnoticed by many botanists and weed managers, and it was not included in the 1993 edition of *The Jepson Manual* of California flora (Hickman 1993).

In its native range and some introduced regions, stinkwort inhabits riparian woodlands, margins of tidal marshes, vernal pools and alluvial floodplains, although it has not yet invaded these wildland areas in California. In California and other introduced areas of the world, stinkwort is most often found in disturbed places, such as overgrazed rangelands, roadsides, pastures, wastelands, vineyard edges, gravel mines, levees, washes and mining sites, although in California it is seldom found in rangelands or pastures (DiTomaso and Healy 2007; Higueras et al. 2003). Stinkwort grows best on well-drained, sandy or gravelly soils and thrives in areas with hot, dry summers but can also do well along the margins of wetlands. In addition, this plant tolerates a variety of soil types and survives under a range of soil conditions, temperatures and precipitation regimes (Preston 1997). When adequate moisture is available, stinkwort can even survive on serpentine or saline soils. In Europe, this plant was shown to tolerate and to possibly hyperaccumulate heavy metals, including mercury, zinc and copper (Higueras et al. 2003; Shallari et al. 1998).

Worldwide invasion

While stinkwort is native to the Mediterranean region, including Egypt and other areas of North Africa, this species has also been introduced to several European countries where it is not native. Within the last two decades, this weed has been spreading rapidly along the highways of Central Europe. In summer 2008, stinkwort was detected for the first time in Slovenia and Austria (Frajman and Kaligaric 2009). Outside of

Online: http://californiaagriculture.ucanr.edu/landingpage.cfm?article=ca.v067n02p110&fulltext=yes
doi: 10.3733/ca.v067n02p110

California Agriculture 67(2):110-115
April 2013

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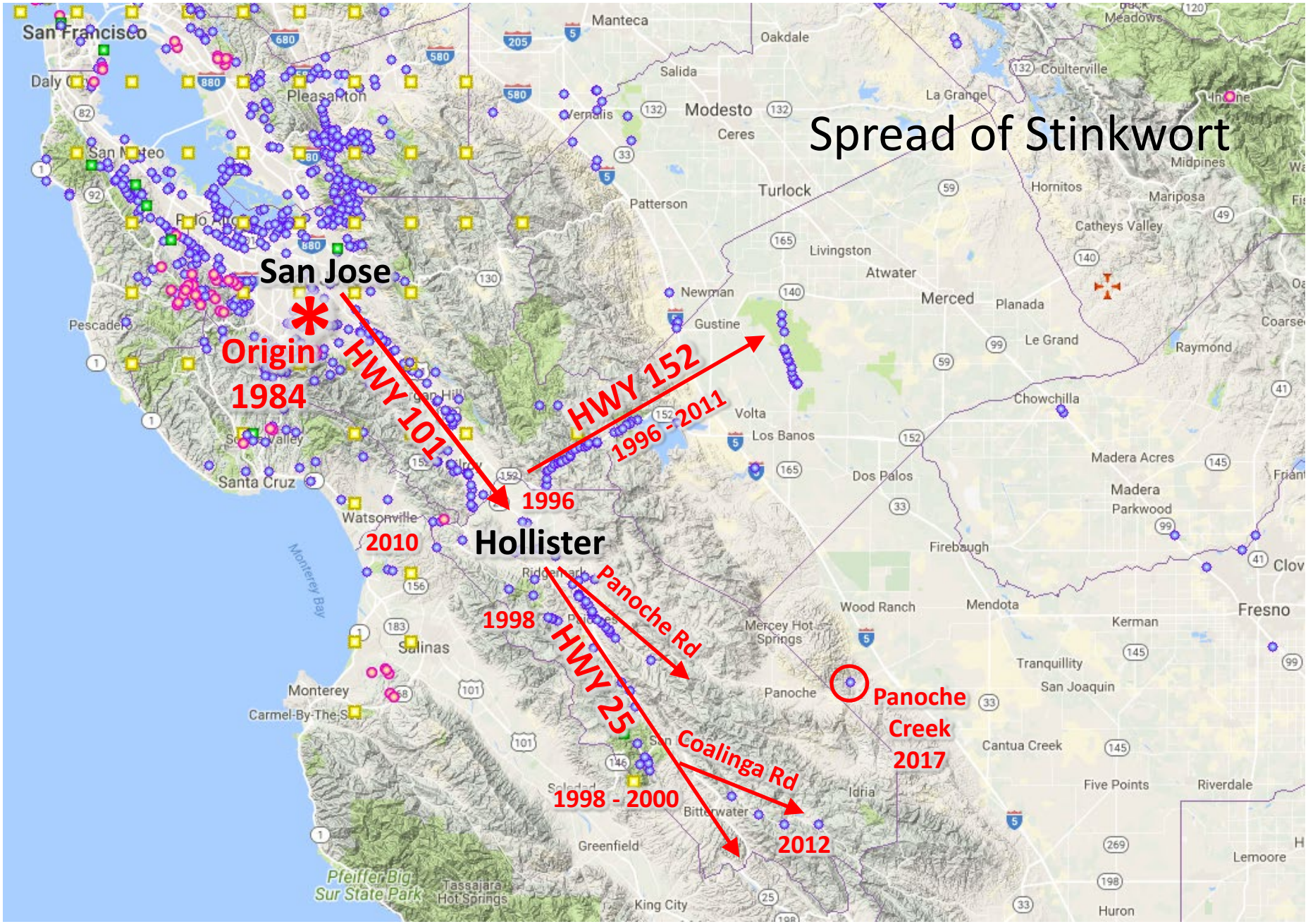
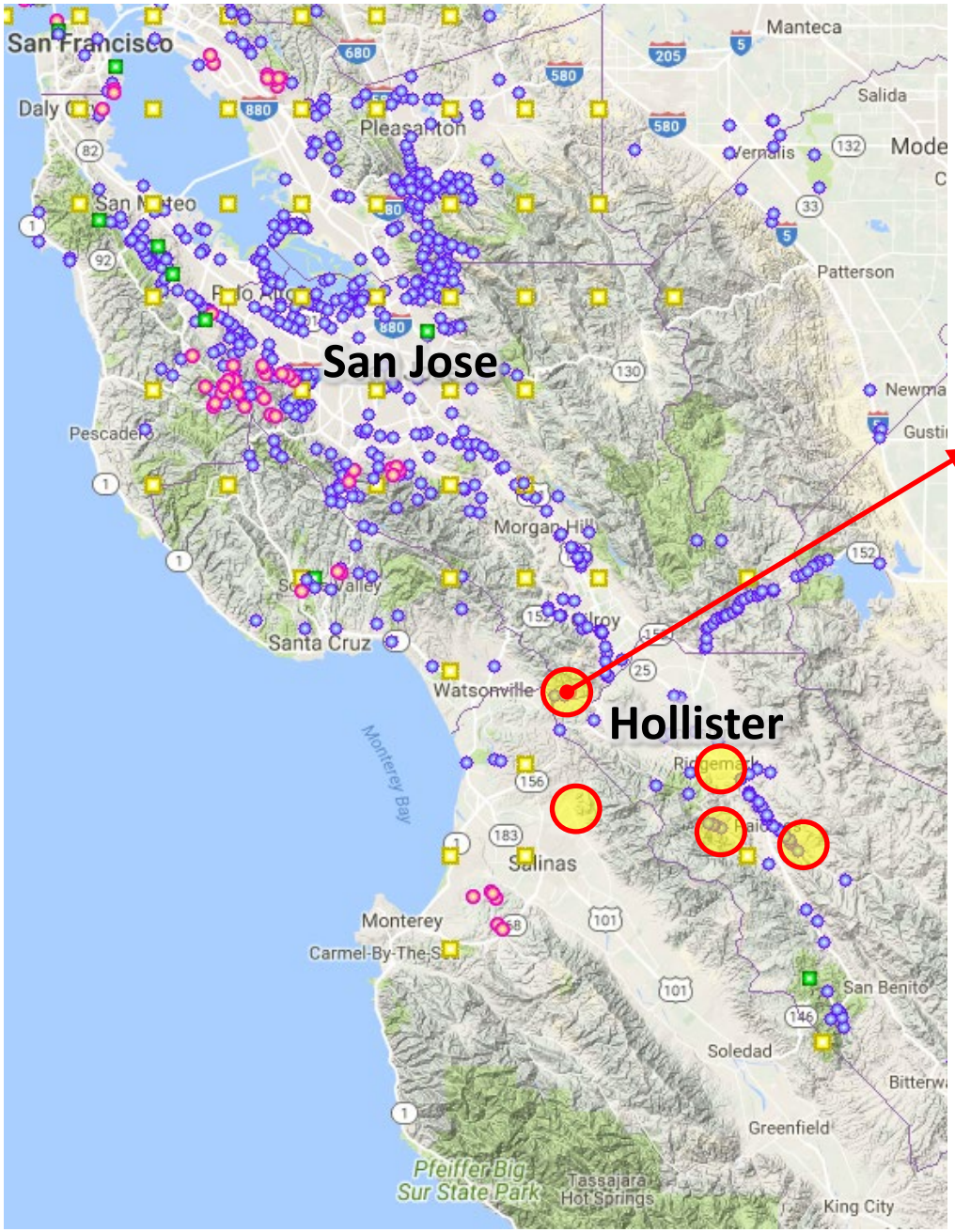

Spread of Stinkwort
San Jose
Origin
1984
HWY 101
1996
HWY 152
1996 - 2011
Hollister
2010
1998
Panoche Rd
HWY 25
Coalinga Rd
1998 - 2000
2012
Panoche
Creek
2017
San Francisco
Manteca
Oakdale
Modesto
Ceres
Turlock
Patterson
Salida
Vernalis
Pleasanton
Livingston
Atwater
Merced
Newman
Gustine
Volta
Los Banos
Dos Palos
Chowchilla
Madera Acres
Madera
Parkwood
Firebaugh
Le Grand
Planada
Raymond
Coulterville
La Grange
Midpines
Hornitos
Mariposa
Catheys Valley
Santa Cruz
Watsonville
Monterey Bay
Salinas
Monterey
Carmel-By-The-Sea
Mercey Hot Springs
Wood Ranch
Mendota
Kerman
Fresno
Tranquillity
San Joaquin
Cantua Creek
Five Points
Riverdale
Lemoore
Huron
Idria
Bitterwater
Greenfield
King City
Pfeiffer Big Sur State Park
Tassajara Hot Springs

Beware of aggregate quarries



What can I do to stop it?

Effective treatments to control Stinkwort

TABLE 1. Effect of postemergence herbicides and mowing on the control of *Dittrichia graveolens*

Treatment	Product trade name	Ounce product/acre	Ounce acid equivalent (a.e.)/acre	Late postemergence treatment* June 24, 2009	
				% cover	Vigor†
Glyphosate	Roundup Pro	16	6	7.3abcd‡	6.8cd
Glyphosate	Roundup Pro	32	12	5.0ab	4.5b
Aminopyralid	Milestone	3.5	0.875	16.3de	9.8d
Aminopyralid	Milestone	7	1.75	15.0cde	9.0d
Aminocyclopyrachlor	—	4	2	10.0bcd	6.5bc
Aminocyclopyrachlor	—	8	4	7.3abcd	6.5bc
Triclopyr amine	Garlon 3A	32	12	3.0ab	8.5cd
Triclopyr amine	Garlon 3A	64	24	0a	0a
Mowing	—	—	—	5.3abc	10.0d
Untreated	—	—	—	23.8e	10.0d

* All late postemergence treatments were made prior to flowering.

† Vigor ratings based on a 0 to 10 scale with 0 = dead plants and 10 = healthy plants.

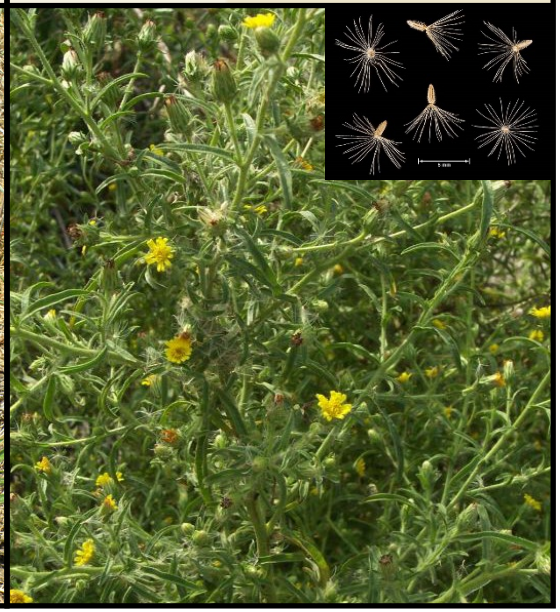
‡ Numbers in the same column with different letters are significantly different at 5% confidence level.

What can I do to stop it?

- Garlon 3A (Triclopyr amine; ~$90/ga) and Round-up (glyphosate; ~25/ga)
- 2,4-D (~$14/ga, rate:~25oz/acre) somewhat effective
- Small infestations can be hand pulled
- Repeated mowing can reduce, help prevent spread…but major problem if done too late and mower not cleaned

Effective treatment timing to control Stinkwort

A. Stinkwort	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Germination	Germination										Germination	
Growth				Rosette		Moderate growth		Exponential canopy growth		Too late– seed has dispersed		
Reproduction	Generally too early to see or identify			Optimal treatment interval					Flowering			
										Seed production		
Dispersal										Dispersal		

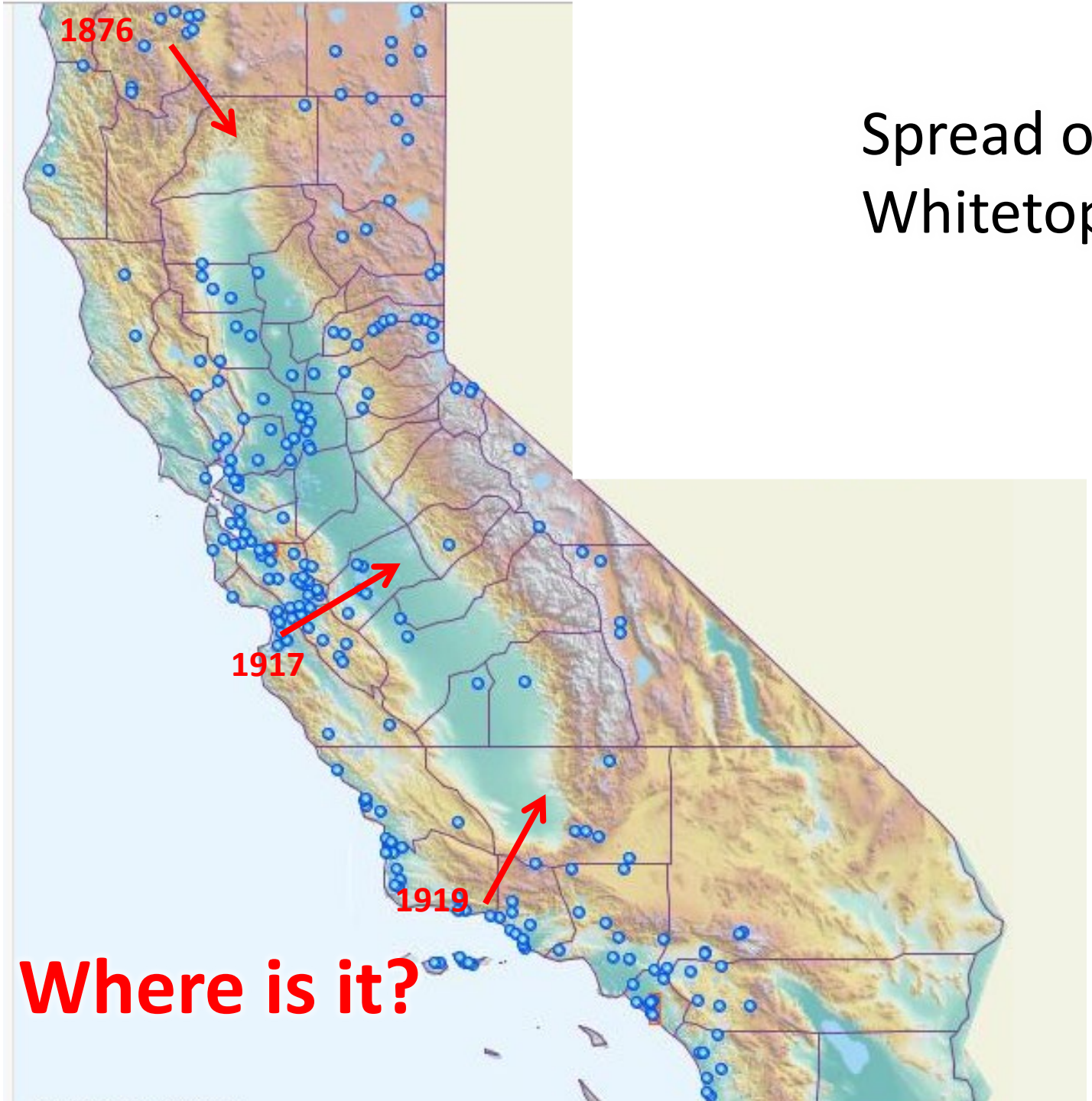


What is it?

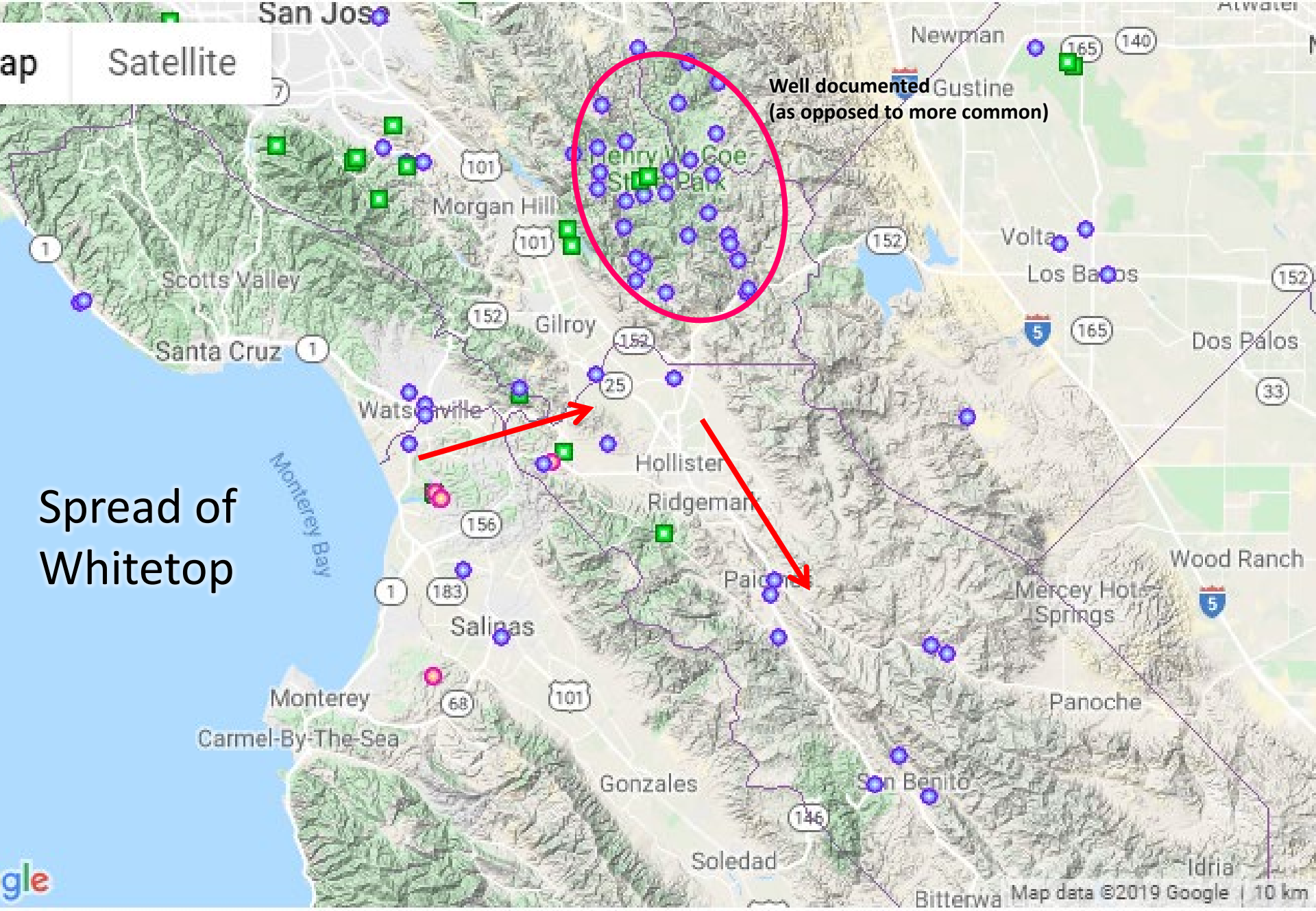

sarracen

Hoary Whitetop *aka* Hellweed (*Lepidium draba/Cardaria draba*)

- Perennial forming large mats via deep underground roots (rhizomes)
- Spreads by seeds and root fragments (but more by roots)
- 1,400-4,800 seeds per plant (prolific seeders in wet years)
- Seedbank lasts ~3-5 years
- Starts blooming ~April (sometimes March)
- Needs some moisture to live (restricted by climate)
- Common in hay (silage weed)
- Encouraged by burning
- Semi-toxic to livestock & taints milk



Spread of Whitetop


ap
Satellite
San Jose
Newman
Gustine
Well documented
(as opposed to more common)
Henry W. Coe
State Park
Morgan Hill
Scotts Valley
Santa Cruz
Gilroy
Volta
Los Banos
Dos Palos
Watsonville
Hollister
Ridgemark
Monterey Bay
Salinas
Monterey
Carmel-By-The-Sea
Gonzales
San Benito
Soledad
Panoche
Wood Ranch
Mercey Hot Springs
Idria
Bitterwa
Spread of
Whitetop
Map data ©2019 Google | 10 km

What can I do to stop it?

Non-chemical

- Repeat tilling every 2 weeks in growing season for 3 years to exhaust roots. Infrequent tilling will cause it to SPREAD
- Can tarp small patches. Extend tarp several feet beyond patch edge.
- Grazing doesn't help: ineffective & linked to spread, germinates in cow patties

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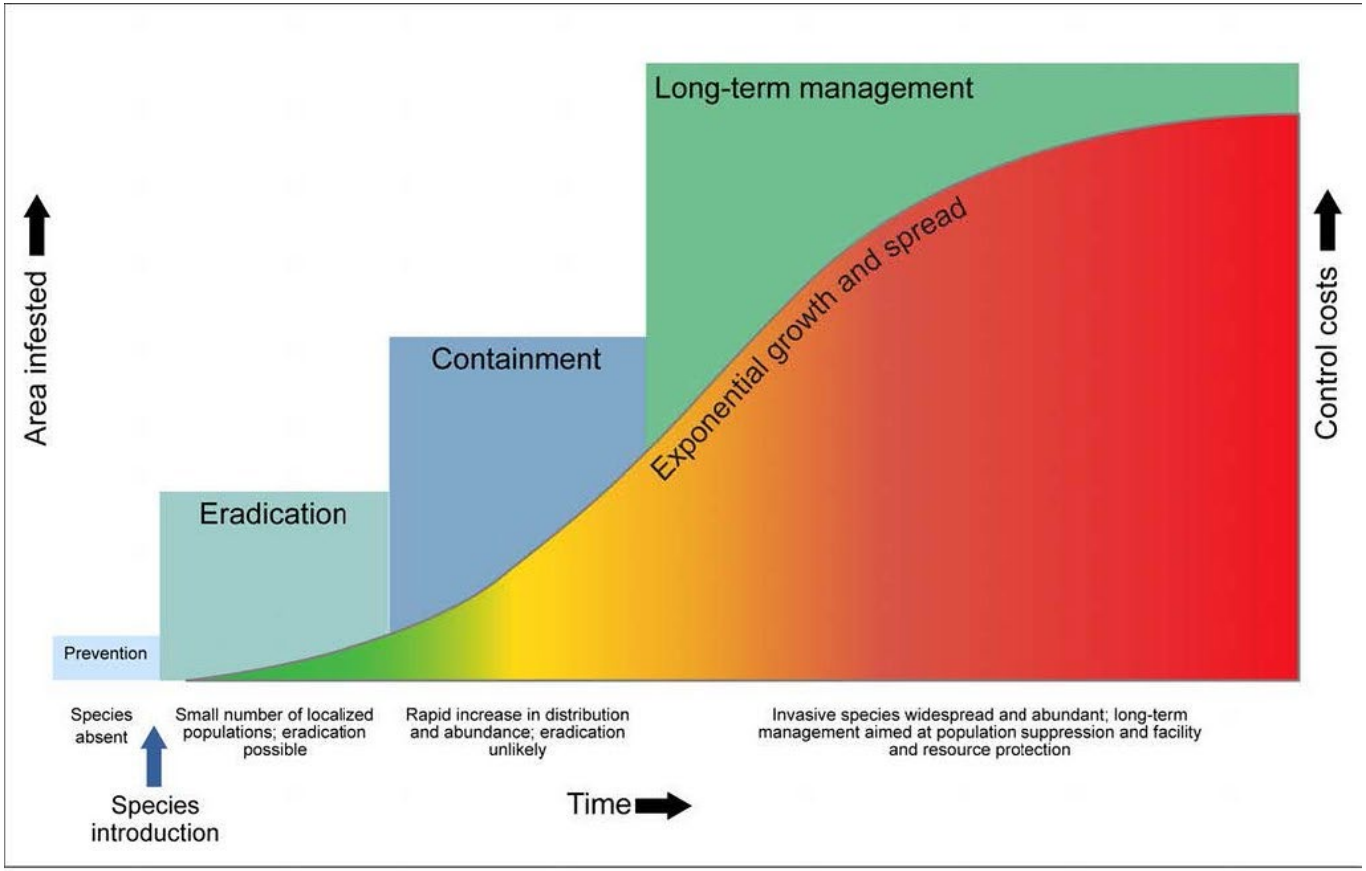
What can I do to stop it?

Chemical

- Telar (~$21/acre, chemical = Chlorsulfuron) most effective herbicide:
  - Mostly safe for grasses if applied at proper time: care needed. Can effect other non-target species
  - Apply pre-bloom to bloom and fall rosette
  - Near, but NOT in water

- Glyphosate @2% ($25/acre) can be used to spot spray (more effective w/ammonium sulfate)



Sources: National Invasive Species Council; U.S. Department of Agriculture; National Park Service; U.S. Fish and Wildlife Service; Rodgers, L, South Florida Water Management District; Department of Primary Industries, State of Victoria, Australia; and GAO. | GAO-16-49


Questions?