Legacy effects of imazapyr soil residues on riparian forest re-establishment after giant reed (*Arundo donax*) removal





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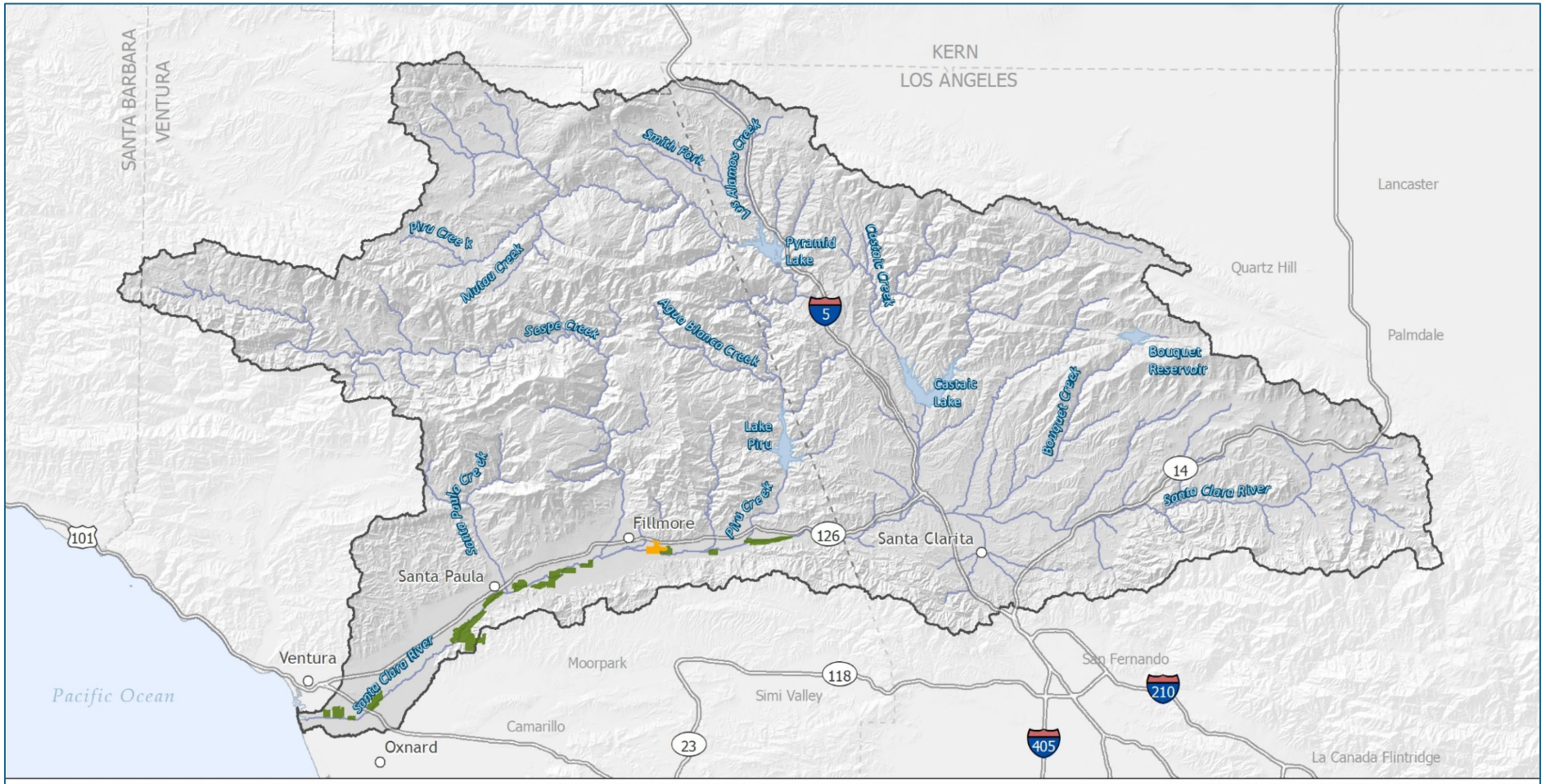
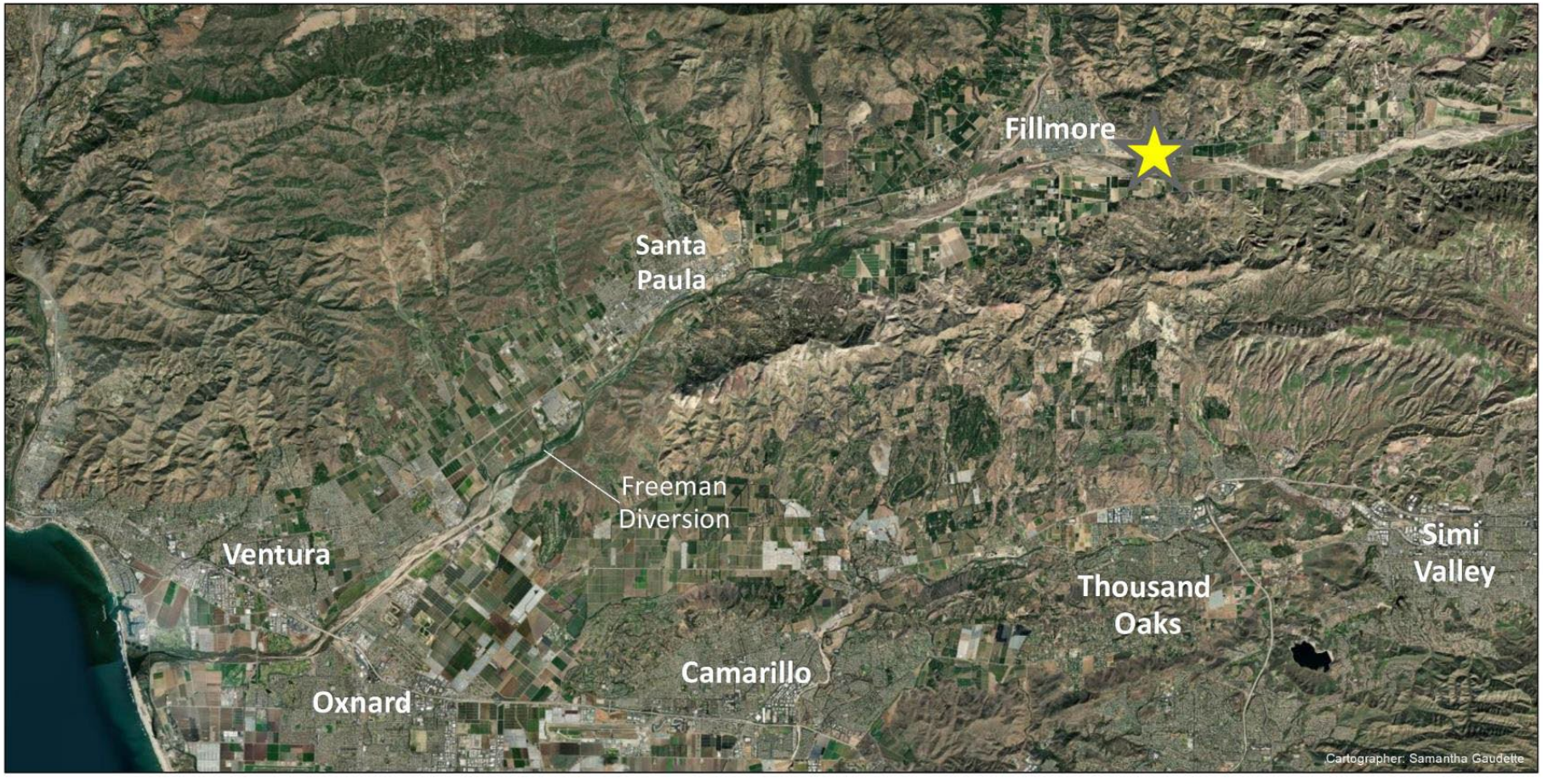
[2]Santa Clara River Conservancy

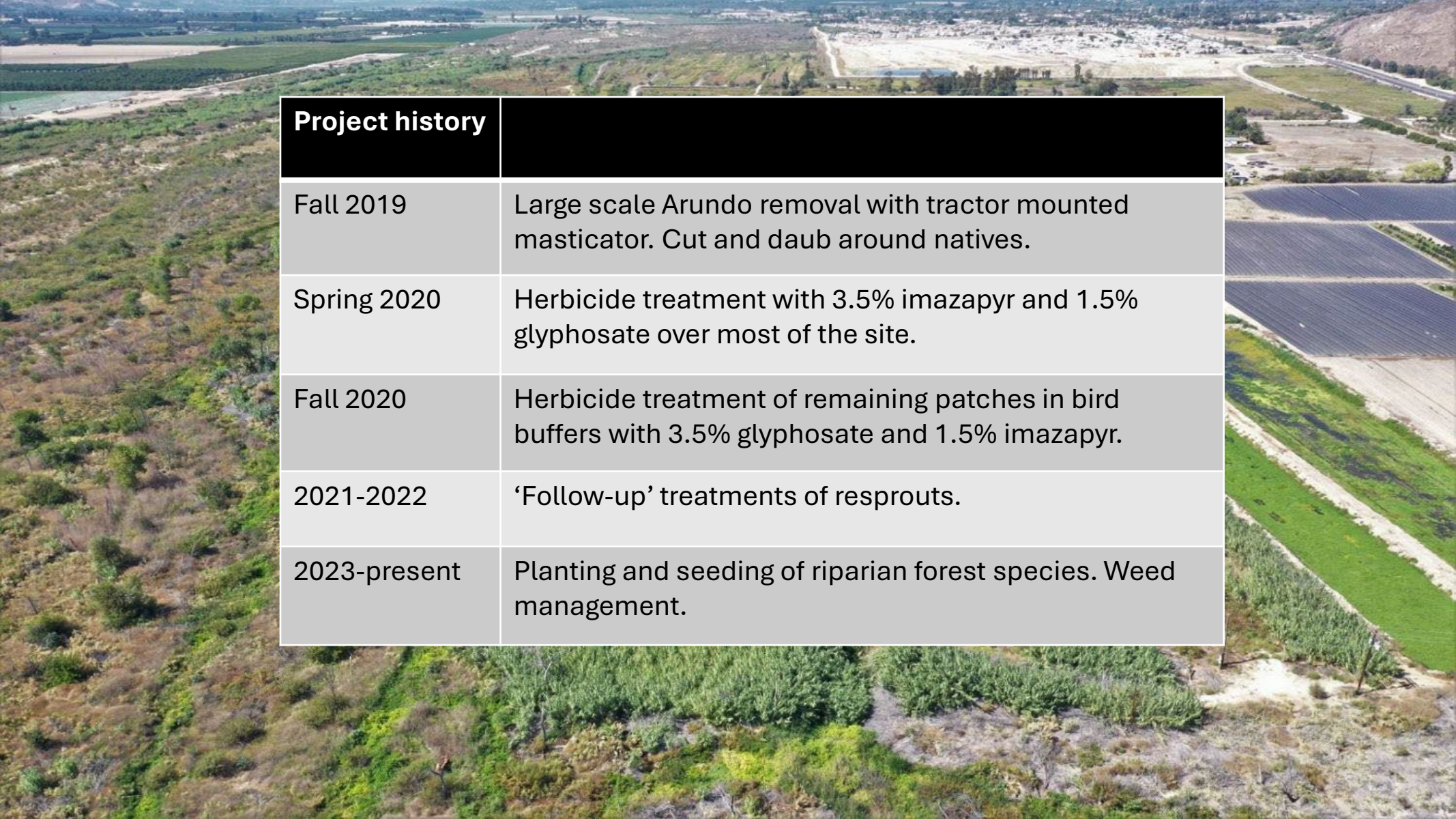

SANTA BARBARA
VENTURA
KERN
LOS ANGELES
Lancaster
Quartz Hill
Palmdale
Smith Fork
Lake Alamos Creek
Piru Creek
Mutau Creek
Pyramid Lake
Castaic Creek
Sespe Creek
Agua Blanca Creek
5
Bouquet Reservoir
Castaic Lake
Bouquet Creek
Lake Piru
14
Santa Clara River
Santa Paula Creek
Fillmore
Piru Creek
126
Santa Clarita
101
Santa Paula
Ventura
Santa Clara River
Moorpark
118
Simi Valley
San Fernando
210
Pacific Ocean
Camarillo
Oxnard
23
405
La Canada Flintridge
Overview
Sespe Cienega
Santa Clara River Watershed
SCR Parkway Parcels
Lakes/Reservoirs
Cities/towns
Rivers/streams
County boundaries
Map Sources:
Roads, Cities, Counties: ESRI 2016
Rivers, Waterbodies: NHD
Parkway parcels: Ventura County/TNC
Sespe Cienega: UCSB
N
0 3 6 12 Kilometers
0 2 4 8 Miles
Stillwater Sciences
Map Location
Santa Barbara
Los Angeles



Cienega Springs Ecological Reserve (CSER), Fillmore, CA


Fillmore
Cavin
Santa Clara River
Bardsdale


Summer 2019



Project history	
Fall 2019	Large scale Arundo removal with tractor mounted masticator. Cut and daub around natives.
Spring 2020	Herbicide treatment with 3.5% imazapyr and 1.5% glyphosate over most of the site.
Fall 2020	Herbicide treatment of remaining patches in bird buffers with 3.5% glyphosate and 1.5% imazapyr.
2021-2022	‘Follow-up’ treatments of resprouts.
2023-present	Planting and seeding of riparian forest species. Weed management.


December 2019

April 2020

August 2020

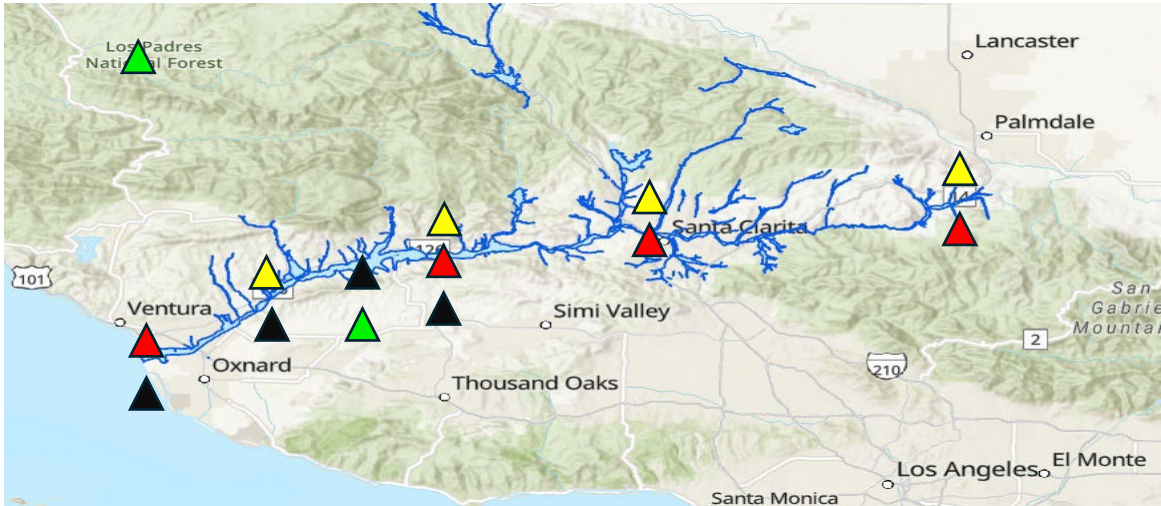
Riparian forest re-establishment

Foundational tree species

- Red willow (*Salix laevigata*)
- Fremont cottonwood (*Populus fremontii*)
- Black cottonwood (*P. trichocarpa*)
- Hybrids (*P. xparryi*) from two hybrid zones

Climate gradient

- Cooler/wetter coastal
- Warmer/drier interior



Riparian forest re-establishment

Planting design

- Over 2000 pole cuttings planted in Spring 2023
- 2.5 meter spacing
- Species/source population randomized across four blocks
- Cuttings irrigated in first year.

Measurements

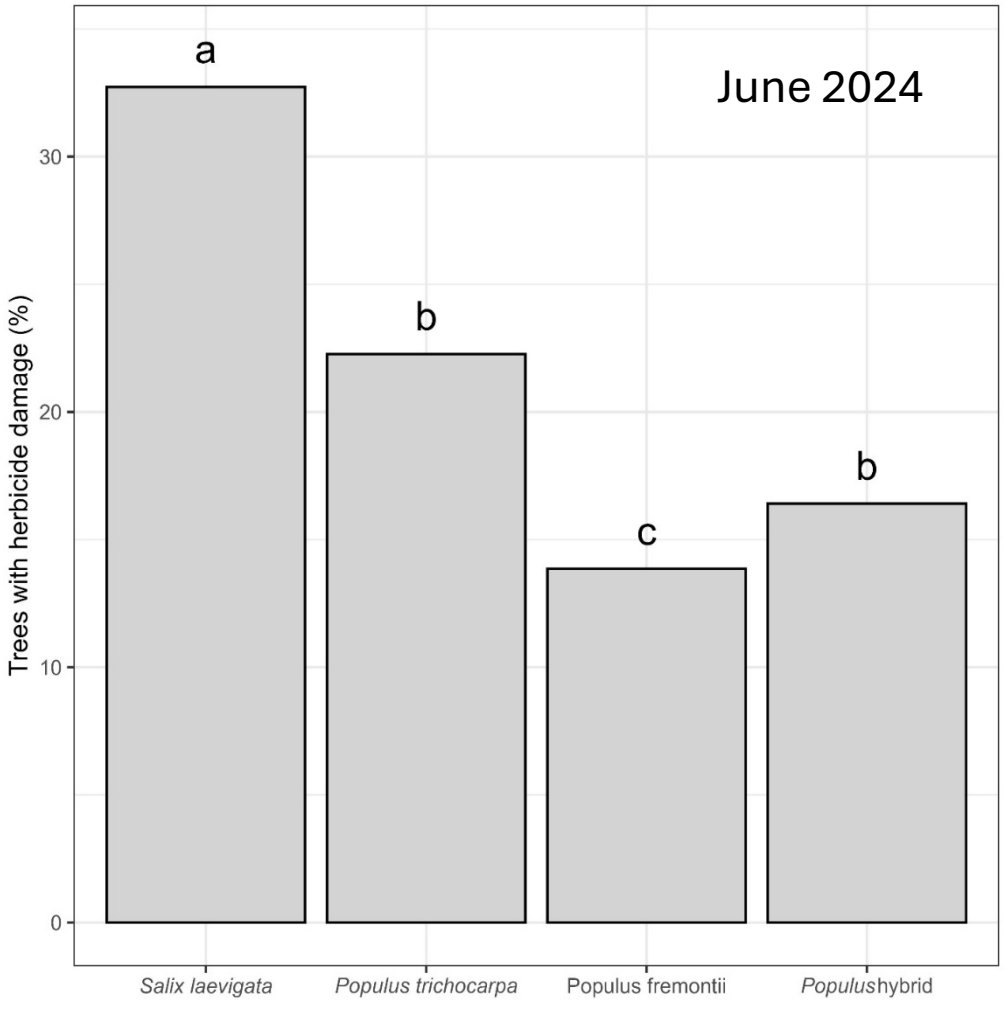
- Phenology
- Ecophysiology

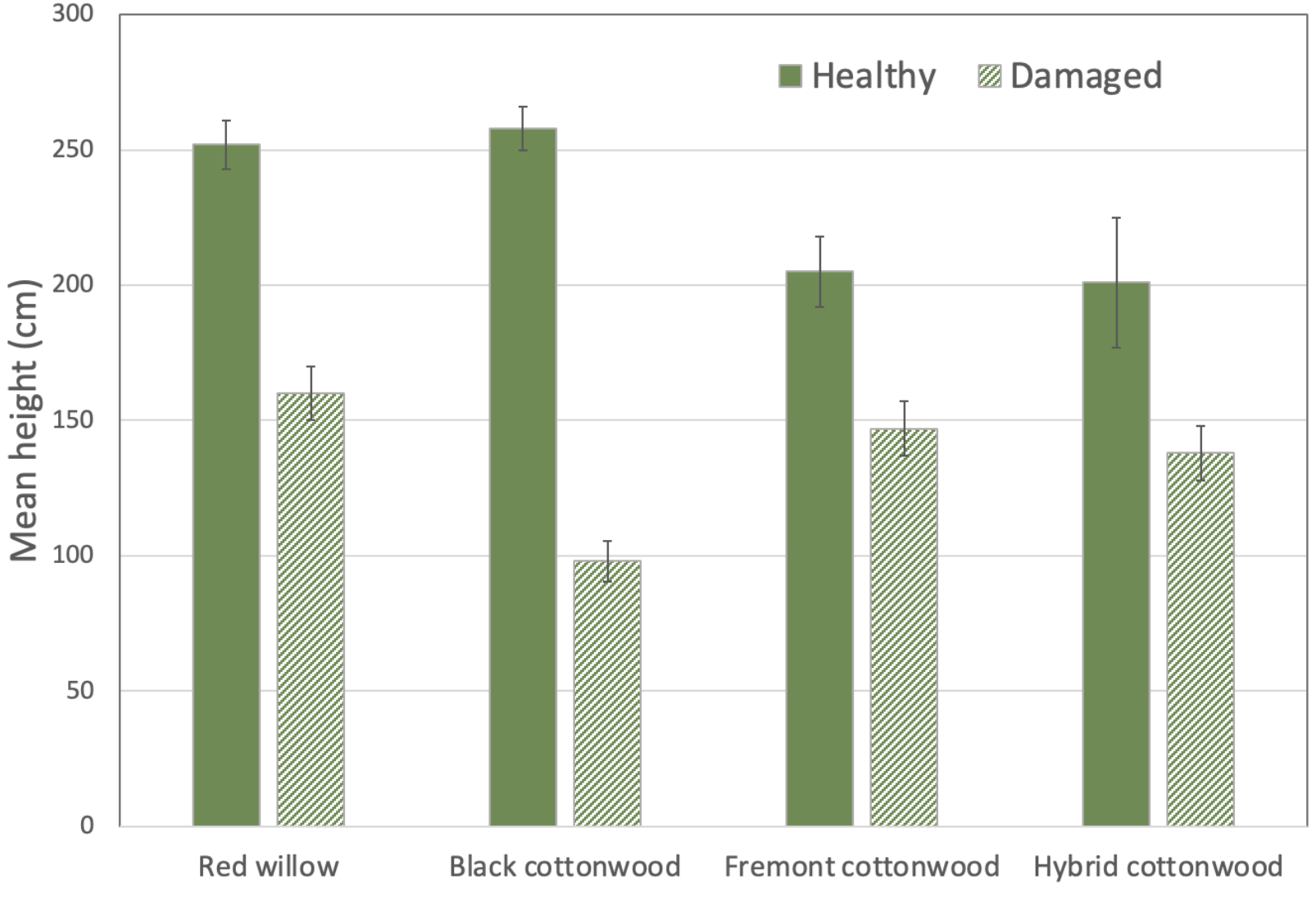
April 2023

August 2024

Measurements

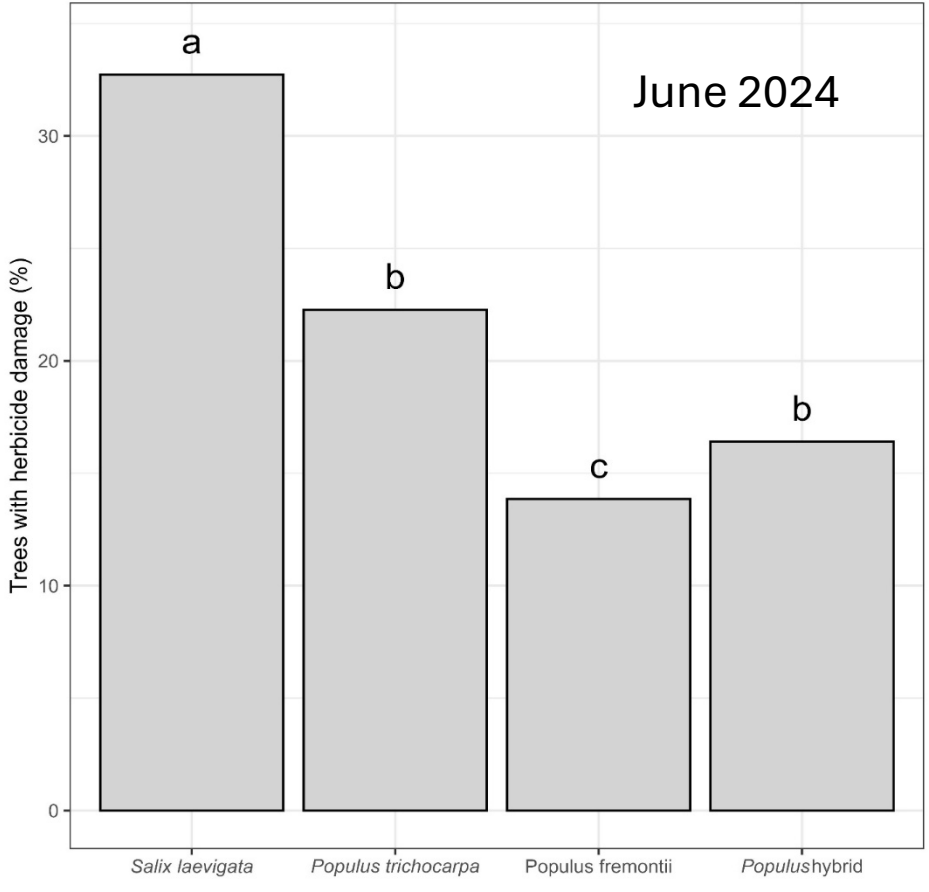
- Percent herbicide damage by species
- Growth (height, volume)
- Survival

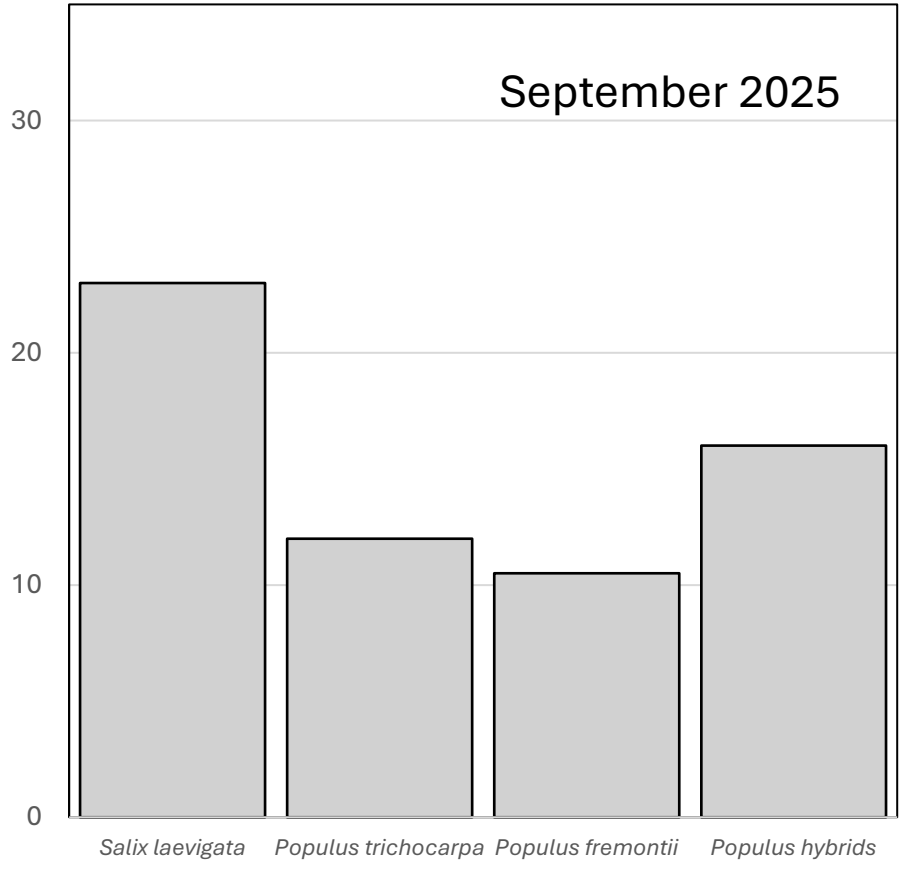

June 2024
Trees with herbicide damage (%)
0
10
20
30
a
b
c
b
Salix laevigata
Populus trichocarpa
Populus fremontii
Populushybrid


300
250
200
150
100
50
0
Mean height (cm)
Healthy
Damaged
Red willow
Black cottonwood
Fremont cottonwood
Hybrid cottonwood

- Replanting necessary over two years to achieve desired density and cover.
- Effects appeared ‘patchy’
  - Soil texture?
  - Soil moisture?
- Similar effects across site, but susceptibility/damage variable among native species.

Do effects resolve over time?





Salix exigua (sandbar willow)

Salix lasiolepis (arroyo willow)

Atremisia californica (California sagebrush)

Heteromeles arbutifolia (toyon)

Erigeron canadensis (horseweed)

Native plants strongly affected	
narrowleaf willow	*Salix exigua*
arroyo willow	*S. lasiolepis*
red willow	*S. laevigata*
toyon	*Heteromeles arbutifolia*
laurel sumac	*Malosma laurina*
Western sycamore	*Platanus racemosa*
Fremont cottonwood	*Populus fremontii*
black cottonwood	*P. trichocarpa*
coast live oak	*Quercus agrifolia*
California sagebrush	*Artemisia californica*
saltbush	*Atriplex lentiformis*

Native plants with mild or no observed damage	
Canada horseweed	*Erigeron canadensis*
coyote bush	*Baccharis pilularis*
mulefat	*B. salicifolia*
cocklebur	*Xanthium strumarium*
blue elderberry	*Sambucus mexicana*
telegraph weed	*Heterotheca grandiflora*
Californica walnut	*Juglans californica*
salt heliotrope	*Heliotropium curassavicum*
nightshade	*Solanum americanum*
saltgrass	*Distichlis spicata*

*Not a complete list.
**Effects on initial establishment unknown.

Take home…

- Strongest effects on willows (and Salicaceae).
- Unclear how (but likely) imazapyr residuals affect initial survival.
- Most trees recover, but effects may last years.
- Herbicide selection and timing important.
- Consider planting palette carefully.

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Partners

- Santa Clara River Conservancy
- The Nature Conservancy
- UCANR
- CalPoly Pomona
- Western Foundation for Vertebrate Zoology
- CIR
- United Water Conservation District
- Ventura County Agricultural Commissioner
- Turtle Conservancy

Funders

- Wildlife Conservation Board
- California Department of Fish and Wildlife
- US Fish and Wildlife Service
- California State Coastal Conservancy
- UCANR Hanson Agricultural Fund