Biological Control of *Arundo donax*

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RIPARIAN INVASION RESEARCH LABORATORY

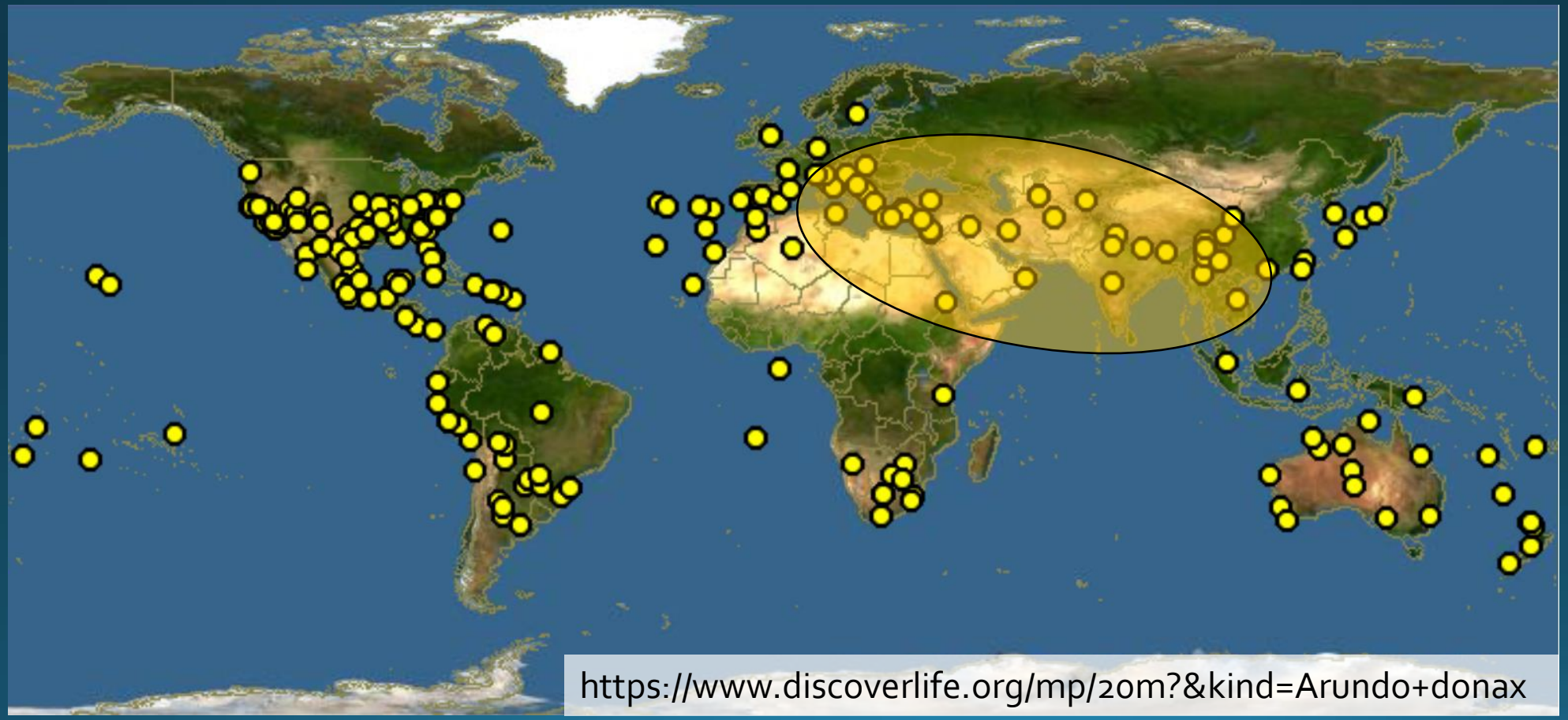
Arundo donax (Giant Reed)

1. Grows and spreads rapidly in a wide range of conditions
2. Promotes:
   - Flooding
   - Drought
   - Fire
   - Disturbance of native flora and fauna

5 Worst Weeds - California Invasive Plant Council
Top 100 Invasive Species – International Union for Conservation of Nature (IUCN)

Arundo donax

- Native to S. Asia, Middle East
- Established in sub-tropical and semi-arid regions (and some temperate zones)



Arundo in North America

- Uses in California:
  - Erosion control
  - Thatching
  - Wind instruments
  - Horticultural

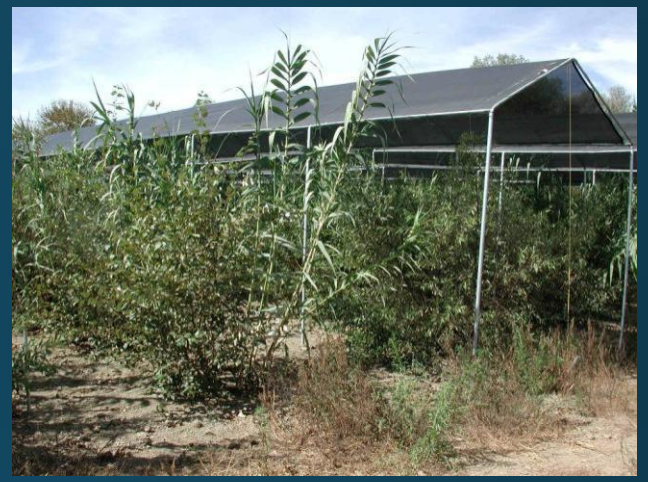
Why is *Arundo* a successful invader?

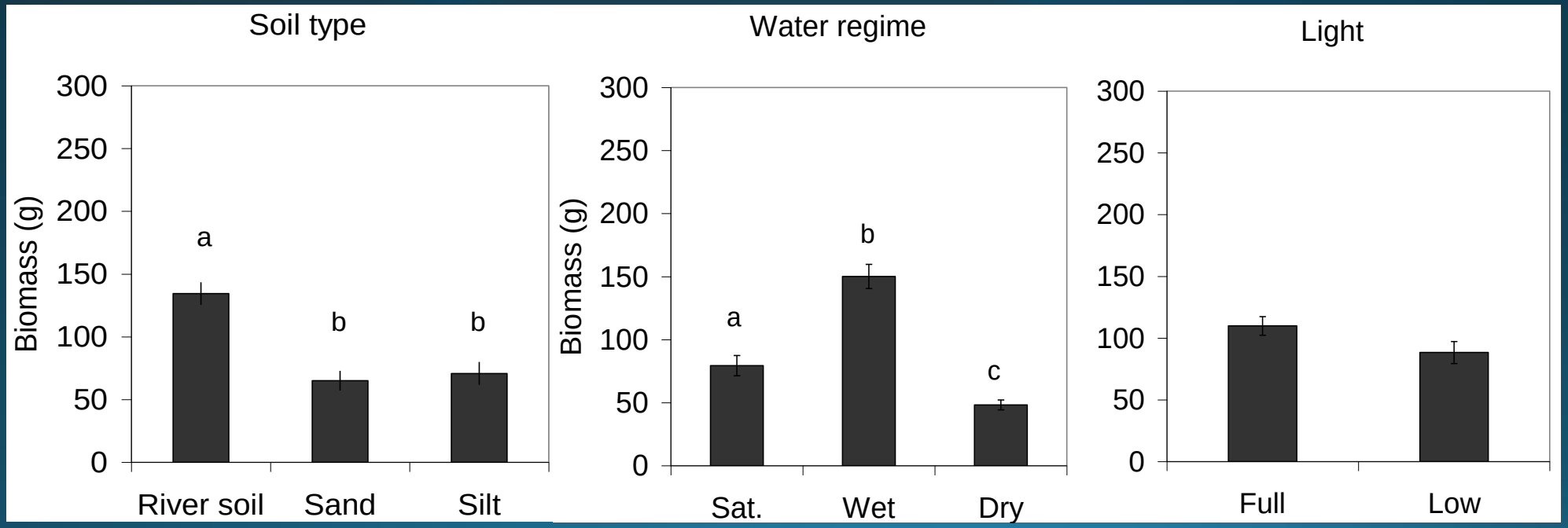
Flowers, but no viable seed

Why is *Arundo* a successful invader?

- Large, tough rhizomes
  - Spread and grow quickly
  - Successful under a broad range of stressful conditions

Tolerant of a range of conditions





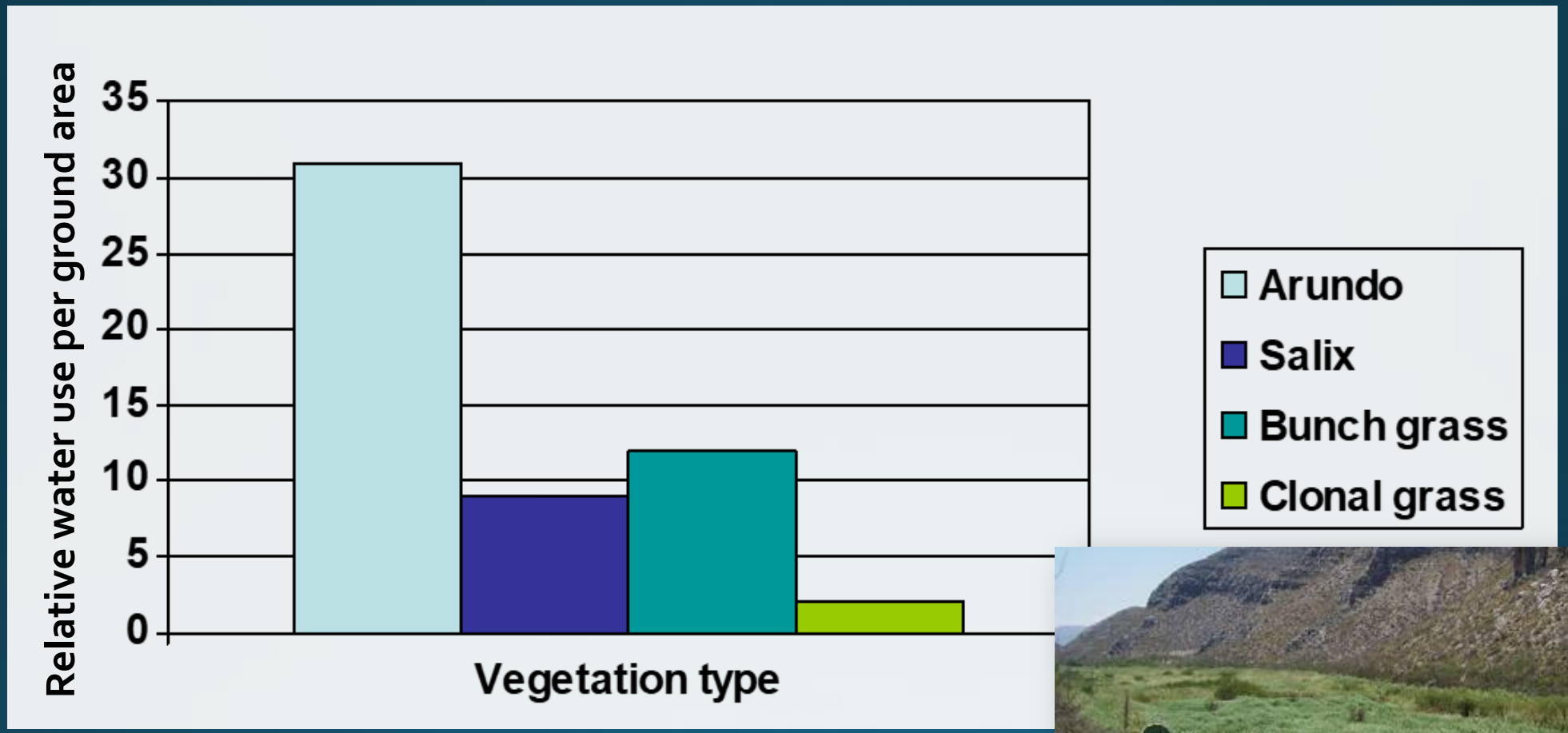
Lambert et al., unpublished

Tolerant of physiological stress

- Regrows rapidly from droughts, floods, and fires

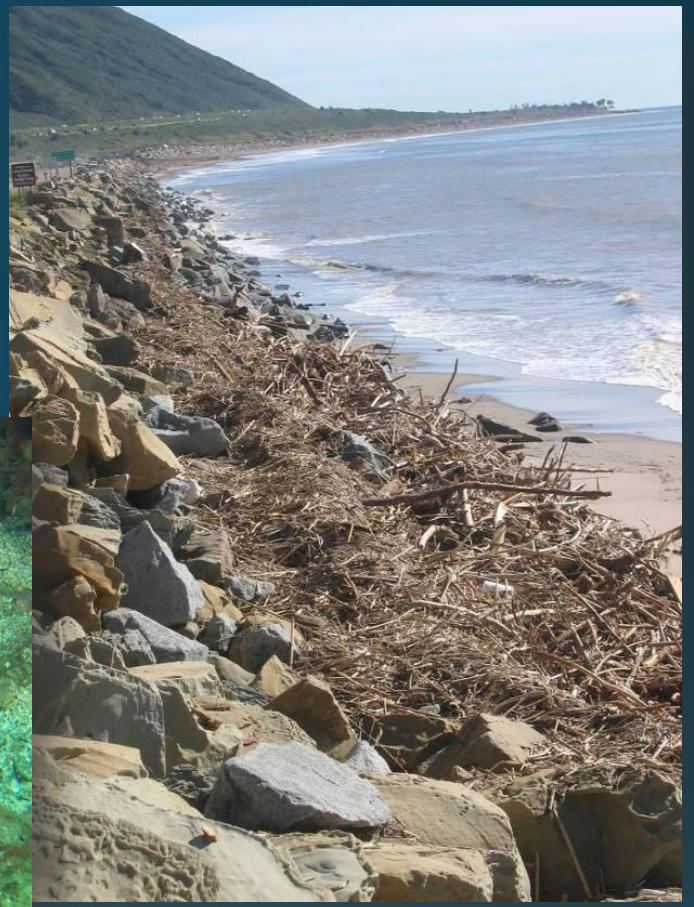
Why is *Arundo* a problem?

Drought

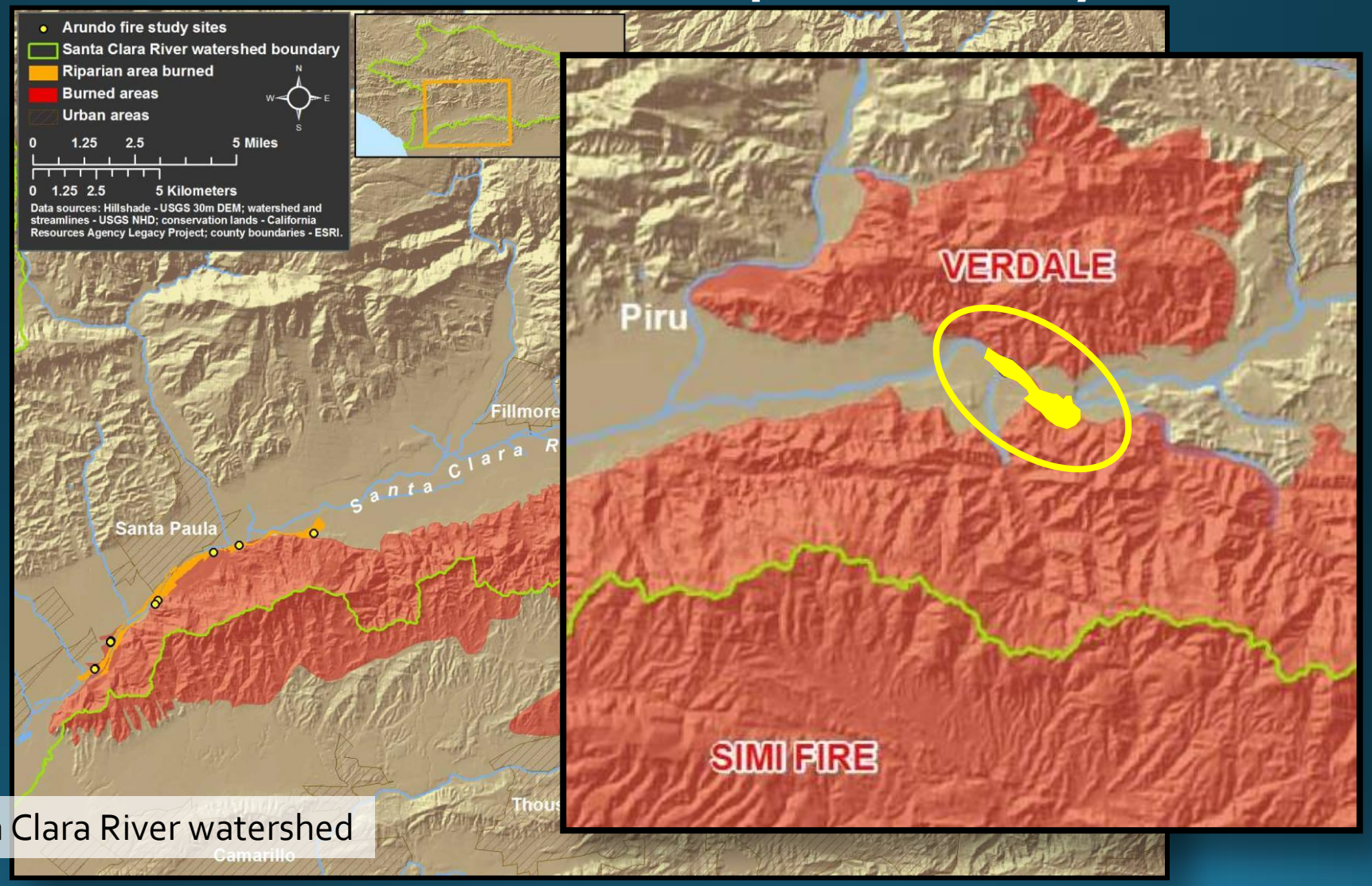


Cole & Dudley 2010

Debris accumulation



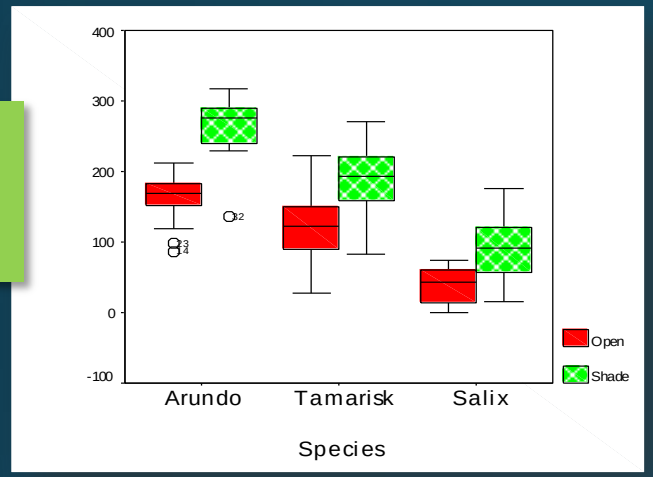
Arundo converts riparian areas from fire barriers to fire pathways

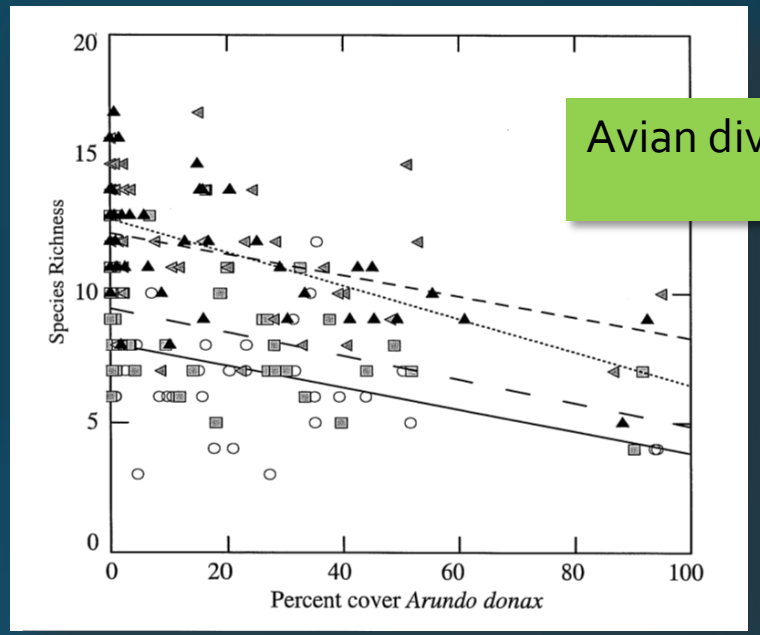


Santa Clara River watershed

Arundo affects native species

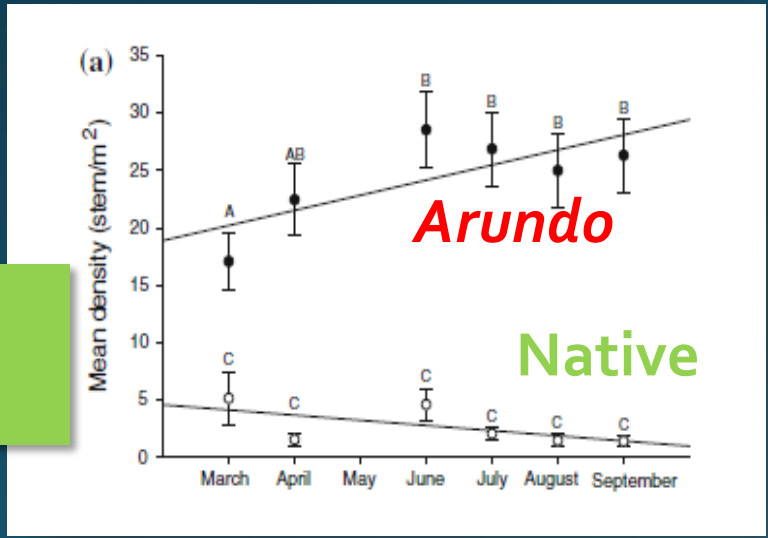
Native vertical growth suppressed
RIVRLAB, unpublished data

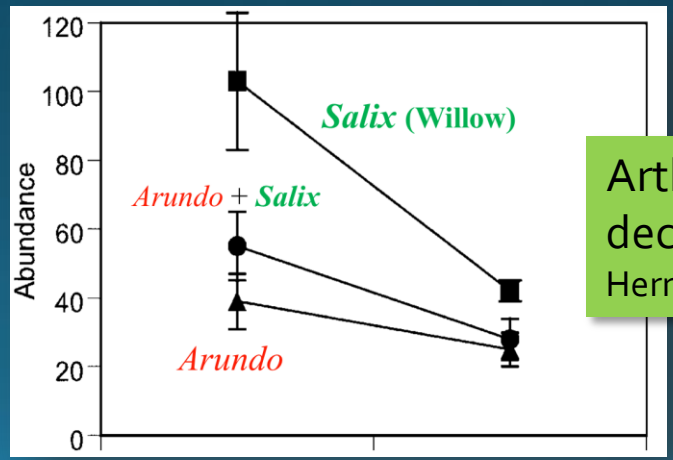




Avian diversity declines
Kisner 2004

Native plant density declines
RIVRLAB, unpublished data

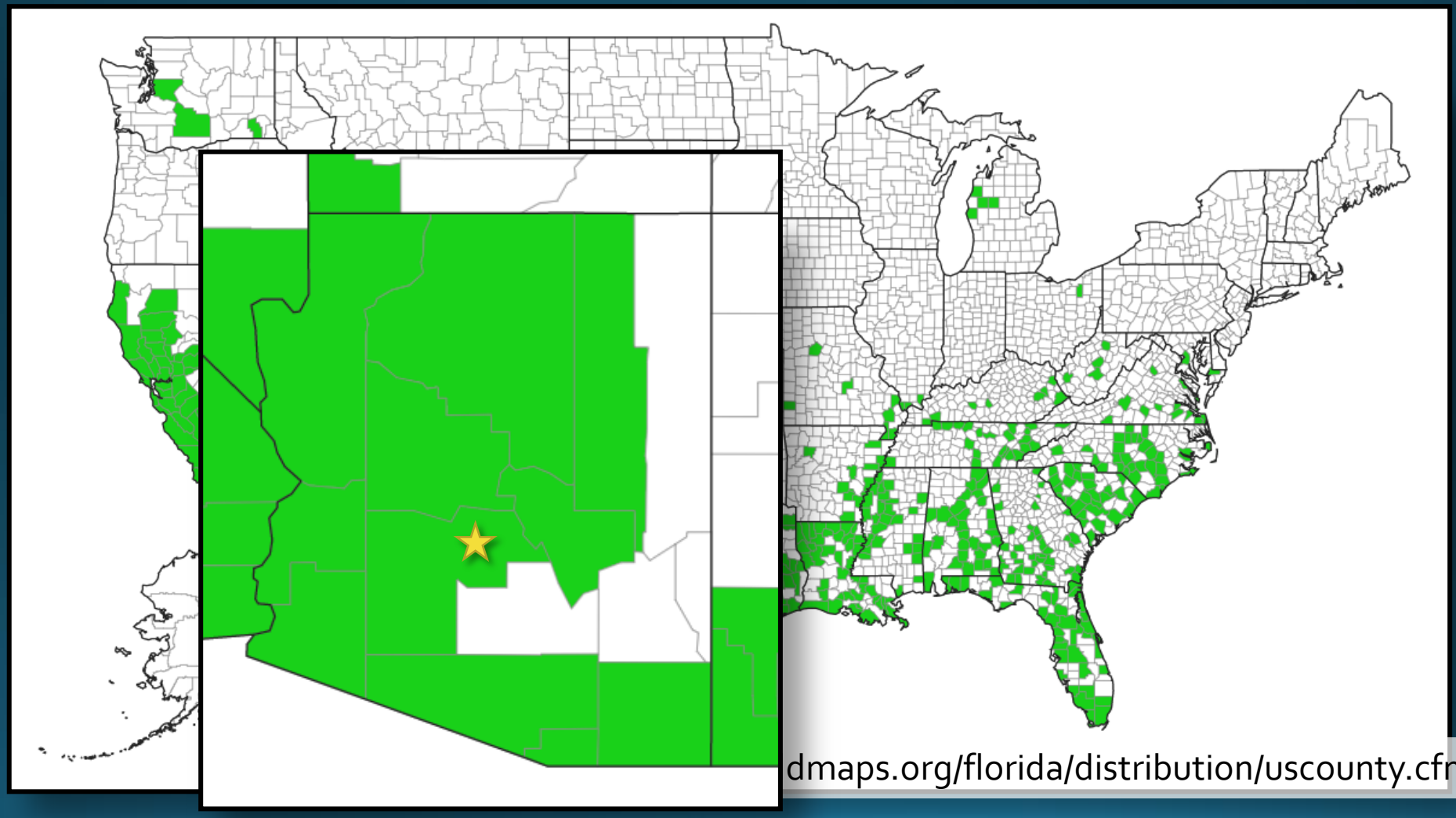




Arthropod abundance declines
Herrera & Dudley 2006

Arundo donax

- *Arundo* is the greatest threat to riparian systems in coastal Southern California (Bell 1997)



dmaps.org/florida/distribution/uscounty.cfm?sub=3009

Research Questions

- How does *Arundo* invasion alter ecosystems?
    - Biodiversity and species composition (native survival)
    - Abiotic factors (especially water availability and fire risk)

- What insect herbivores (native and non-native) are associated with *Arundo* in southwest US?
    - Can they be the biocontrol component of an IPM toolkit?

Biocontrol

- Target organism (often exotic)
- Identify a natural enemy
- Test to prevent accidental host/target switching
- Established agents continue treatment
- Complimentary to other management strategies

One project estimate:

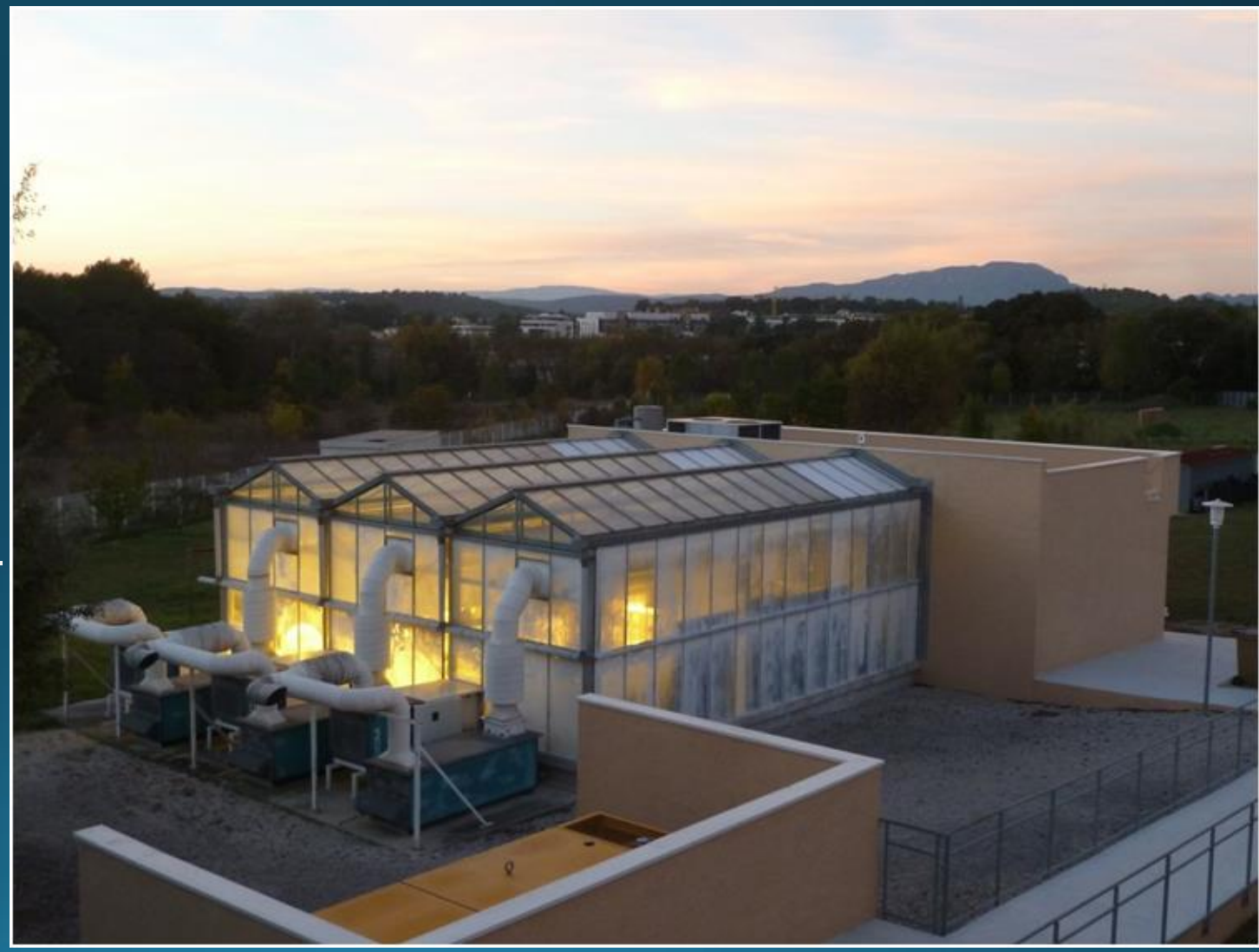
$7.8 million to remove 50 ha of *Arundo* along the Santa Clara River, California.

Average for Arundo removal and restoration:

$4,000-150,000 per acre

Potential for biological control

- Mechanical removal is expensive!
- Only genus member in North America – closest *Phragmites australis*
- Foreign exploration for agents has occurred in coordination with USDA-ARS at EBCL
- Several host specific agents found



Natural enemies of *Arundo* in Europe

Over 60 natural enemies found!

Insects (specialists on *Arundo*)

• Hymenoptera: Eurytomidae	2 species
• Hemiptera: Diaspididae, Aphididae	2 species
• Diptera: Chloropidae	19 species

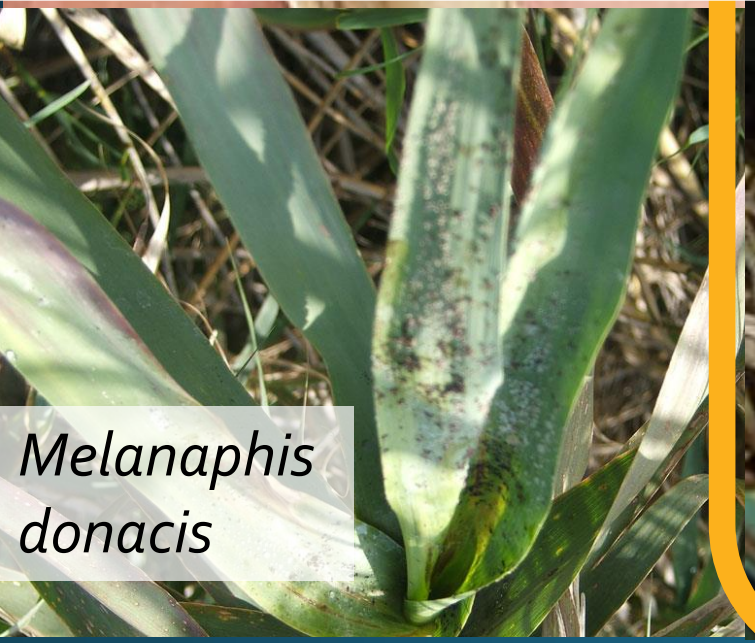
Fungi (specialists on *Arundo*) 4 species

- Puccinia, Selenophoma

Shoot fly (*Cryptonevra sp.)*

Coleoptera

Diptera:Cecidomyiidae
Lasioptera donacis



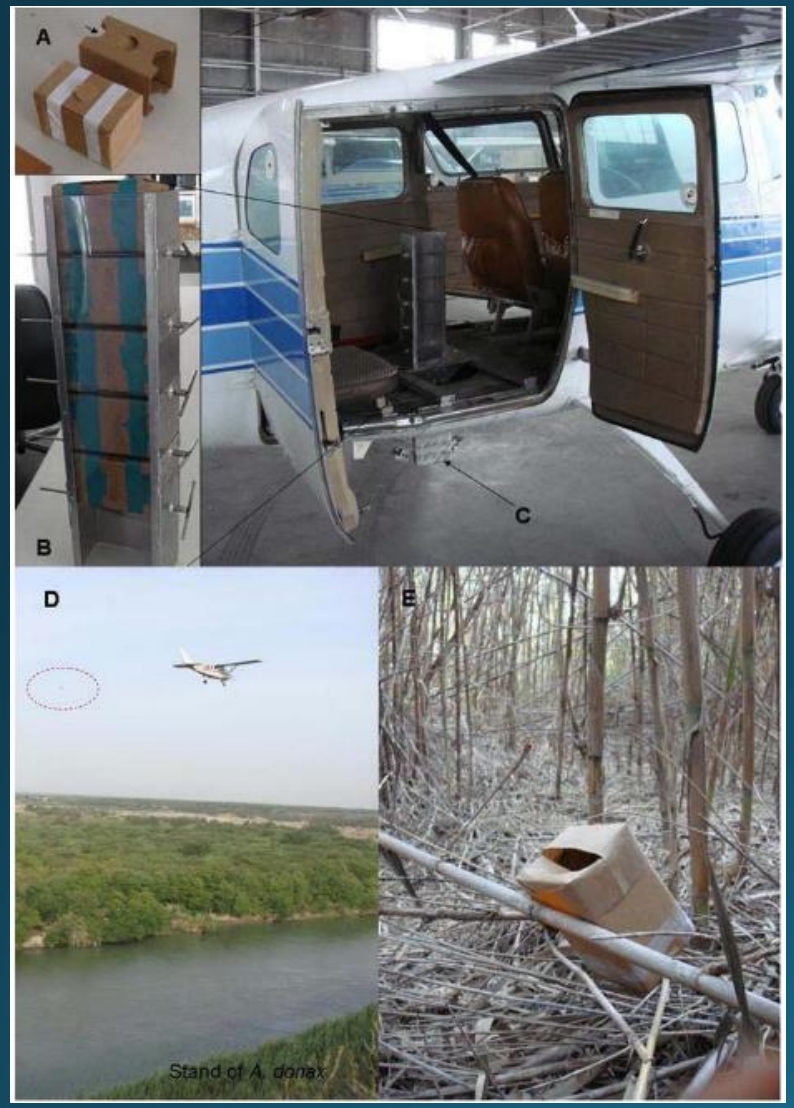
Melanaphis donacis

Stem-boring wasp
Tetramesa romana

Scale insect
Rhizaspidiotus donacis

Arundo wasp (*Tetramesa romana)*

Tetramesa from Texas



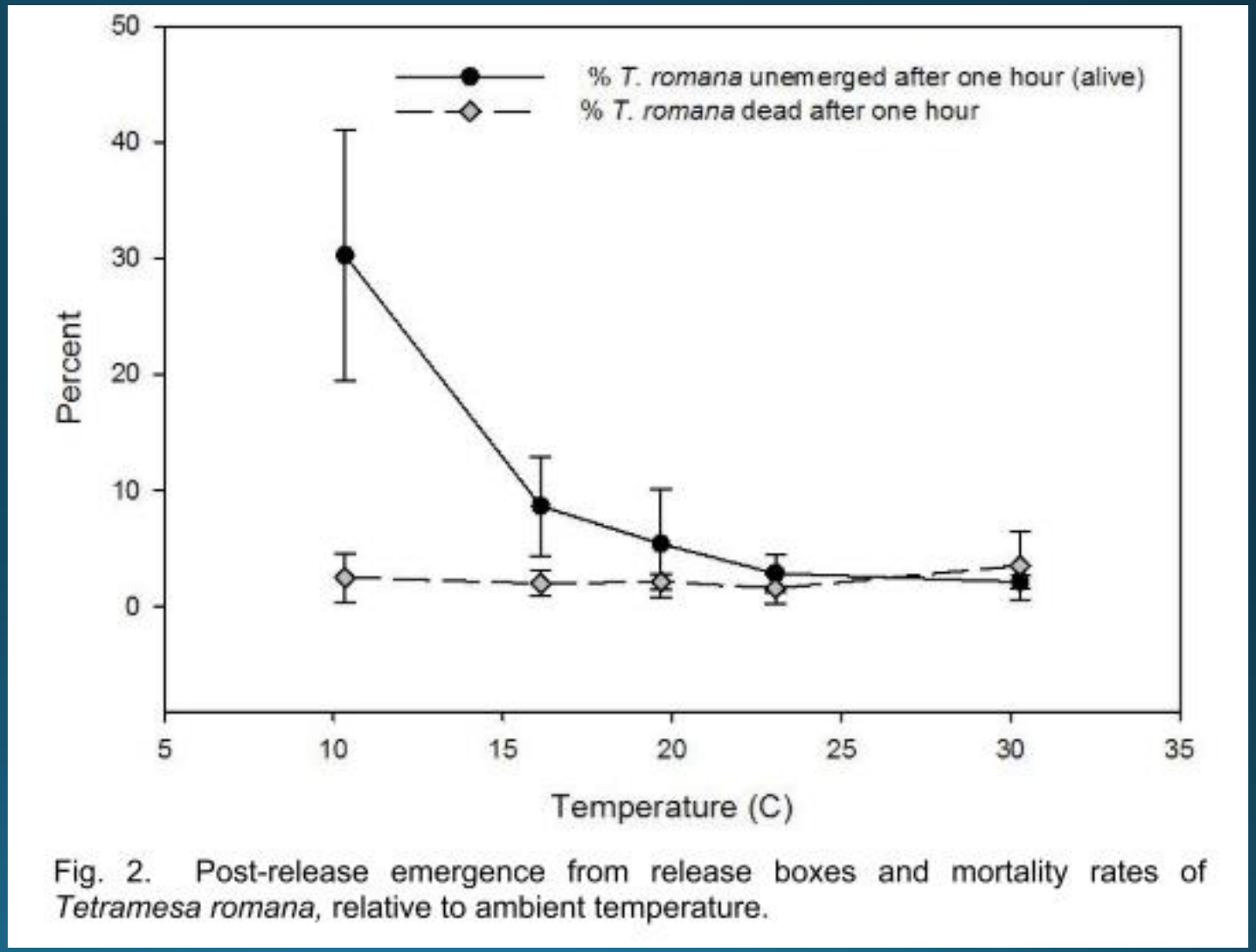


Fig. 2. Post-release emergence from release boxes and mortality rates of *Tetramesa romana*, relative to ambient temperature.

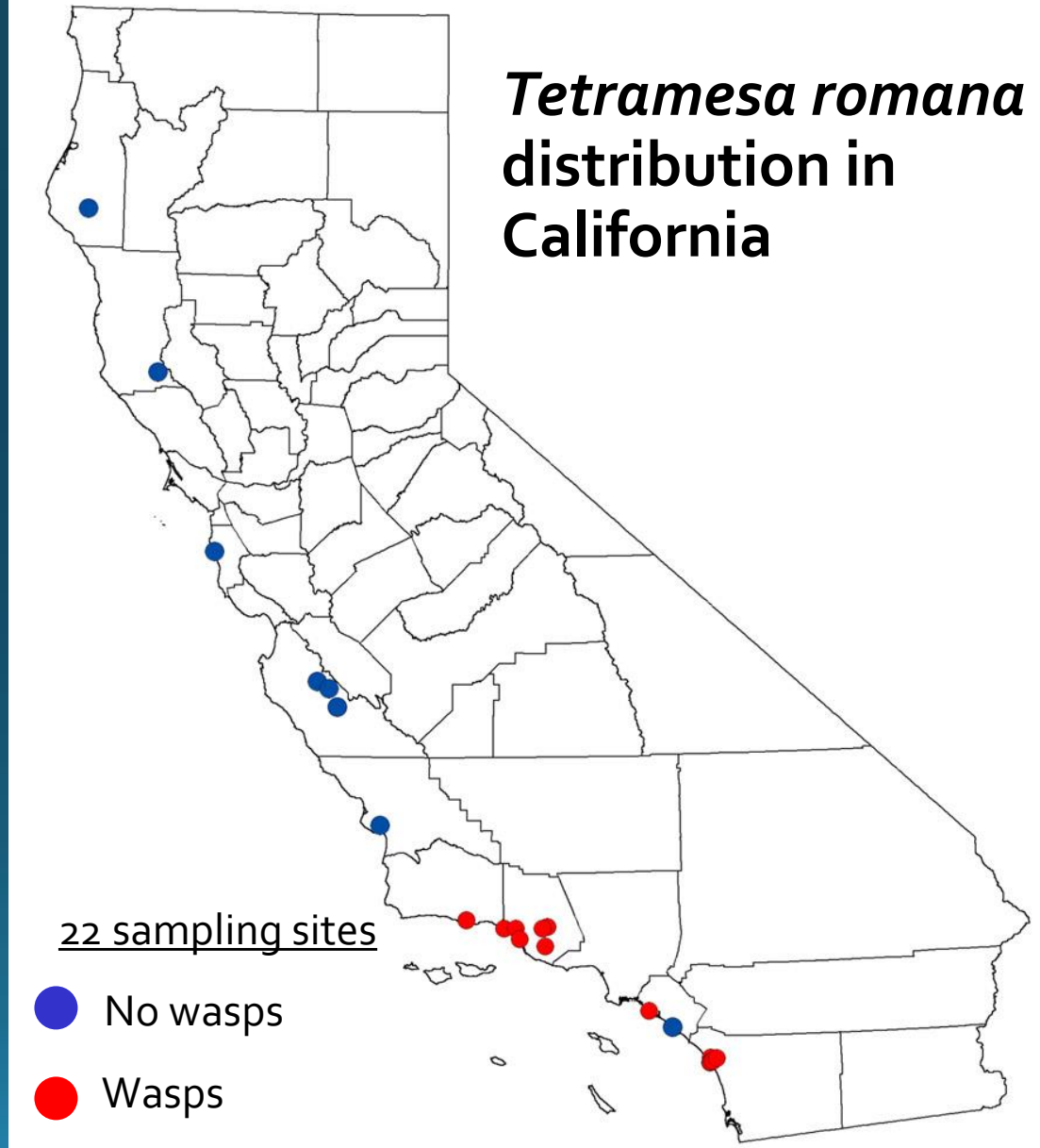
Racelis et al. 2010, Goolsby et al. 2016 (USDA-ARS, USDA-APHIS)

CA Infestation and Damage

Stems ~20.6 %
Side shoots ~33.3 %
Patchily distributed within systems

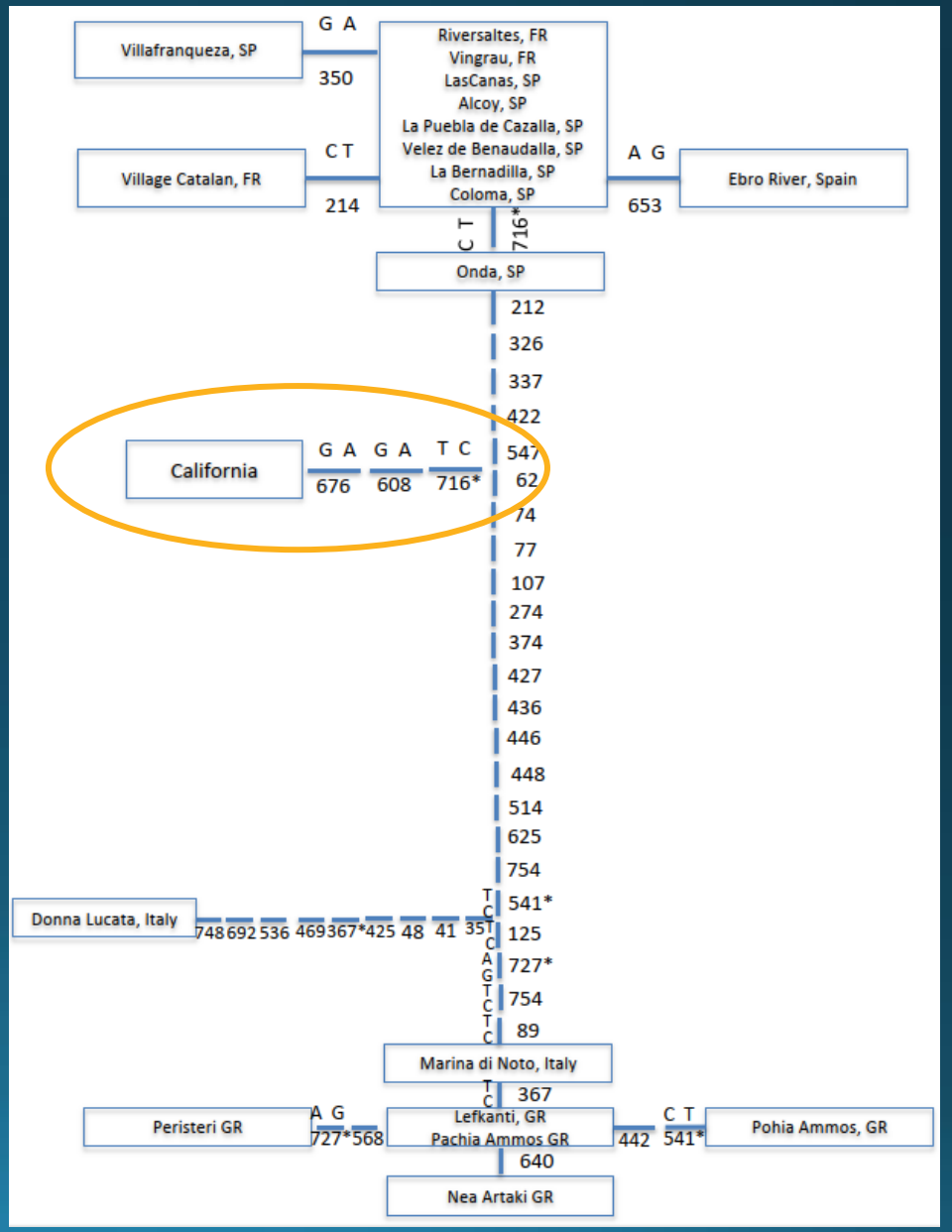
Can cause stem death, but kill mostly side shoots.

Arundo wasp (*Tetramesa romana*)



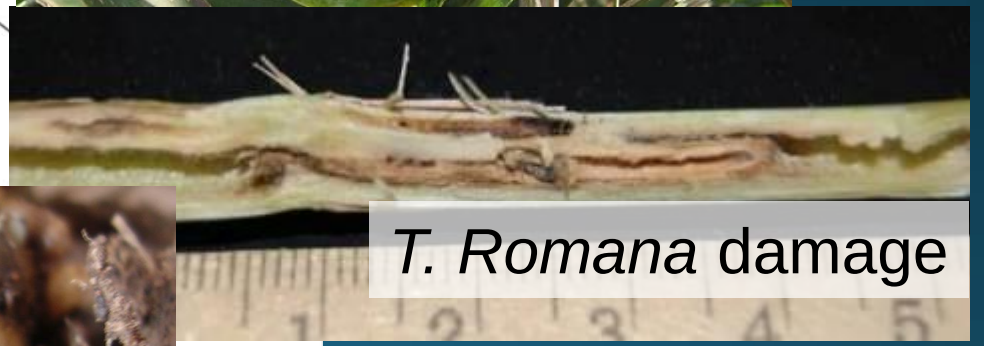
Future biocontrol agents?

- Scale insect (*Rhizaspidiotus donacis*).
  - Feeds at base of stem near rhizome.
  - Currently analyzing genetics (Z. Ozsoy and J. Gaskin)



Synergisms may be key to Biocontrol

Chloropid fly larvae + fungi + bacteria



T. Romana damage

Conclusions

- *Arundo* impoverishes assemblages, exacerbating water and fire stress in a wide range of areas
- A collaborative, strategic approach should be taken with *Arundo*, focusing on factors that slow invasion, as well as population management to ensure overall reduction occurs.
- Biocontrol within an IPM program supports long-term success in reducing *Arundo* abundance

Acknowledgements

Questions?