Invasion Potential of Chinese Tallow (*Triadica sebifera*) in California

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A popular street and garden tree

Chinese tallow… forever.

Popcorn-like seed

Attractive fall color

With a history of invasion

Note green dot!

Pattison and Mack 2007

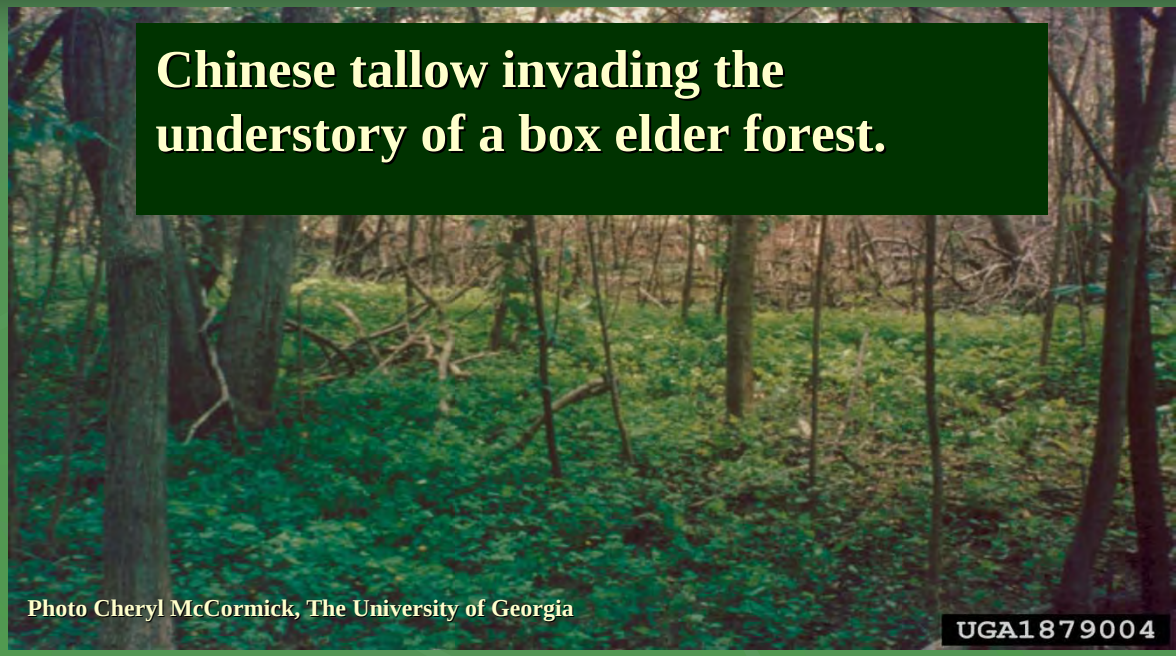
Introduced range of Chinese tallow in the United States

Impacts

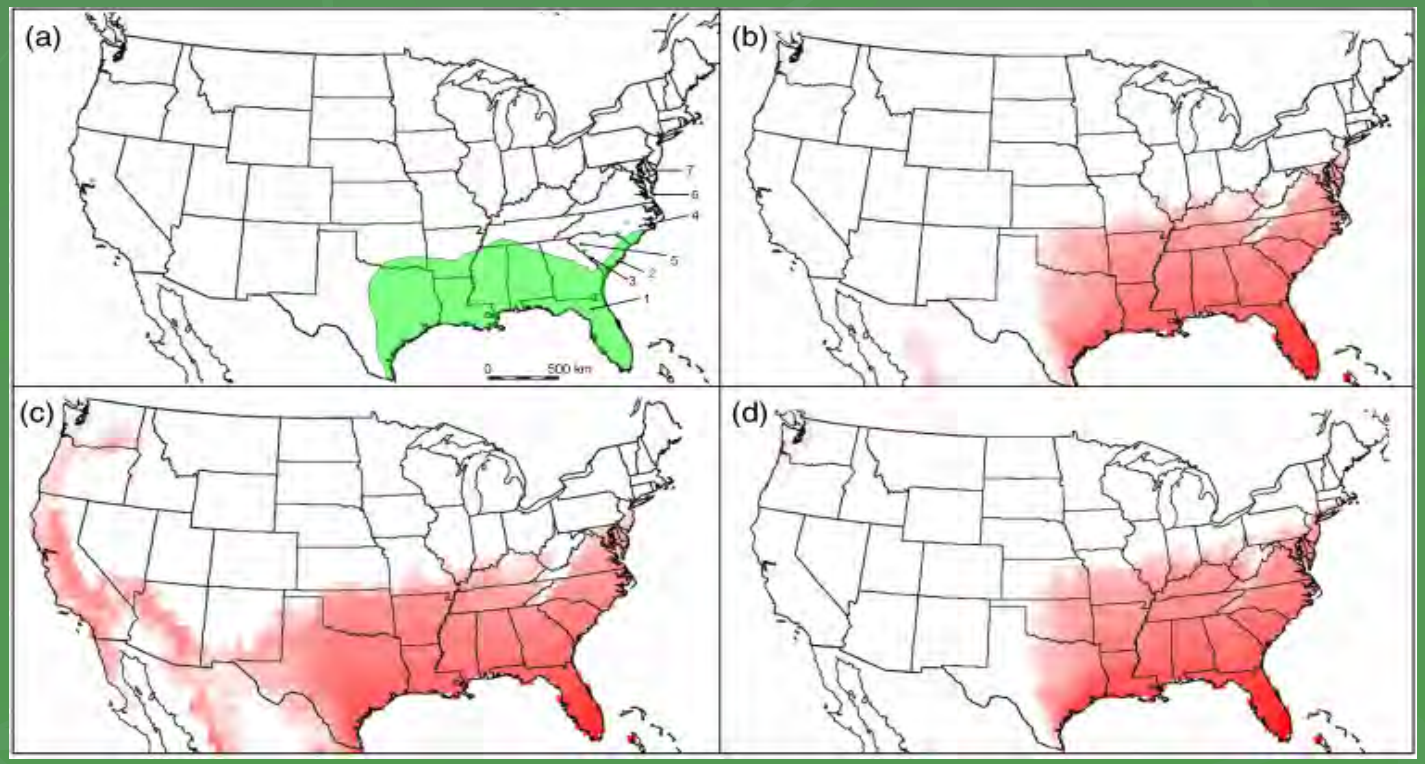
Displaces native plants and forms monocultural stands.

Adds nutrients to the soil through rapid litter decay.

Produces tannins unpalatable to most herbivores and toxic to aquatic life.



Red Colors = Red Flags!



Pattison & Mack 2007

(a) Introduced range of Chinese tallow in the United States
(b) Appropriate Chinese tallow climate, currently
(c) Appropriate Chinese tallow climate with increased summer rainfall to simulate perennial water sources.
(d) Appropriate Chinese tallow climate with 2˚C increases in minimum and maximum daily temperatures.

The Questions

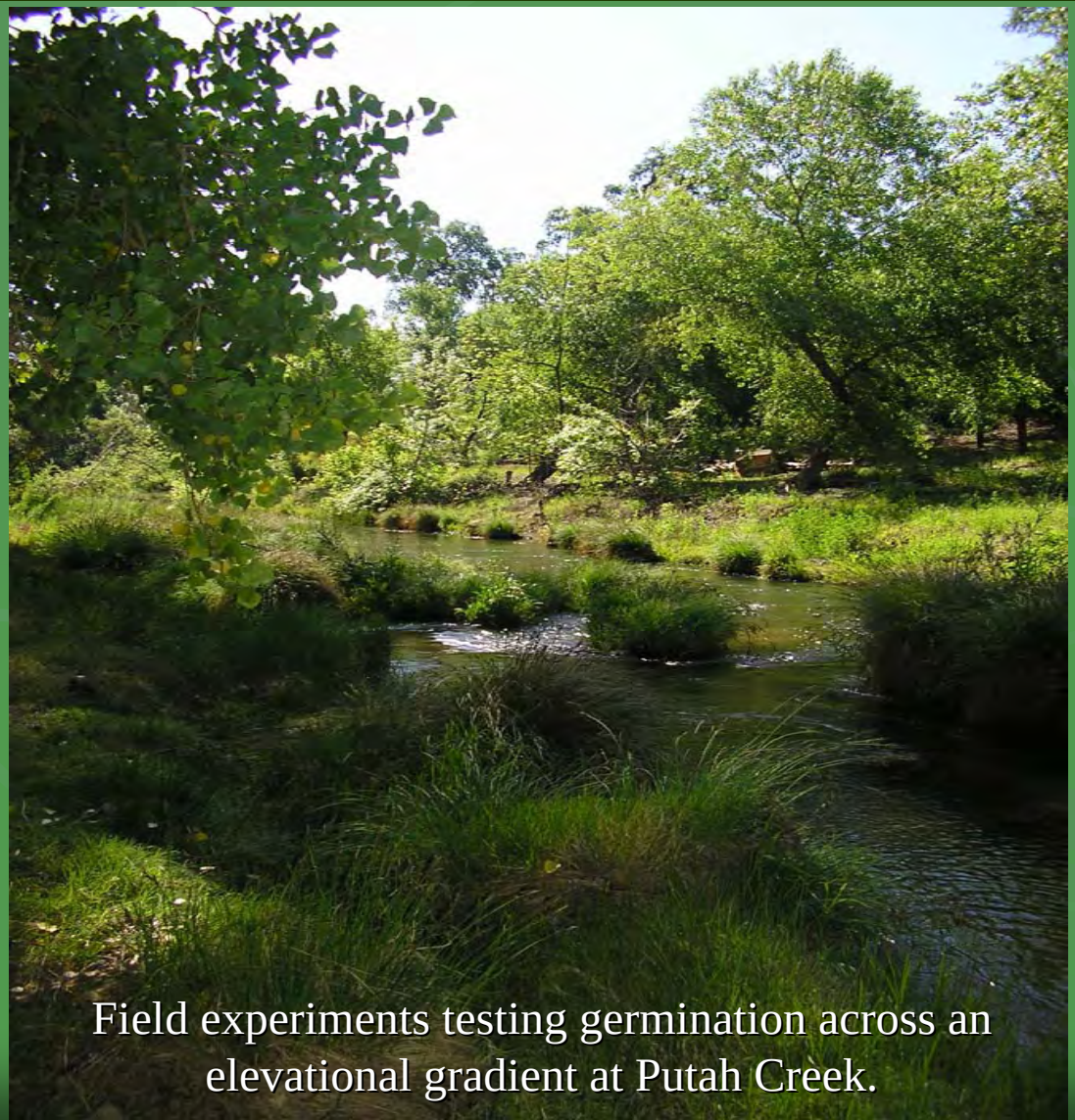
- Where along perennial water bodies in California can Chinese tallow establish?

- Are there significant barriers preventing
  1)reproduction? **No (obs)**
  2)dispersal? **No (obs)**
  3)germination? **???**
  4)growth? **???**

→*If no for all, then we should be concerned!*

Young Chinese tallow along American River Parkway
Photo TNC Global invasive Species Team

Germination



Field experiments testing germination across an elevational gradient at Putah Creek.

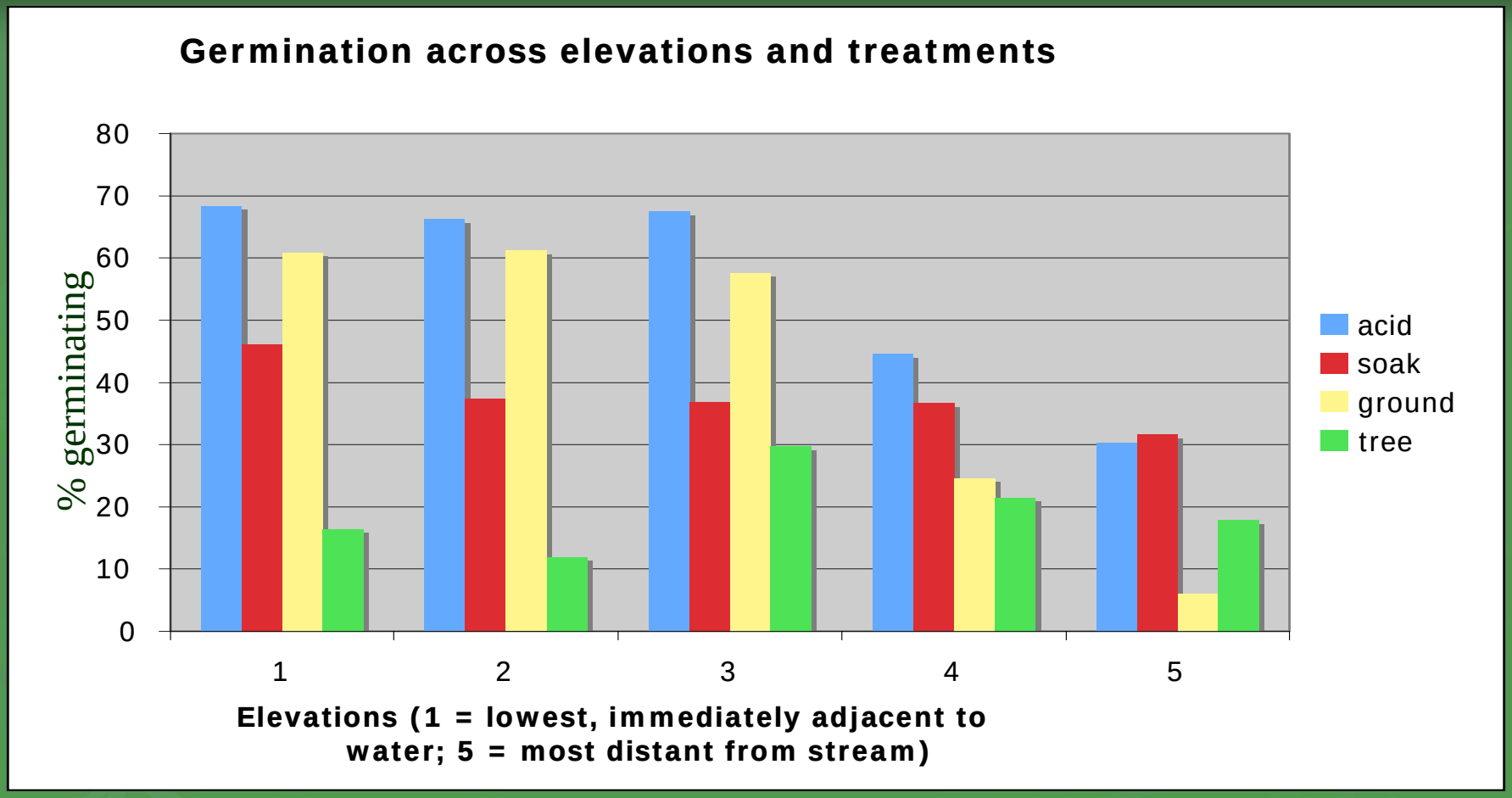
Germination

- Dispersal scenario may influence germination

- Germination pre-treatments imposed:
  - Simulated bird gut passage (H2S04 2h).
  - Simulated hydrochorous dispersal (30d soak).
  - Ground underneath parent trees.
  - Direct planting from tree infructescences (CONTROL).

One month later…

Counting germinated seeds.
Ungerminated were classified as viable or non-viable.



ANOVA

R^2=0.43

Source	Nparm	DF	Sum of Squares	F Ratio	Prob > F
Treatment	3	3	6738.1534	8.2181	<.0001
Elevation	4	4	4717.2682	4.315	0.0033
Elevation*Treatment	12	12	5101.5857	1.5555	0.1224

Treatment			Mean percentage germinating
acid	A		0.550
ground	A		0.398
30 d soak	A	B	0.342
tree		B	0.178

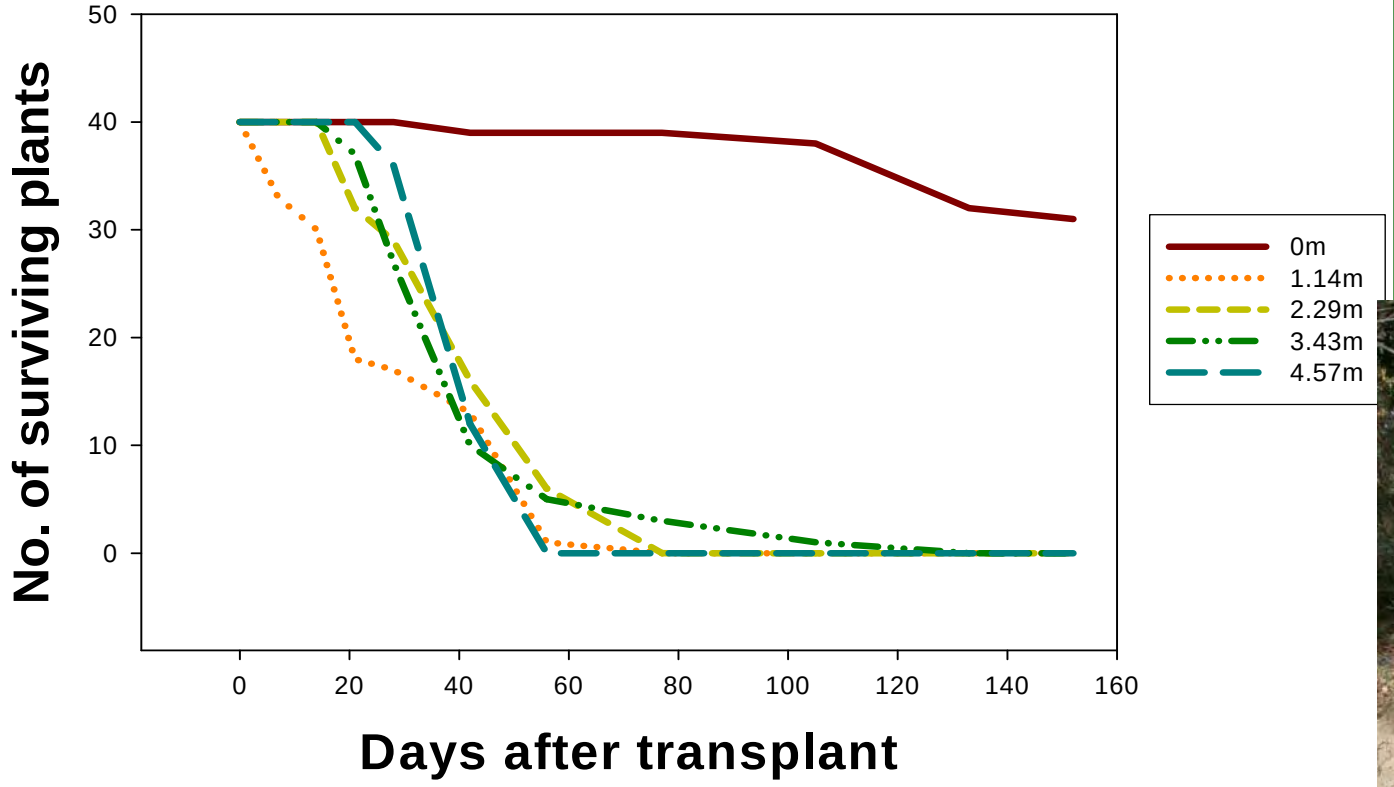
Growth Analysis

Initial seedling mortality is often high and may limit Chinese tallow distribution in CA.

In particular we hypothesized that higher drought stress would limit growth and restrict survival to stream edges at Putah Creek.

Growth/Survival Analysis Results

Survival profile for Chinese tallow seedlings at five elevations above Putah Creek



Seedling Growth/Survival Analysis Conclusions

- 1. Seedlings do not survive at elevations far above the streambed.

The Questions

- Where along perennial water bodies in California can Chinese tallow establish?

- Are there significant barriers preventing
  1)reproduction? **No.**
  2)dispersal? **No.**
  3)germination? **No.**
  4)growth? **No and Yes.**

→*If no for all, then we should be concerned!*

Young Chinese tallow along American River Parkway
Photo TNC Global invasive Species Team

Another Line of Evidence: Naturalized Population Observation

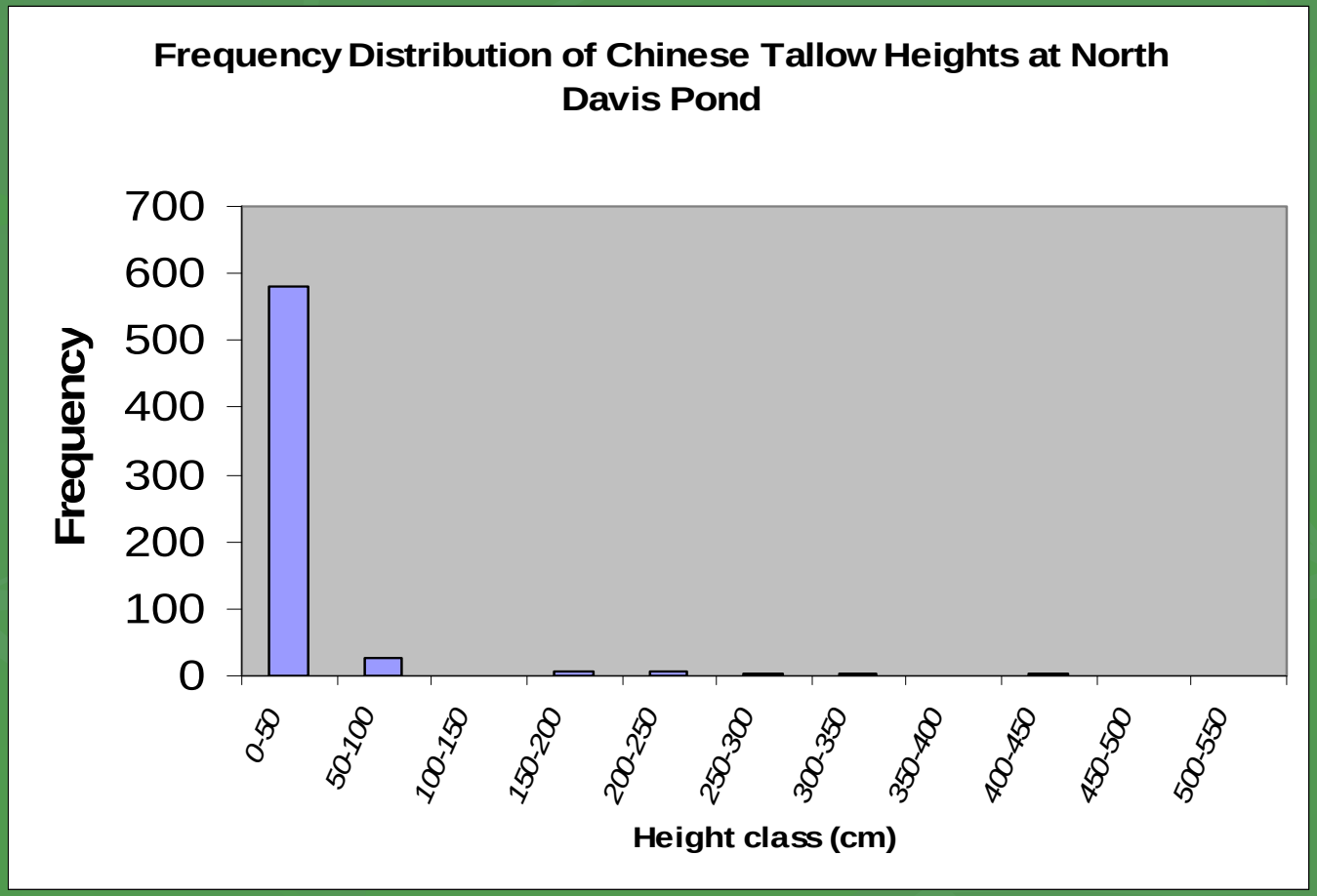
Chinese tallow seedlings growing under *Salix* spp. at North Davis Pond

- Where are individual plants growing?
- Is the population growing?

Escaped seedlings growing at North Davis Pond, CA

All of the **629** individuals counted occurred within 7m of the waters edge

Plant size distribution



Poor survivorship, especially among 1st year seedlings
OR impending monoculture?

OVERALL CONCLUSIONS

- Chinese tallow can and does grow in riparian areas in California's Central Valley without human assistance.
- Poor seedling survival restricts potential habitat to a narrow band immediately adjacent to perennial waters.
- This tree should not be planted in California, especially near perennial water bodies of conservation value.
- Monitoring programs should be biased toward observations immediately next to perennial waters.

Questions

- **Thank you!!!**

- **Acknowledgements:**

Dr. Marcel Rejmánek, Rob McKee, Leslie Smith, Dr. Jennifer Erskine-Ogden, Dr. Eva Grottkopp-Kuo, Elaine Chow, Michelle Chinoraks, and Rachel De Ruvo for providing feedback, helping in the field, and providing always-positive support throughout the duration of the project.

Extra Slides

What does “Elevation” mean?

Our expectation was that the negative effect of elevation was due to soil water content decreasing as one moved away from the stream. This was not the case.

Factor	Range	Mean	Relationship with elevation	
			Correlation coefficient (r)	p-value (relationship)
Soil water content	3.55-25.18%	13.73	0.2540	0.0002 (cubic)
Proportion coarse material	0-0.752	0.2335	-0.6252	<0.0001 (linear)
% perennial cover	0-90%	43.64	0.5448	<0.0001 (quadratic)
Soil temperature	13.75-32.5°C	21.10°C	-0.4688	<0.0001 (cubic)

Going up in elevation meant finer soils, and generally more soil water content. Soil temperature was greater in scoured areas and at maximum elevation.

N. Davis Pond
Marked Seedlings

The height, shade, and proximity to water was assessed for 50 seedlings growing at stratified intervals around N. Davis pond in July 2007.

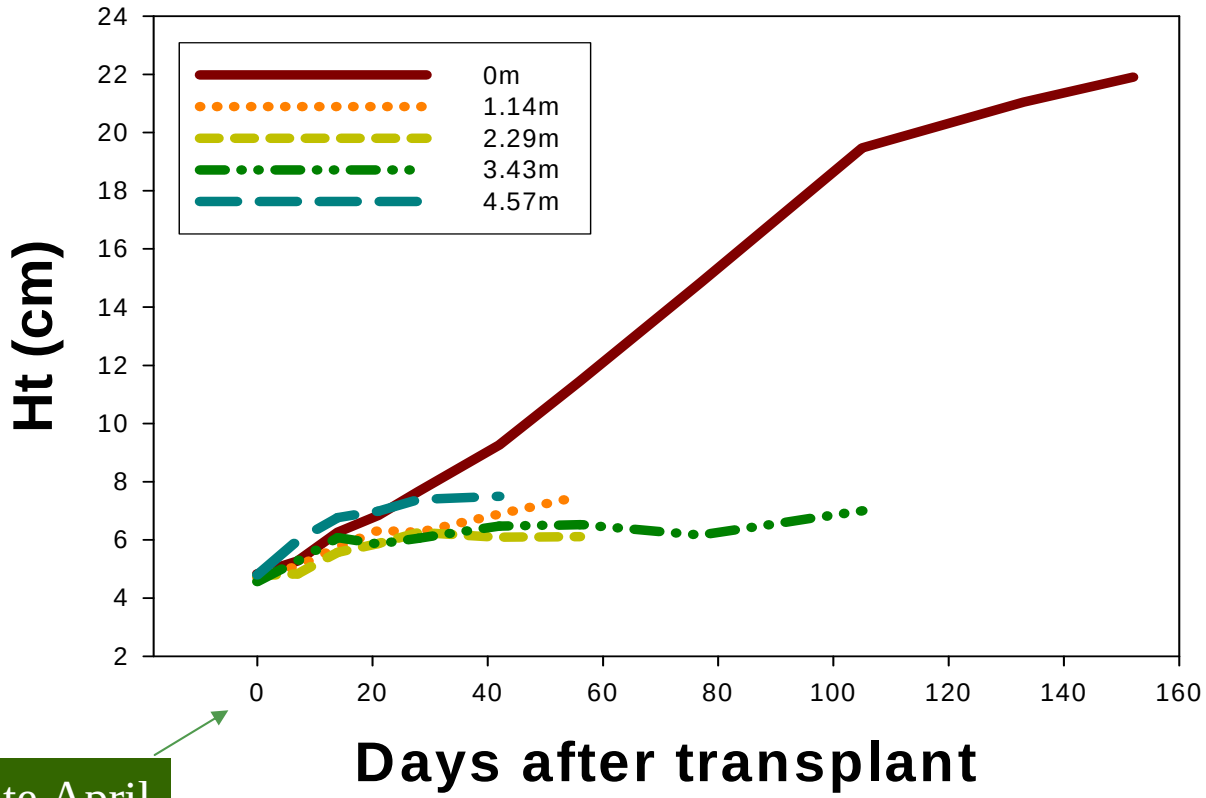
These individuals were re-assessed for height and mortality in October, right before the first major rain.

35/50 survived this period of time, suspected to be the most stressful in terms of water limitation and temperature.

Average absolute growth of survivors was actually slightly negative (-0.17cm)

Growth/Survival Analysis Results

Mean height of surviving Chinese tallow plants over time



Late April

Chinese Tallow Traits

- Fast growth (2-3ft per year)
- High reproductive output (>100,000 seeds per year plus root suckering and resprouting)
- Early first reproduction (3 years)
- 7 year seed bank
- Vectored dispersal (birds and water)
- Few herbivores & diseases in introduced ranges.

Chinese Tallow Traits

- Broad environmental tolerances
  - Flood tolerant
  - Salt tolerant
  - Shade tolerant
  - Drought tolerant
  - Somewhat frost tolerant

Reproduction

- **Observation 1** We counted over 100,000 seeds for some mature individuals in Davis. Many seeds were produced on individuals from naturalized populations as well.
- **Observation 2** Trees hum with pollinators (mostly bees) during summer.
- **Observation 3** All seeds examined had a high proportion of viable seed(>>0.5)

Dispersal

Observation 1: Long distance dispersal already achieved. Anthropochory—Dispersal by man.

Observation 2: Efficient local dispersal through hydrochory (water) and ornithochory (birds).

Seedlings at Putah Creek

One-half of all seedlings were placed in vertebrate herbivore exclosures
Herbivory was infrequent and minor—deemed insufficient to affect growth and survival of seedlings.

Timeline

4.24.07

Seedlings planted at Putah Creek; initial watering

3.17.07

Treatments imposed, seeds planted

Jan/Feb 2007

Seeds collected from > 20 trees in separate areas of Davis, CA

4.22.07

Seeds recovered; viability assessed

10.4.07

End of growth analysis