



Reducing Milk Thistle (*Silybum marianum*) to Zero Density:

A treatment model for eradicating annual weeds with plastic life cycles

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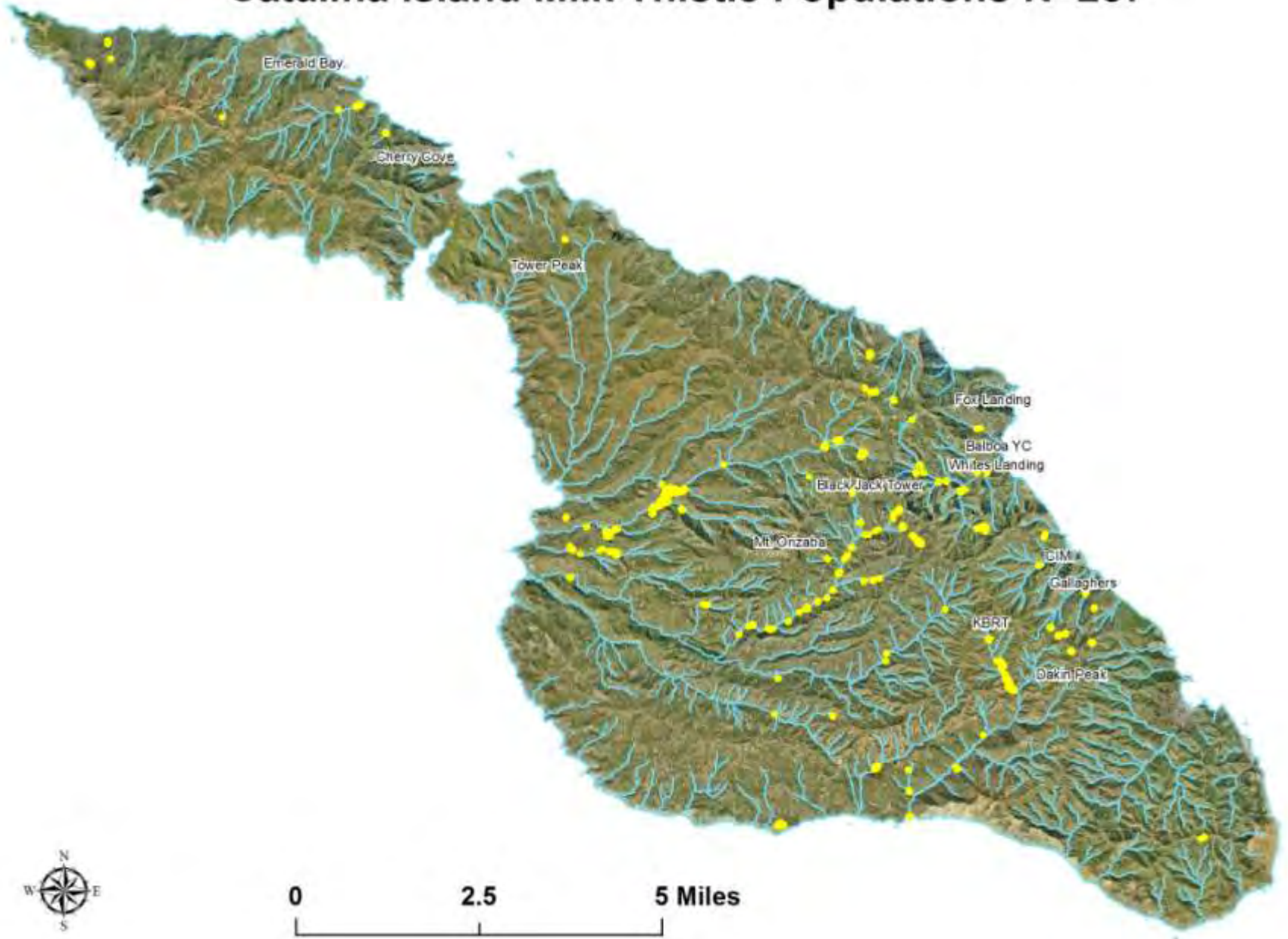


Introduction

- Annual weed - Asteraceae
- Introduced: 1960s (Hochberg, 1979)
- Germination: Oct-May
 - 94% seed viability (Khan, 2009)
- Height: 4" to 8'
- Flowers: April-July
- Reproductive output:
 - To 6,350 seeds/plant
 - To 1,400,000 viable seeds/acre (Khan, 2009)
- Seed bank longevity: 9+ years (King Cty, 2009)
- Allelopathic potential
 - *p*-OH-benzoic, caffeic, syringic, *p*-coumaric, chlorogenic, and ferulic acids (Khan, 2009)



Catalina Island Milk Thistle Populations N=257



Management Challenges

- Germination range: Oct-May
 - Multiple treatments required
- Rosettes difficult to see in tall grass
- Leaf overlap
 - Late season herbicide application not effective
- Seed bank stimulated disturbance
 - Pulling results in more seedlings
- Life cycle from 3 weeks to 8 months
- 257 known locations
- Remote access



Plasticity

← June 22nd – 6" tall plants - typical after 1st round of treatment

April 16th – 8' tall plants - typical with no 1st round of treatment →



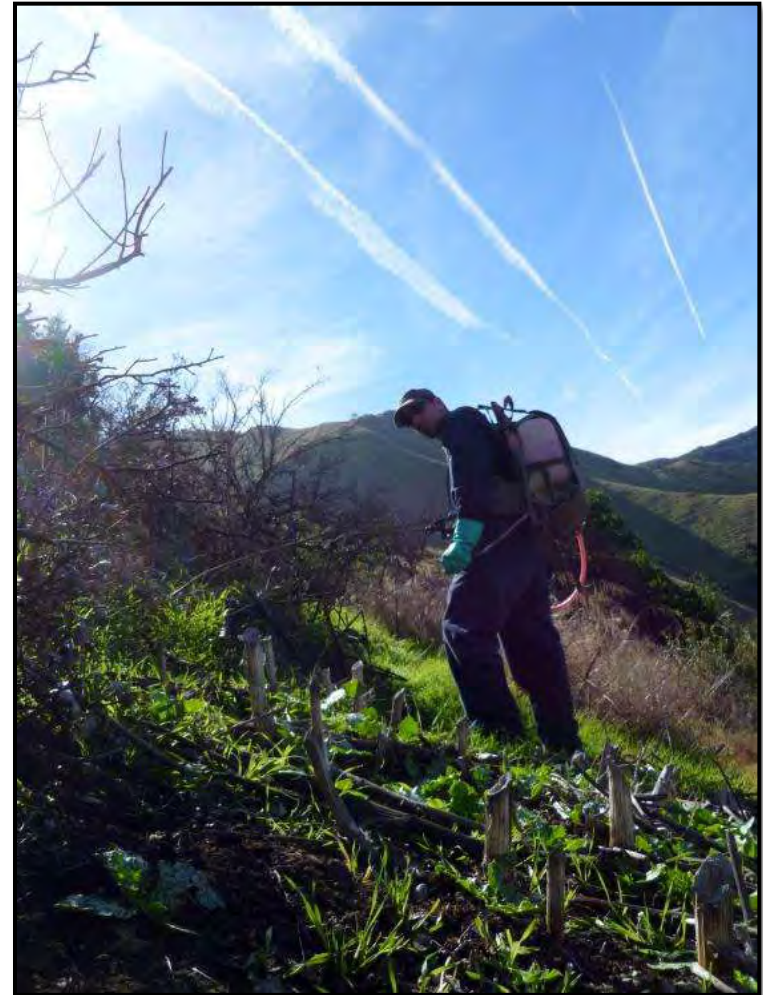
Methods: Previous Treatment

- Post emergent herbicide (Apr-Jun)
 - Leaf overlap effects prevented treatment of all individuals
- Hand pulling (Apr-Jun)
 - New germination occurred, likely from soil disturbance
- Mowing (Apr-Jun)
 - New germination occurred
 - Narrow timing of effective treatment



Methods: Current Treatment

- Early herbicide application Oct-Jan
 - Milestone at 6 oz a.i./ac
- Late season herbicide application May-Jun
 - 5% Glyphosate or 1% Garlon 4
 - Flower heads buried on site if present
- Treatment of 257 populations totaling 43.3 acres in 2012
 - 232 staff hours and 295 intern hours
 - Labor and supplies ~\$8,000



Timing of Pre Emergent Application

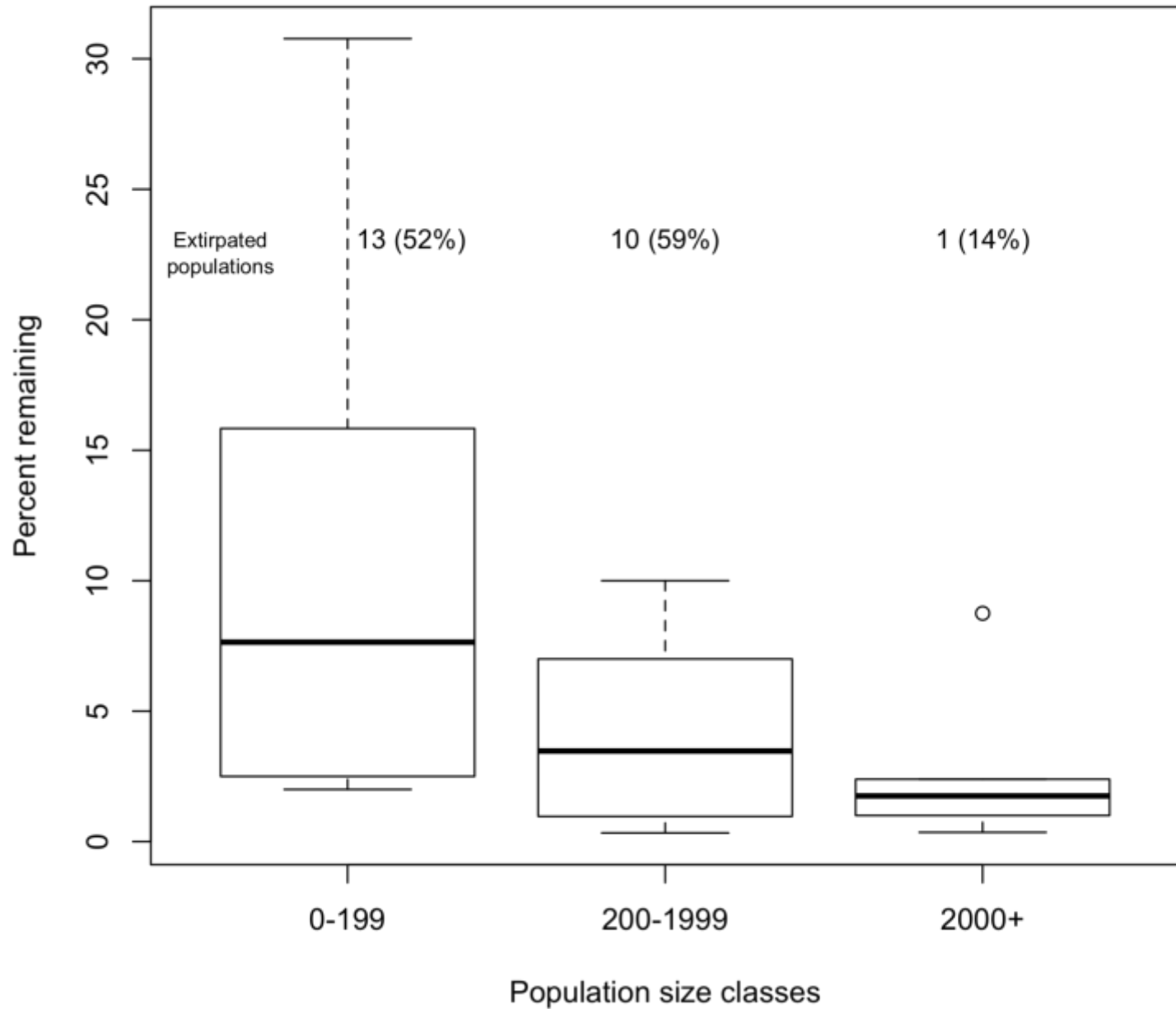
- Apply to plants and soil when grass is short
- Apply to seedlings and 5 ft buffer zone
- If no seedlings present, no herbicide applied



Results: Pre Emergent Treatment

- Analyzed populations with peak population counts of >10 with population estimates prior to pre emergent treatment
 - N=49
 - Average reduction: 97%
 - Populations reduced >90% $p < .001$
 - Large populations (2000+) had greater mean % reduction than smaller populations (< 2000)
 - Possibly due to more consistent herbicide application
 - 24 populations (49%) reduced to 0 plants after pre emergent treatment

Percent of individuals remaining after treatment







Summary

- Early season treatment appears to drastically reduce milk thistle cover
 - Pilot: population of 2000+ reduced to 2
 - Average reduction of 97% for $N > 10$ populations
- Late season mop up effective at eliminating all remaining plants
 - 2 populations (.8%) produced seed in 2012
- Trajectory toward total eradication from Catalina Island

Broader Implications

- Effective control possible with only pre emergent herbicide
 - Eradication unlikely
- Backcountry eradication possible
 - 4 gallon backpack sprayer can treat .25 acre (10,890 sq. ft) population at 6 oz a.i./acre (.30% mix rate)
 - 32 oz spray bottle can treat 725 sq. feet at 6 oz a.i./acre (.30% mix rate)
- Accessible populations eradicated with spray rig
 - 158 gallon spray rig can treat 4 acre population at 6 oz a.i./acre (.12% mix rate)

Literature Cited

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Thank You



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