Integrating Chemical and Biological Controls for the Aquatic Weed *A. philoxeroides* (Alligatorweed)

Gary Ervin, Samuel Schmid, and Gray Turnage

Department of Biological Sciences and
GeoSystems Research Institute
Mississippi State University

Alligatorweed is a highly plastic pest plant

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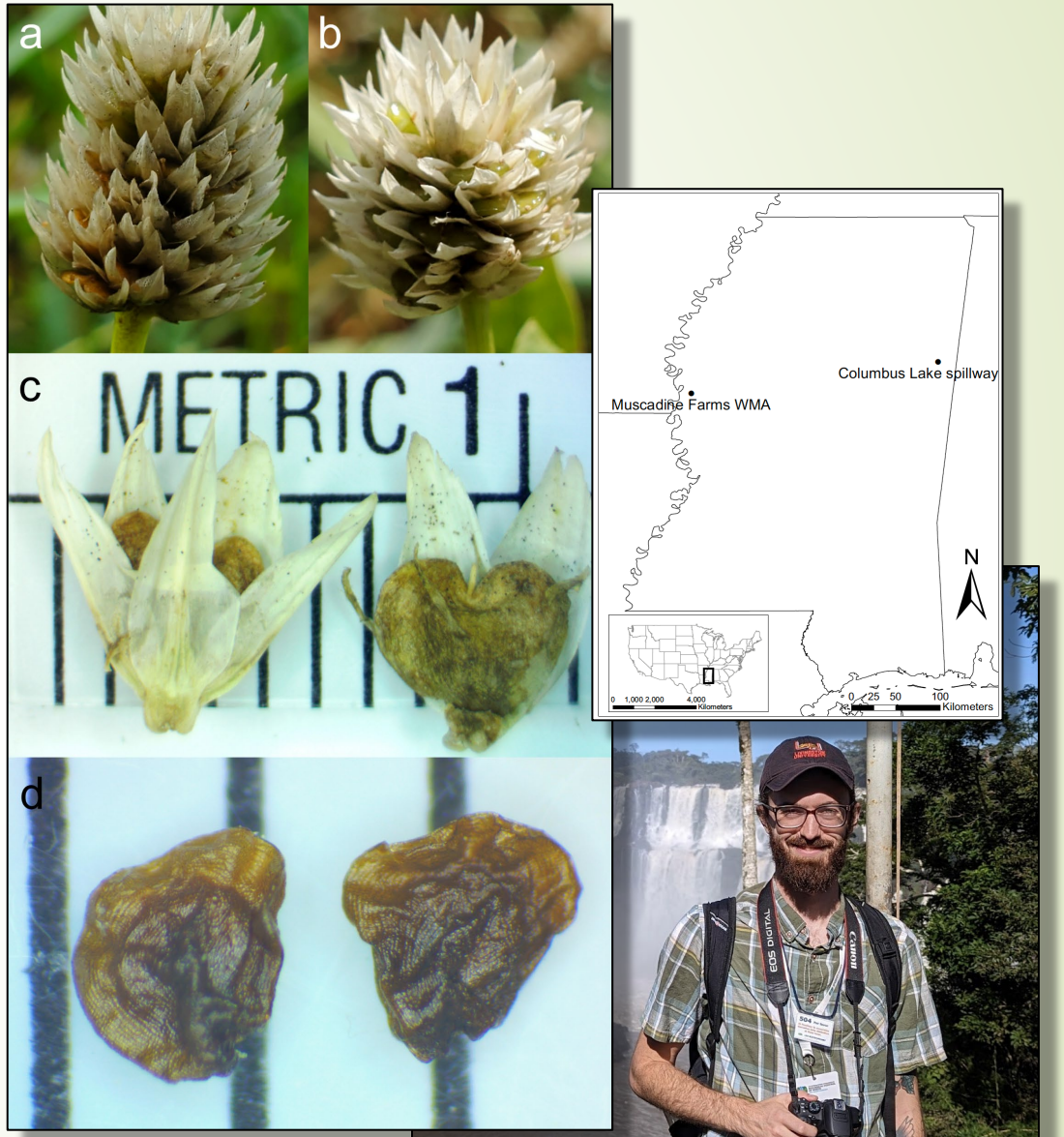
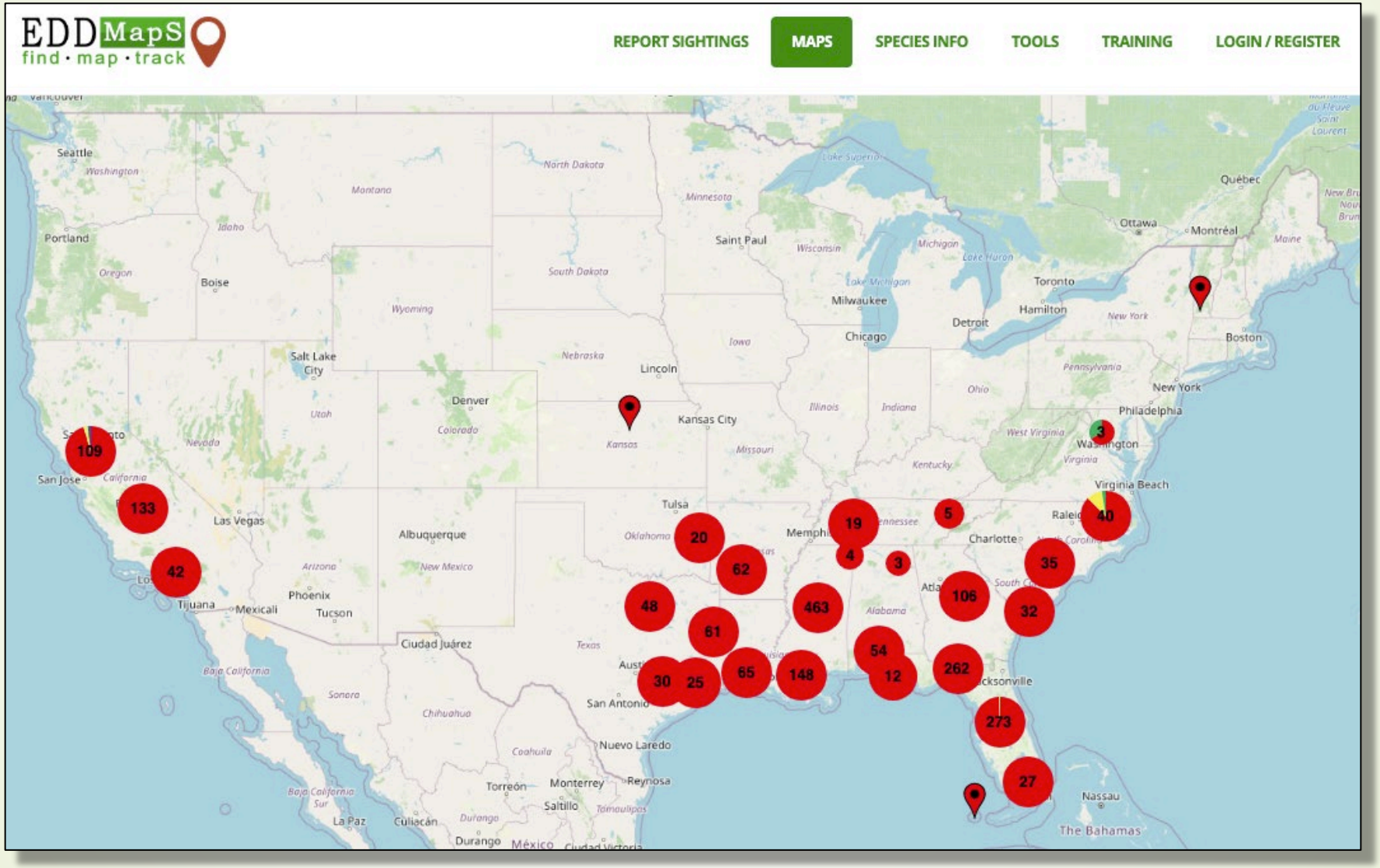


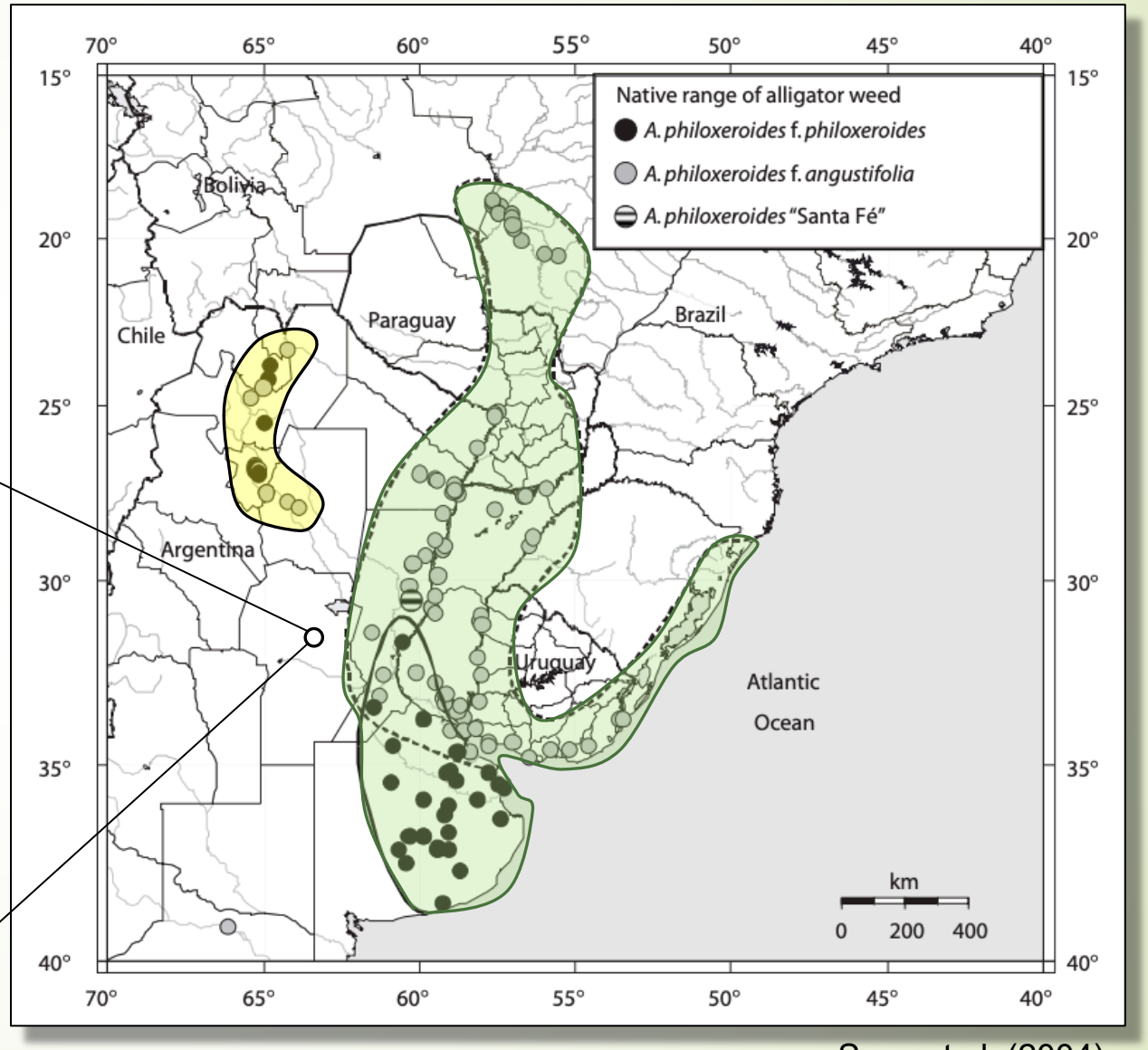
Schmid et al. (2024)

Alligator weed distribution in the US



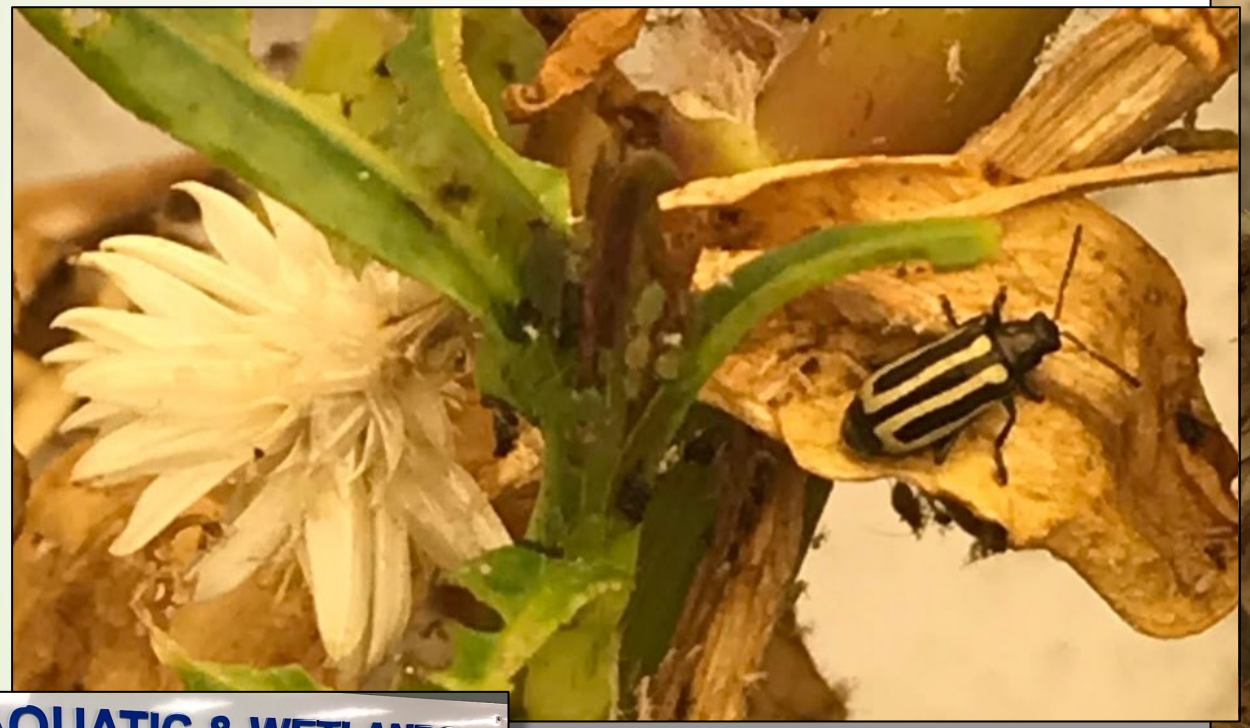
Alligator weed native range

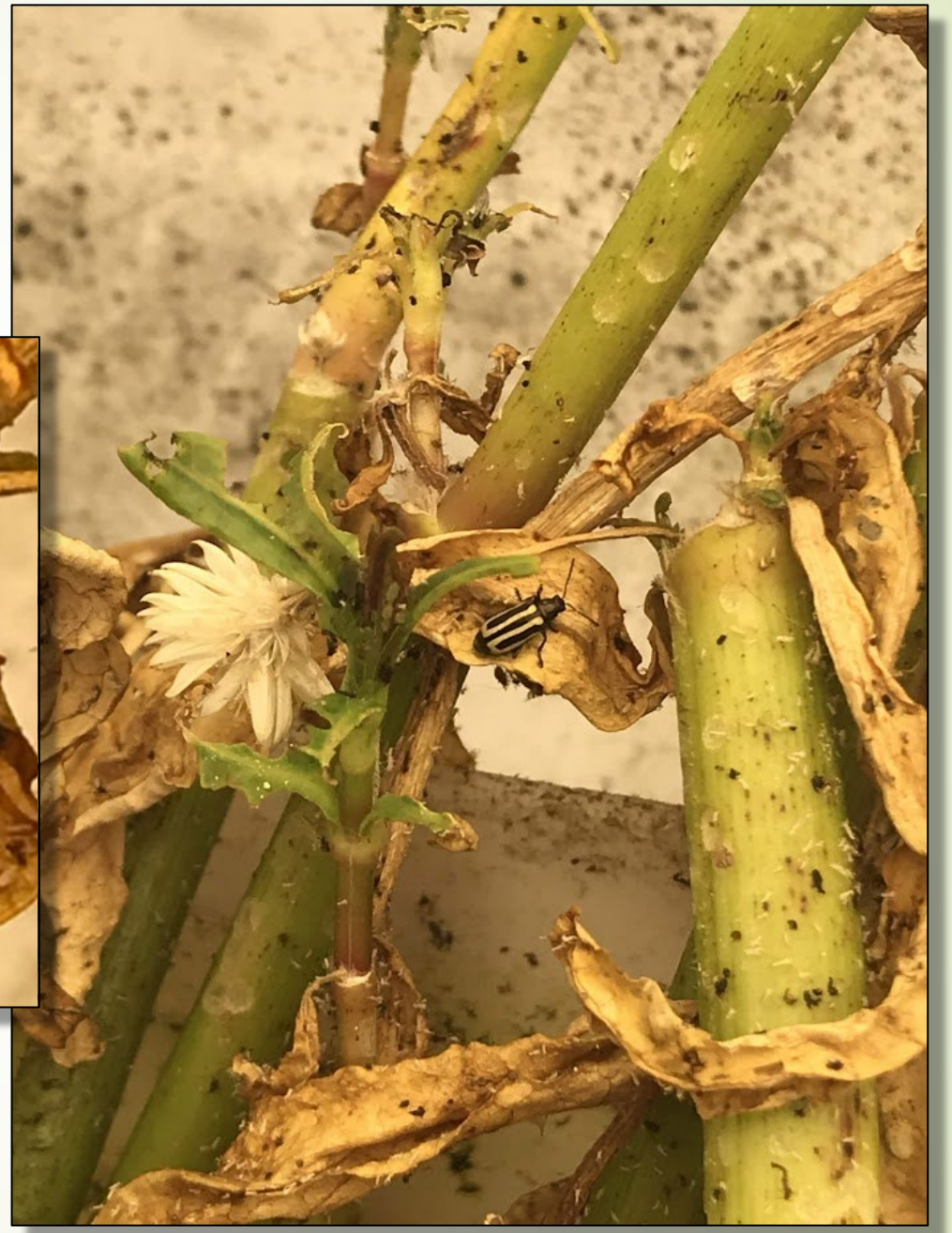
- Native to Paraná River Region
- Introduced into the United States in 1897



Sosa et al. (2004)

Agasicles hygrophila: Alligatorweed flea beetle





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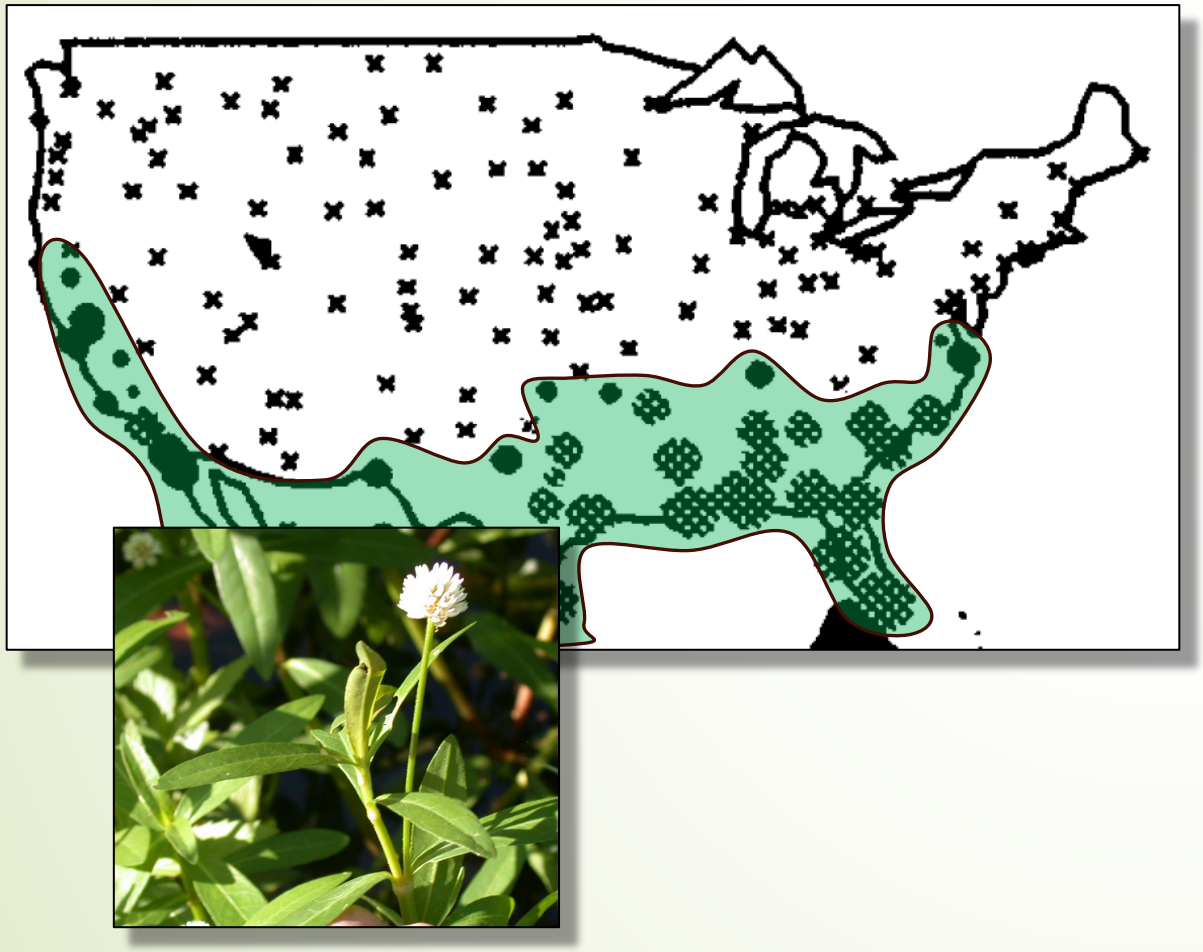
Thermal tolerance mismatch

Alligatorweed

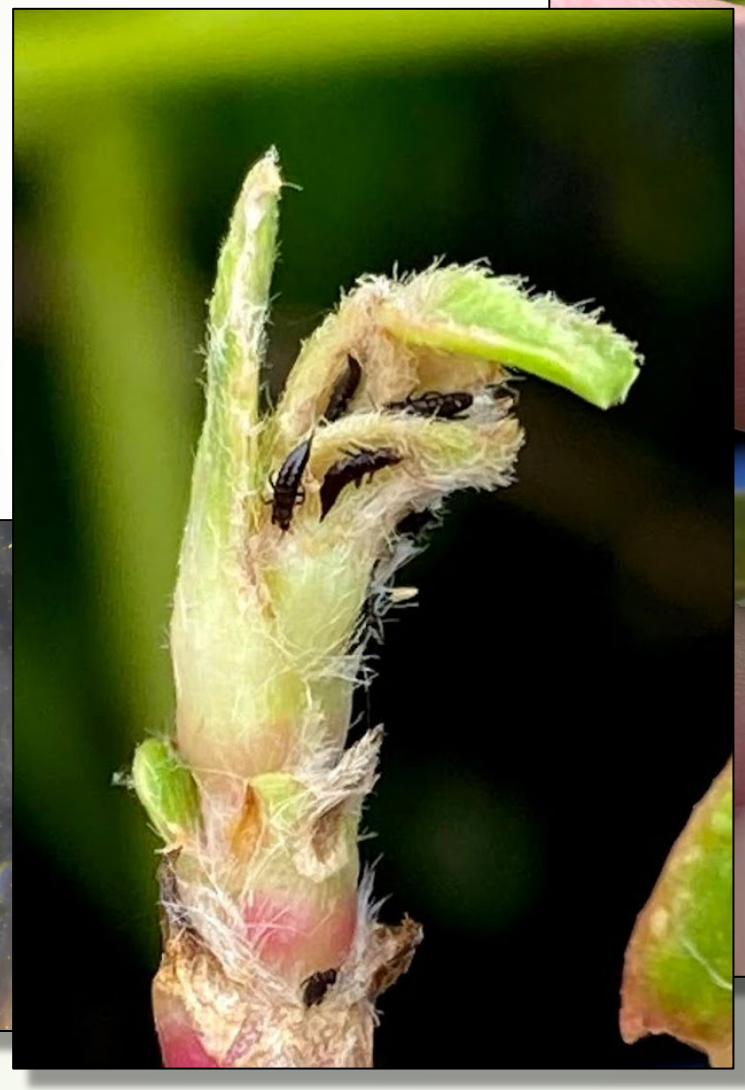


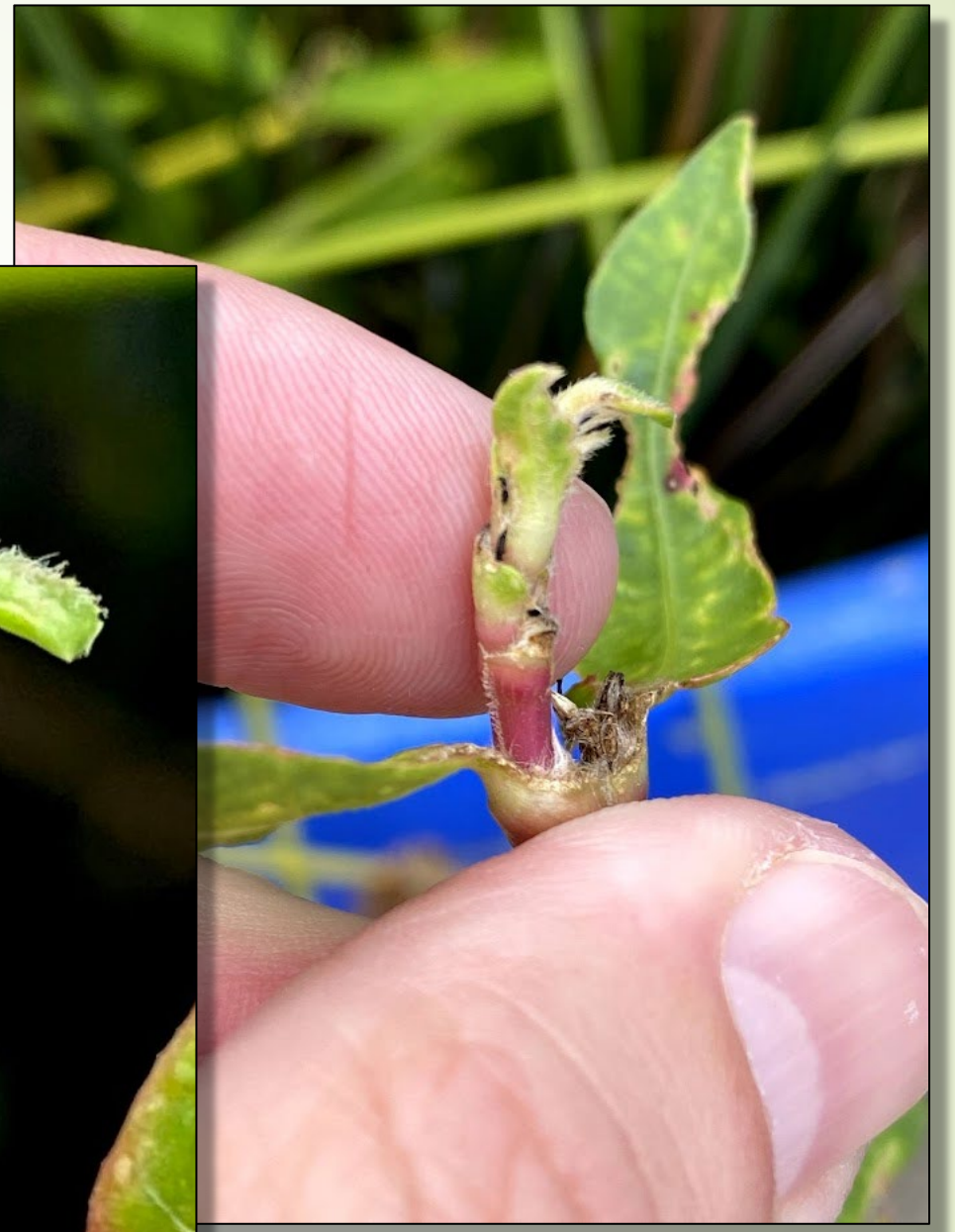
Flea beetle

Julien et al. (1995)

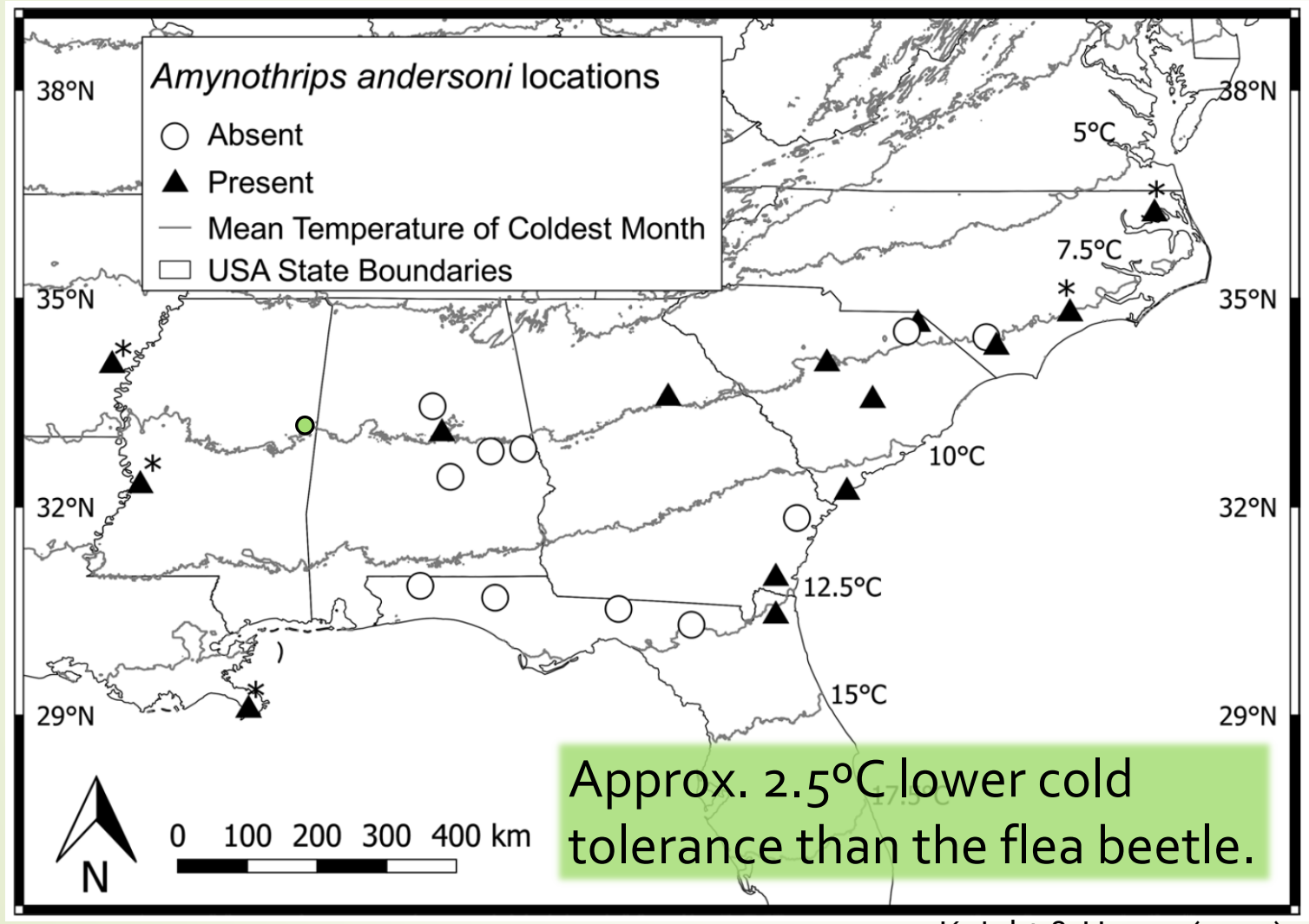
Amynothrips andersoni: Alligatorweed thrips

"The thrips, *Amynothrips andersoni* O'Neill was found at every site at every visit. This is the most ubiquitous insect on *A. philoxeroides* regardless of plant form." (Sosa et al. 2004)





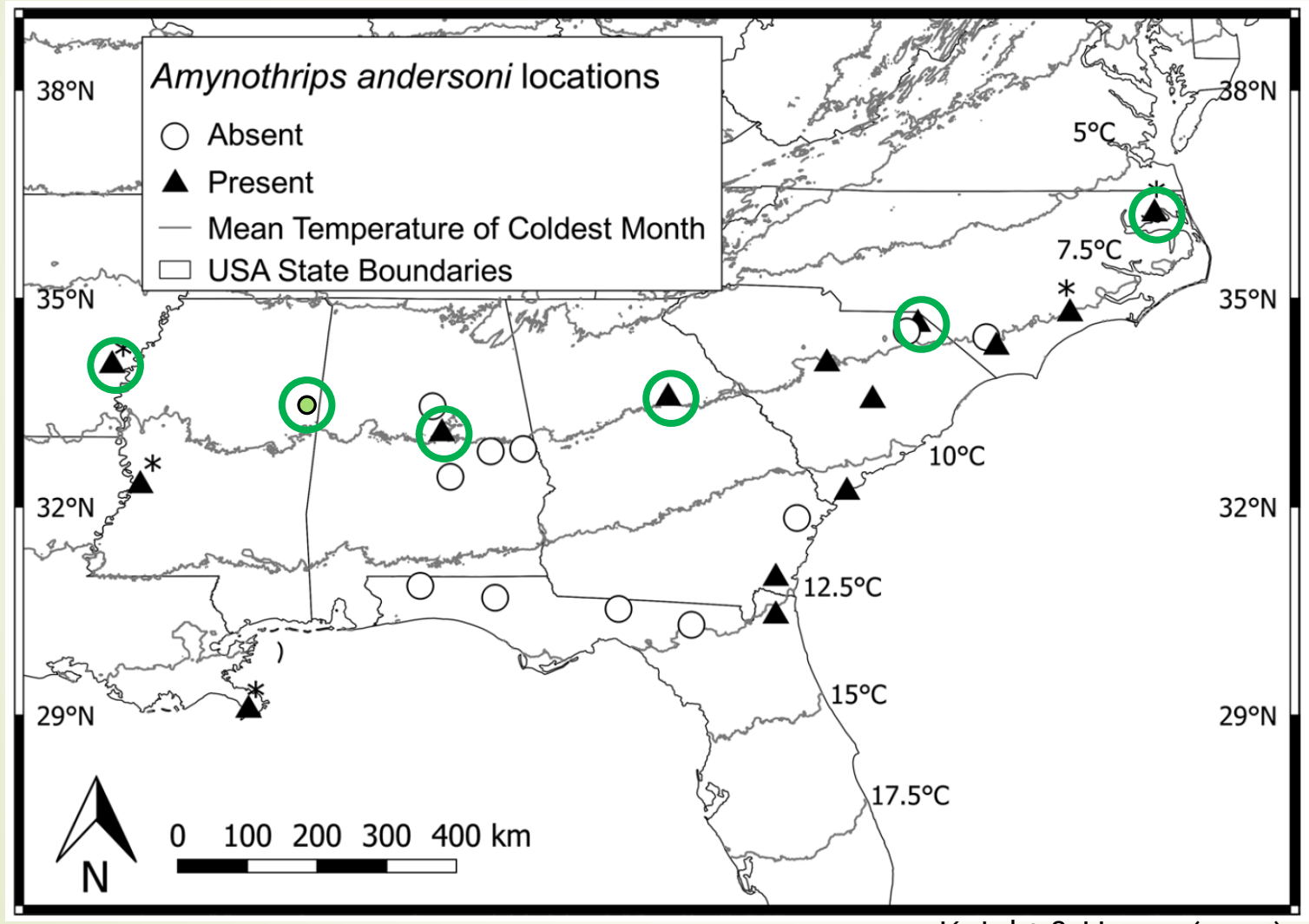
Amynothrips andersoni: Alligatorweed thrips



Approx. 2.5°C lower cold tolerance than the flea beetle.

Knight & Harms (2022)

Coexistence of alligatorweed and the thrips at colder latitudes



Knight & Harms (2022)

Integrated alligatorweed control

Step 1: chemical control

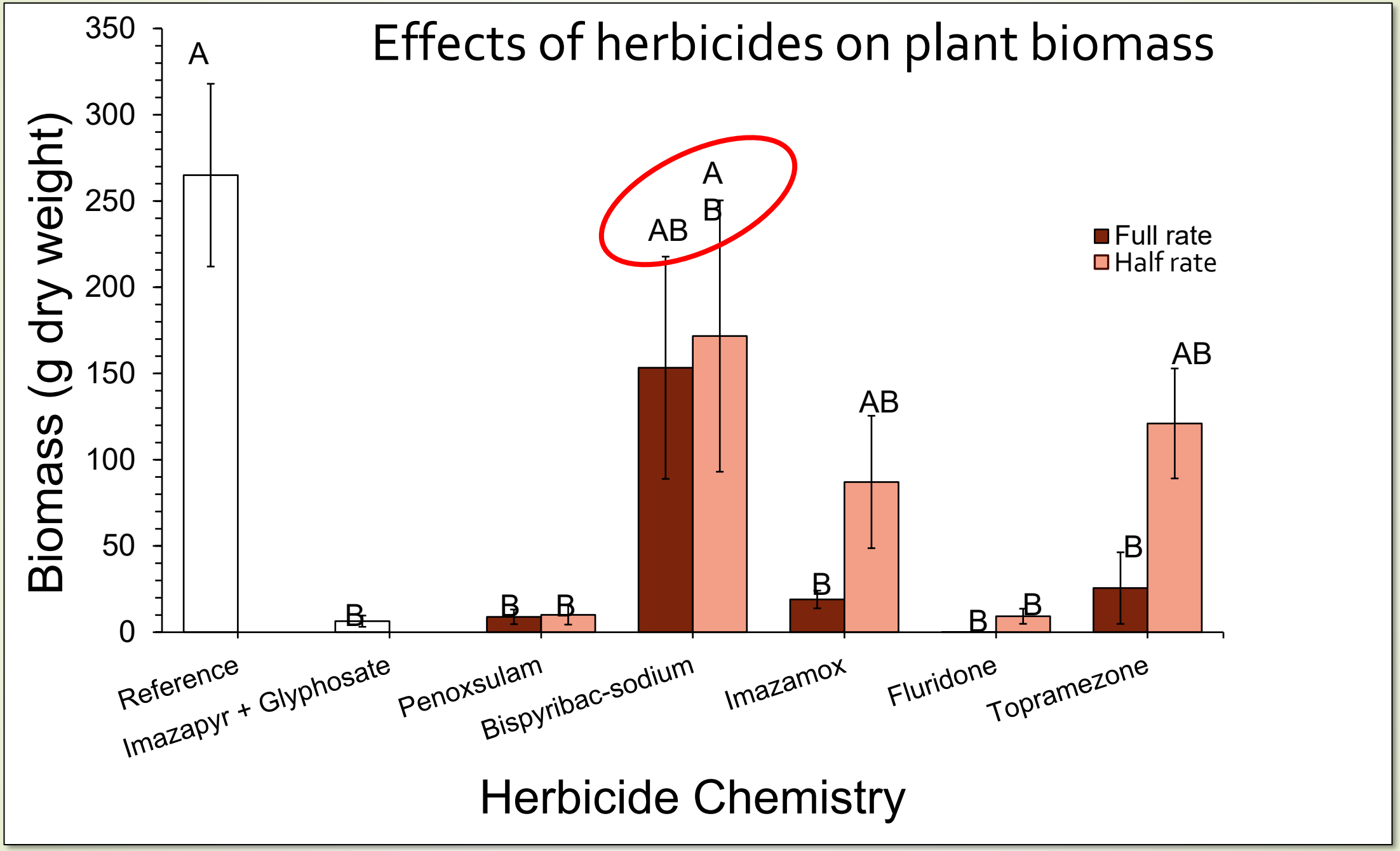
- Randomized mesocosm trials
- Testing 5 untested chemicals at max rate and half of max rate, via submersed application

Integrated alligatorweed control

	Herbicide trials		Herbicide-thrips trials	
Chemistry	Rate one	Rate two	excluded	inoculated
reference	-	-	a	b
imazapyr + glyphosate	0.56 + 4.5 kg ai/ha	-	b	b
penoxsulam	150 ppb	75 ppb	c	c
bispyribac-sodium	45 ppb	22.5 ppb	c	c
imazamox	500 ppb	250 ppb	c	c
fluridone	150 ppb	75 ppb	c	c
topramezone	50 ppb	25 ppb	c	c

Definitions: rate one = max label rate; rate two = half max label rate; reference = no herbicides applied; excluded = no thrips applied; inoculated = thrips applied; a = control; b = positive control; c = experimental treatment

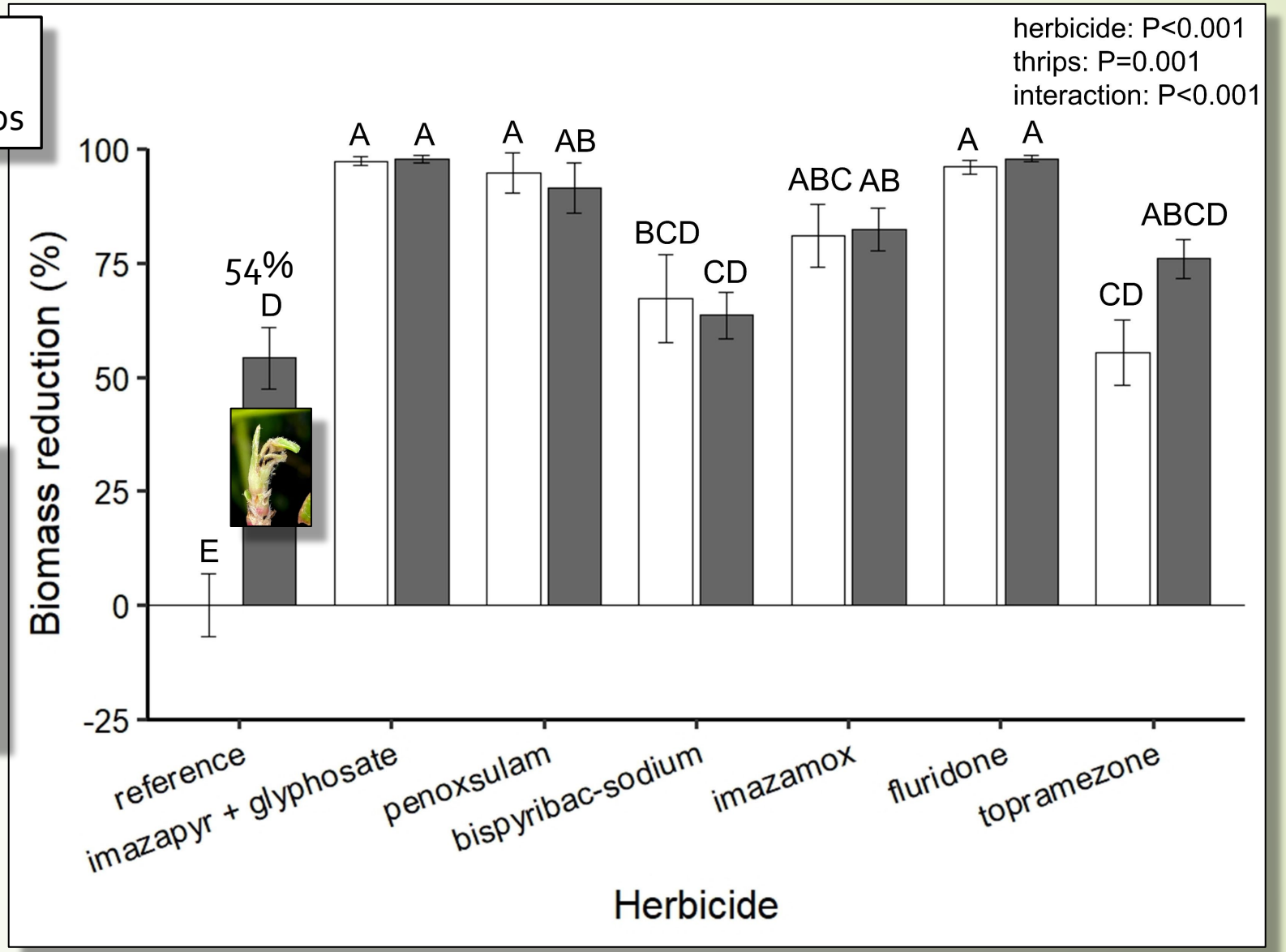
Imazapyr + glyphosate is a previously used combination, used here as a positive control and applied as a foliar spray.



Schmid et al. (2024)

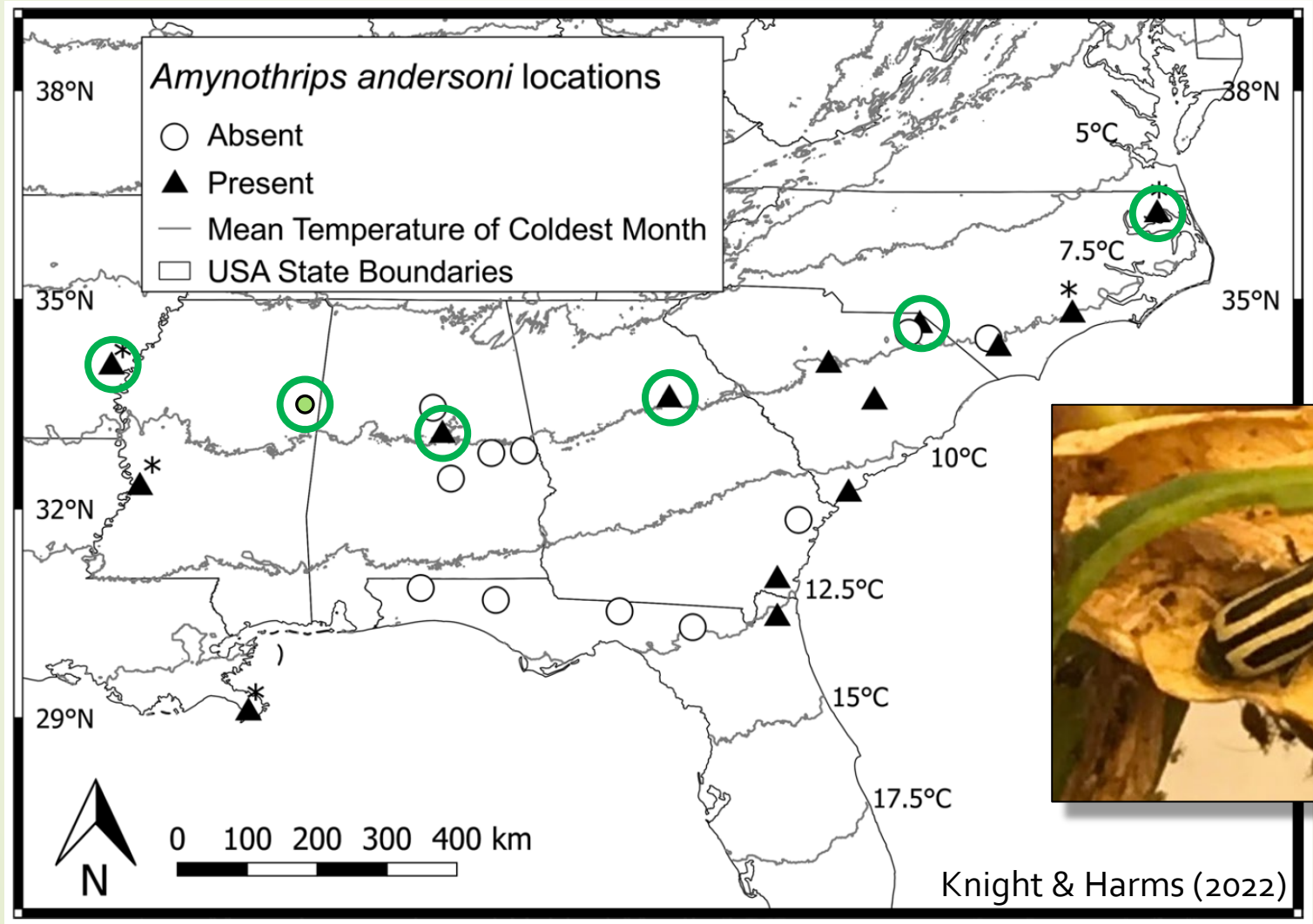
Integrated alligatorweed control

Bispyribac-sodium and imazapyr+glyphosate applied at max label rate; others applied at half max rate



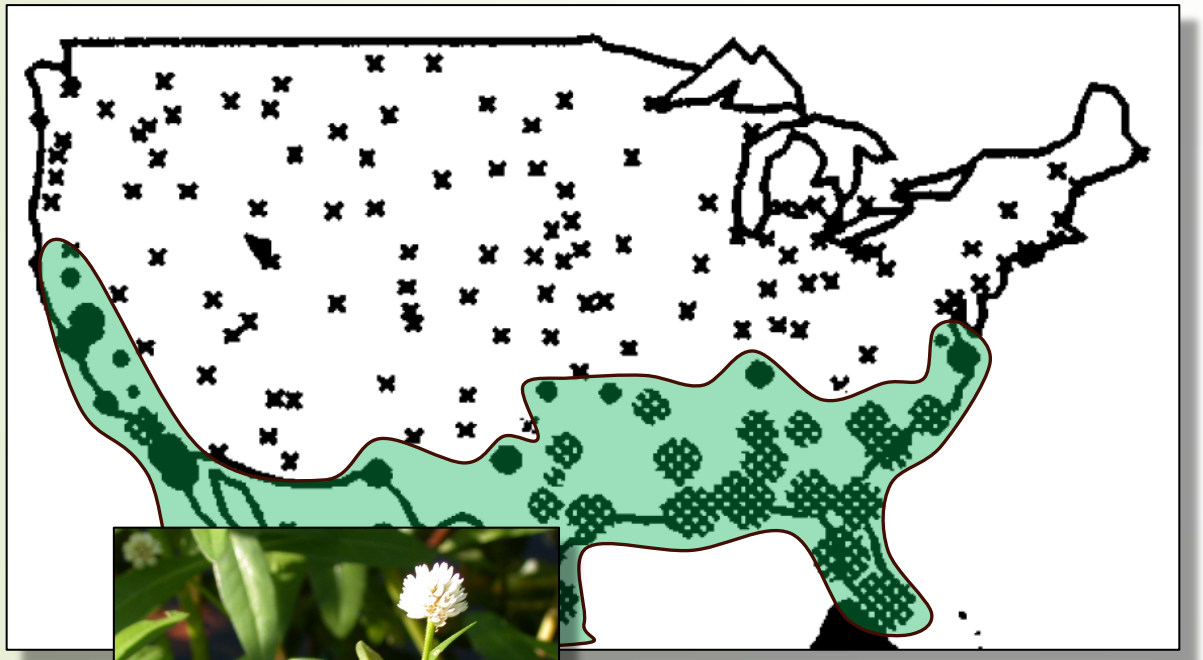
Schmid et al. (2024)

What happens under a warming climate?

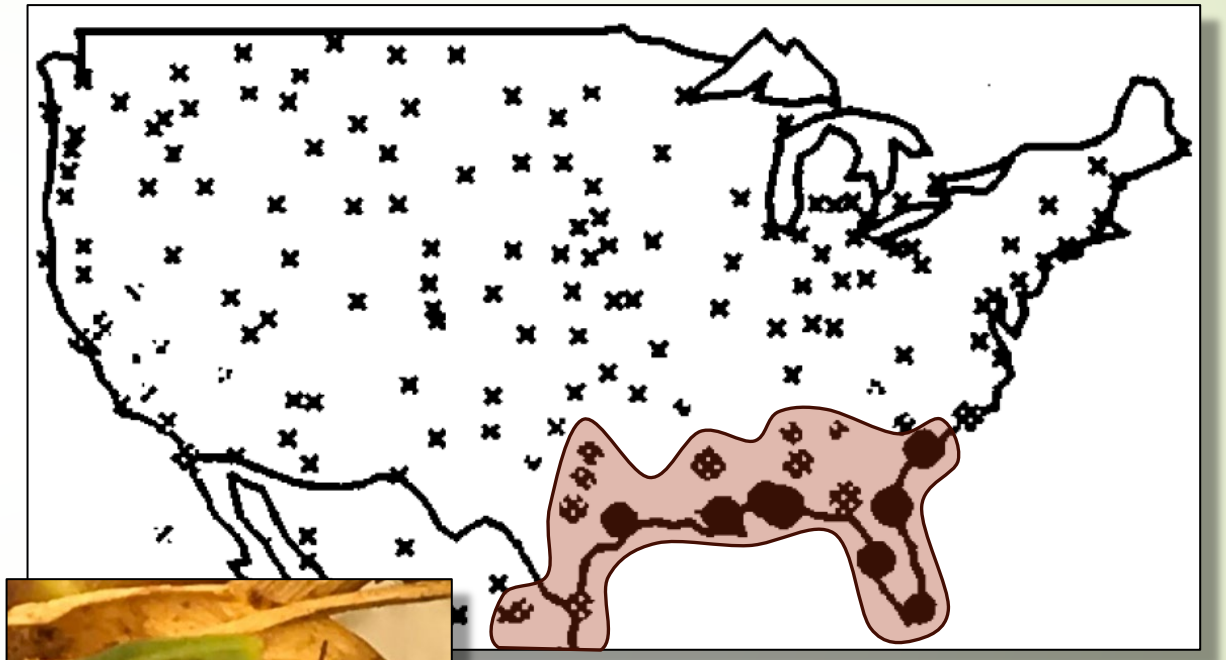


Ecological niche modeling

Alligatorweed



Flea beetle

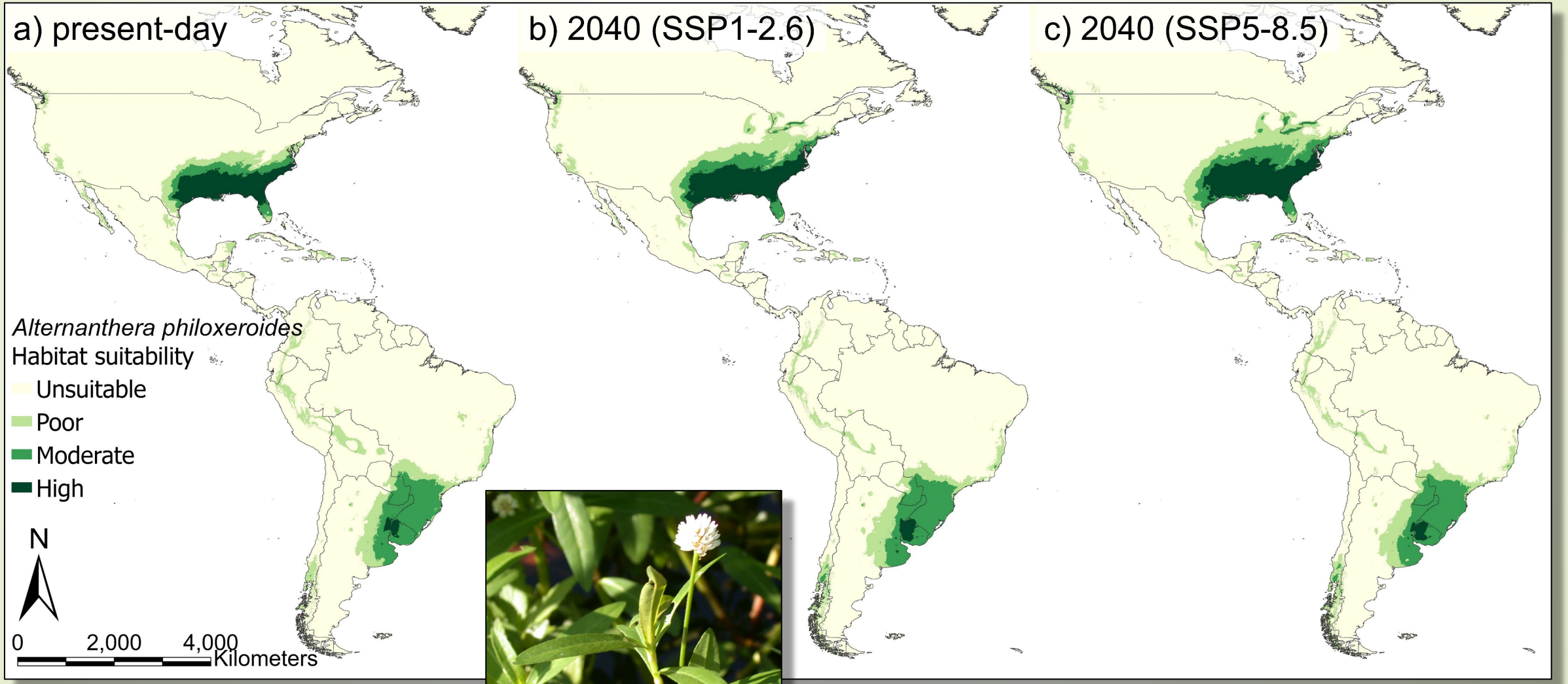


Julien et al. (1995)

Ecological niche modeling

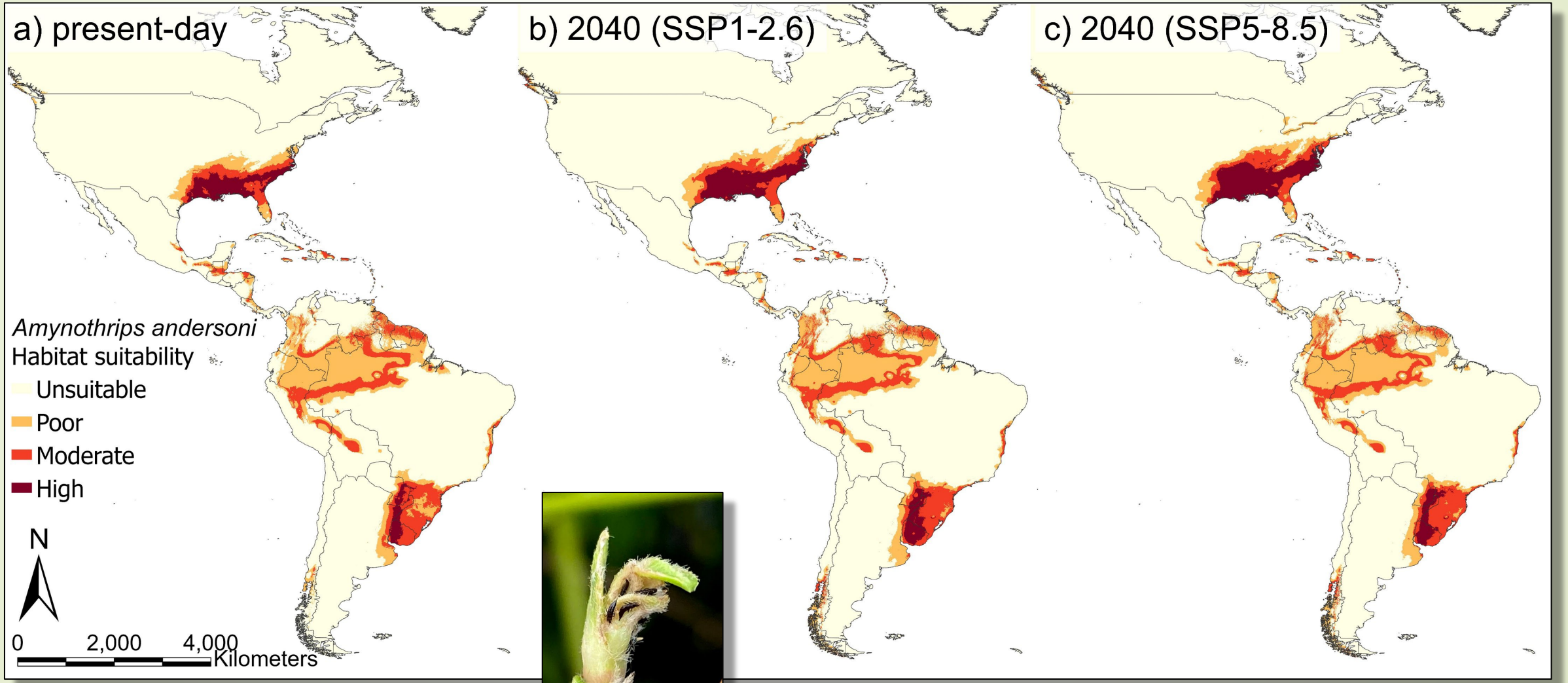
- Models for alligatorweed, thrips, and flea beetle
- Modeling method – **Maxent** using four bioclim temperature and precipitation variables
- Three climate scenarios
  - Present-day climate
  - 2040 SSP1-2.6 (best case)
  - 2040 SSP5-8.5 (worst case)

Ecological niche modeling - alligatorweed



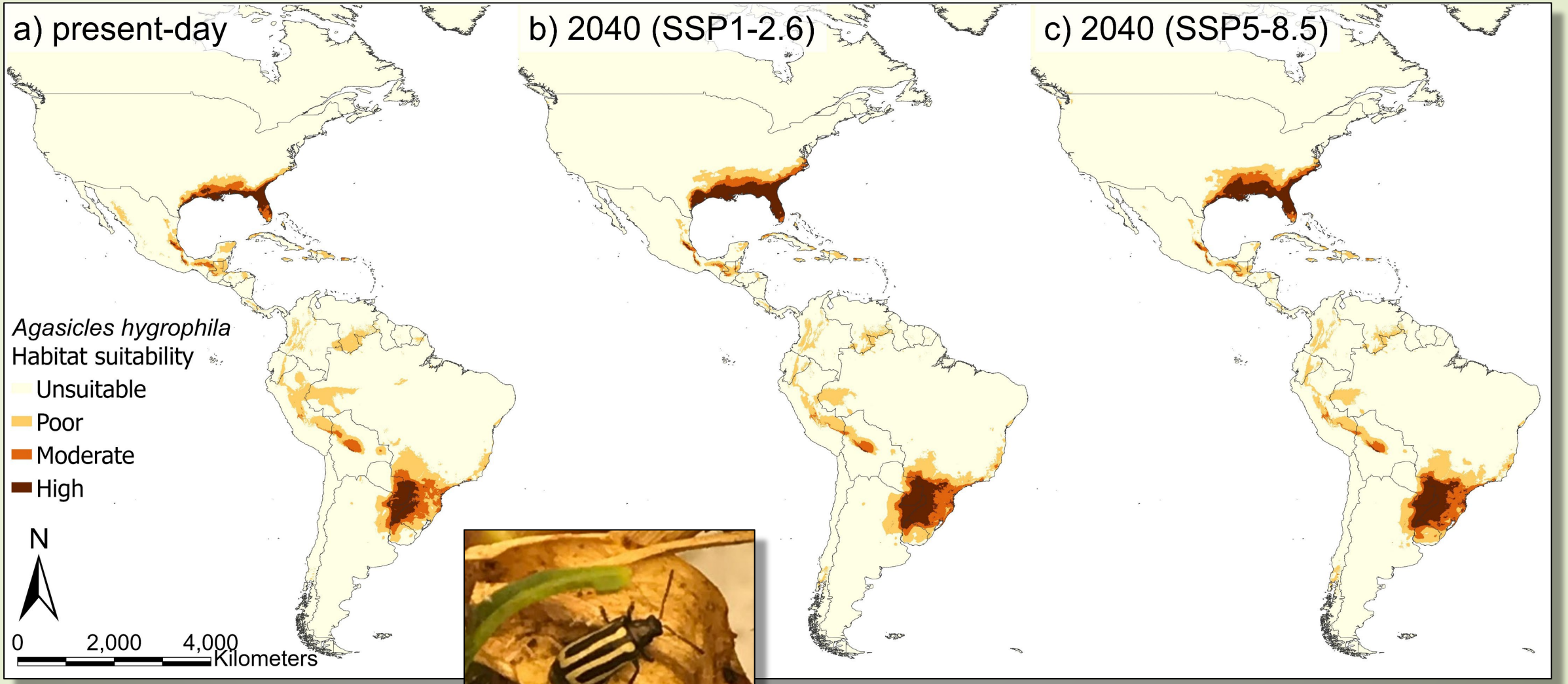
Schmid *et al.* – accepted, pending revisions

Ecological niche modeling - thrips



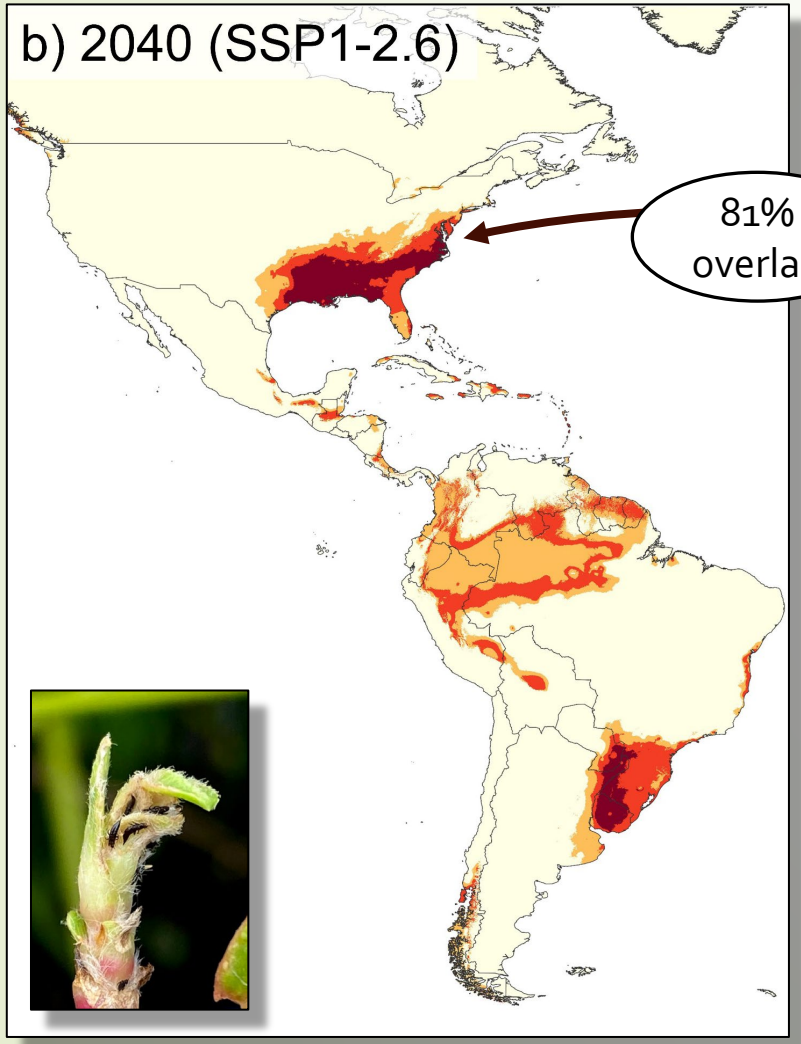
Schmid *et al.* – accepted, pending revisions

Ecological niche modeling – flea beetle

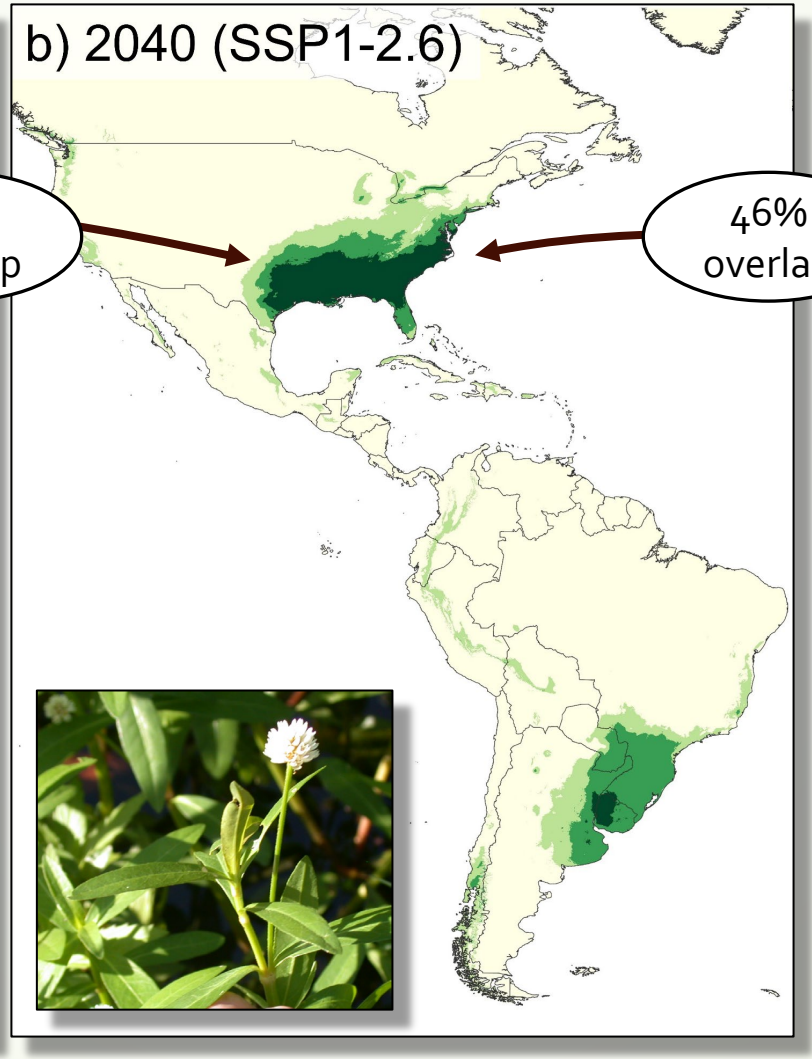


Schmid *et al.* – accepted, pending revisions

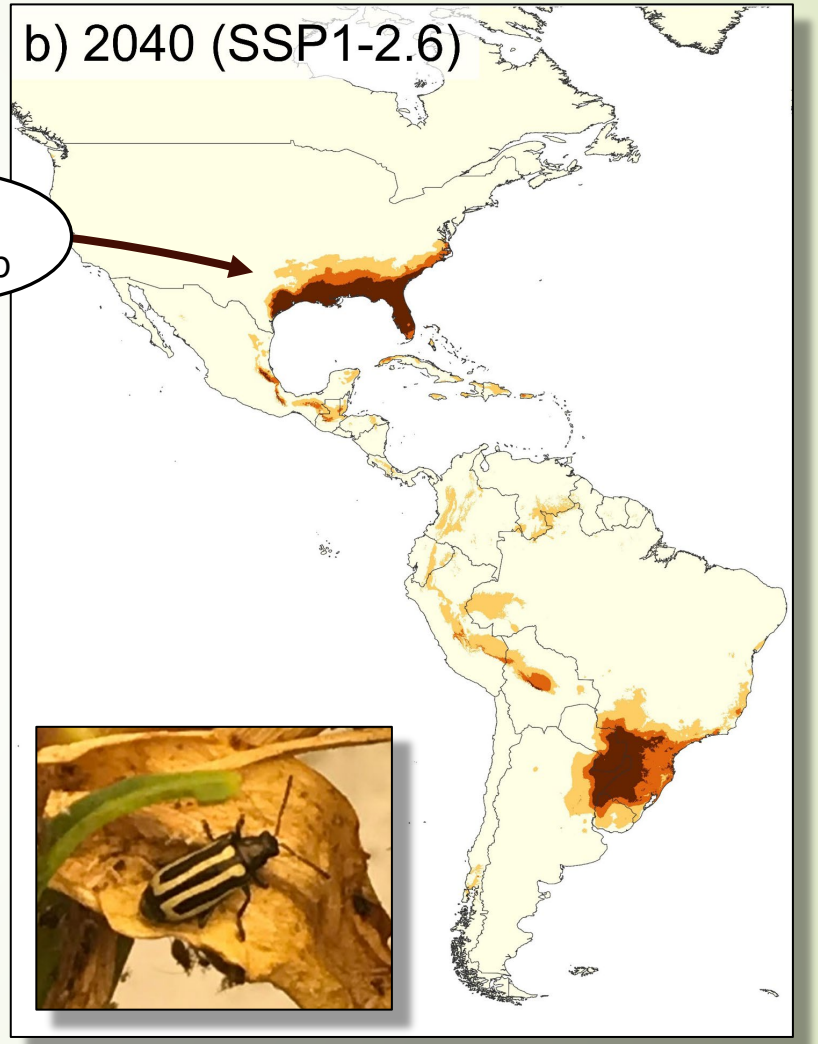
Comparisons



81% overlap



46% overlap



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In summary…

Niche models suggest increases in potential distribution for all three organisms but continued greater overlap for the thrips than for the flea beetle.

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We identified some effective submersed-application herbicide chemistries.

We found indications that the thrips in combination with submersed herbicide application may be an integrated strategy with potential to enhance control of alligatorweed.

Thank you!

Gratitude to:

- Alejandro Sosa and Andrés Sánchez-Restrepo, collaborators from the Fundación para el Estudio de Especies Invasivas, Argentina
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email: gary.ervin@msstate.edu
web: garyervin.com

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