Relationships between fire, plant invasions, and tick-borne disease

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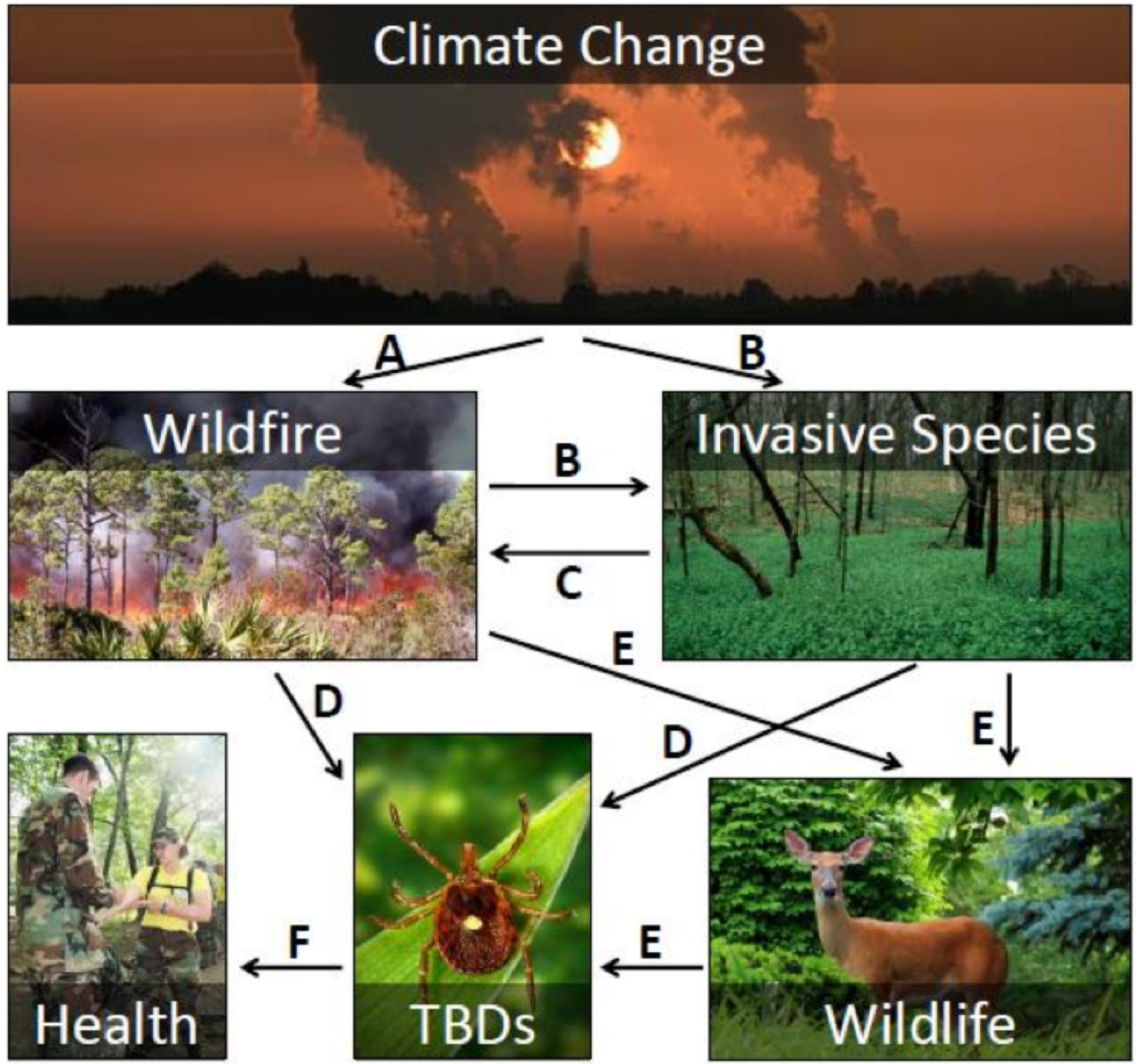
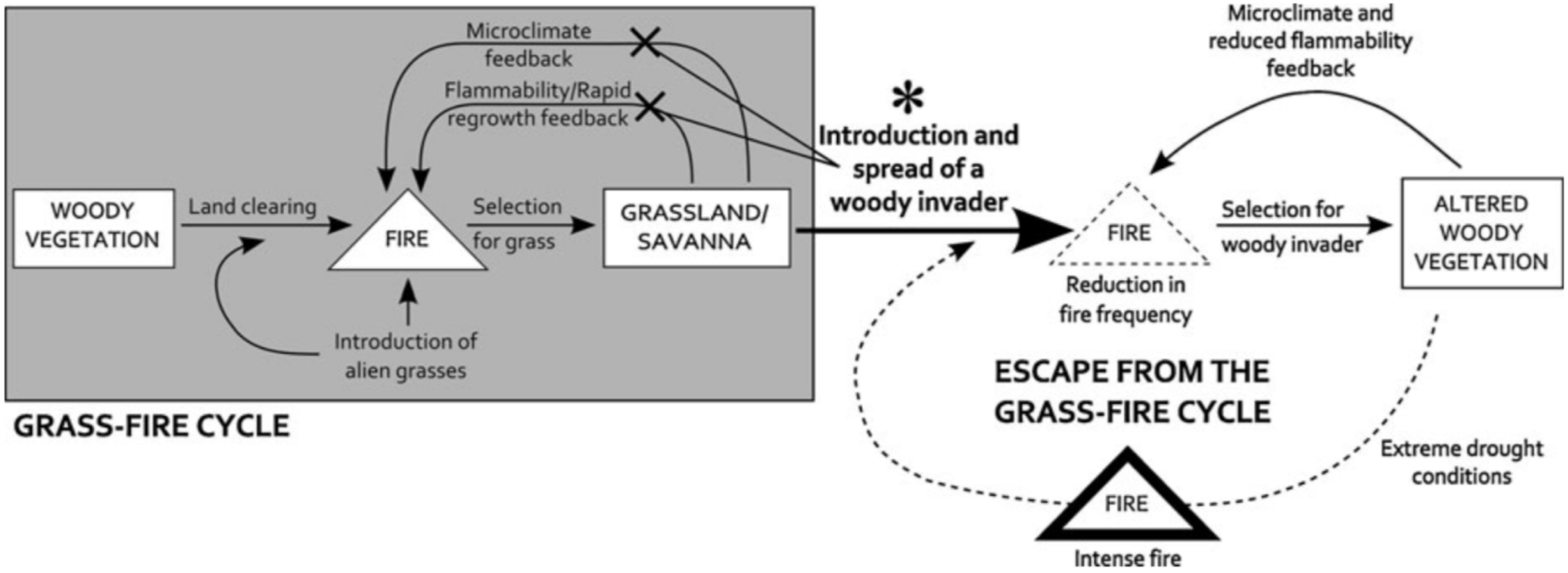

Climate Change
A
B
Wildfire
B
Invasive Species
C
E
D
E
D
Health
F
TBDs
E
Wildlife

Plant invasions and the fire cycle



Mandle et al., *Biological Invasions*, 2011

Some invasive plant species in eastern forests

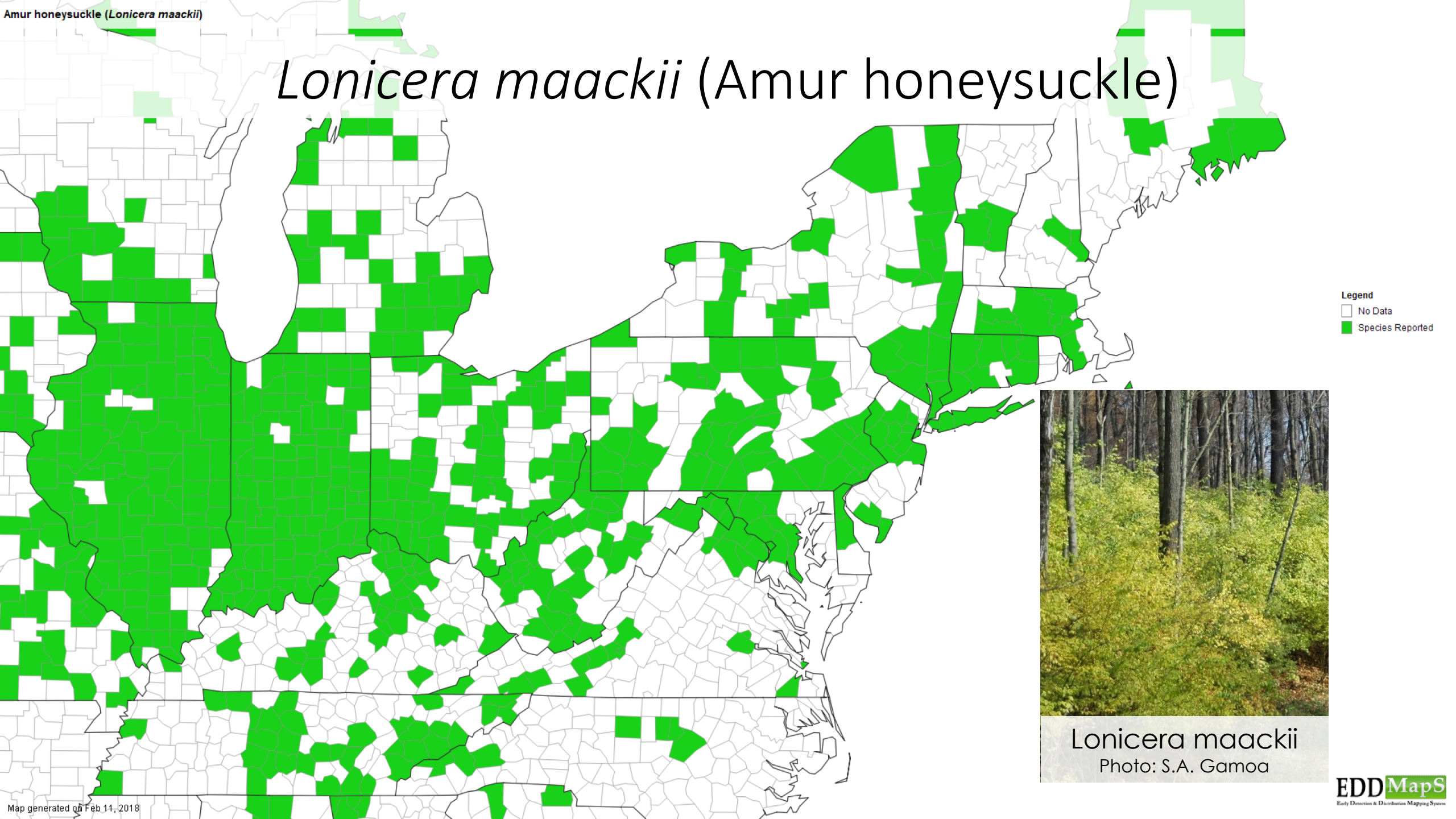
Lonicera maackii
Photo: Solomon Abby Gamoa

Ailanthus altissima
Photo: John Delano

Microstegium
Photo: S. Luke Flory

Cogongrass
Photo: Drew Hiatt

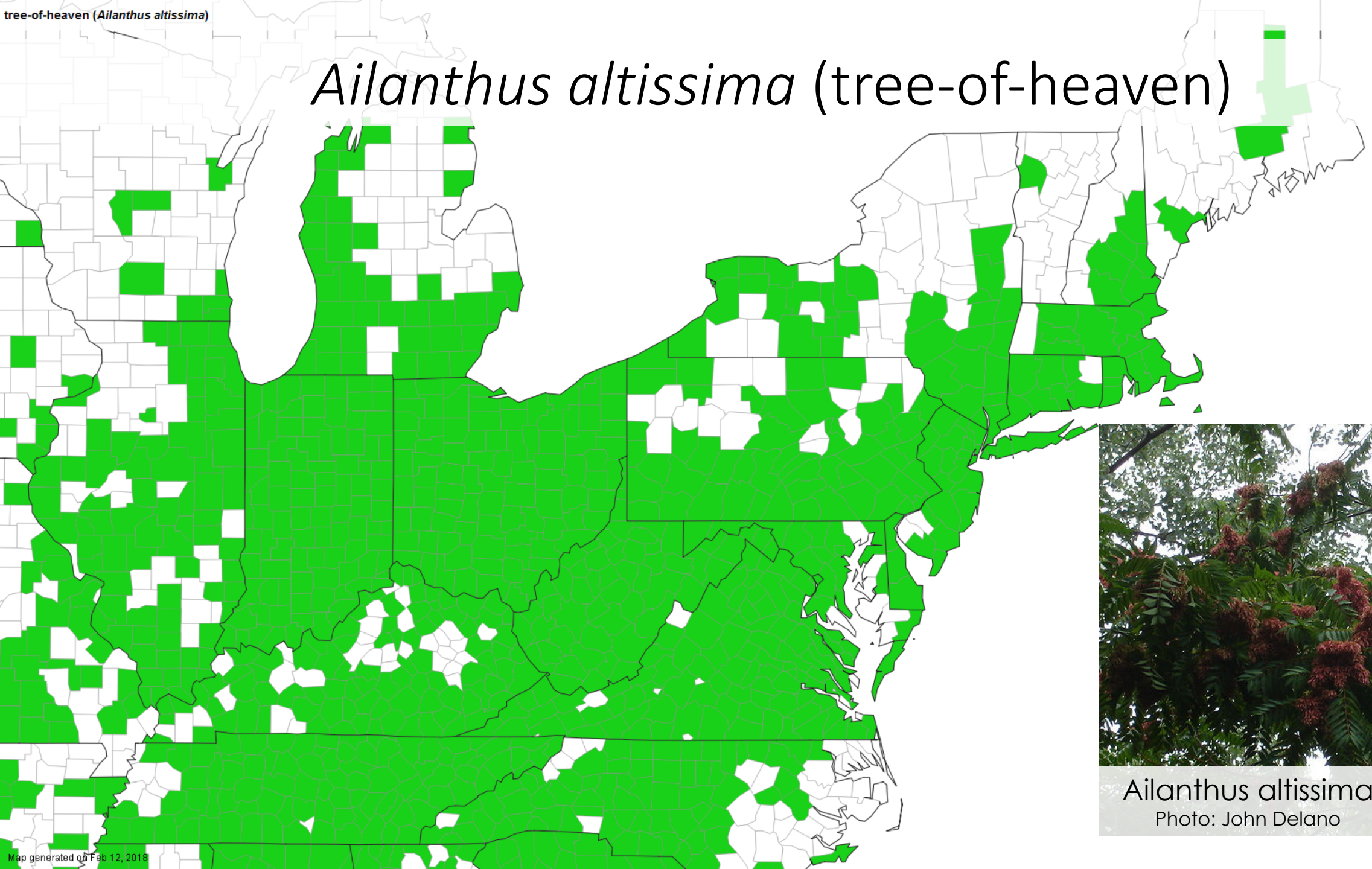
Lonicera maackii (Amur honeysuckle)



Lonicera maackii
Photo: S.A. Gamoa

EDDMapS
Early Detection & Distribution Mapping System

Ailanthus altissima (tree-of-heaven)



Ailanthus altissima
Photo: John Delano

EDDMapS
Early Detection & Distribution Mapping System

Imperata cylindrical (cogongrass)

Cogongrass
Photo: Drew Hiatt

Map generated on Feb 12, 2018

EDDMapS
Early Detection & Distribution Mapping System

Japanese stiltgrass (*Microstegium vimineum*)

Microstegium vimineum (stiltgrass)

Legend
No Data
Species Reported

Microstegium
Photo: S. Luke Flory

Map generated on Feb 11, 2018

EDDMapS
Early Detection & Distribution Mapping System

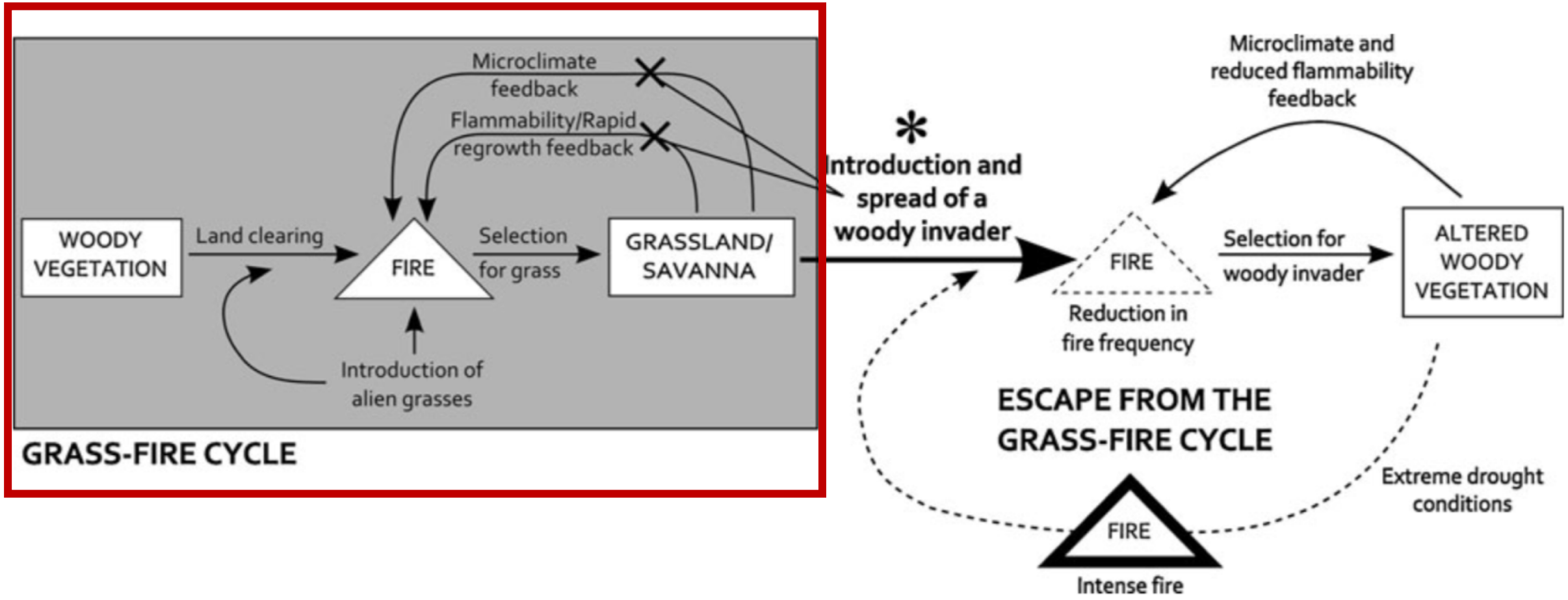
M. vimineum invasions

Disturbed and undisturbed forests

Full sun to <5% ambient light

Photo: S. Luke Flory

Grass invaders and fire



Mandle et al., *Biological Invasions*, 2011

Hypothesized *Microstegium* – Fire Cycle

1. *Microstegium* Invades

2. Dense, continuous litter layer

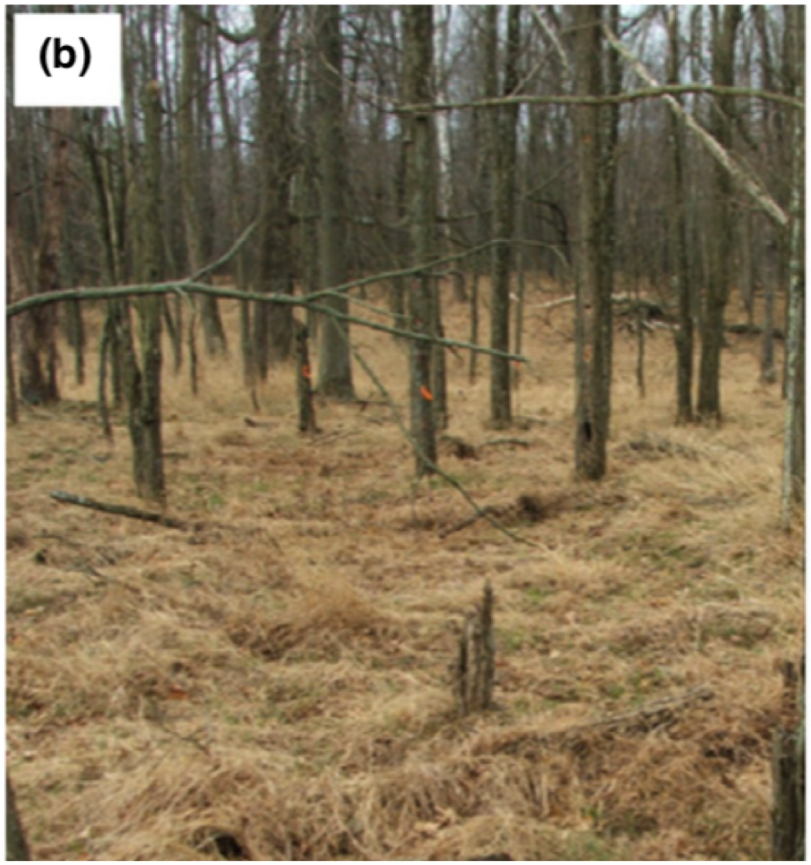
3. Increased fire severity and extent

4. Damage to native community

Photo: S. Luke Flory

Native vs. invader fuel

Native-fueled fire



M. vimineum fuel bed

M. vimineum fire

Flory et al., *Journal of Applied Ecology*, 2015

Plant invasion **intensifies** prescribed fires

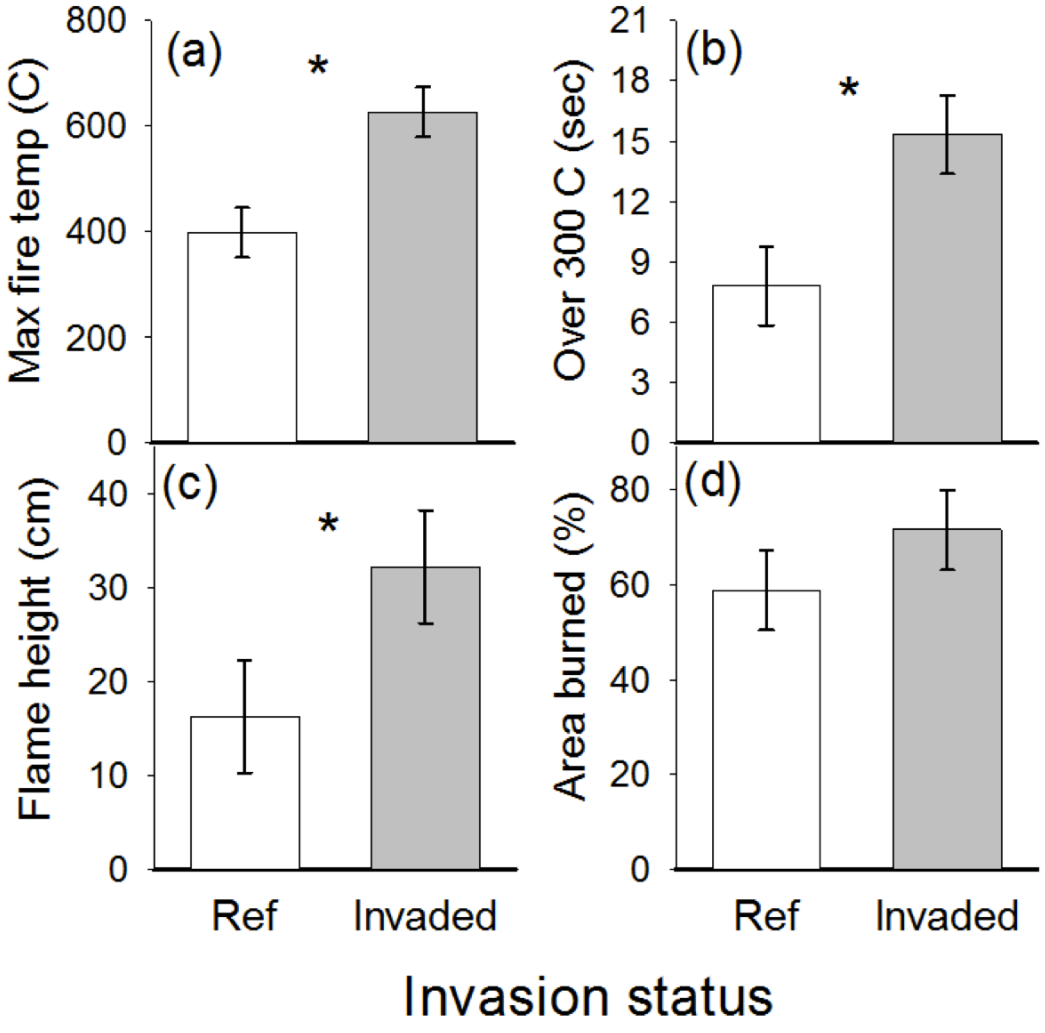


Photo: S. Luke Flory

Flory et al., *Journal of Applied Ecology*, 2015

Fire-invasion interaction **reduces** tree survival

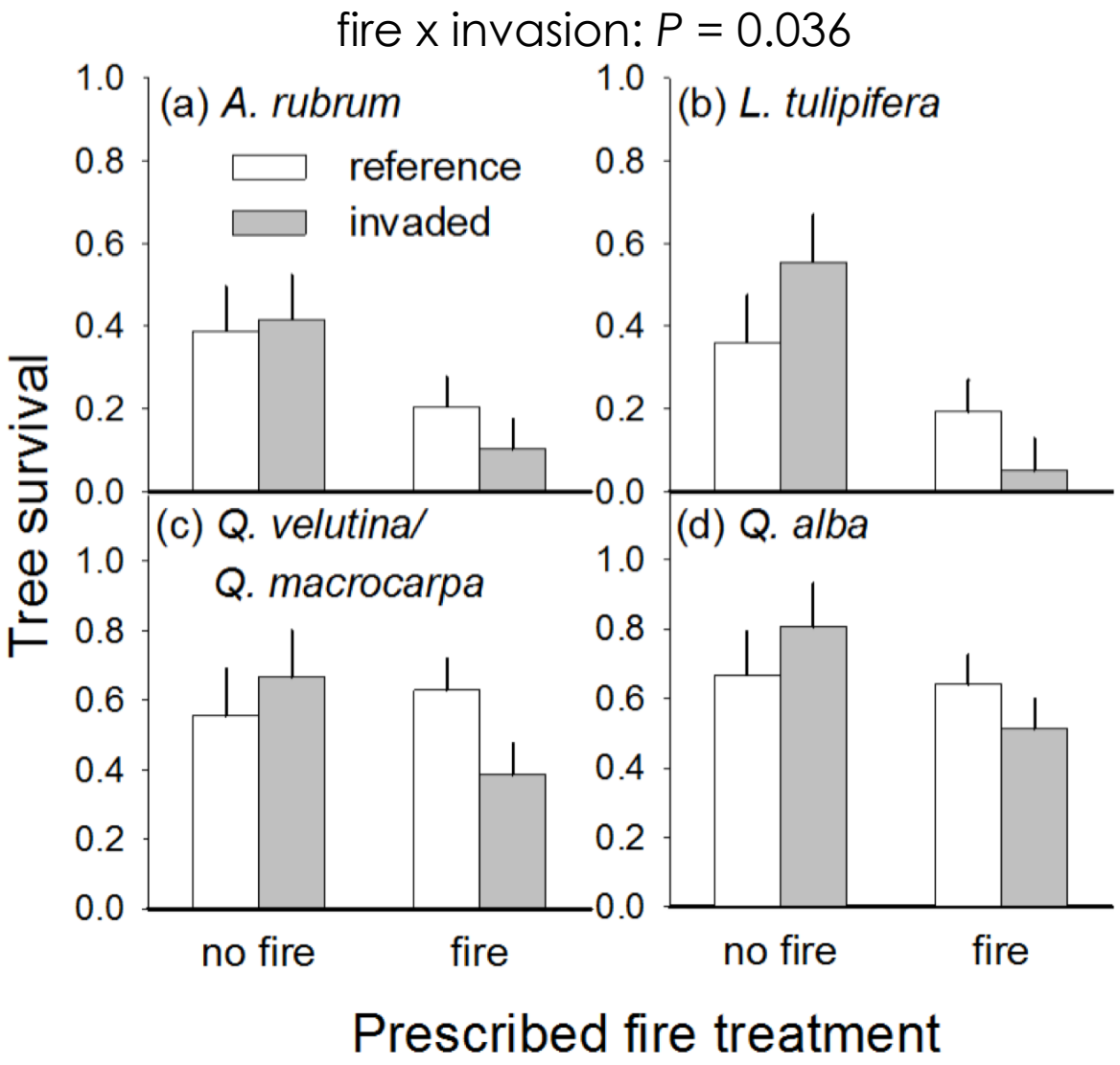
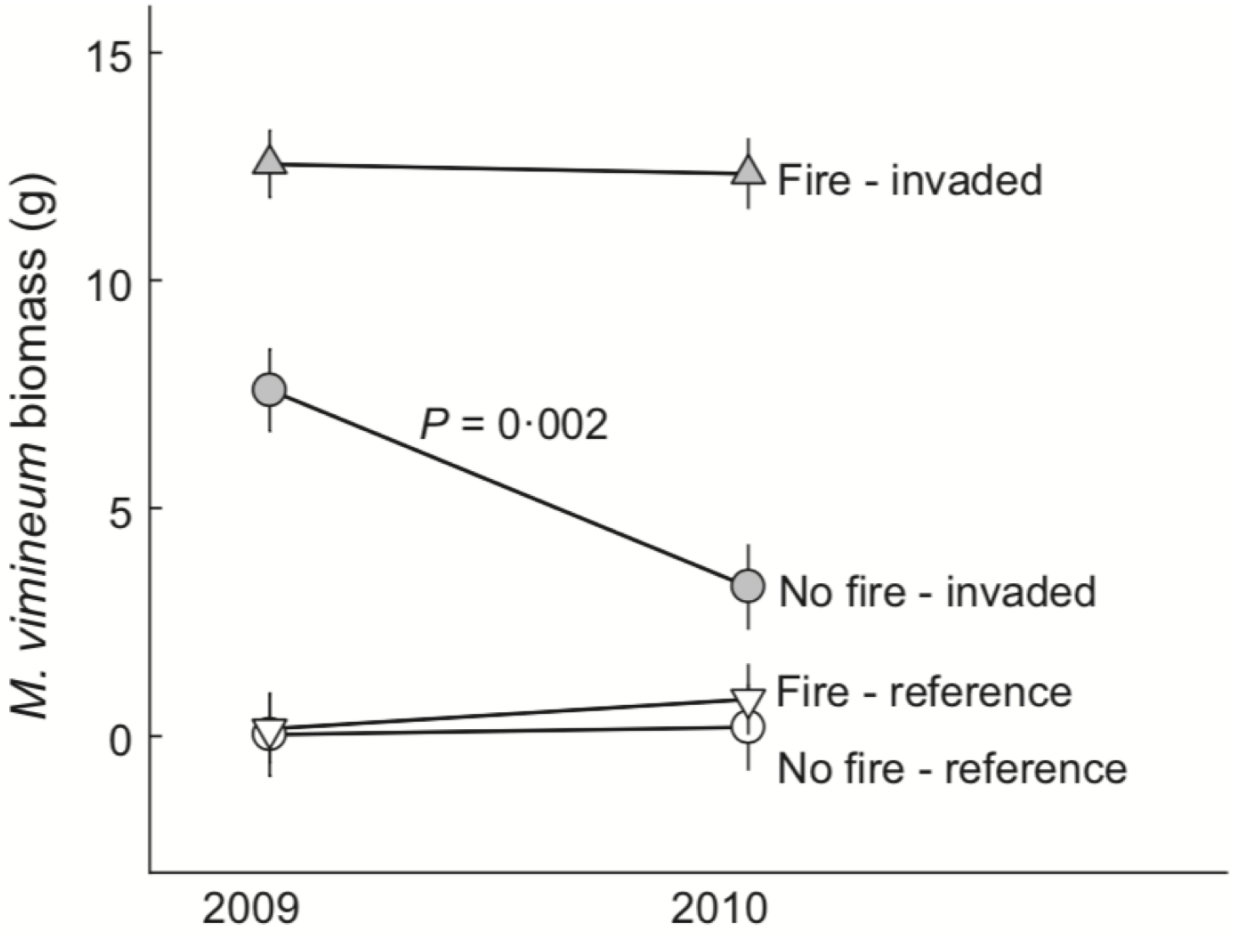


Photo: S. Luke Flory

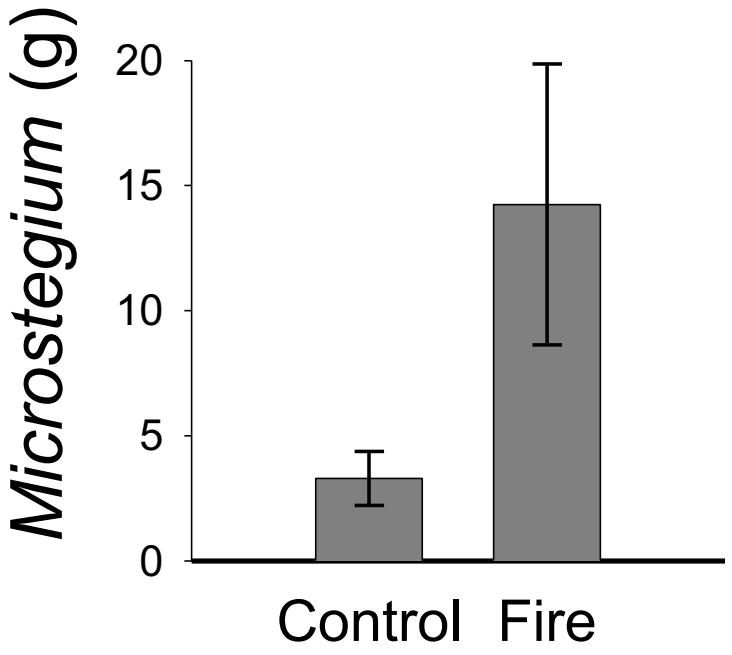
Flory et al., *Journal of Applied Ecology*, 2015

Fire **promotes** *Microstegium*



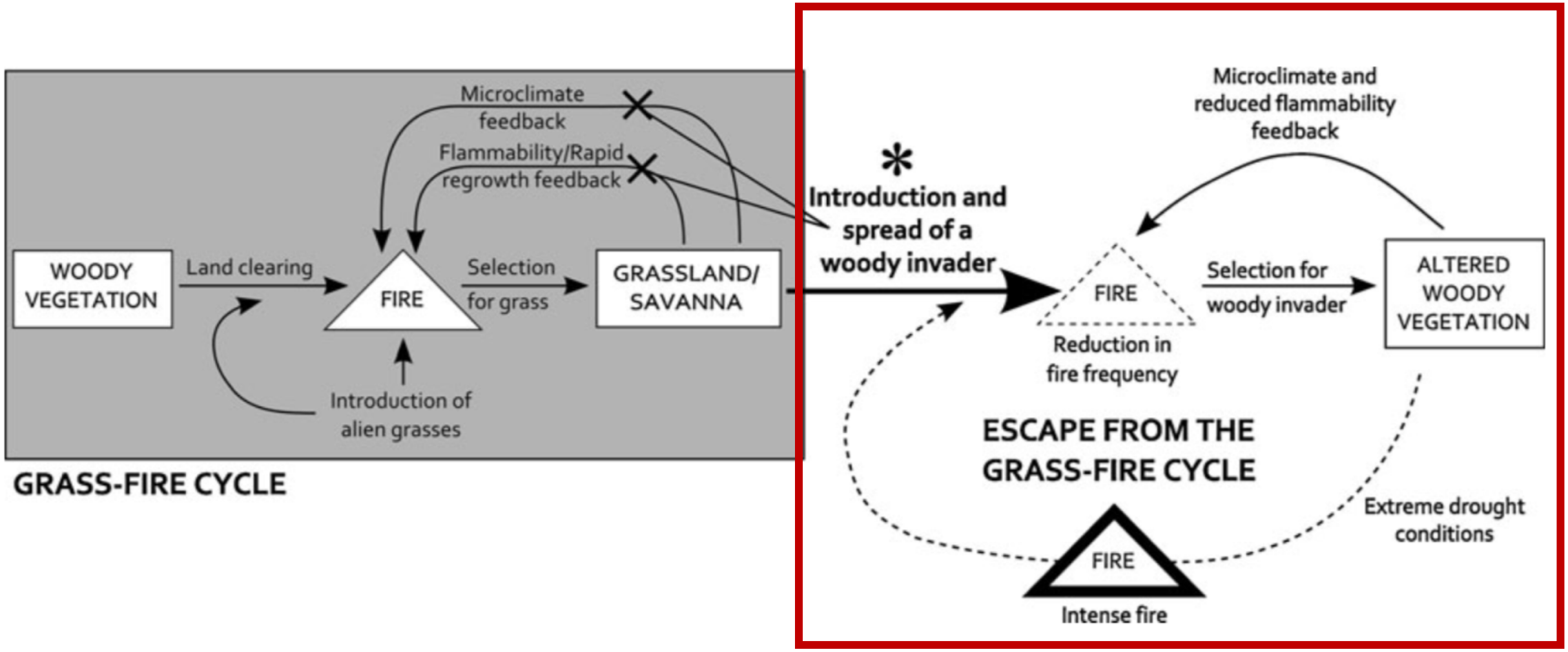
Flory et al., *Journal of Applied Ecology*, 2015

Fire **increases** *Microstegium* productivity



>300% increase in biomass
the year after the prescribed fire

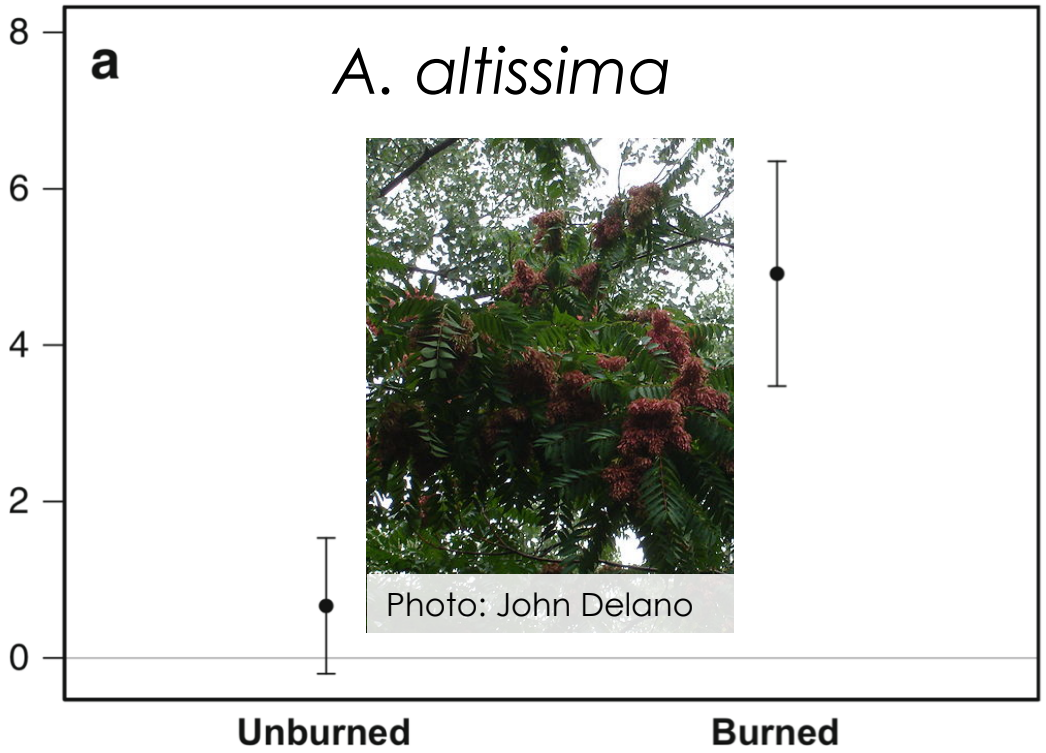
Woody invaders and fire

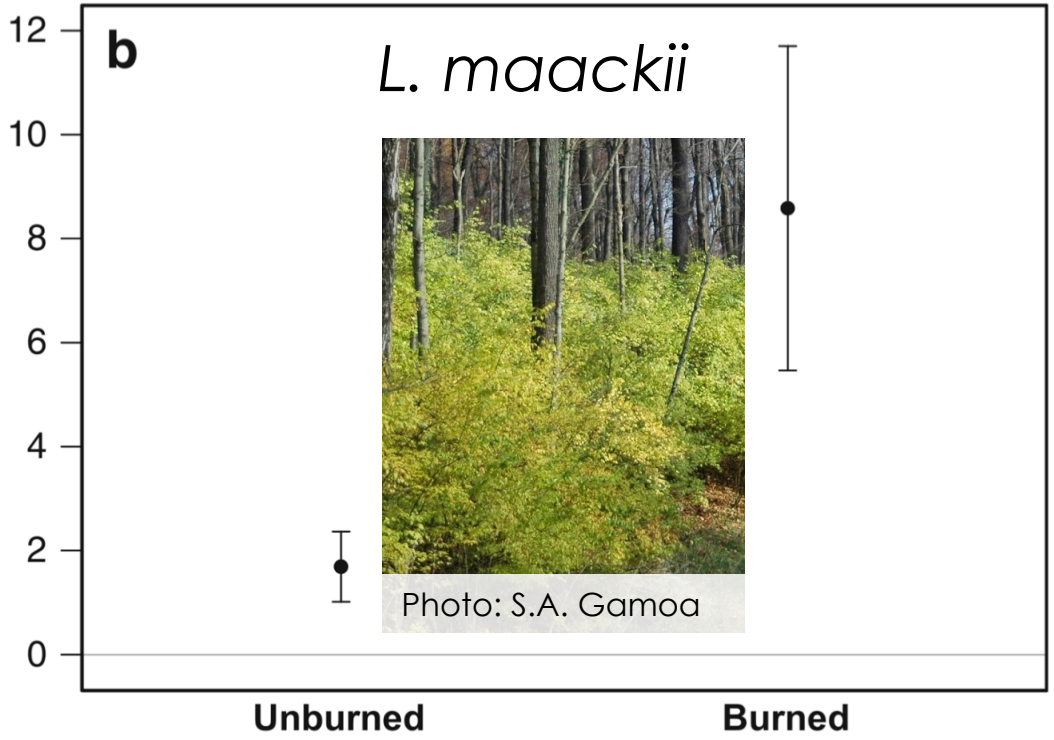


Mandle et al., *Biological Invasions*, 2011

Fire **increases** woody plant seedling recruitment

More seedlings emerged in burned areas (Missouri Ozarks)



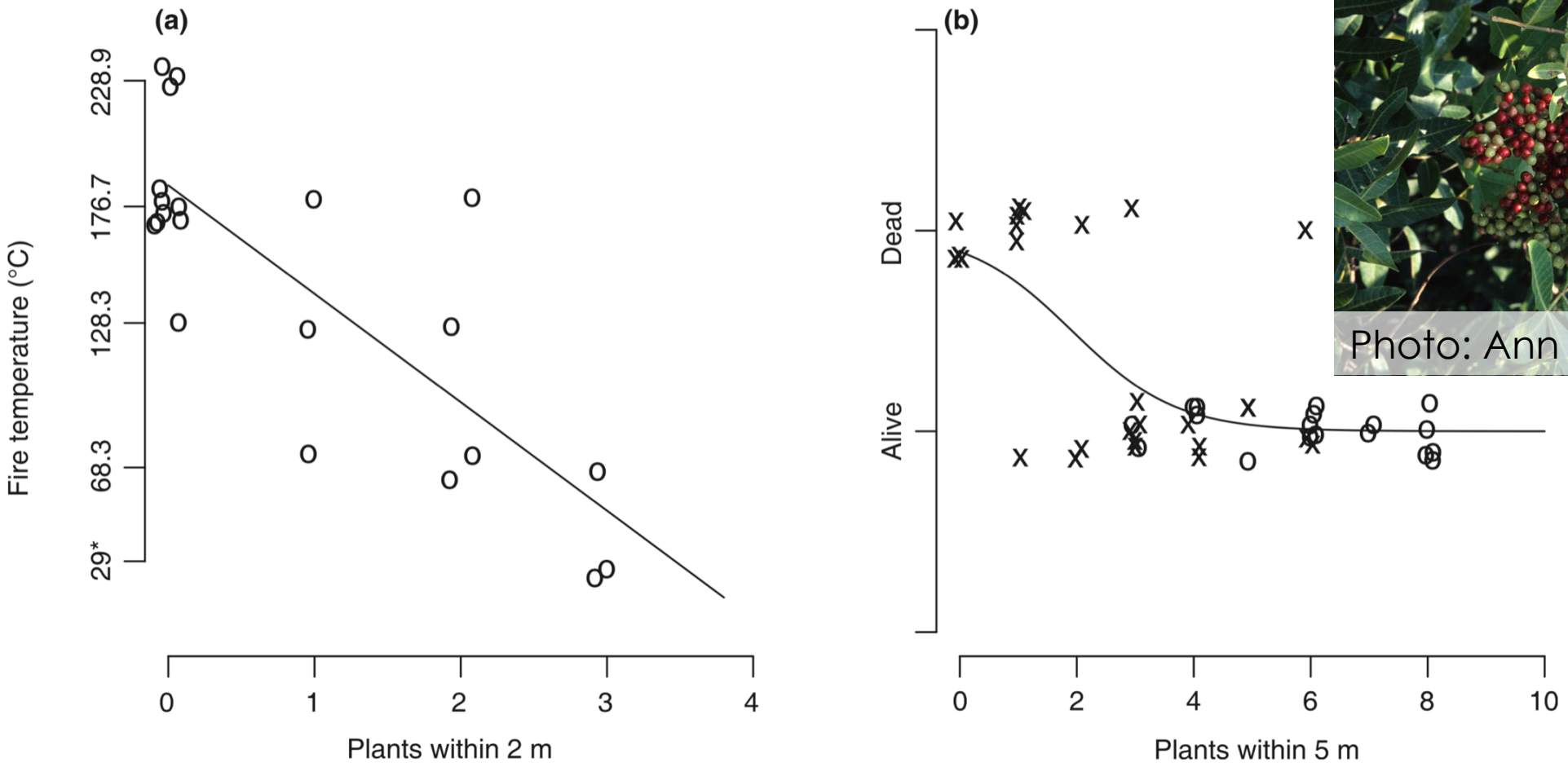


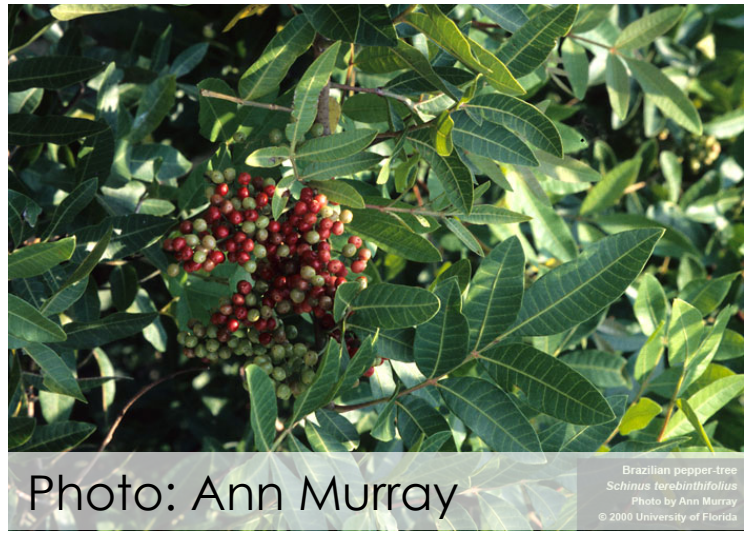
Exposure to high temperature reduced germination from 75% to <10%

Guthrie et al., *Biological Invasions*, 2016

Woody plant invasion **suppresses** fires intensity

Effects on fire facilitate invasion of pine savannas by Brazilian pepper





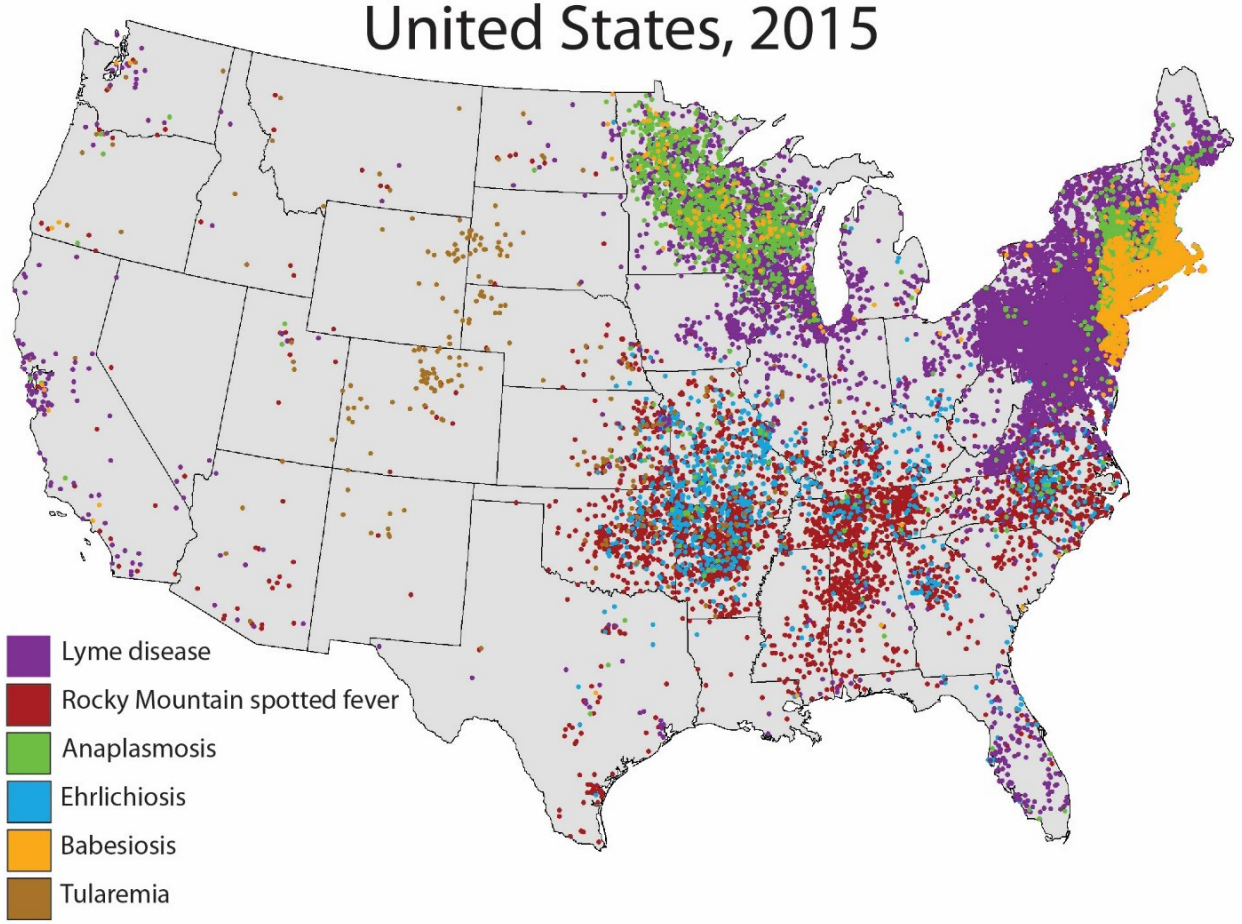
Stevens & Beckage, *New Phytologist*, 2009

Plant invasions and tick-borne disease risk

Photo credit: James Gathany

Lonicera maackii
Riparian understory invasion in late fall, near Dayton, OH
Photo by R.W. McEwan

Distribution of Key Tickborne Diseases, United States, 2015



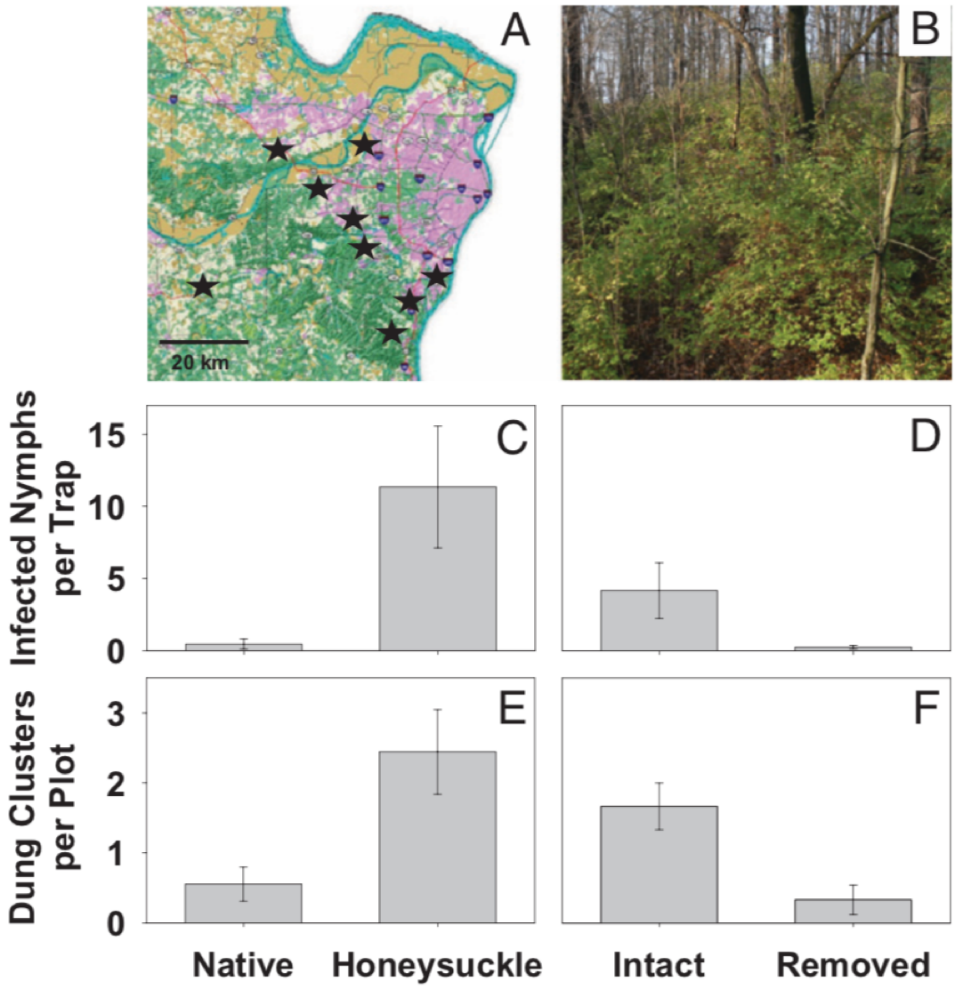
NOTE: Each dot represents one case. Cases are reported from the infected person's county of residence, not necessarily the place where they were infected.

NOTE: During 2015, babesiosis was reportable in AL, AR, CA, CT, DE, IL, IN, LA, KY, ME, MD, MA, MI, MN, MT, NE, NH, NJ, NY, ND, OH, OR, RI, SC, SD, TN, TX, UT, VT, WA, WV, WI, and WY.

NOTE: In 2015, no cases of tickborne illness were reported from Hawaii. In 2015, Alaska reported 1 travel-related cases of Lyme disease and 2 cases of tularemia.

Plant invasion **promotes** tick abundance

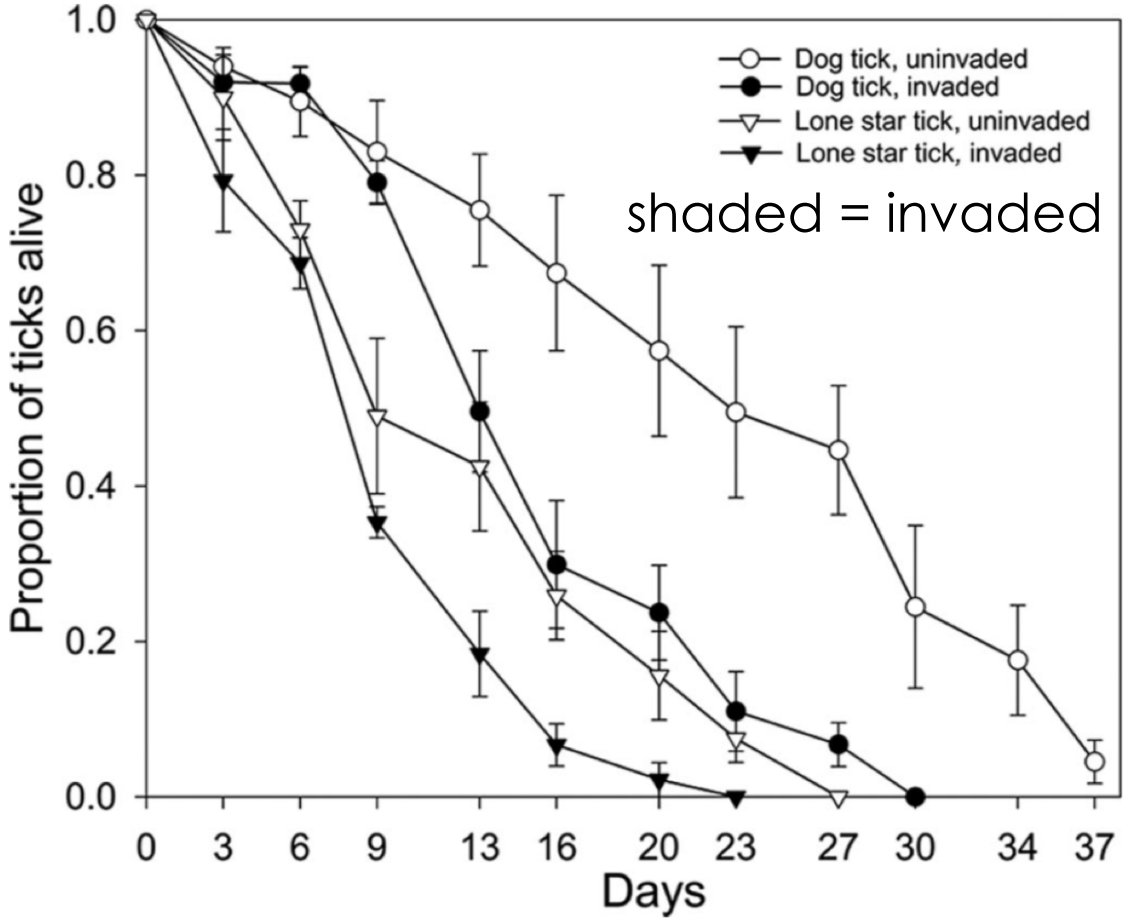
Eradicating *L. maackii* reduces tick-borne disease risk (St. Louis, MO)



Allan et al., *PNAS* 2010

Plant invasion **reduces** tick survival

M. vimineum reduces tick survival: higher temps, lower humidity



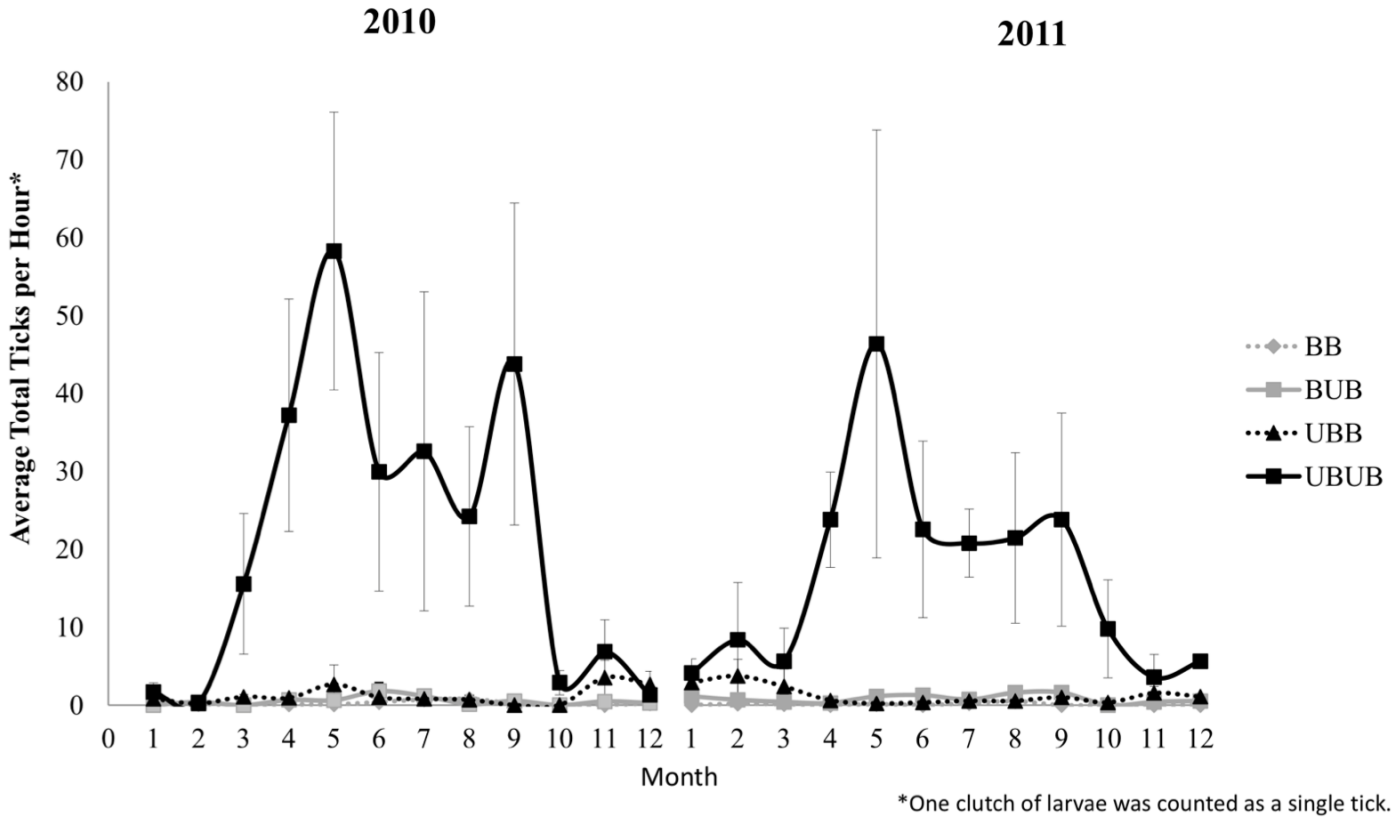
Civitello et al., *Journal of Medical Entomology* 2008

Fire and tick-borne disease risk

Photo credit: James Gathany

Prescribed fire **lowers** tick abundance

Southwest Georgia

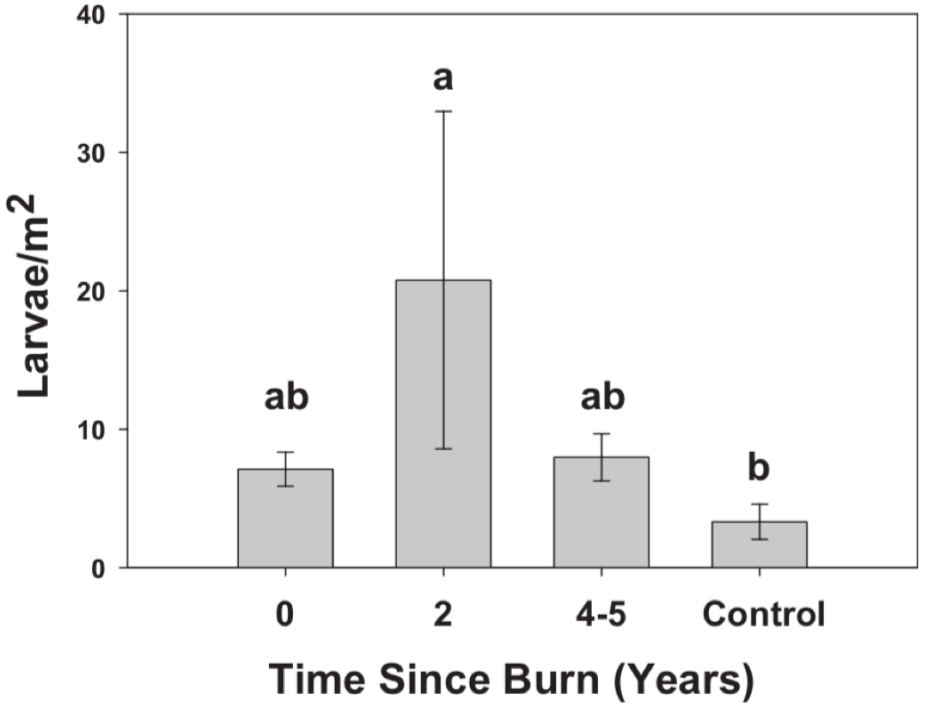


*One clutch of larvae was counted as a single tick.

Gleim et al., *PLoS ONE* 2014

Prescribed fire **increases** tick abundance

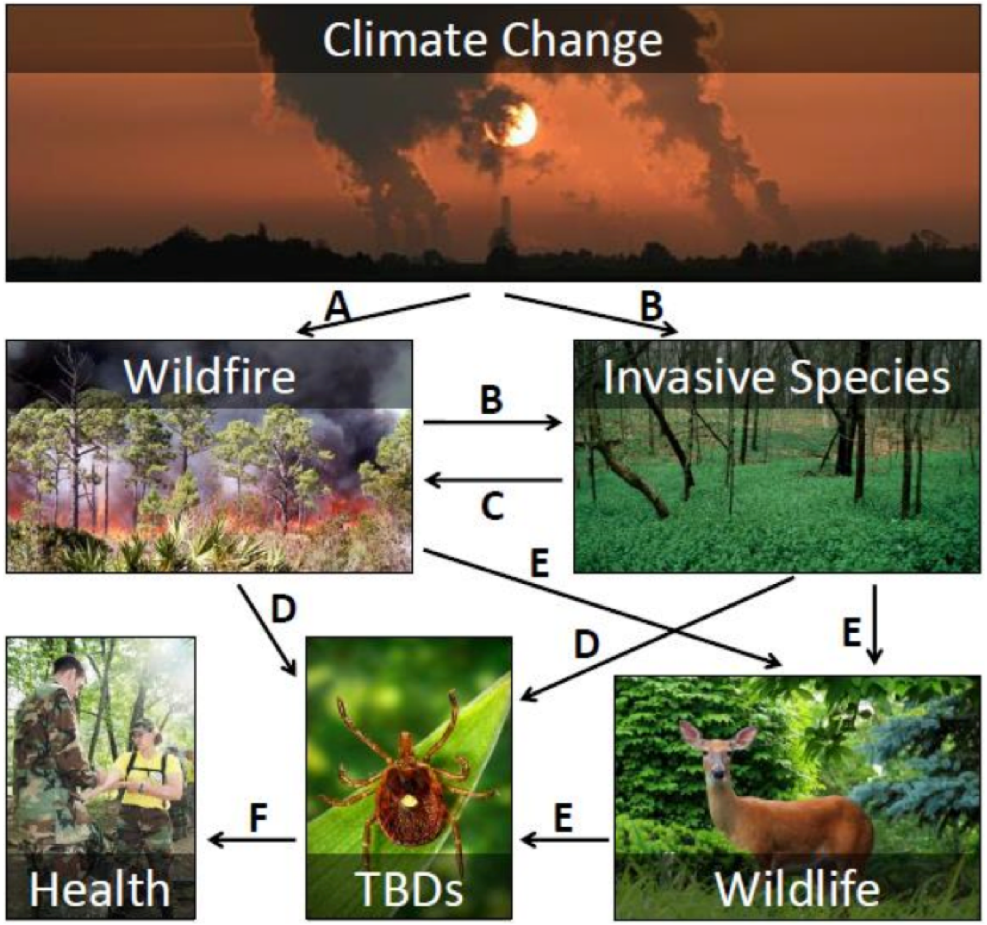
Missouri Ozarks, 12 burn units ranging from 61 to 242 ha

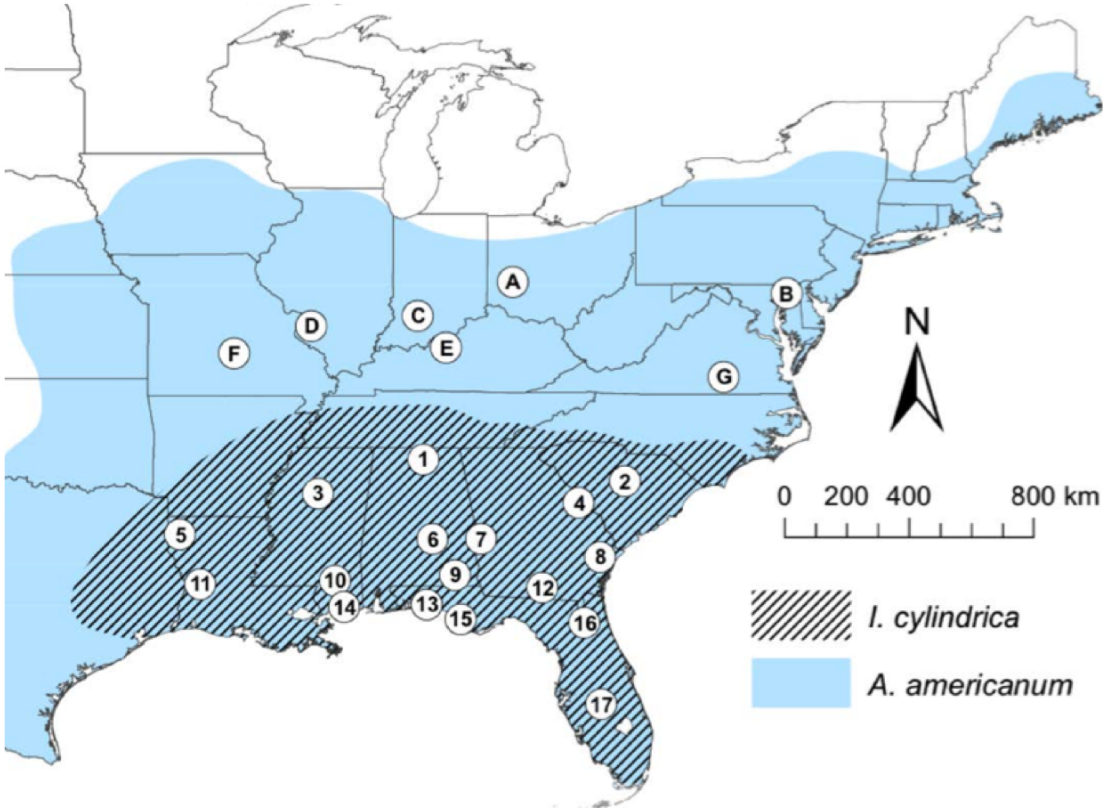


Allan *Journal of Medical Entomology* 2009

Fire, plant invasions, and tick-borne disease risk

Preliminary results from an ambitious project





Fire, plant invasions, and tick-borne disease risk

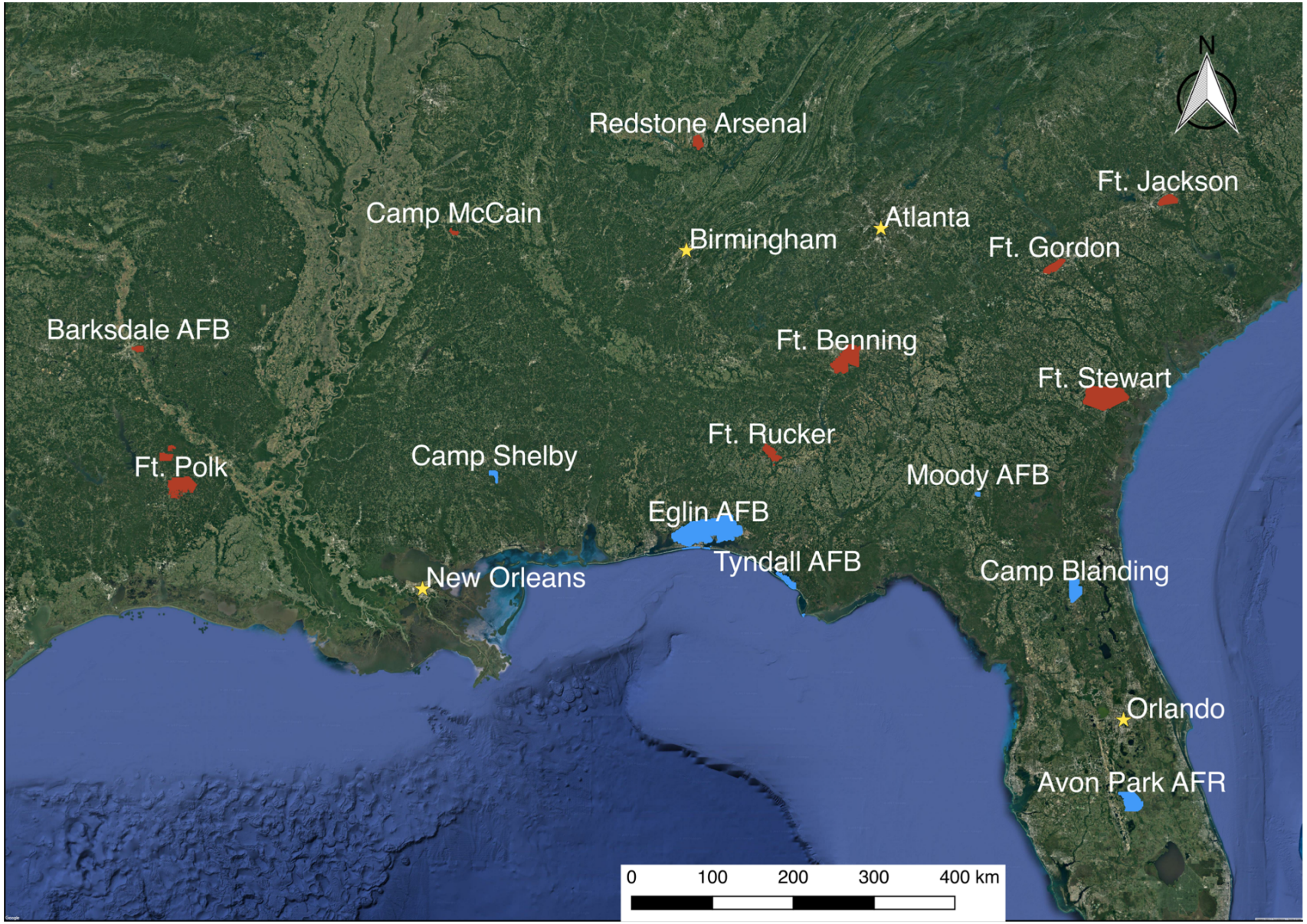
Cogongrass

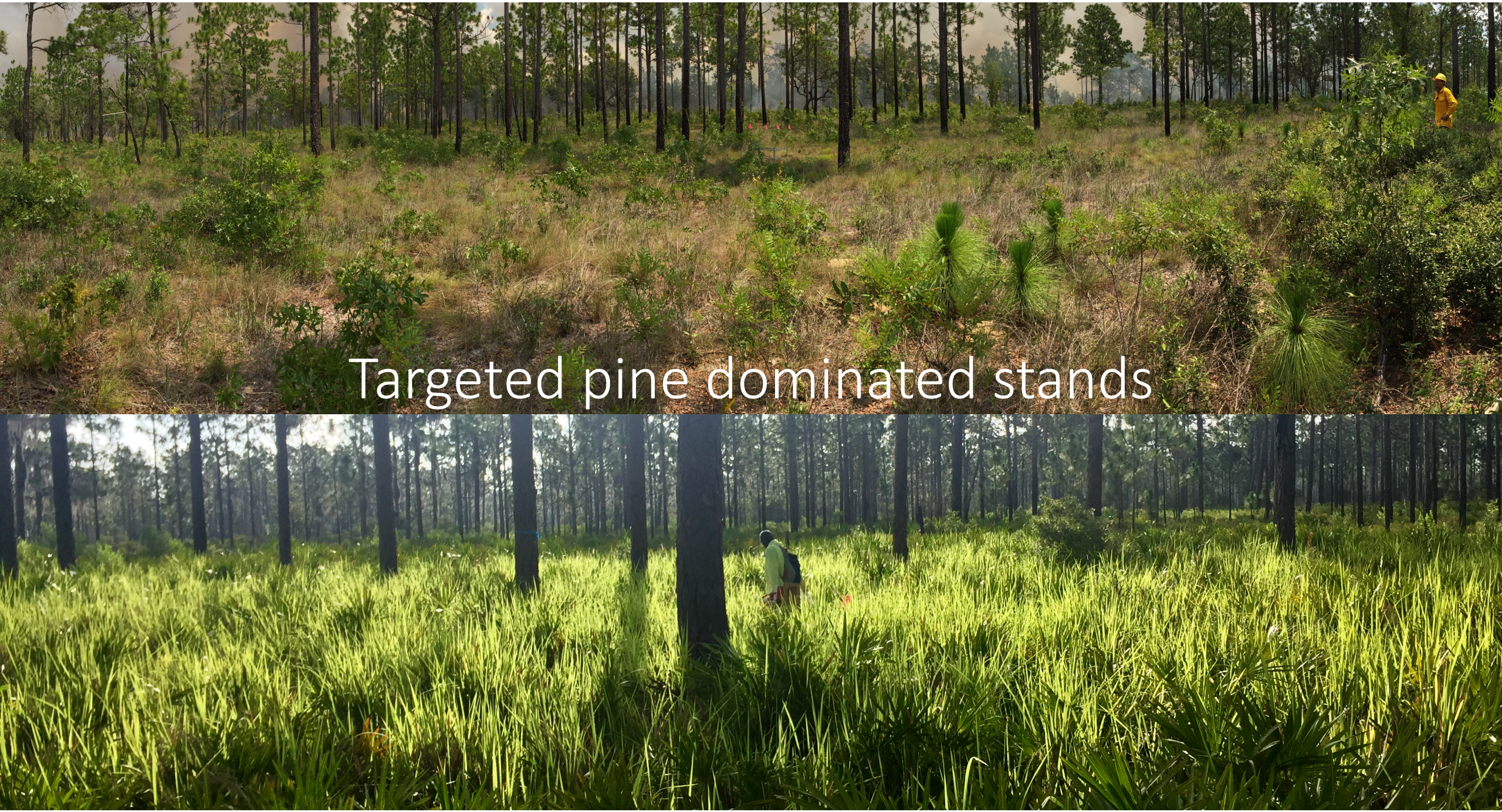
Photo credit: Drew Hiatt

Lone-star tick

Photo credit: James Gathany

Sites across the southeastern U.S.

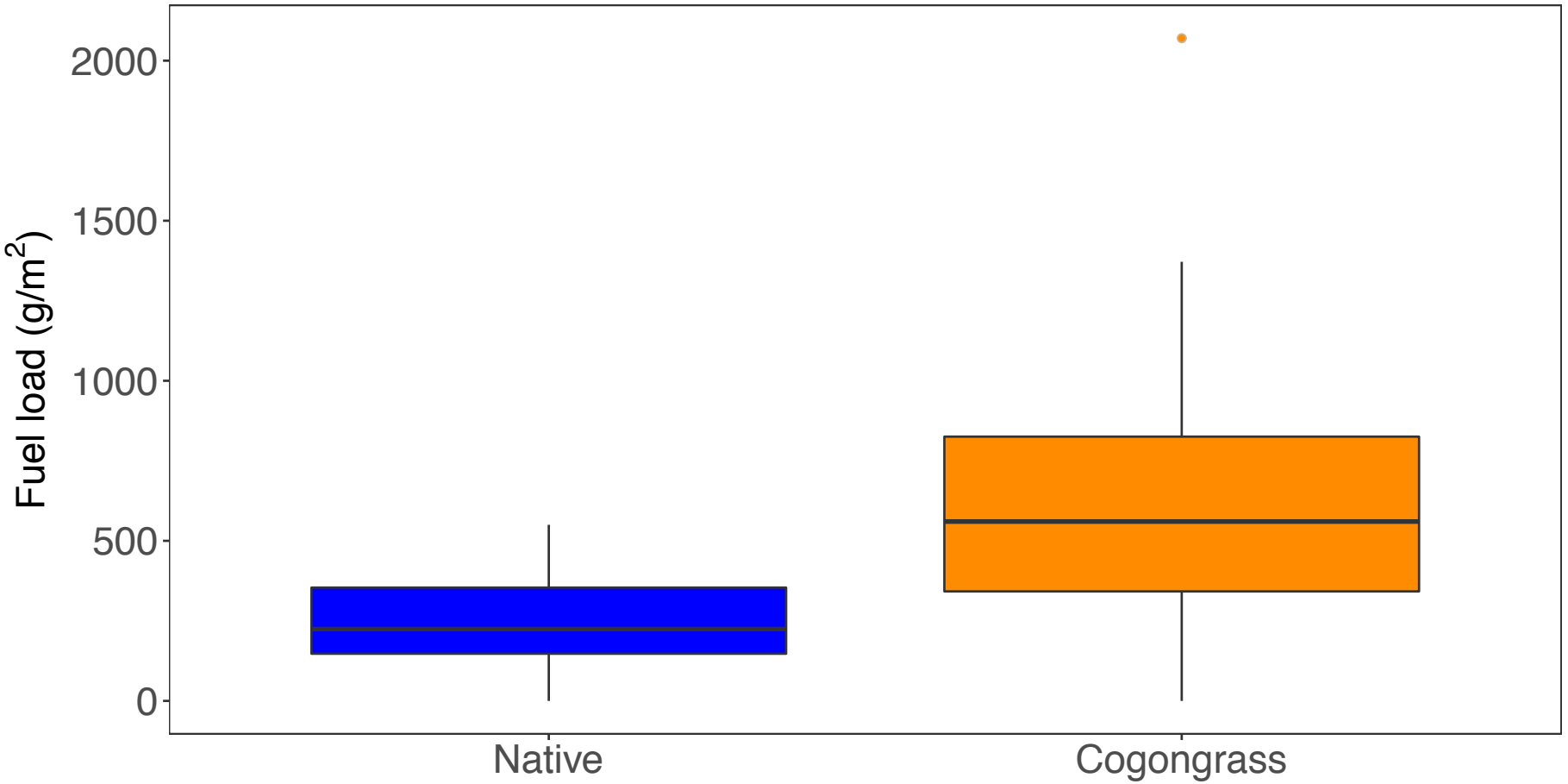




Targeted pine dominated stands

Cogongrass can generate lots of fuel

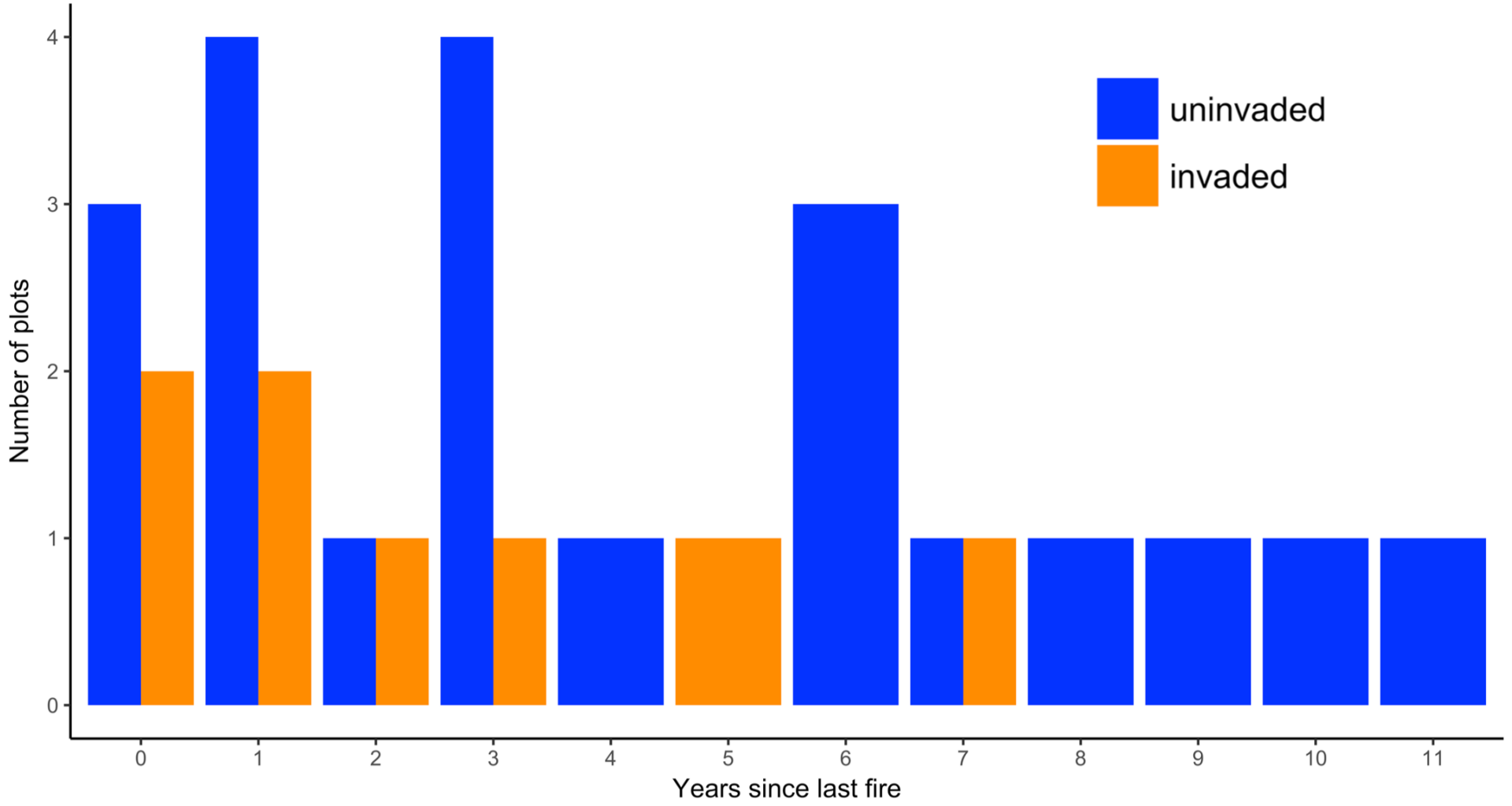
~250% more standing fuel load in cogongrass invasions



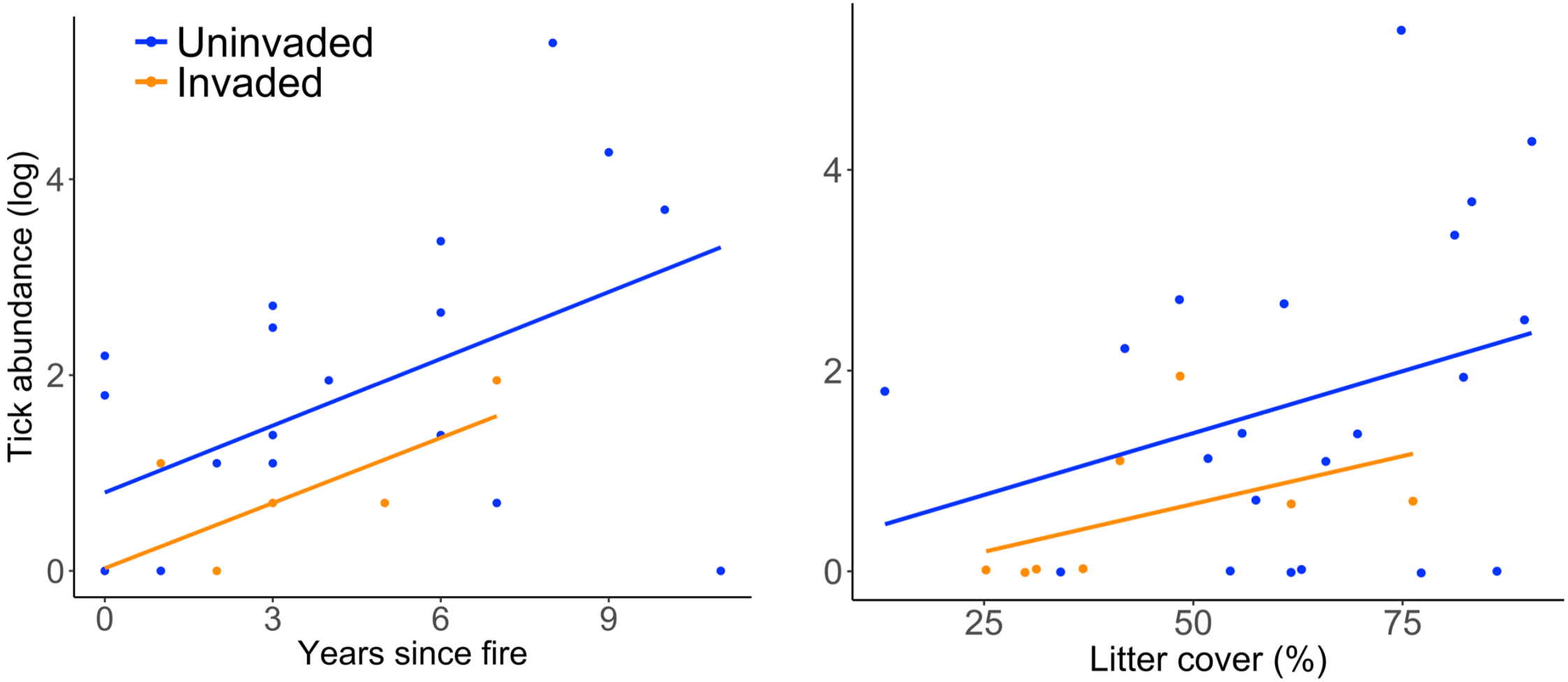
Cogongrass and fire

Cogongrass invasion and fire

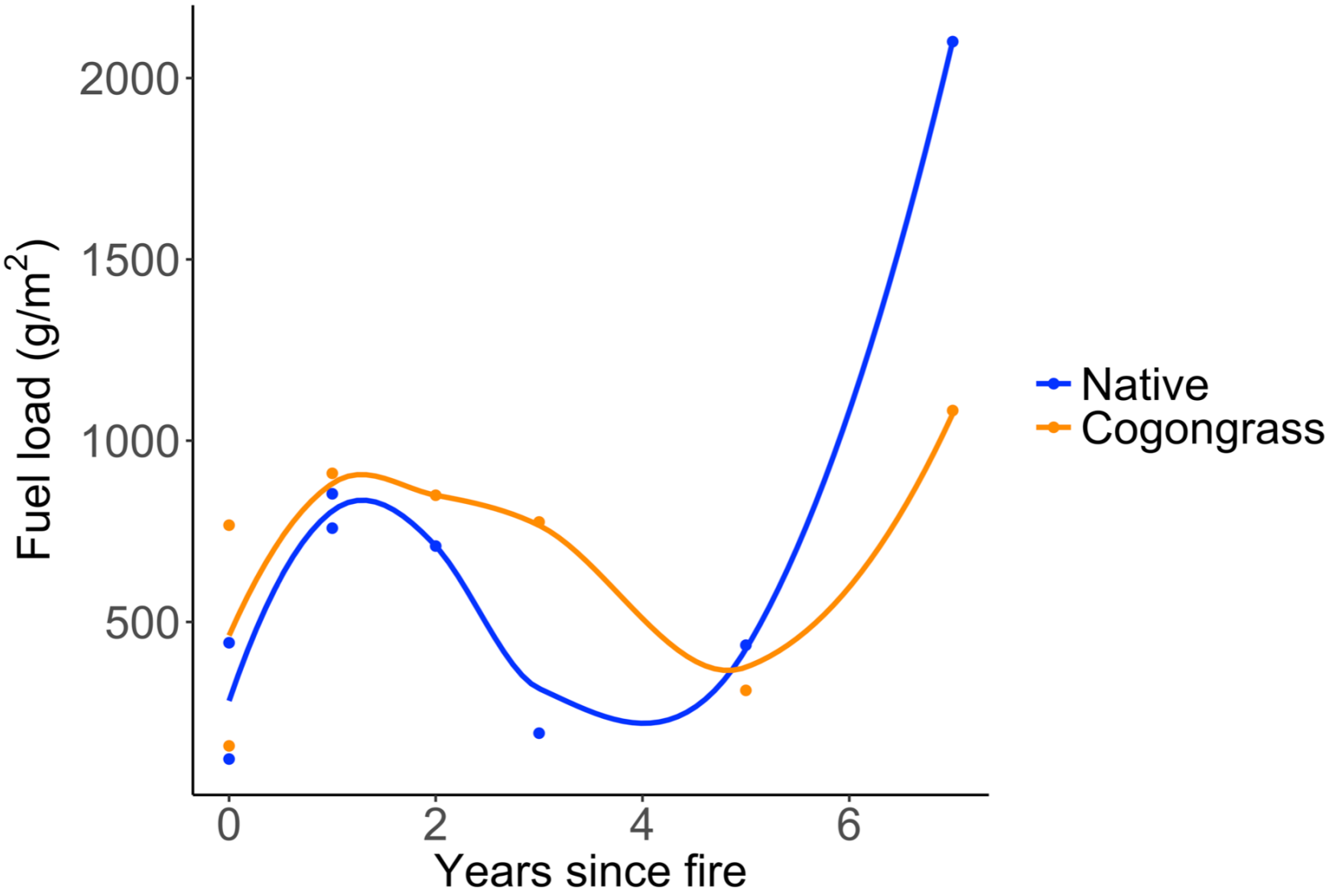
Invasions were more common in recently burned plots



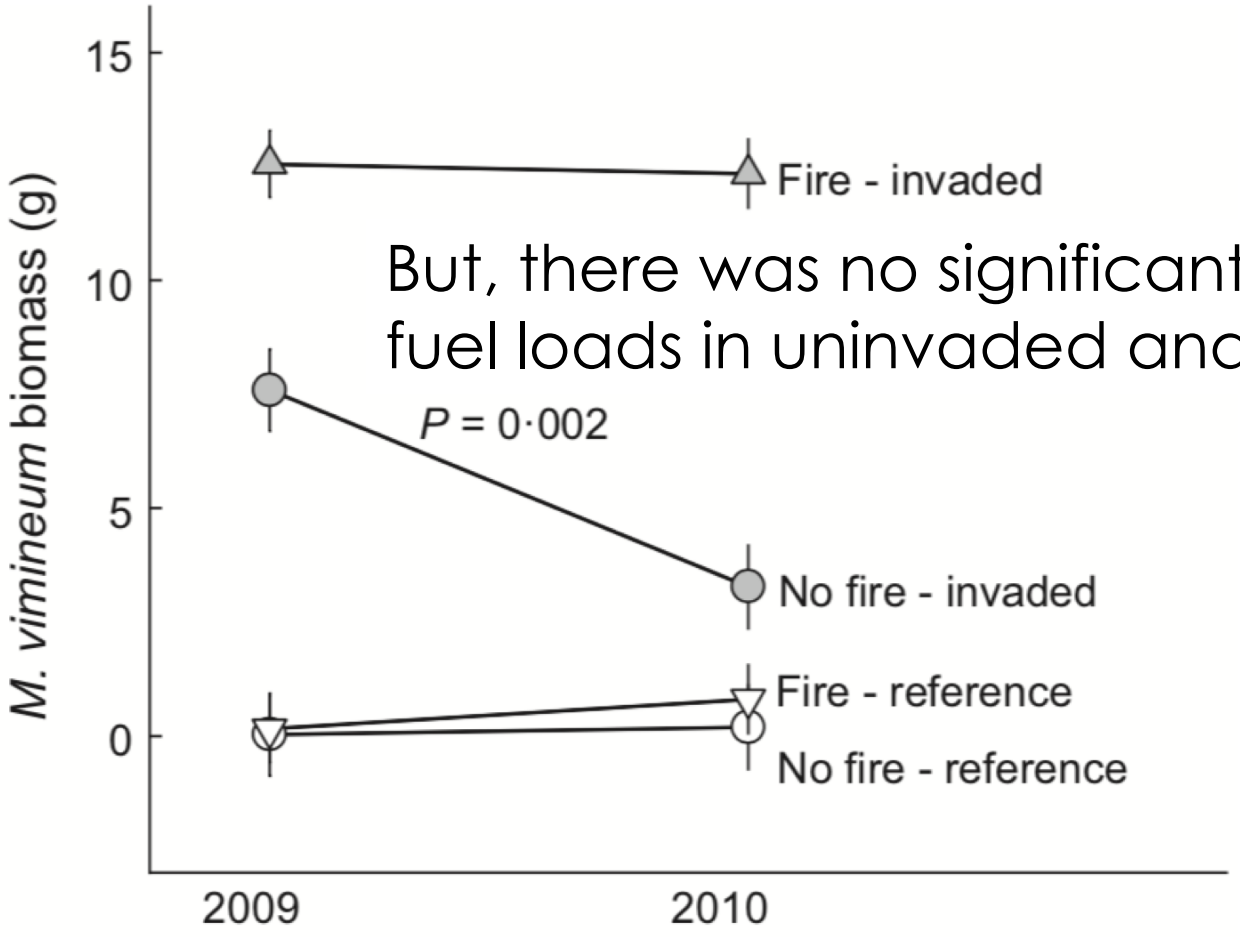
Tick abundance, time since fire, & plant invasion



Fuel loads and fire



Fire promotes *Microstegium*

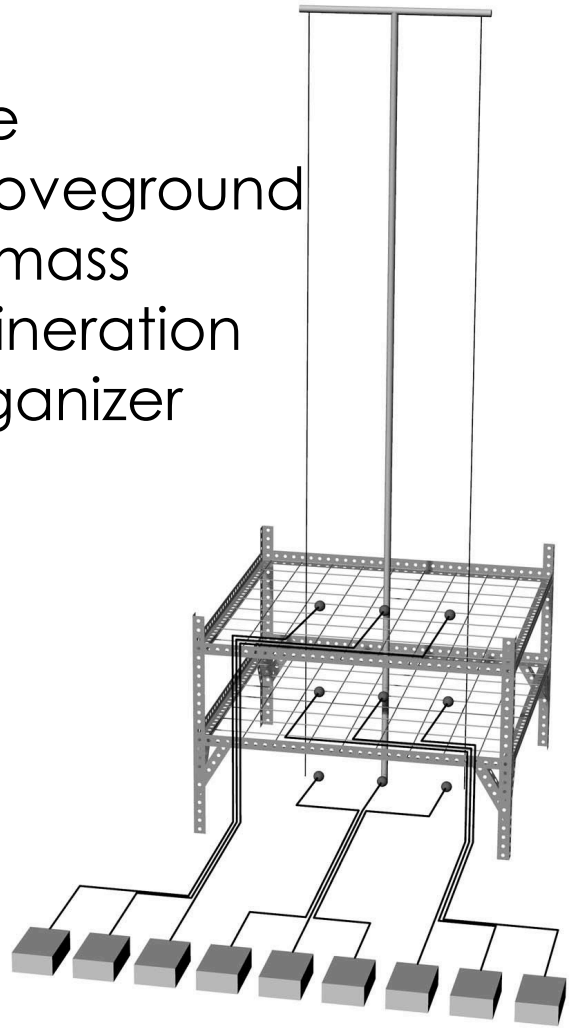


But, there was no significant difference between fuel loads in uninvaded and invaded plots

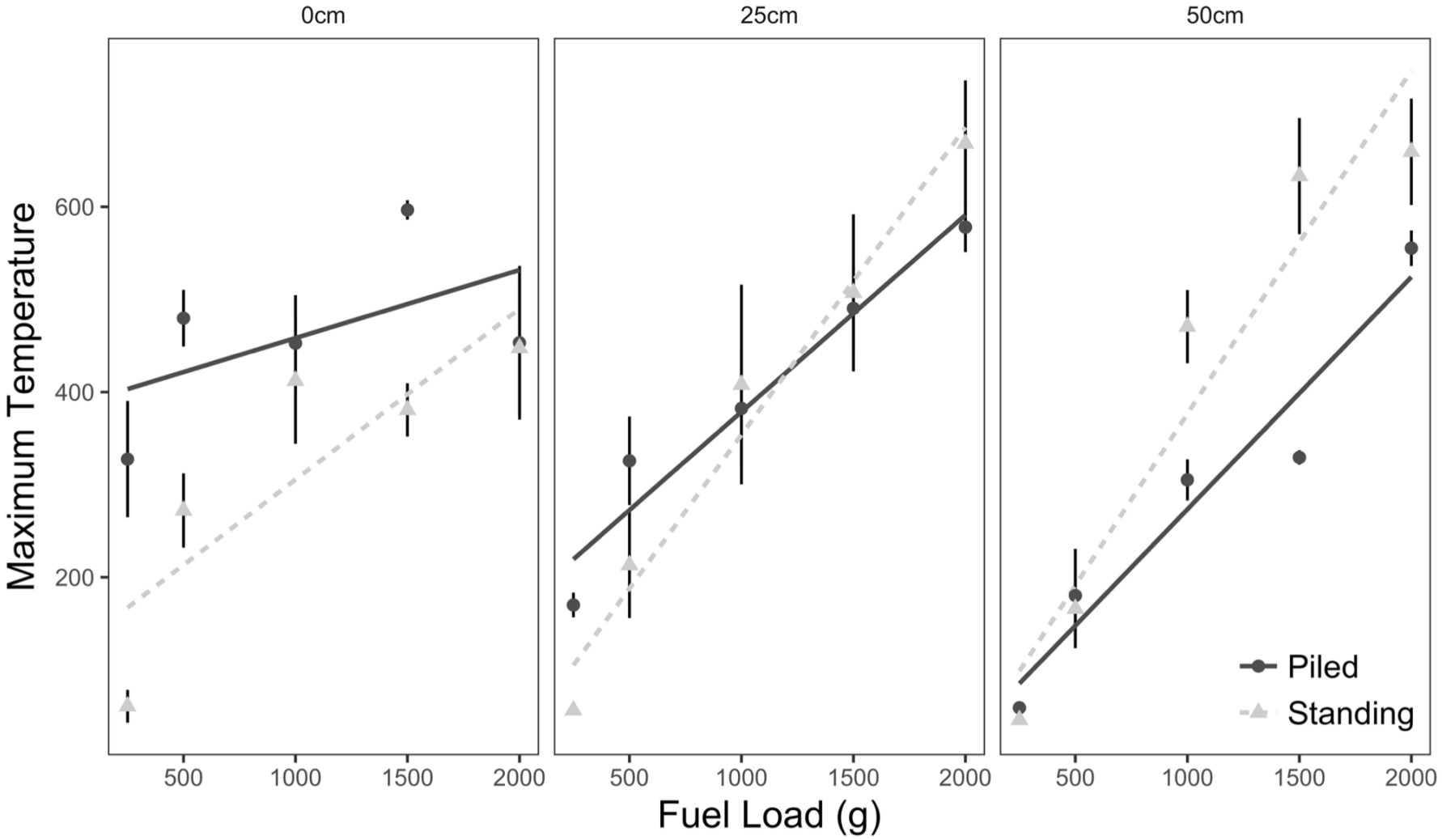
Flory et al., *Journal of Applied Ecology*, 2015

Experimentally manipulate fine fuel structure

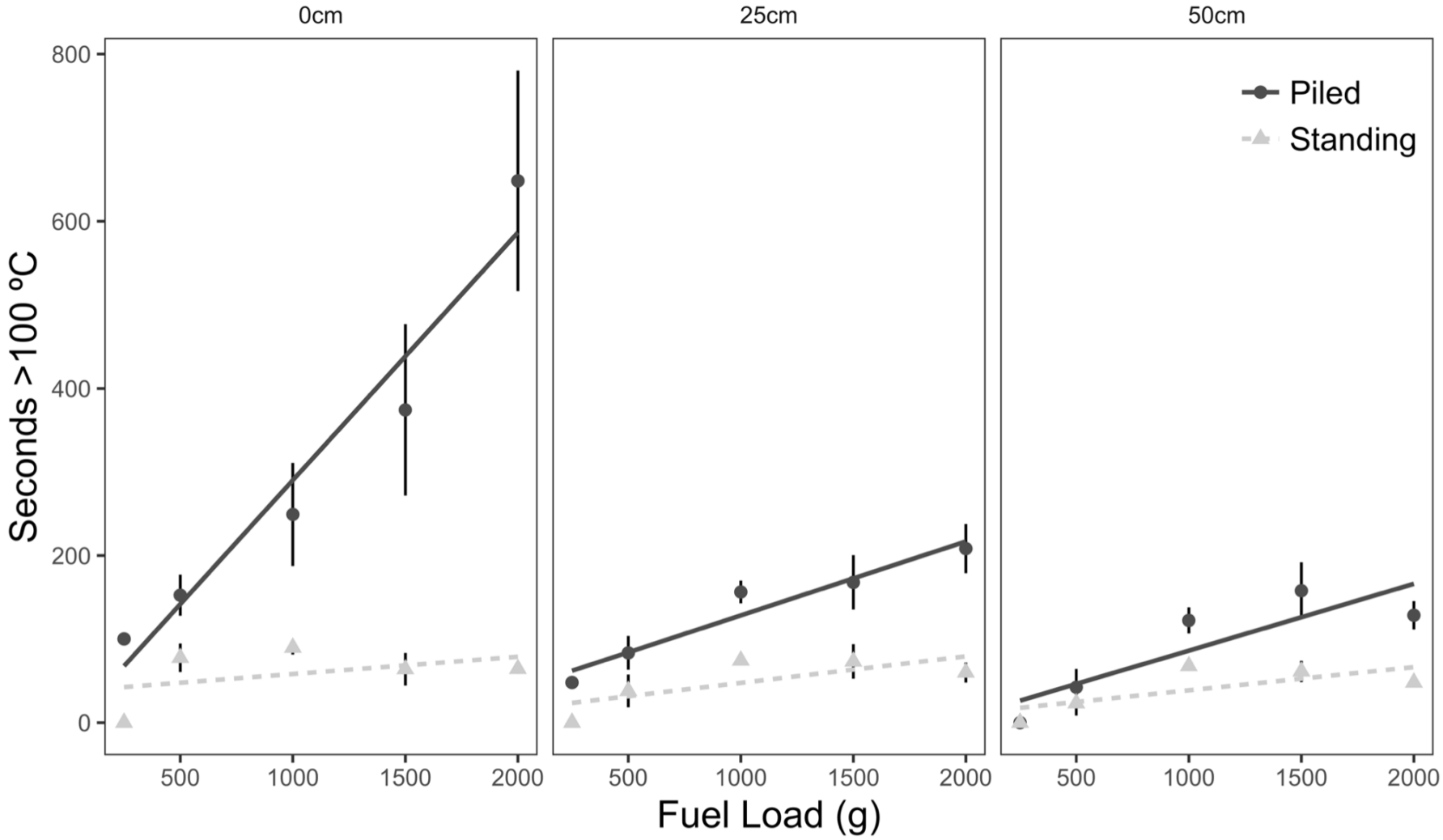
Fine
Aboveground
Biomass
Incineration
Organizer



Effects of fine fuel structure on fire intensity



Effects of fine fuel structure on fire intensity



Take Home

1. Plant invasions can affect fire and tick abundance either positively or negatively.
2. Eastern forests have invasive plants that can suppress or promote both ticks and fire.
3. The effect of an invasion depends on the characteristics of the plant.

Collaborators

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Drew Hiatt, University of Florida

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