Invasive grass (*Microstegium vimineum*) increases fire intensity and reduces tree regeneration in eastern forests

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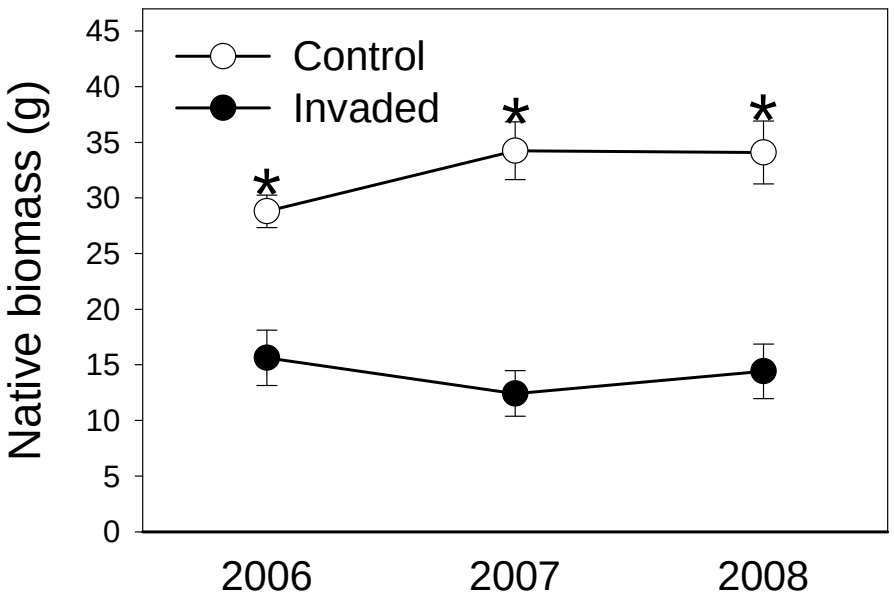
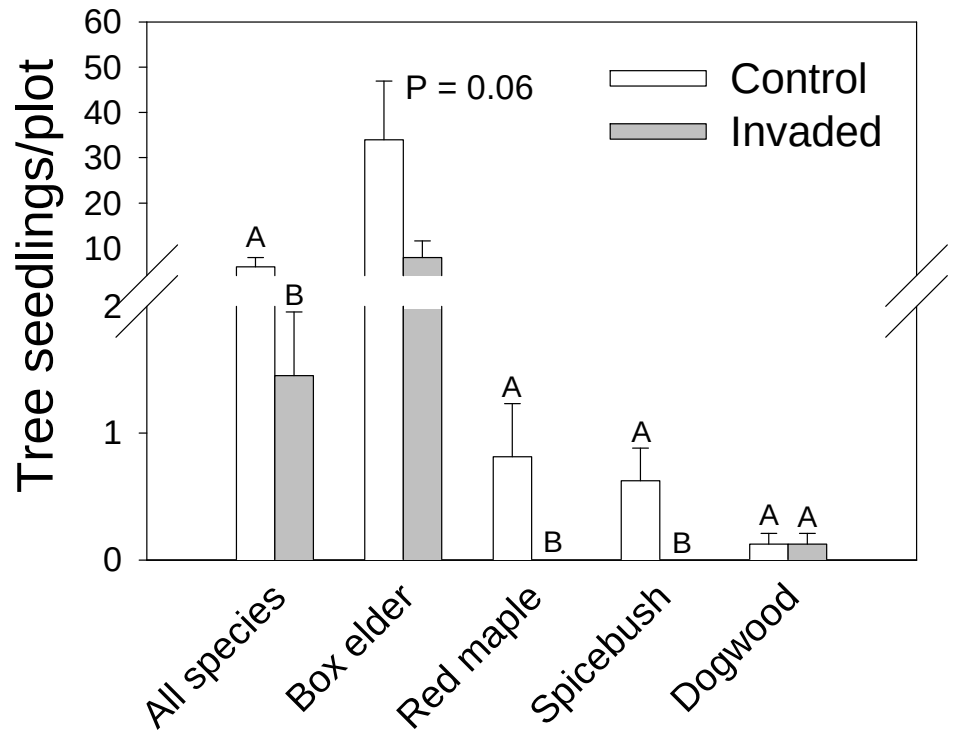
Biological invasions as agents of global change

Direct effects:

- Declines in biodiversity
- Altered succession patterns



Flory and Clay, *Biological Invasions,* 2010

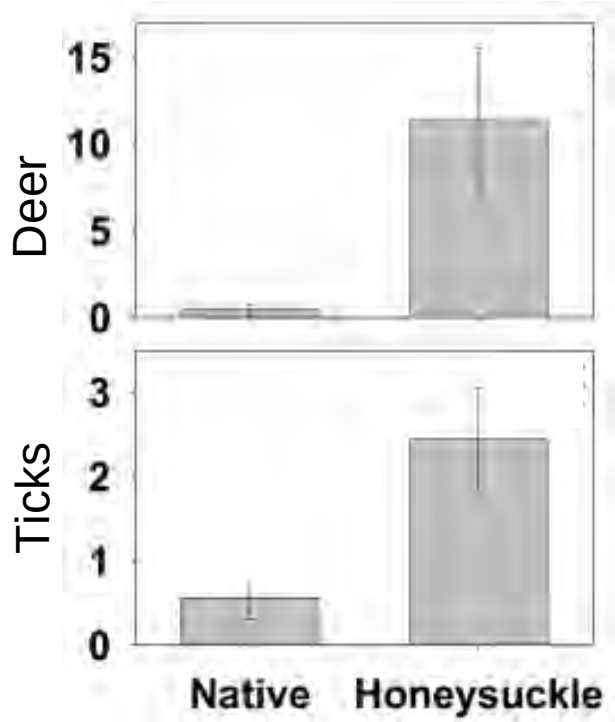


Flory and Clay, *Oecologia,* 2010

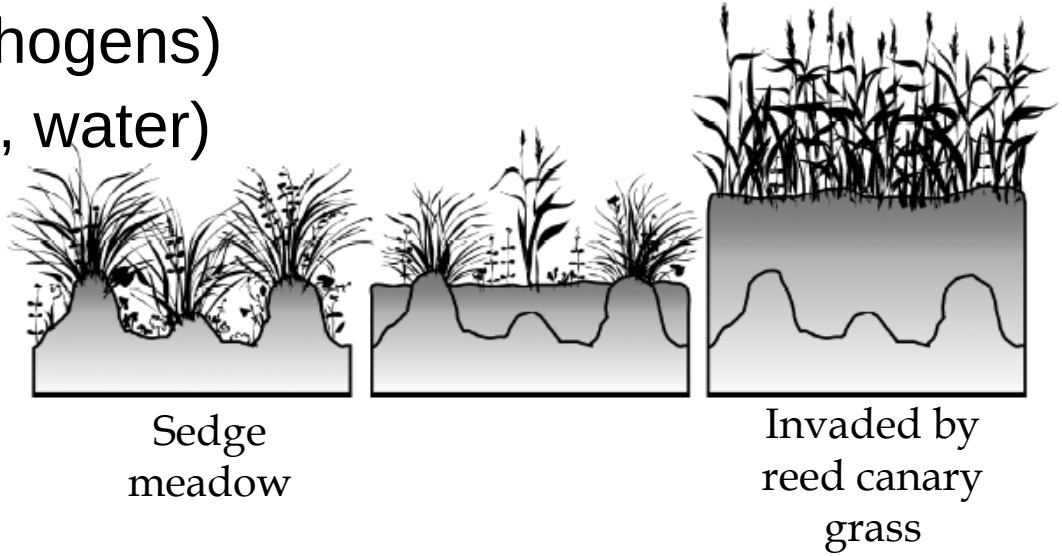
Biological invasions as agents of global change

Indirect effects:

- Resources: (water, nutrients)
- Enemies: (herbivores, pathogens)
- Disturbance patterns: (fire, water)



Allan, *PNAS,* 2010

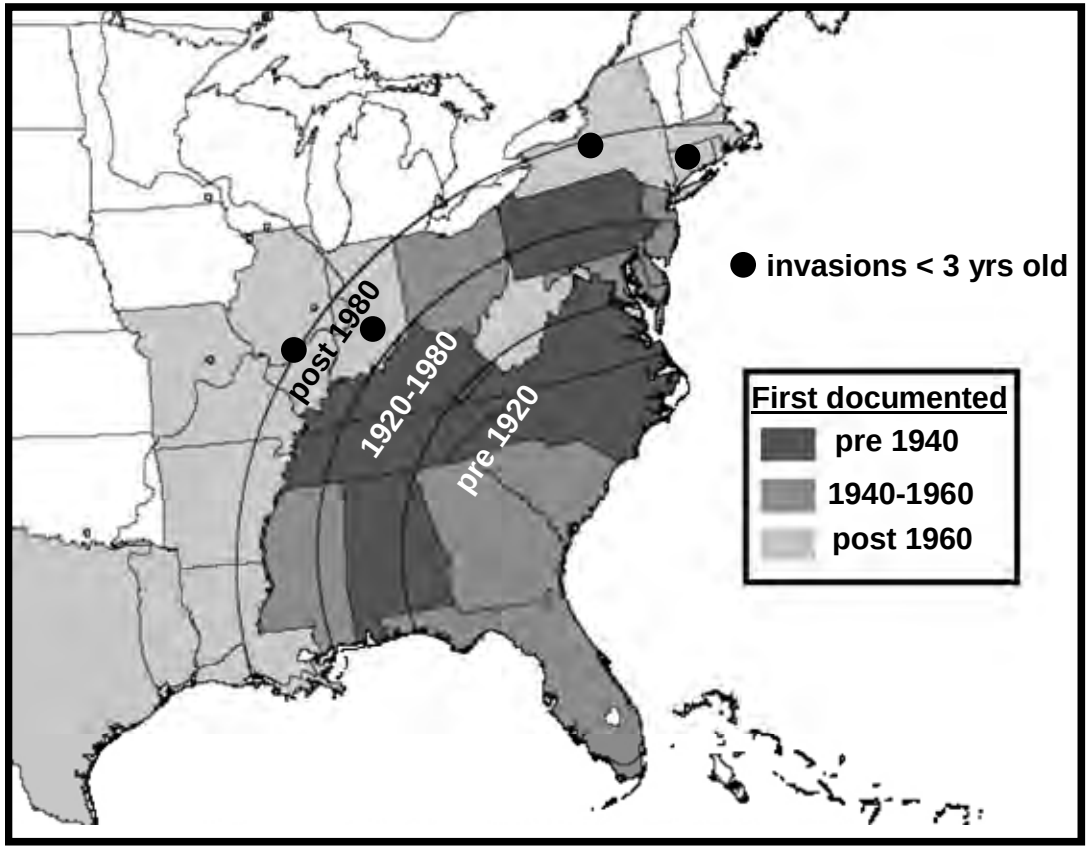


Research questions

1. **Do plant invasions increase fire intensity?**
2. **Does greater fire intensity suppress tree regeneration?**
3. **Are plant invasions promoted by fire or can we use fire as a management tool?**

Microstegium vimineum

(Japanese stiltgrass)



Characteristics

- Shade tolerant annual grass
- May fill “empty niche”
- Prolific seed production
- Native to southeast Asia
- Few herbivores/pathogens

1. *Microstegium* Invades

Hypothesized *Microstegium* – Fire Cycle

2. Dense, continuous litter layer

3. Increased fire severity and extent

4. Damage to native community

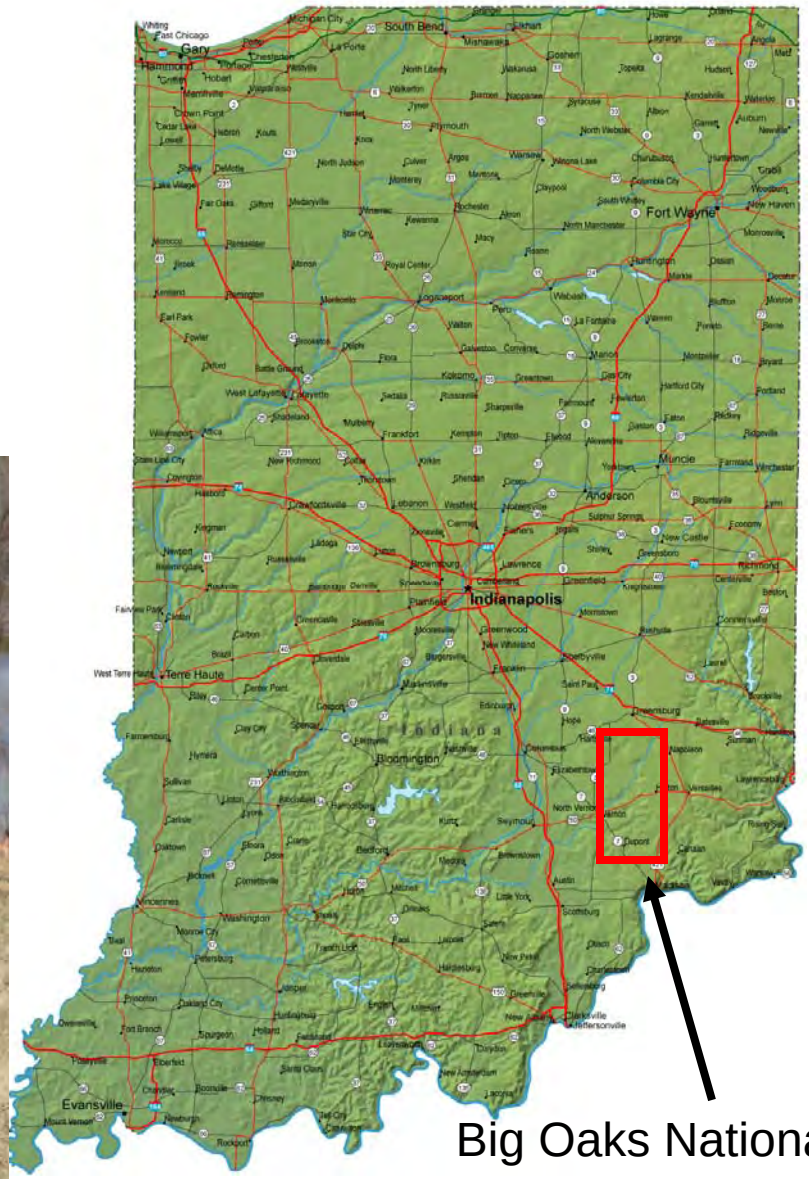
Prescribed fire in *Microstegium*- invaded area

Research plan: fire intensity, effects

Prescribed fires

a. Fire intensity

b. Tree/plant community responses



Big Oaks National Wildlife Refuge

Research plan: fire intensity, effects

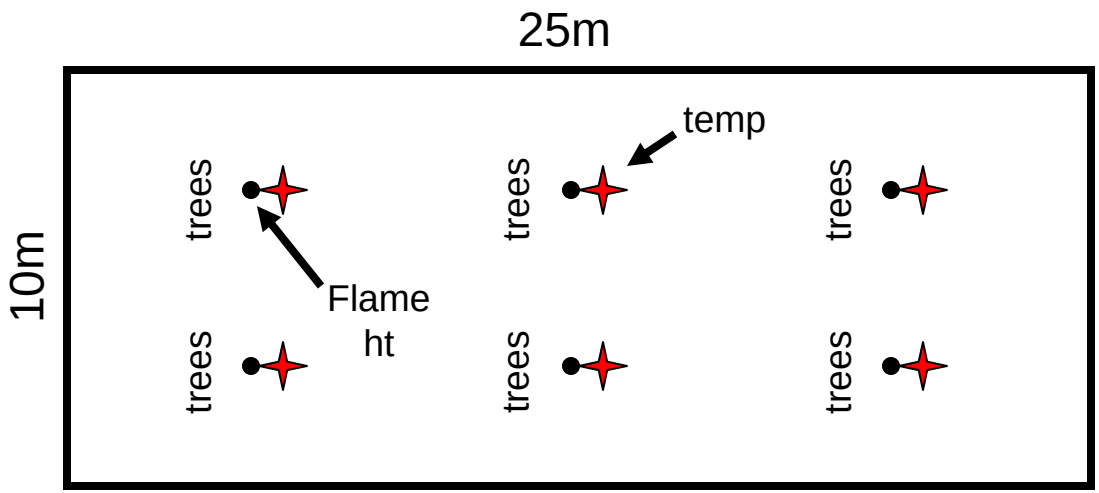
Methods:

a. Paired plots (10x25m) invaded/uninvaded

b. Vegetation before and after

c. Experimentally planted trees

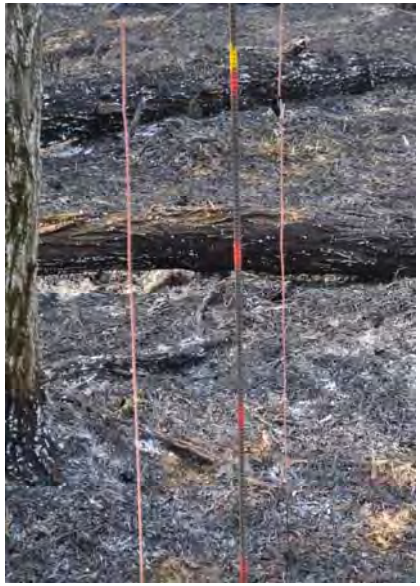
d. Temperature, flame height, area burned



Thermocouple data loggers

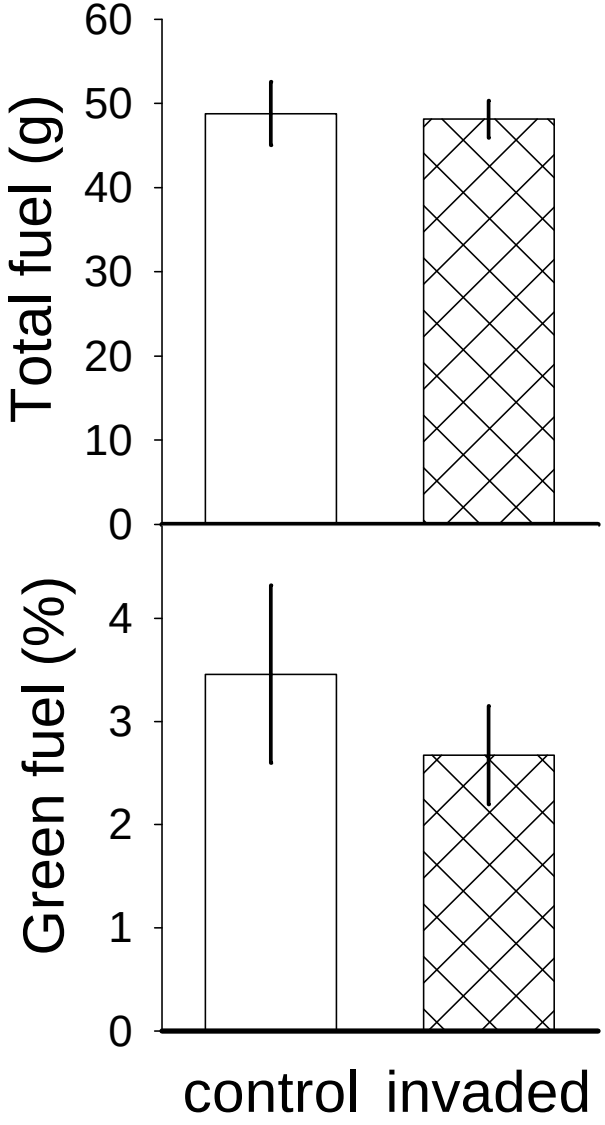
Experimental trees

Flame height

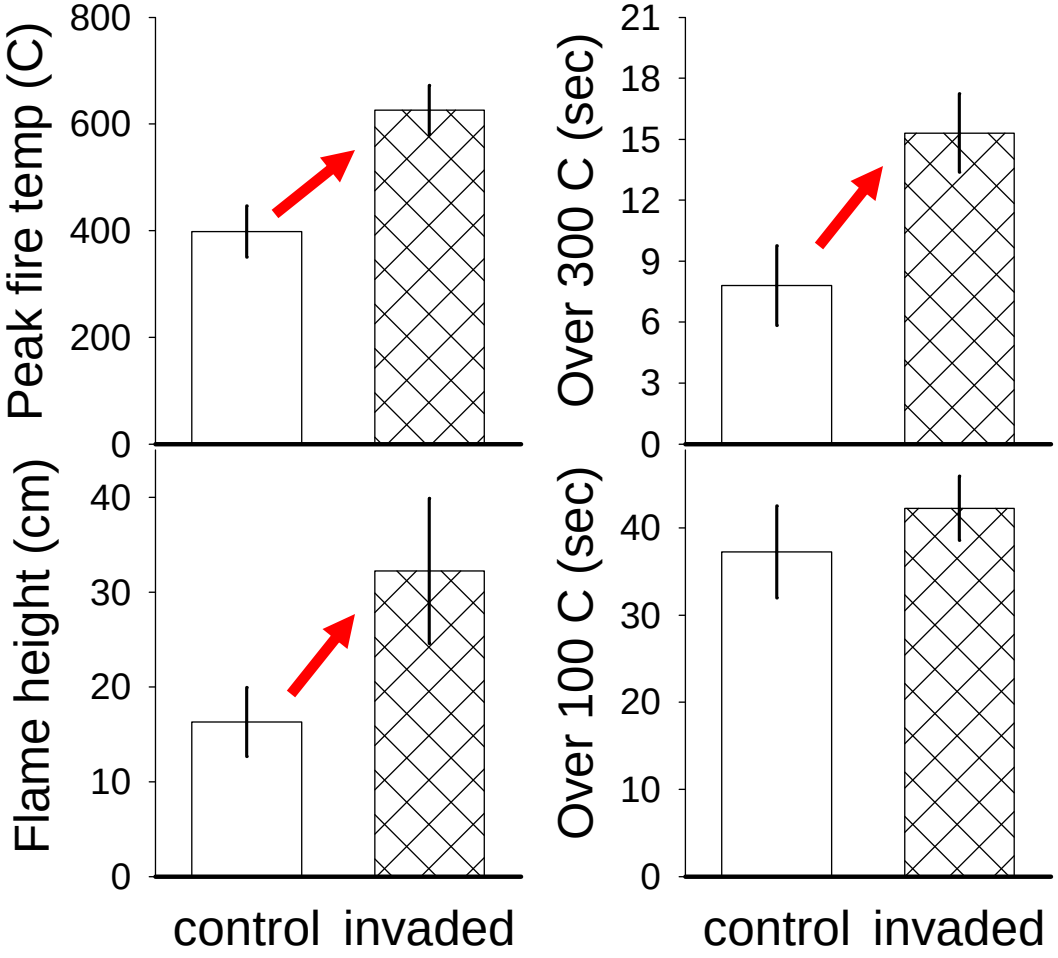


Video

Results: fuel load

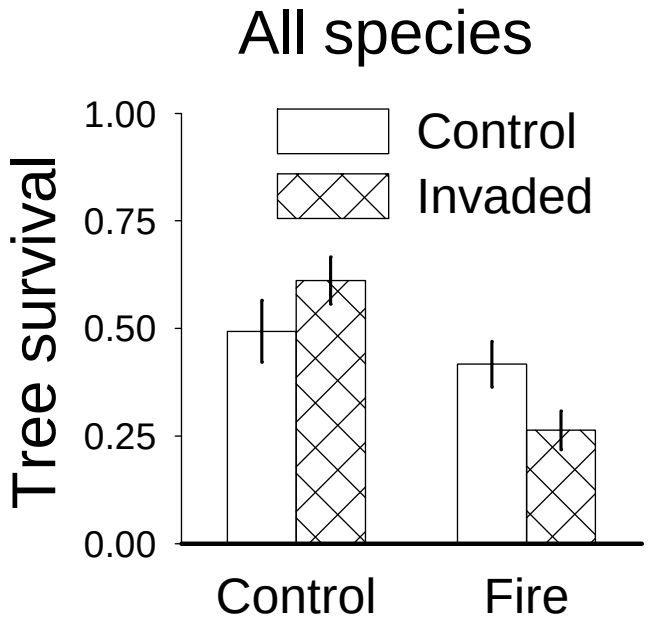


Results: fire intensity



Results: tree survival and regeneration

<u>Experimental trees:</u>
White oak (*Quercus alba*)
Bur/black oak (*Quercus macrocarp/velutina*)
Tulip (*Liriodendron tulipifera*)
Maple (*Acer rubrum*)



Invasion x burn P = 0.01

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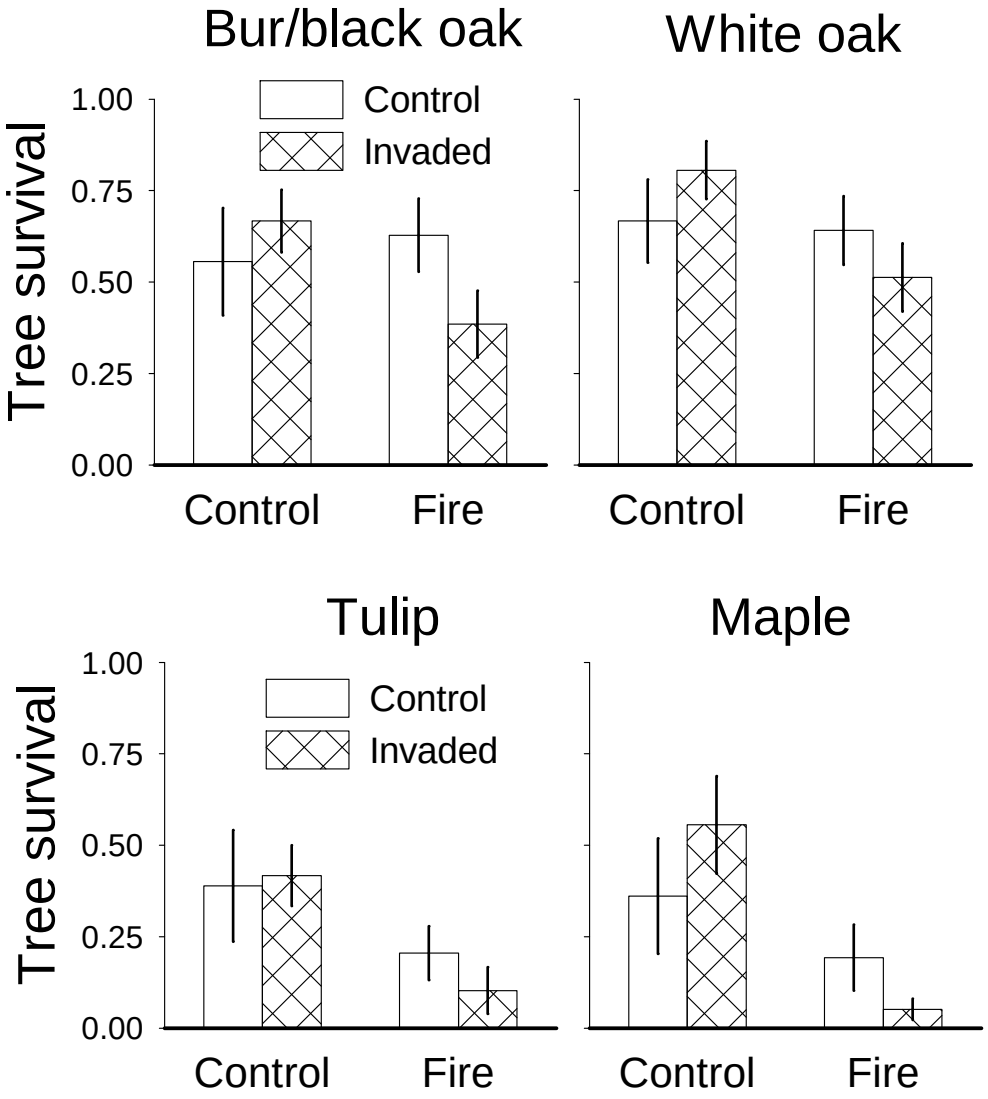

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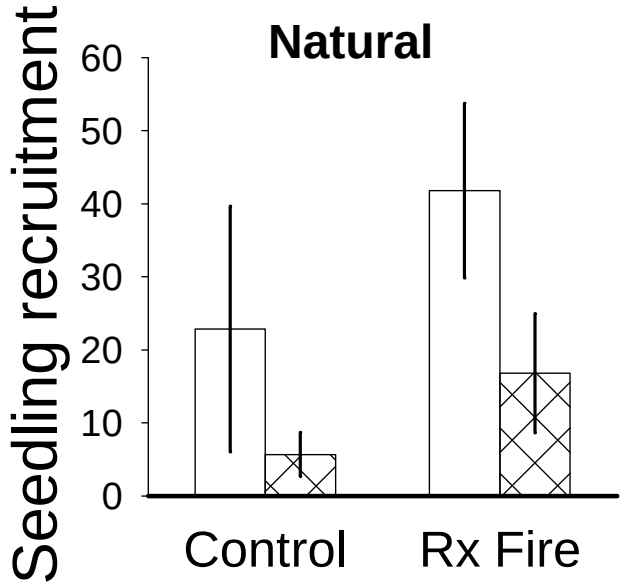
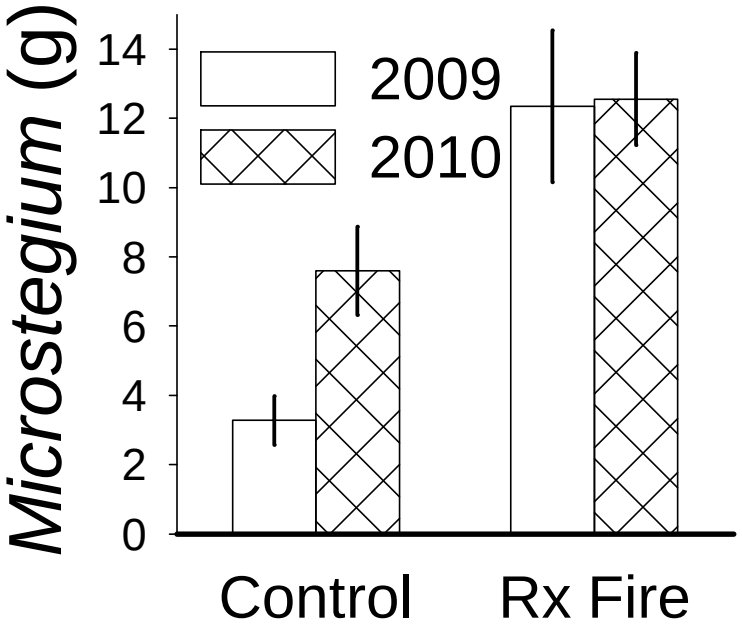


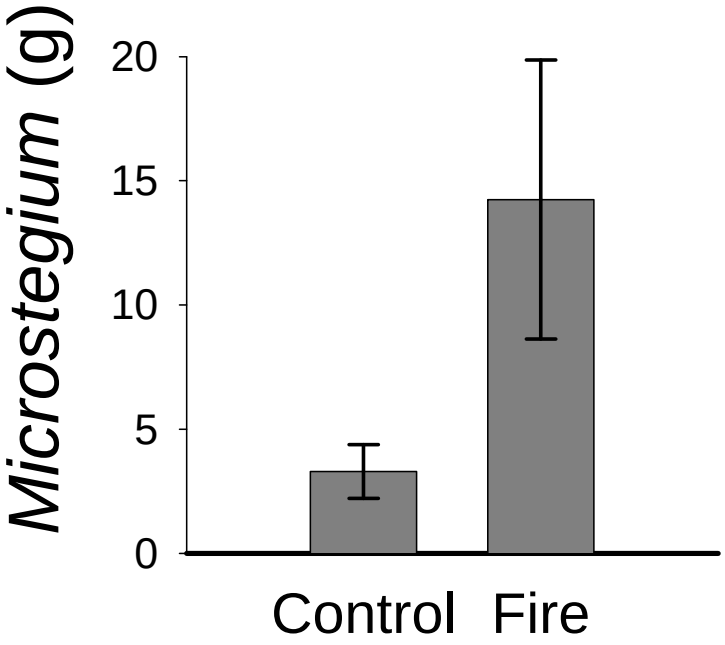
<u>Most common:</u> sweetgum, poplar, red maple, oak spp., ash spp

Results: *Microstegium*



Results: *Microstegium*

Bayles Road experimental invasion



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

Research plan: restoration, demography

Methods:

a. 8 treatments x 6 reps x 5 sites

b. 2 x 2m plots

   a. Spring and fall fires

   b. grass-specific herbicide (fluazifop)

   c. Pre-emergent (pendimethalin) + fire

   d. untreated control

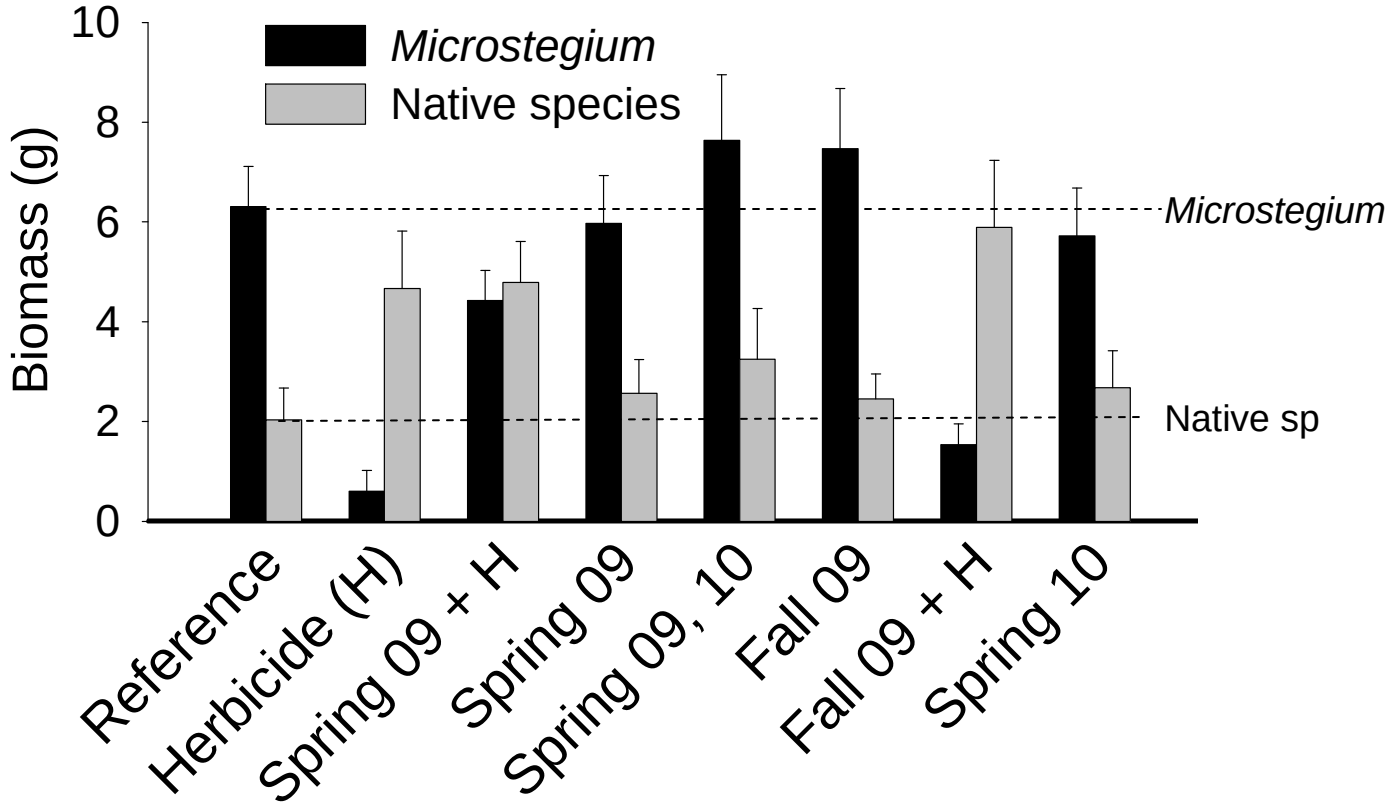
Data (from 25x25cm quadrats):

- adult mass
- seed production
- seedlings
- seed bank

* Demographic models in collaboration with Sarah Emery, Univ of Louisville

Results: restoration

Fall 2010



Conclusions

- Greater fire intensity in invaded areas can reduced tree regeneration and alter forest composition
- Prescribed fires may promote invasions (further research needed)
- Grass-specific herbicide can be used with fire for restoration and management to remove invasions and promote native species