Feedbacks of nitrogen cycling and invasion by *Microstegium vimineum* in restored wetlands

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Yates Millpond restoration

Photos courtesy of Barbara Doll

Fig. 1 Restoration construction disturbance at Yates Millpond in Raleigh, NC

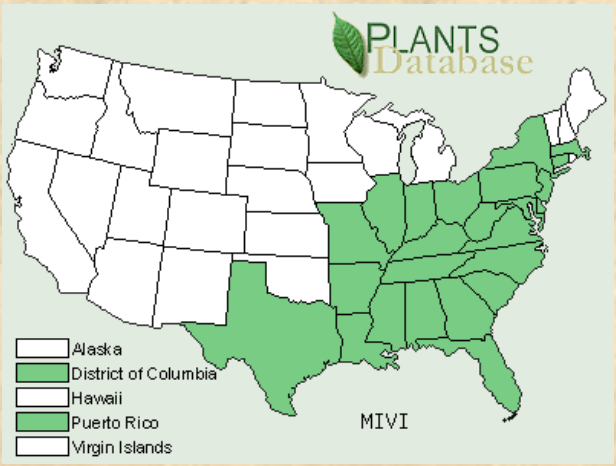
Yates Millpond Stream Restoration in Raleigh, NC

Research questions

- How does diversity change when *Microstegium* is removed?
- How is N cycling affected with the presence of *Microstegium*?
- Is *Microstegium* more invasive in high N?
- Does restoration disturbance increase N and promote invasive species?

Microstegium vimineum

- Annual C4 grass
- First reported in TN, 1919
- Dominates native vegetation in 3-5 years
- Aggressive growth, abundant seed



http://www.plants.usda.gov/java/nameSearch?keywordquery=microstegium+vimineum&mode=sciname

Research questions

- How does diversity change when *Microstegium* is removed?
- How is N cycling affected with the presence of *Microstegium*?

Yates Millpond Stream Restoration in Raleigh, NC

Yates Millpond *Microstegium* Removal Study

- 6 pairs of plots in sunny locations; each plot 2.25m^2

- One pair continuously weeded of *Microstegium*, one reference control

June 2005

July 2005

August 2005

September 2005

June 2, 2006

Weeded

Not weeded

July 11, 2006

Weeded

Not weeded

September 6, 2006

Weeded

Not weeded

March 23, 2007

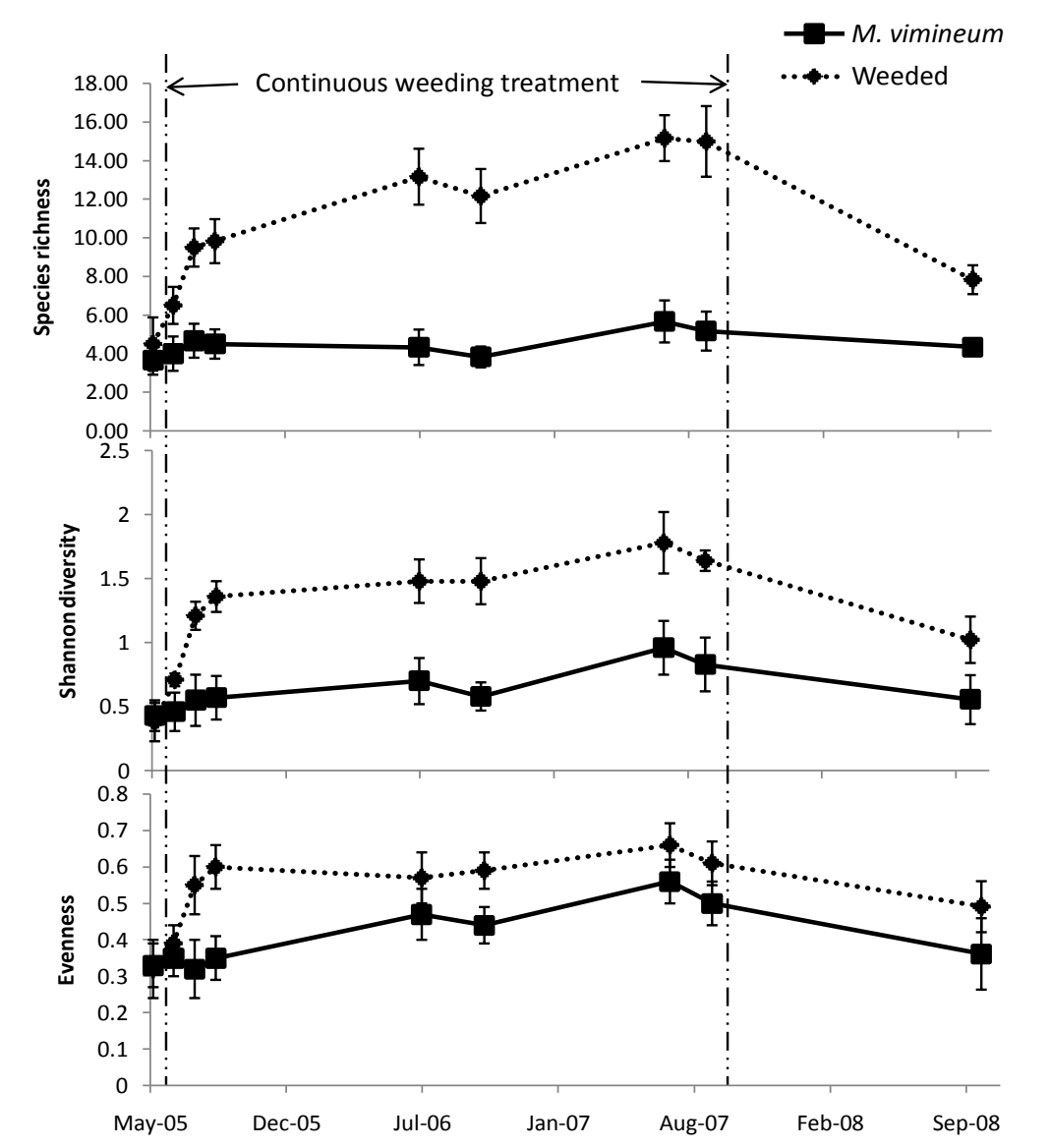
May 8, 2007

June 21, 2007

July 17, 2007

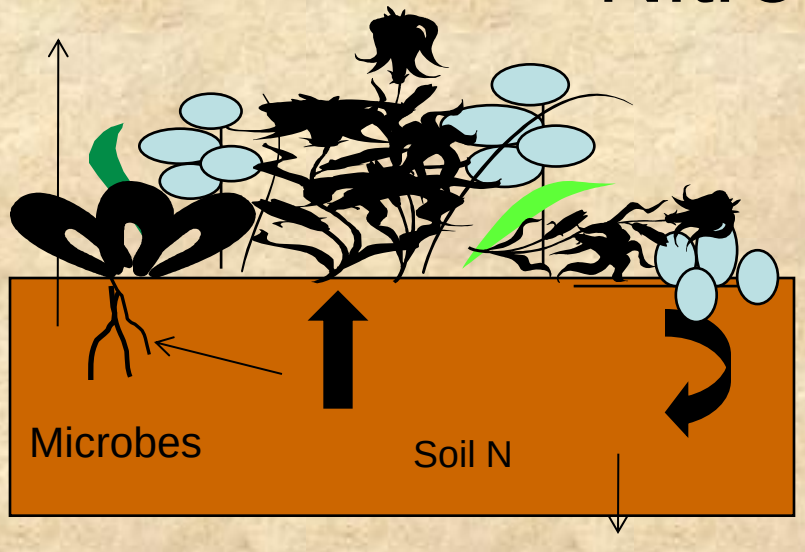
Sept 23, 2007

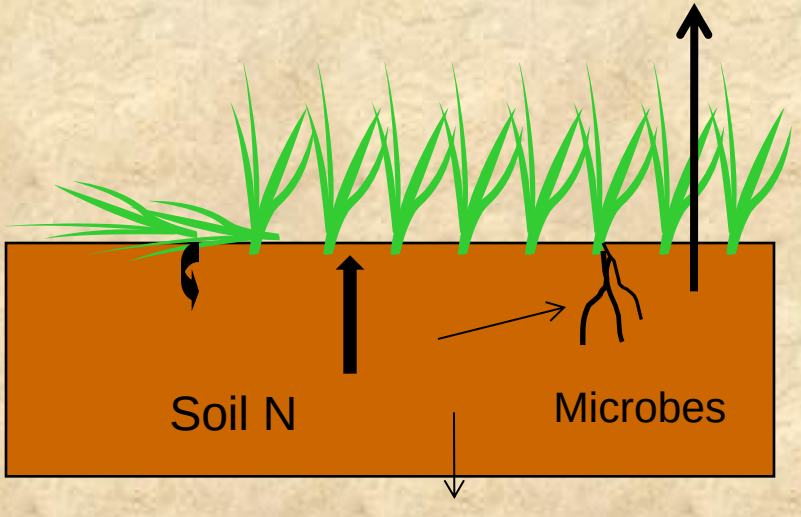
Species richness, diversity, and evenness quickly and dramatically increase



How does nitrogen cycling change when *Microstegium* dominates an otherwise diverse community?

Nitrogen cycling



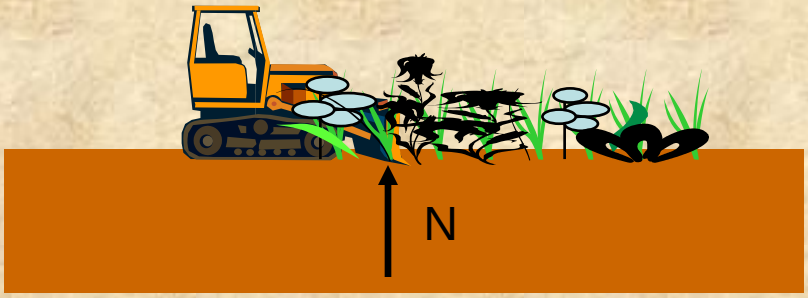


				Difference per m^2
Aboveground biomass N	9.36g	Aboveground biomass N	5.04g	4.40g
Root N	0.80g	Root N	0.59g	0.21g
Litter N recycling to soil	5.24g	Litter N recycling to soil	1.19g	4.05g
Soil inorganic N	0.94g	Soil inorganic N	1.31g	-0.37g
Mineralization potential	1.02g	Mineralization potential	0.91g	0.11g
Soil water leaching N	0.06g	Soil water leaching N	0.04g	0.02g
Redox	higher	Redox	lower	?

Research Questions

- Is *Microstegium* more invasive in high N?
- Does restoration disturbance increase N and promote invasive species?

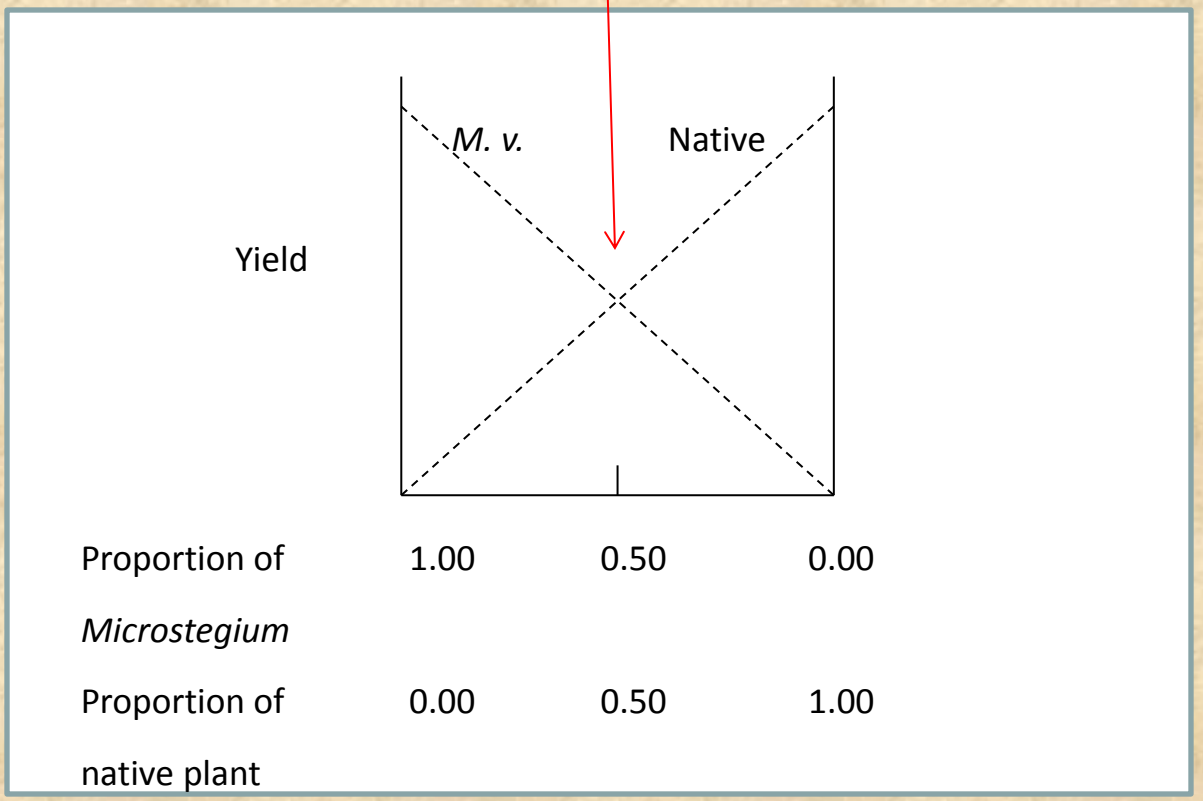
Does restoration disturbance elevate inorganic N and promote invasive plant growth?



- Clear-cut studies show that available N increases after vegetation removal

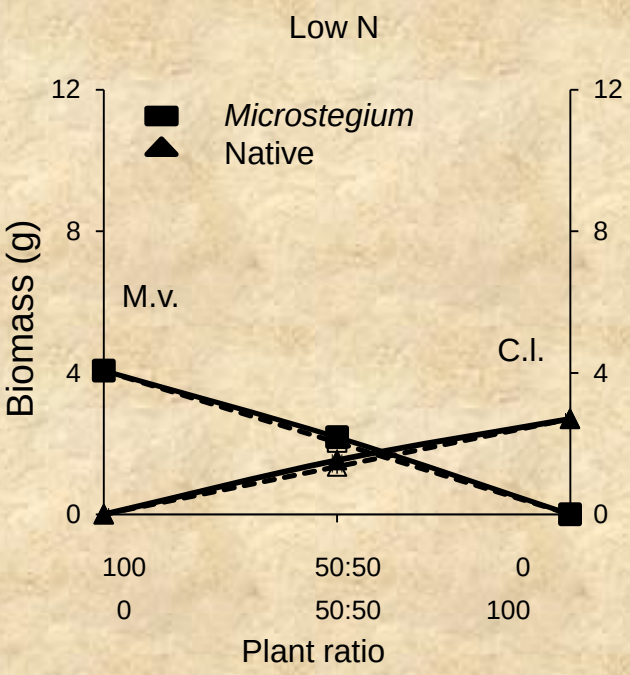
- Invasives show superior growth traits in high resources

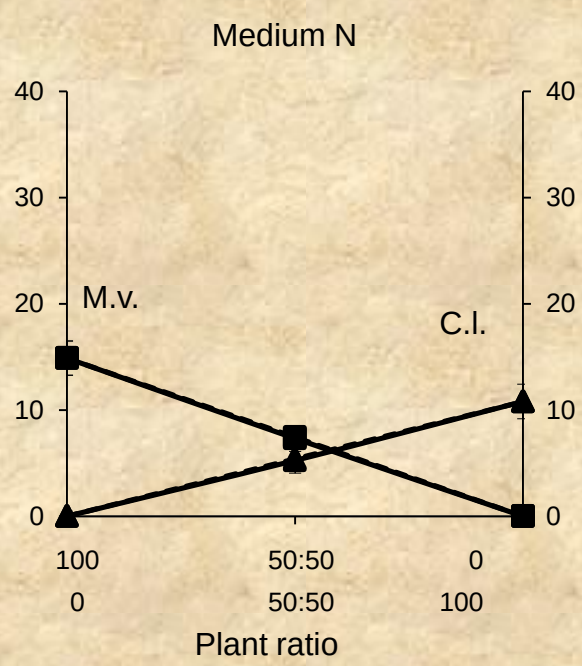
Replacement series design

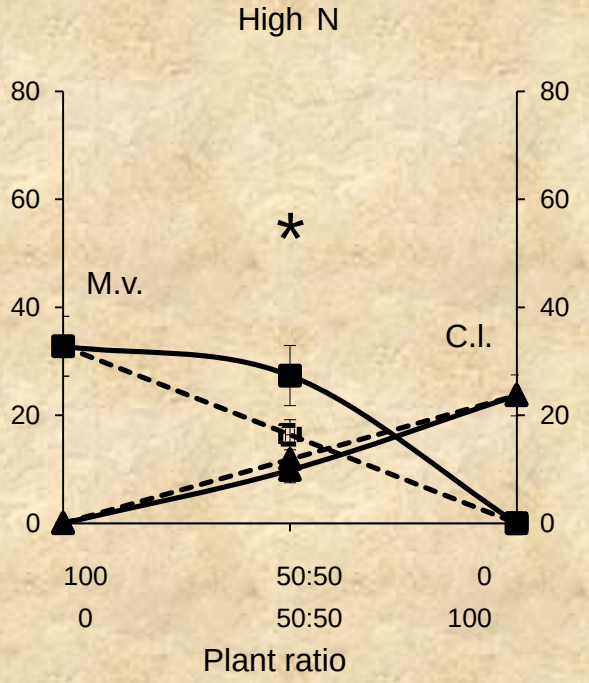


An example of no competition.

Microstegium vs. Carex





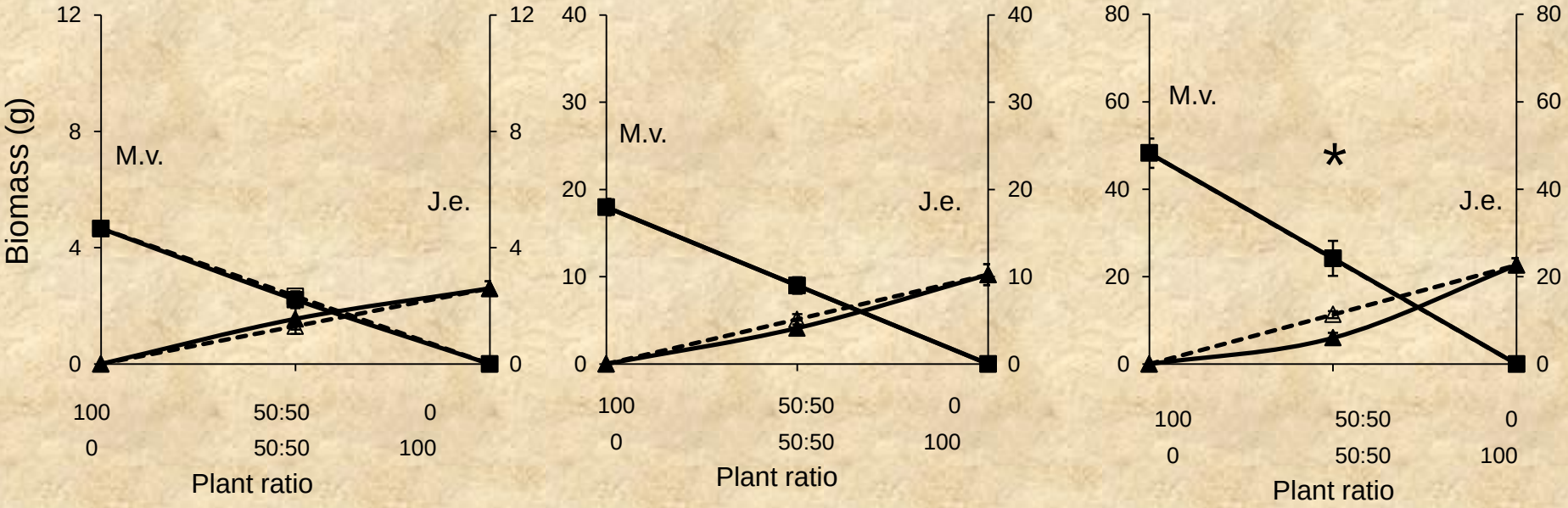


Microstegium vs. Juncus

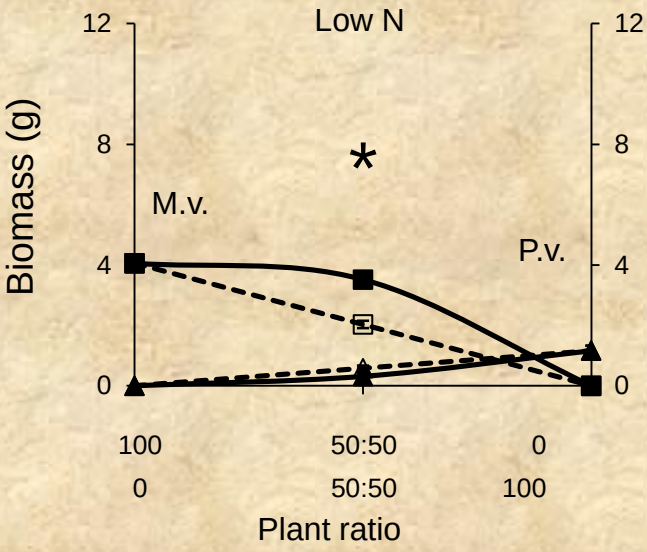
Low N

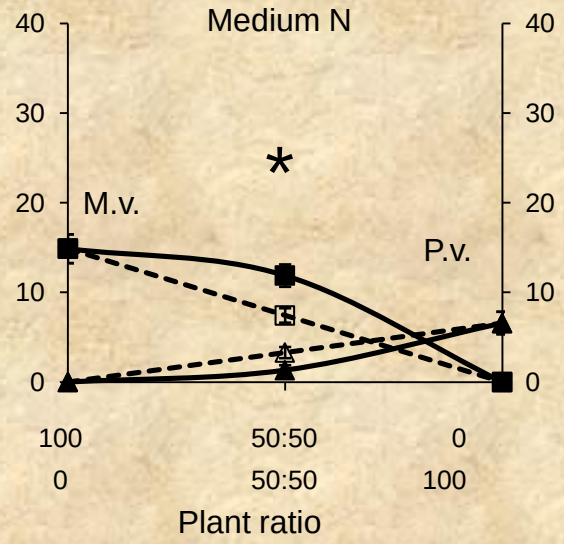
Medium N

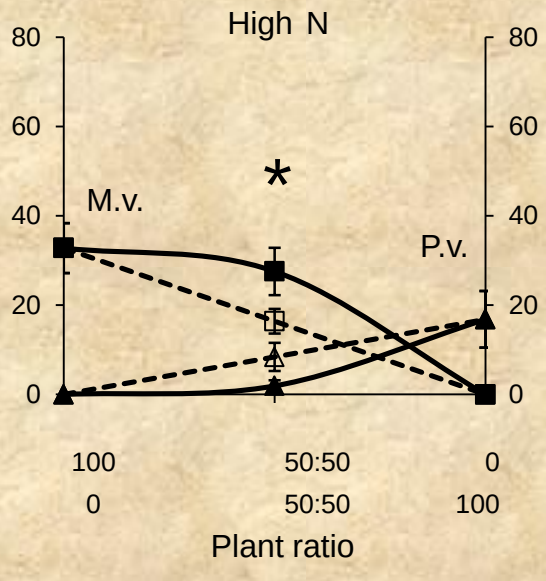
High N



Microstegium vs. Panicum





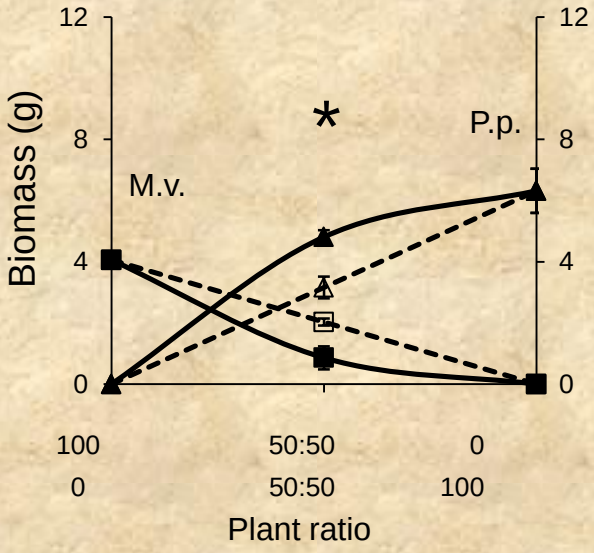


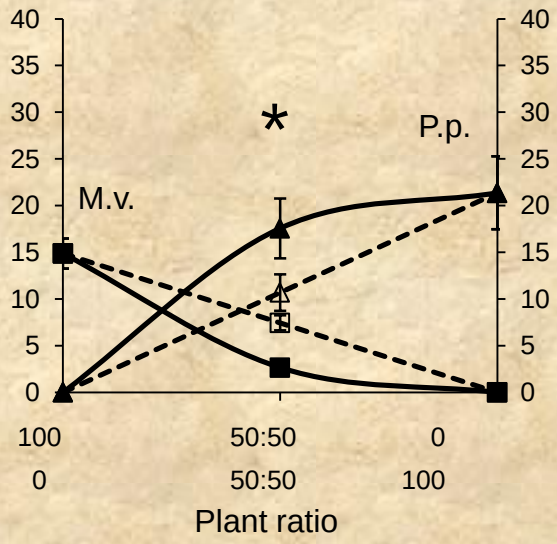
Microstegium vs. Polygonum

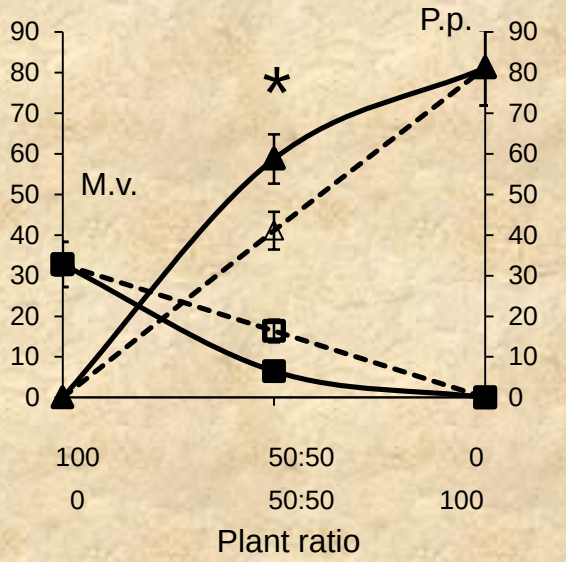
Low N

Medium N

High N







Greenhouse conclusions

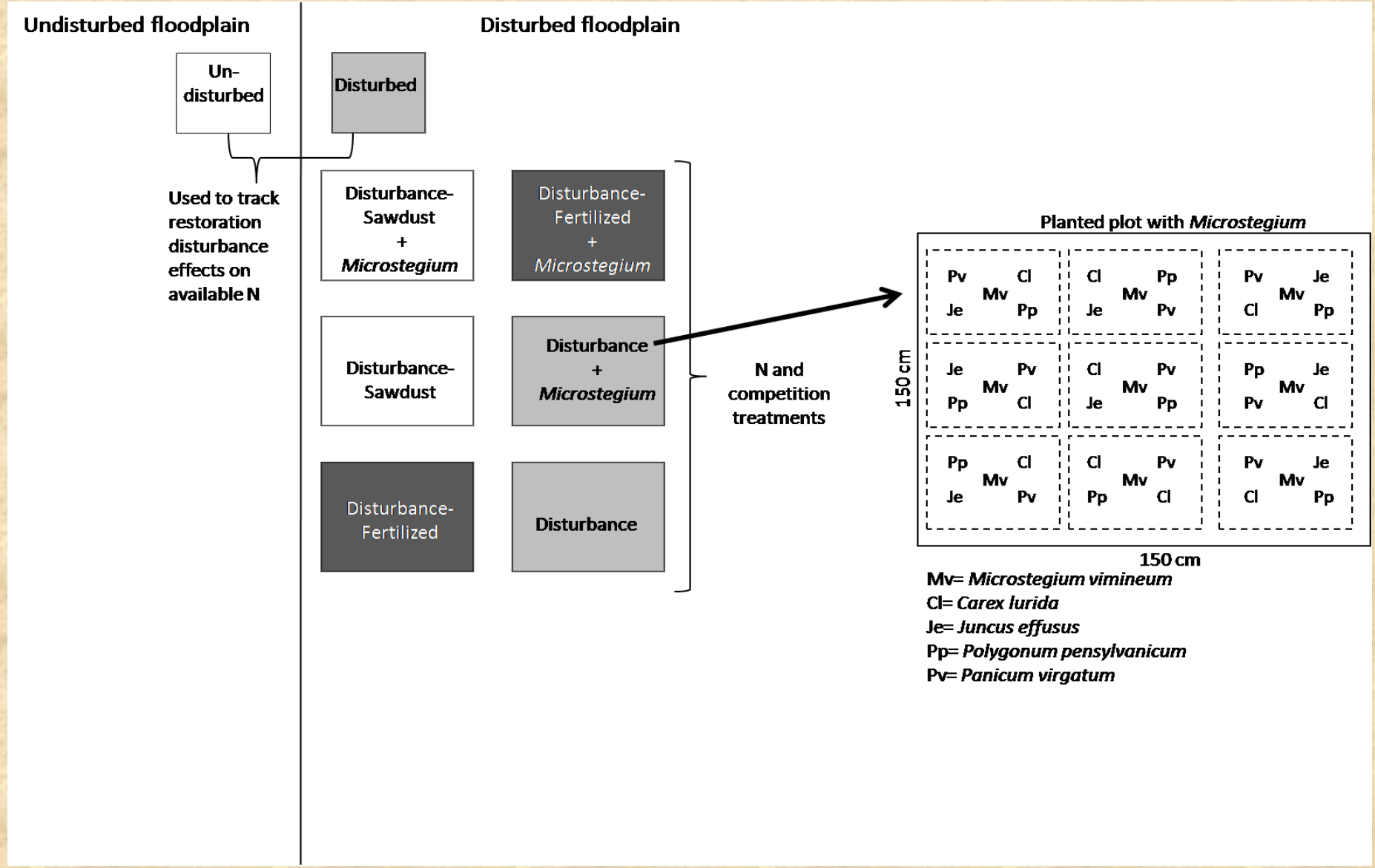
- *Microstegium* shows the most competition effects at high N

- *Microstegium* competition outcomes with native plants were species specific

Now to the field……

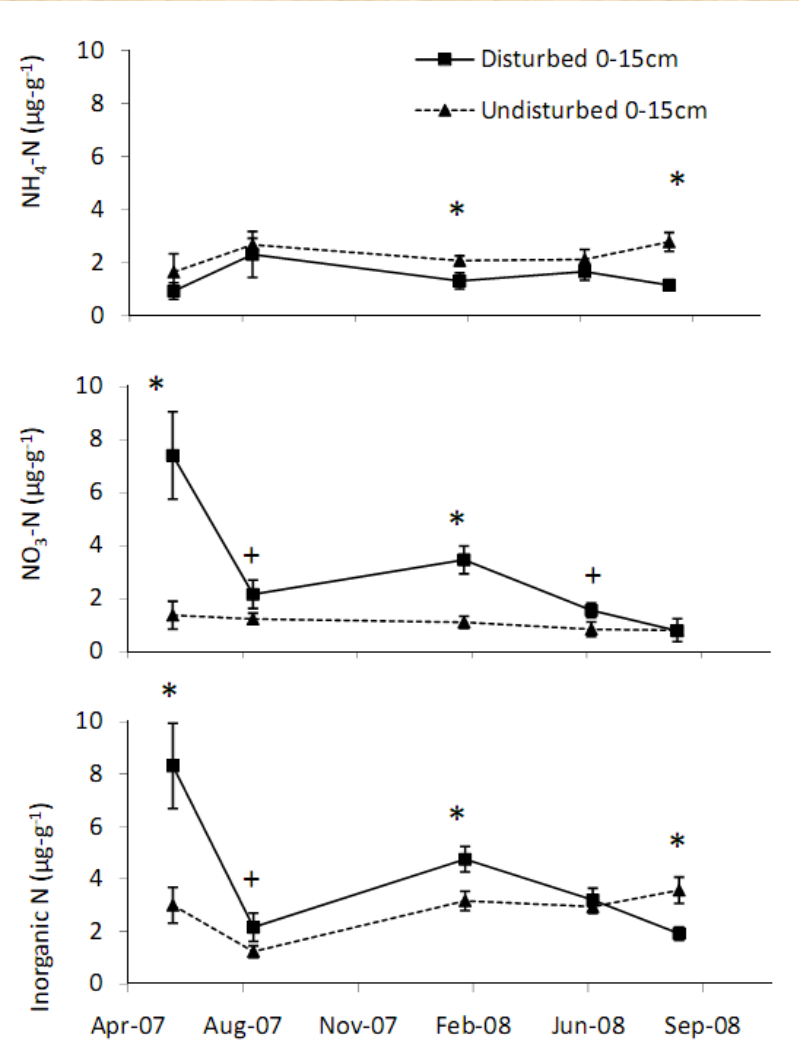
Disturbed floodplain…. rainbowland

Experimental design



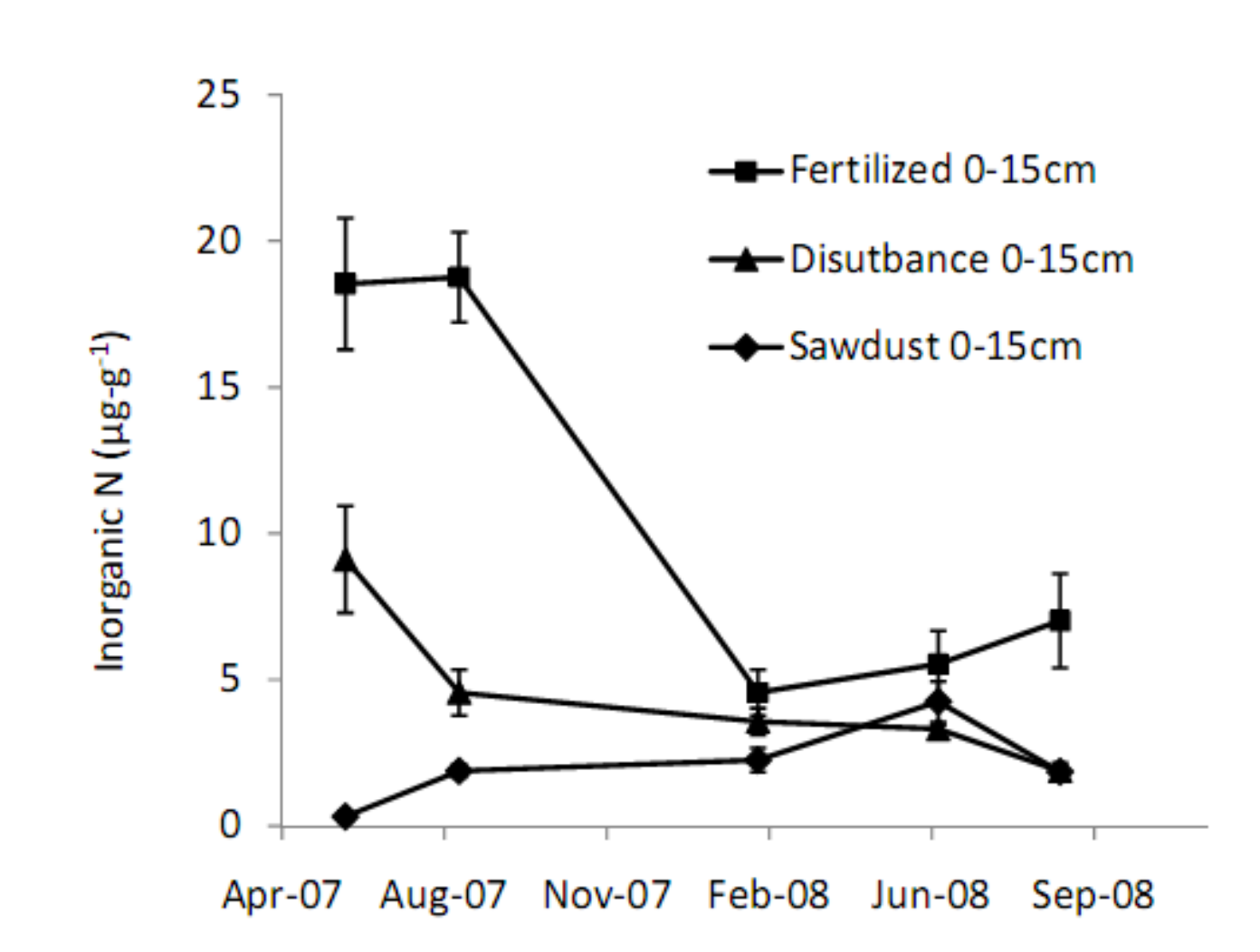
3 N treatments, 2 Invasive treatments, 2 controls, 6 blocks for 48 plots

Soil N after disturbance



Inorganic N is elevated for over a year, especially NO_3

Treatment plot N



Year 1- sawdust plots

With *Microstegium*

No *Microstegium*

Year 1- disturbance plots

With *Microstegium*

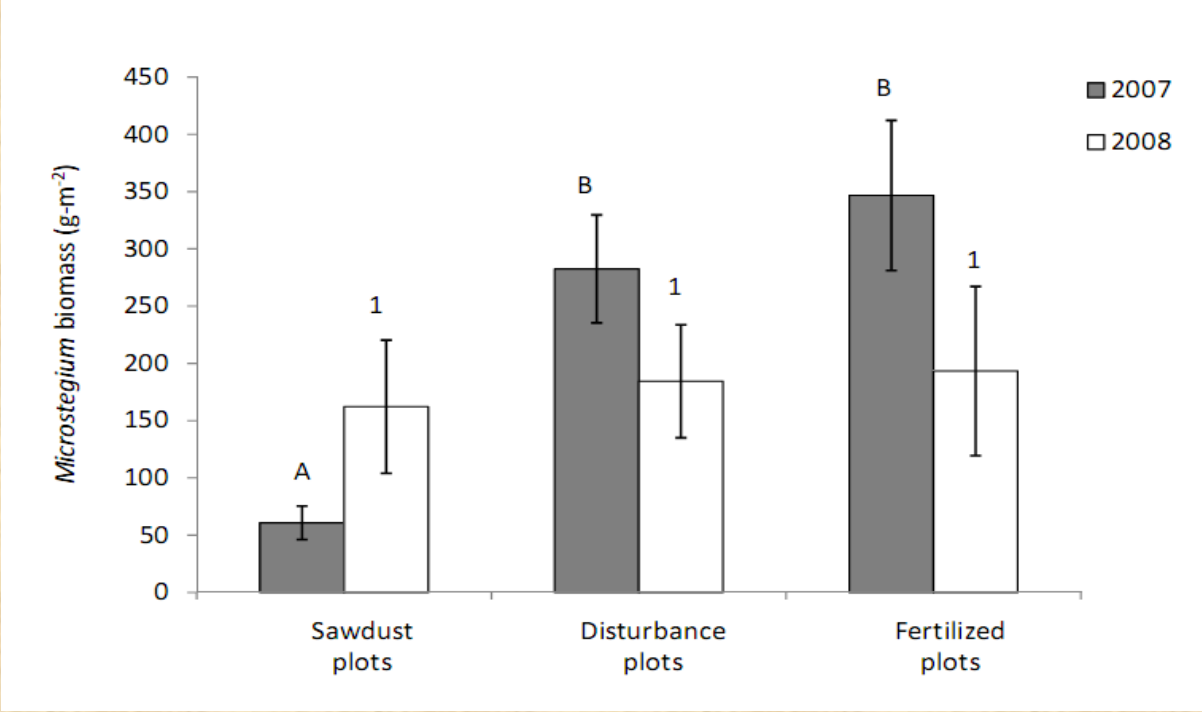
No *Microstegium*

Year 1- fertilized plots

With *Microstegium*

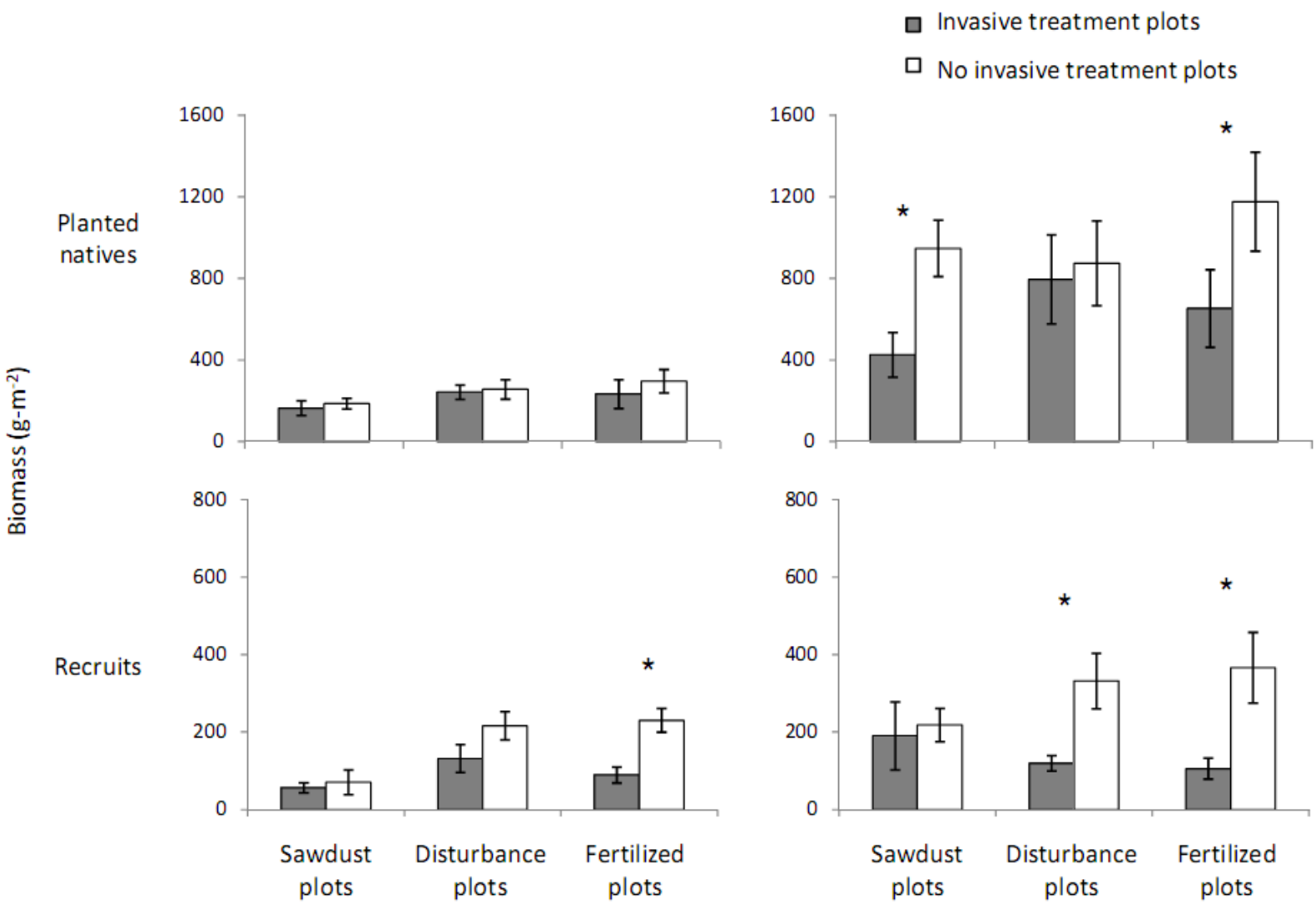
No *Microstegium*

Microstegium biomass



- *Microstegium* biomass significantly correlated with N in year 1…
- *Microstegium* biomass becomes more similar in year 2

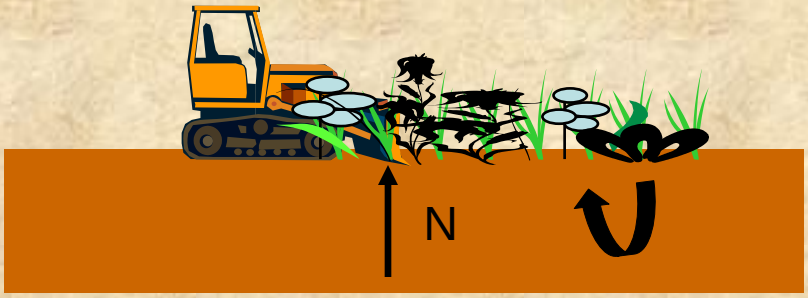
Treatment plot biomass



Disturbance conclusions

- Restoration disturbance caused a significant increase in inorganic N > 1 year
- Sawdust was a short-term remedy for high N
- *Microstegium* was correlated with N and had the most biomass in year 1, yet only suppressed recruit vegetation…..
- There was a lag invasive effect- year two *Microstegium* reduced the biomass of the vegetation by ~42% compared to non-MV plots

Overall conclusions



- Restoration disturbance is elevating inorganic N and promoting *Microstegium*… yet the invasive effect takes more than a year to appear
- *Microstegium* is N responsive and shows the most competition at high N
- *Microstegium* reduces diversity and slows internal N cycling


Questions?