Getting the jump on invasives: Considerations during habitat management and restoration

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Getting the jump on invasives

-  Invasion and disturbance
-  Predicting susceptible areas
-  An example with cogongrass
-  Interpreting results

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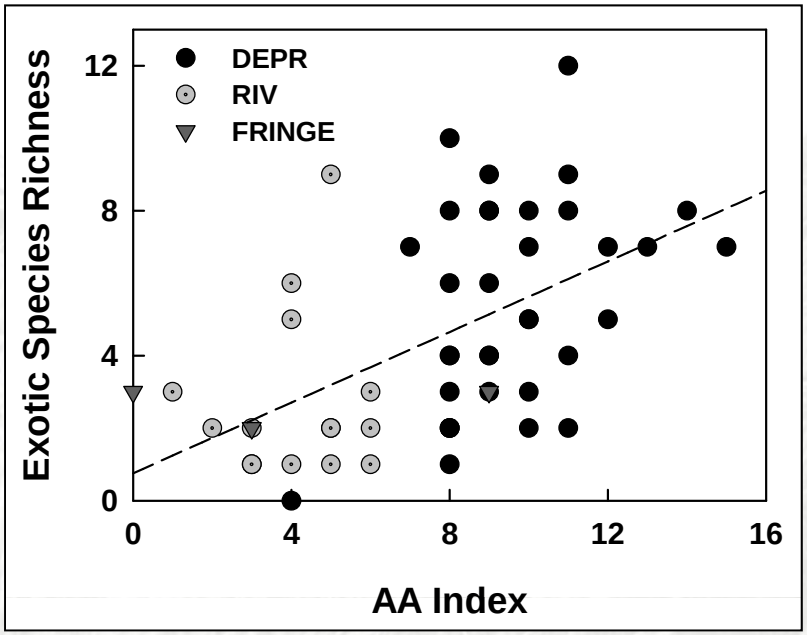
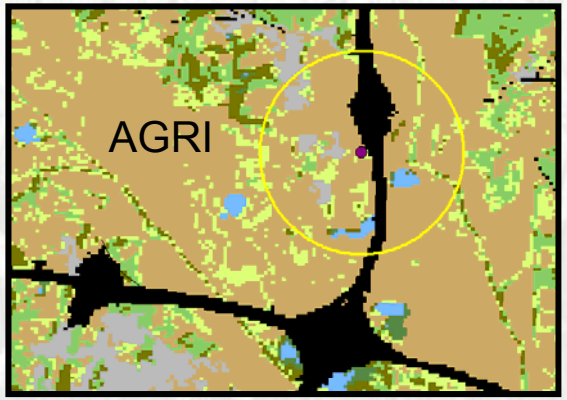
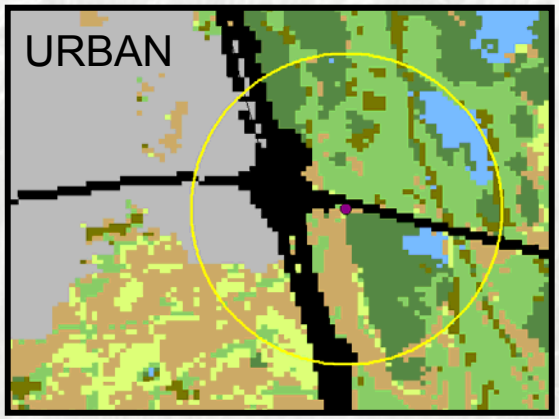
Human disturbance and exotic species in wetlands

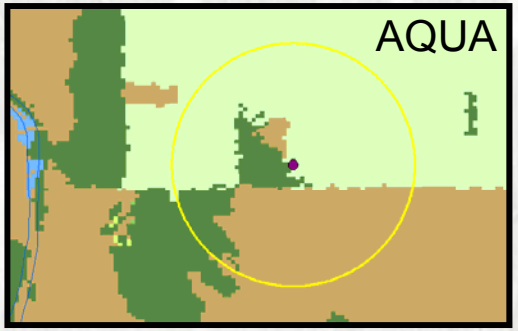




AAI = 13
41 Native
7 Exotic



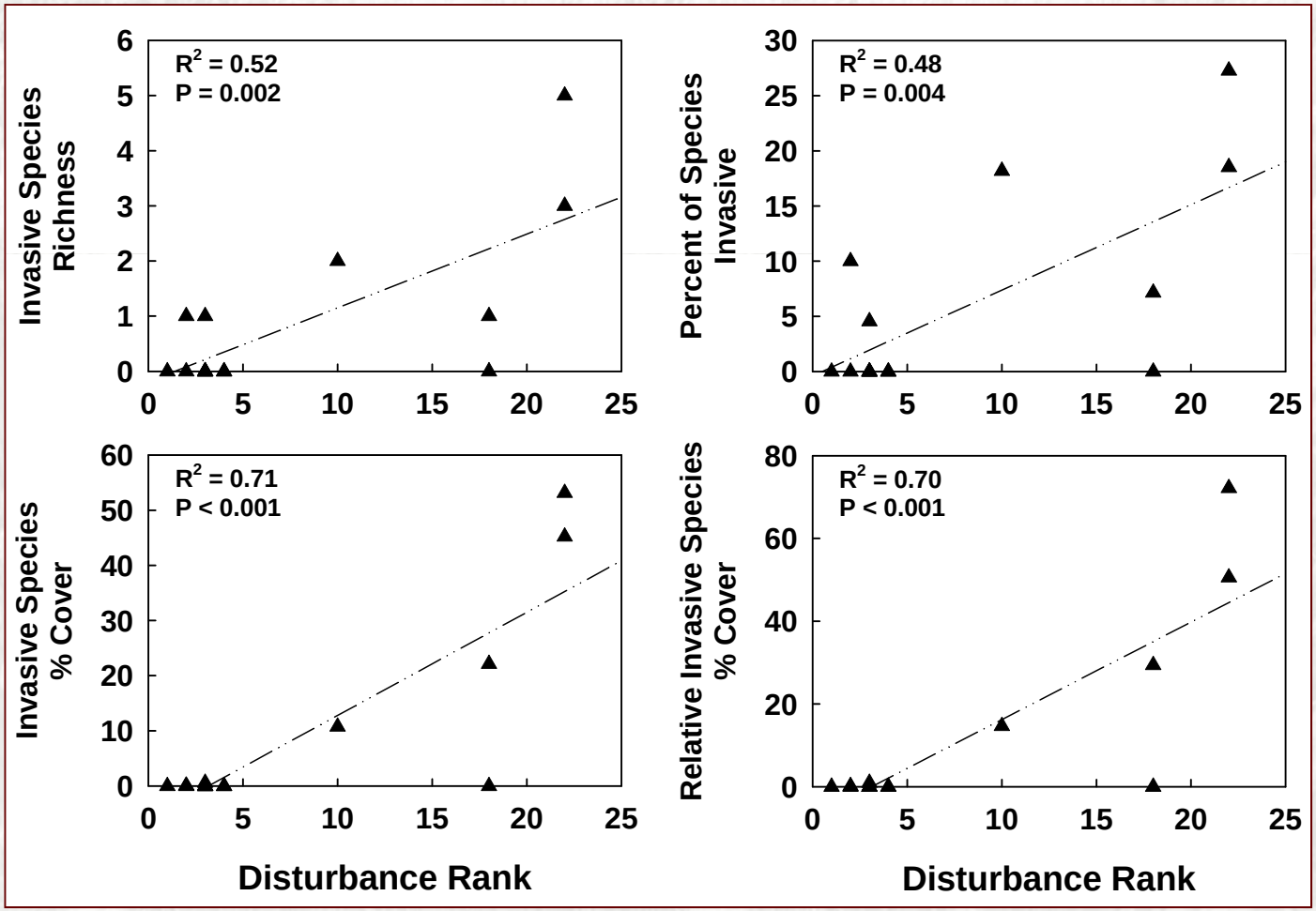
AAI = 9
39 Native
8 Exotic



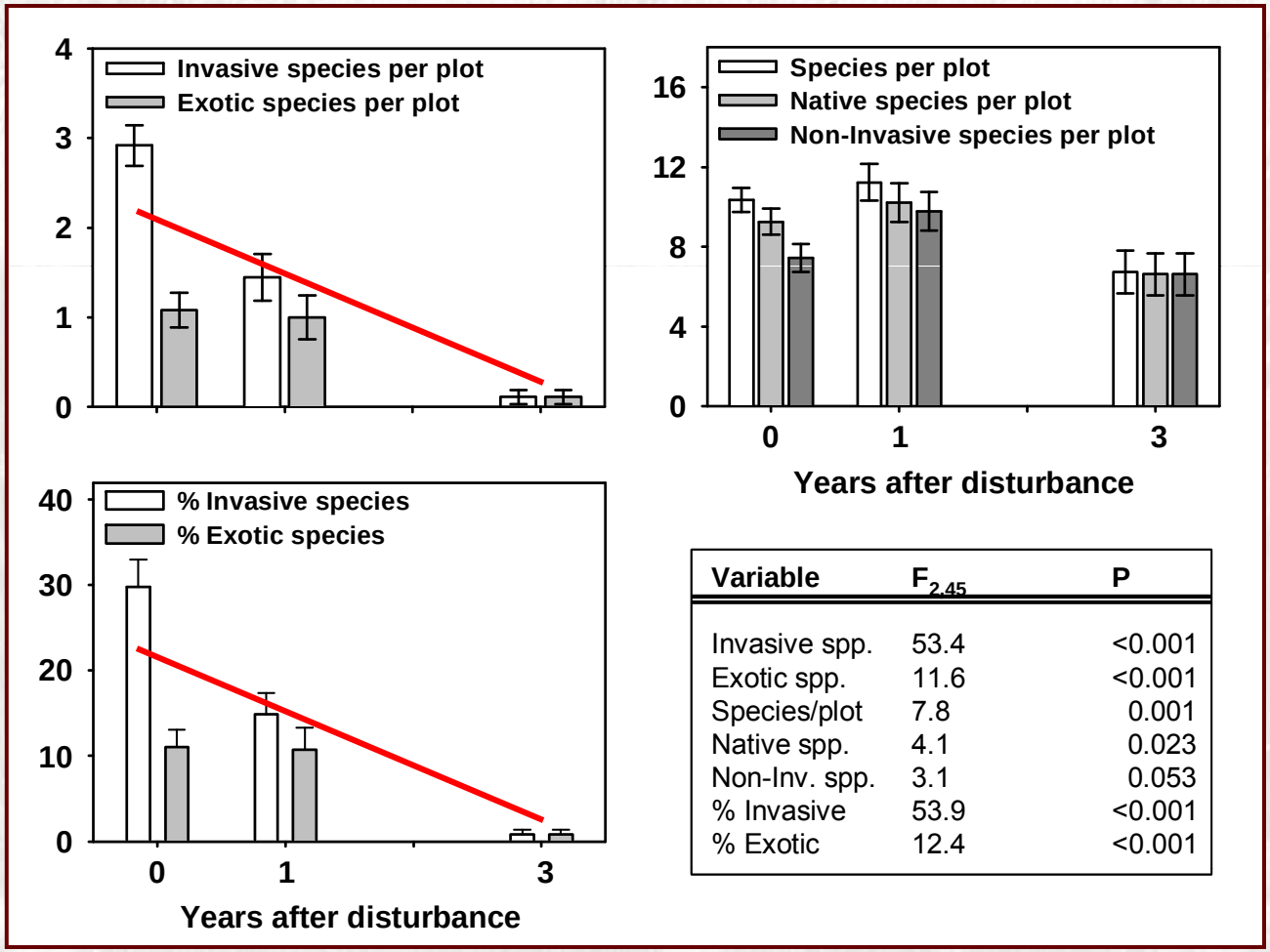
AAI = 14
37 Native
7 Exotic

Ervin et al., 2006. *Wetlands.*

Human disturbance and exotic species in wetlands

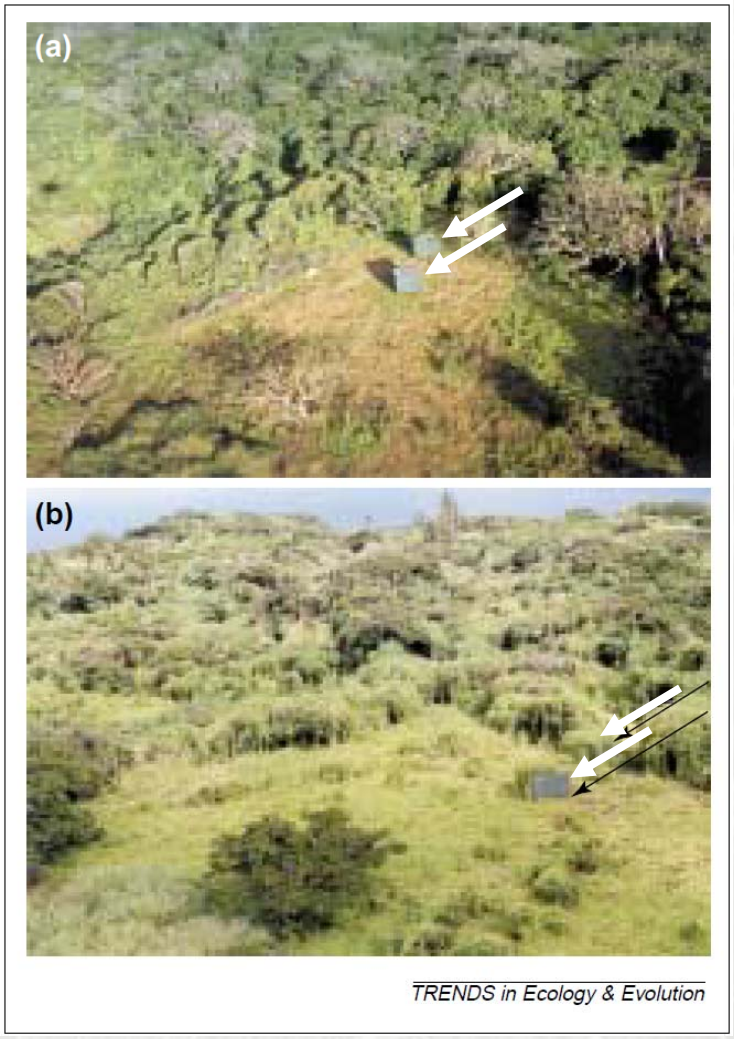


Human disturbance and exotic species in wetlands



Variable	$F_{2,45}$	P
Invasive spp.	53.4	<0.001
Exotic spp.	11.6	<0.001
Species/plot	7.8	0.001
Native spp.	4.1	0.023
Non-Inv. spp.	3.1	0.053
% Invasive	53.9	<0.001
% Exotic	12.4	<0.001

An example of invasion after restoration - Release of an exotic vine after feral goat and pig removal, Mariana Islands



Zavaleta et al., 2001

“Spread by Cogongrass...has doubtless been due to wind-blown seed and stolons transported along highways by road machinery” (Tabor 1952).

John D. Byrd, Mississippi State University, Bugwood.org

Mark Atwater, Weed Control Unlimited, Inc. Bugwood.org

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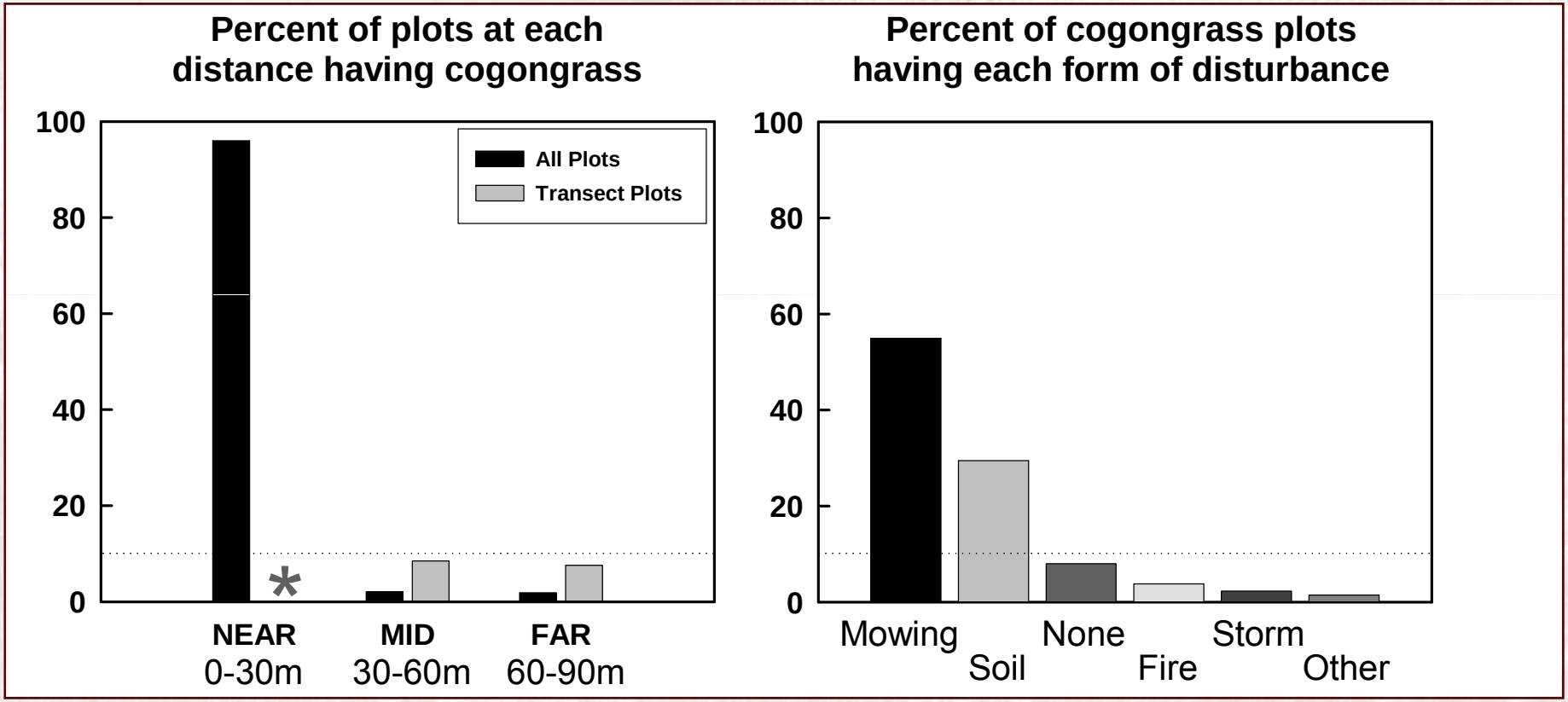
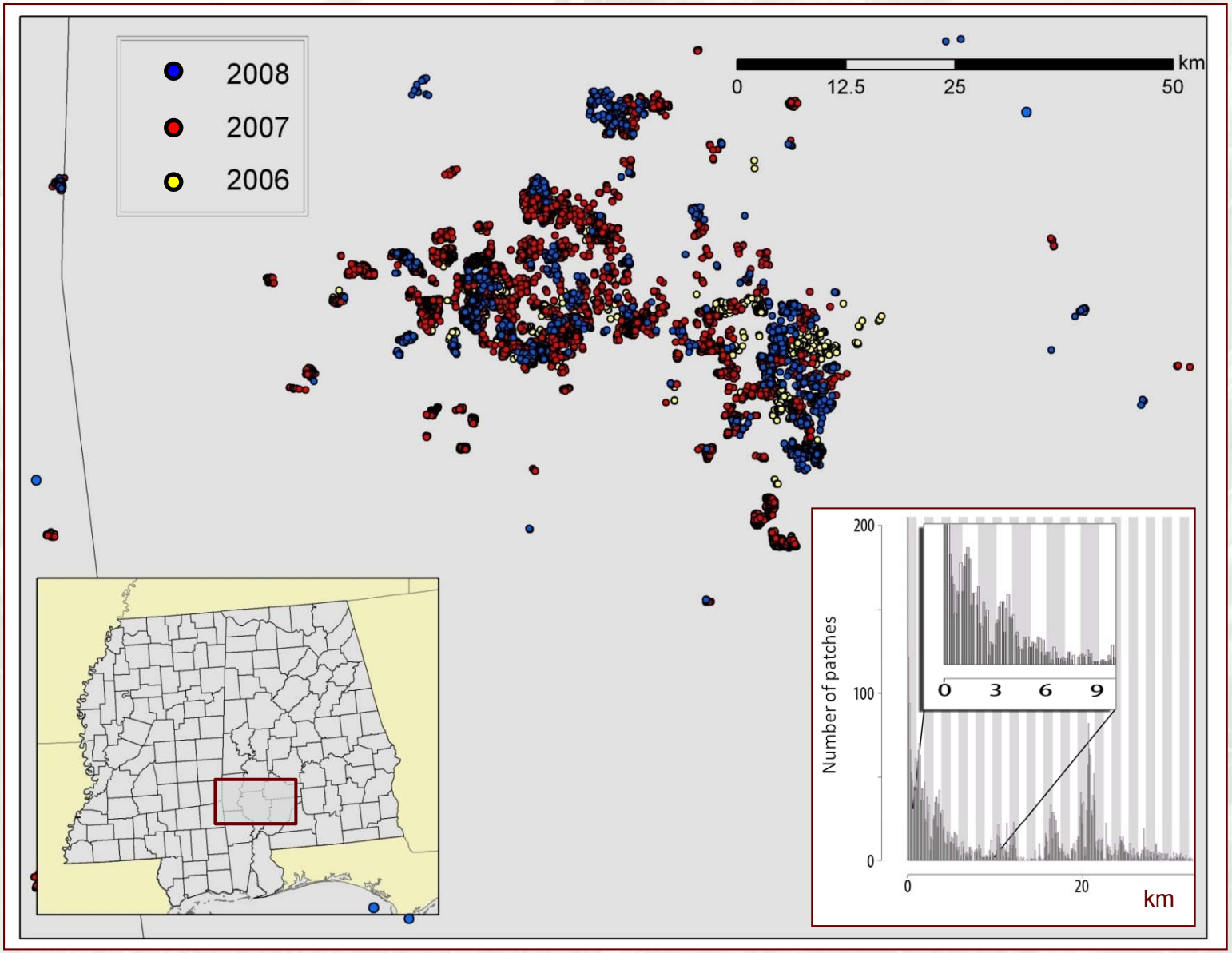
Cogongrass and disturbance



Cogongrass patch density



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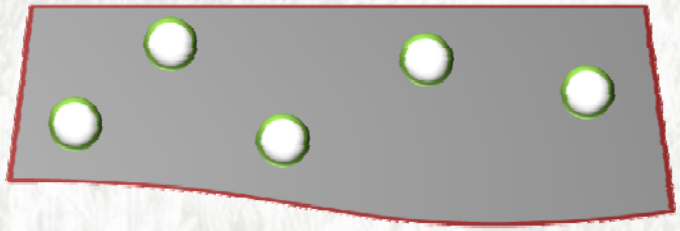
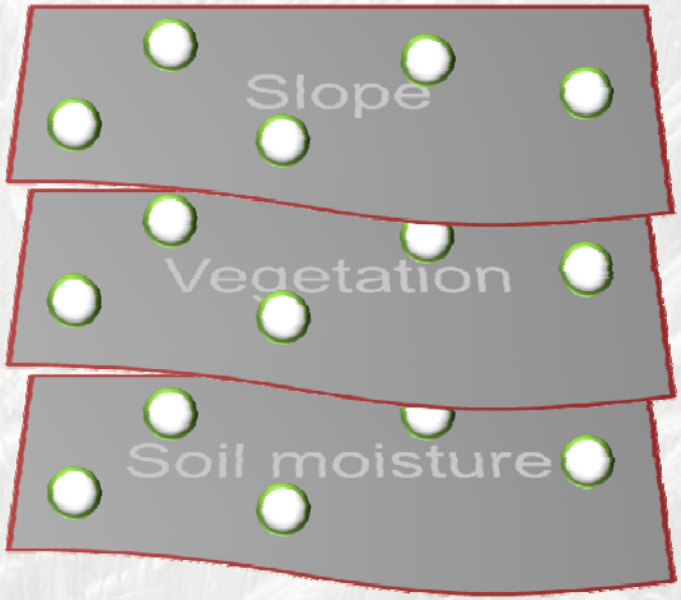
Interpreting results

Habitat modeling - General approach

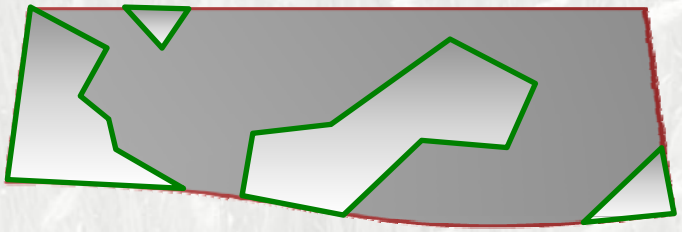
Occurrence points



Environmental data



Predicted habitat



Application of habitat modeling for rare/threatened species

Rare broadleaf trees in Utah

Zimmermann et al. 2007

Endangered *Eryngium* in Switzerland

Engler et al. 2004

Monarch butterflies

Oberhauser & Peterson 2003

Application of habitat modeling for invasive species

Eurasian watermilfoil in Wisconsin

Buchan & Padilla 2000

Purple loosestrife in North America

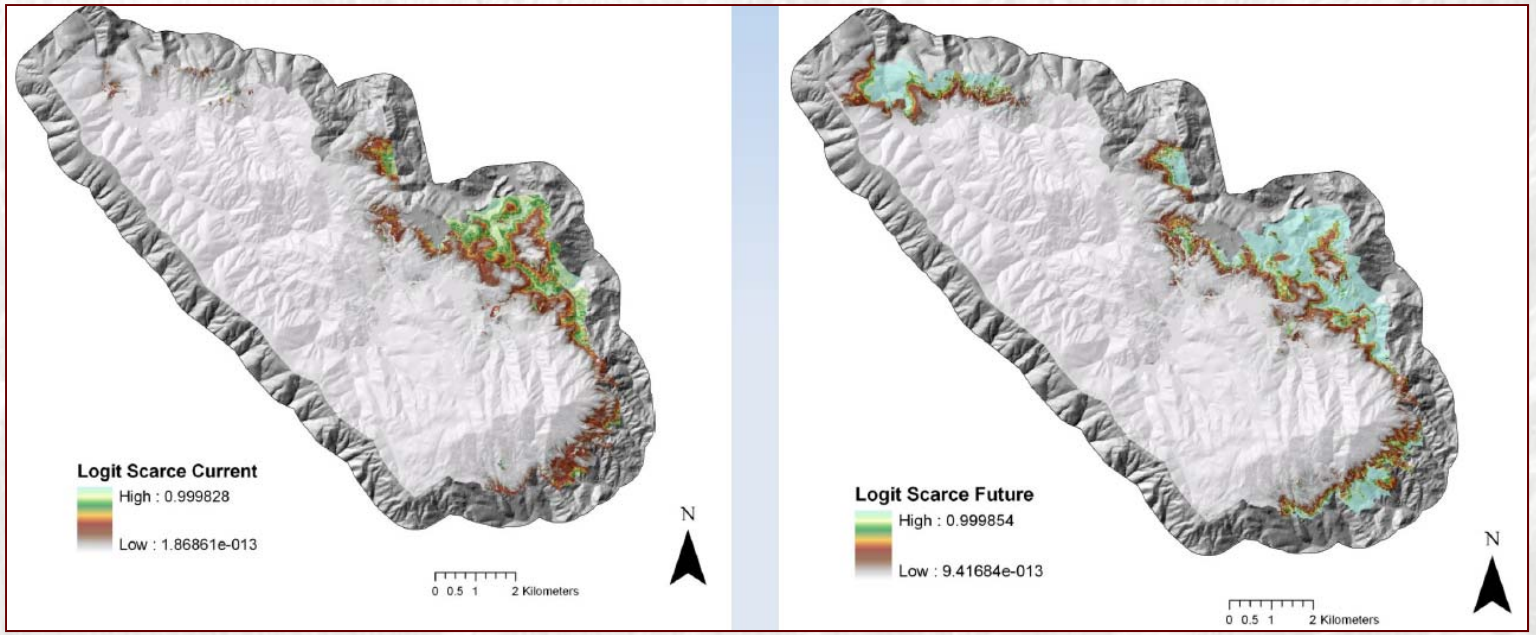
Welk 2004

Invasive plants across North America

Peterson et al. 2003

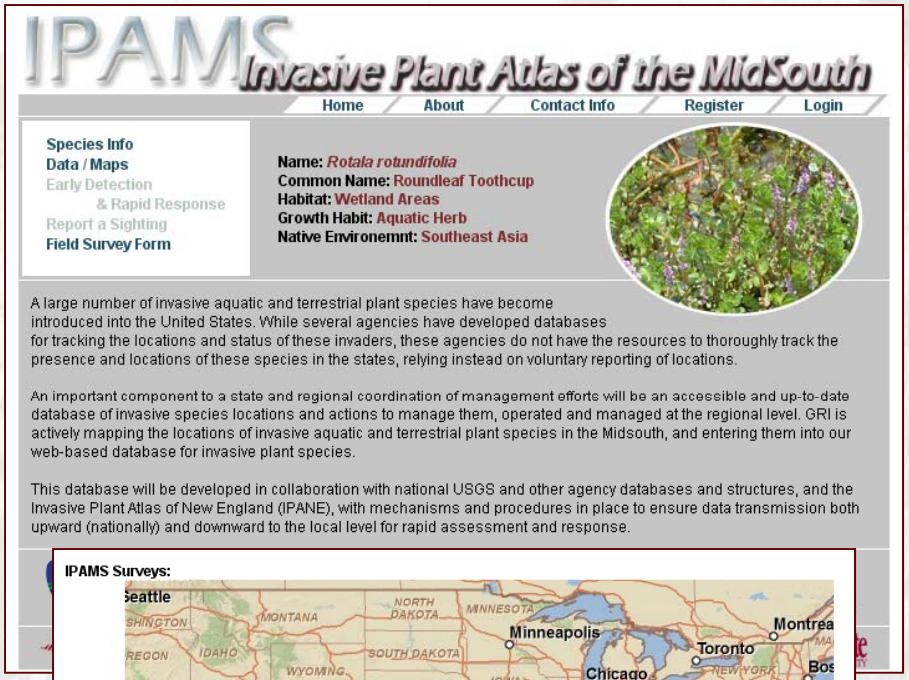
Example

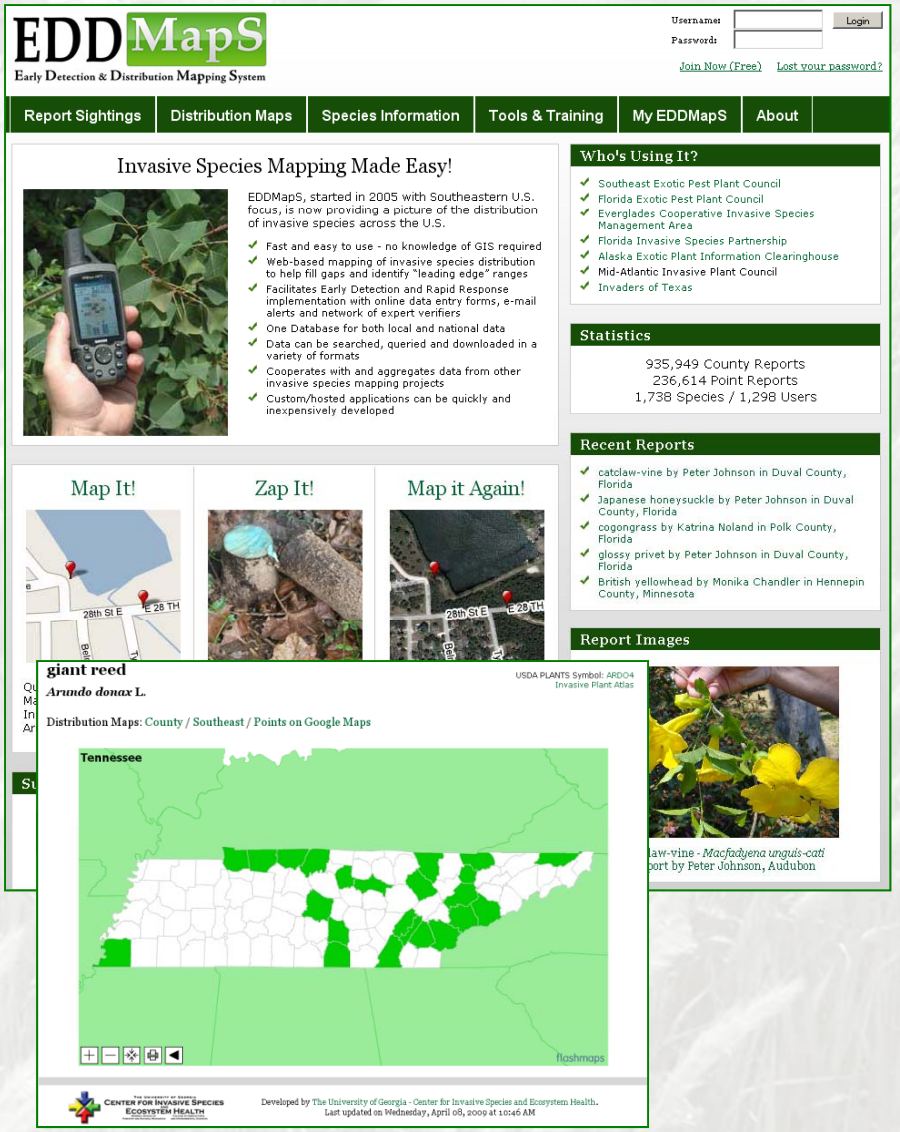
Modeling of *Genista monspessulana* spread in association with prescribed burning, Marin County, CA



Hollander and DiPietro, 2010

Databases for invasive species





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An example with cogongrass
Interpreting results

Imperata cylindrica - cogongrass

First introduced through the port of Mobile Bay, AL during early 20th century

One of worlds “Ten Worst Weeds”

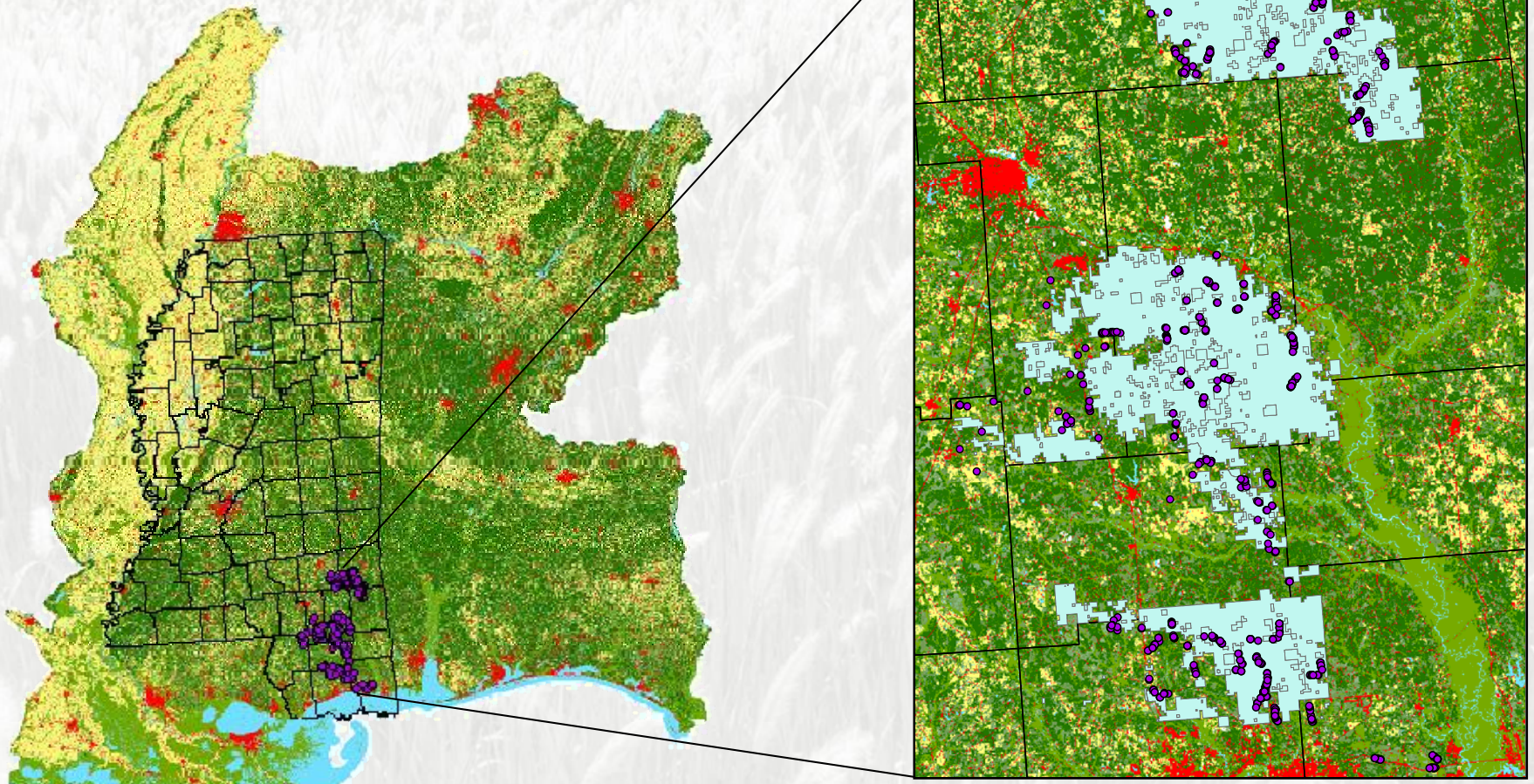
Infests between 500,000 to 1 million acres of land in MS, AL, and FL

Causes significant economic costs for land managers

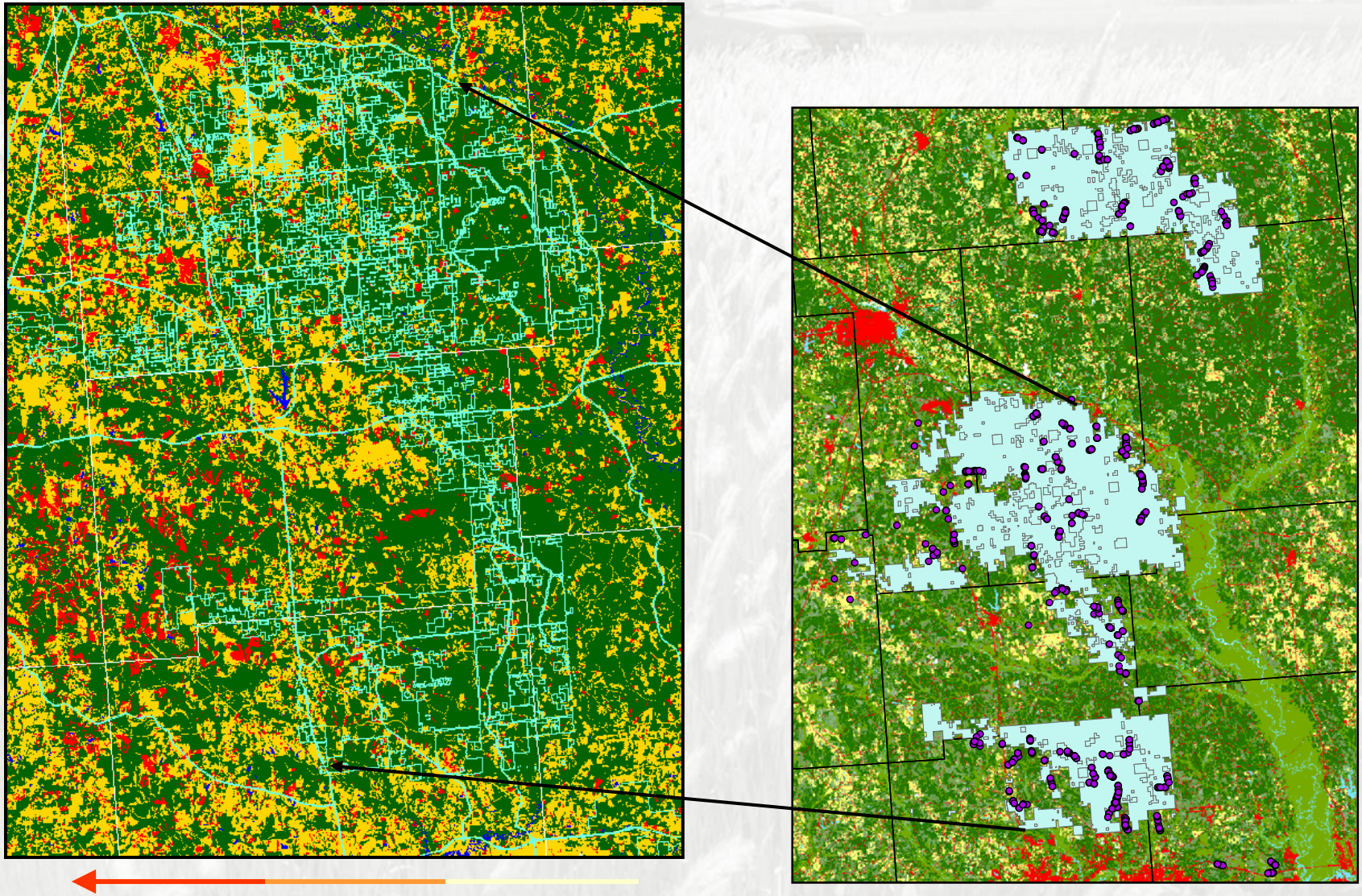
Threatens native biodiversity and ecosystem function

Completely alters native south MS *Pinus palustris* fire regimes

Study area

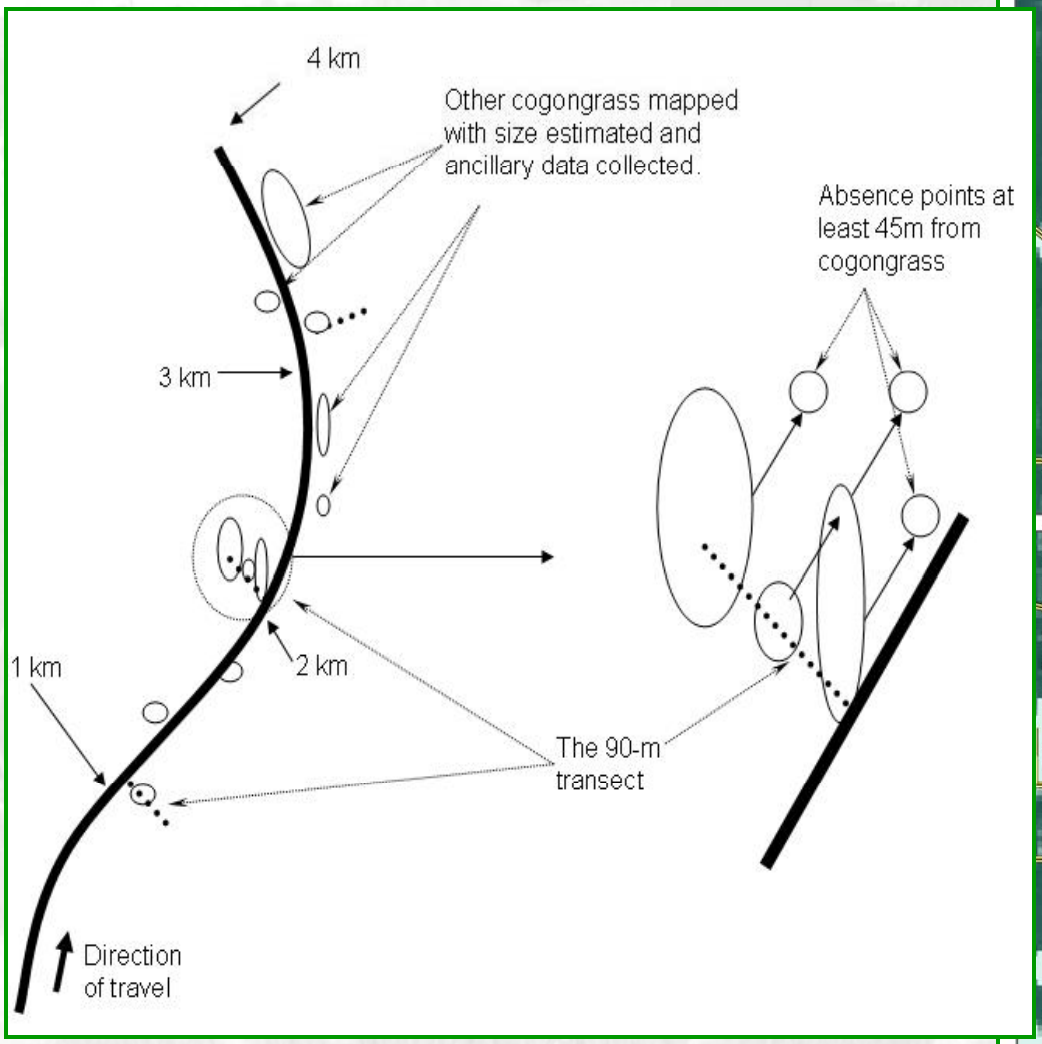


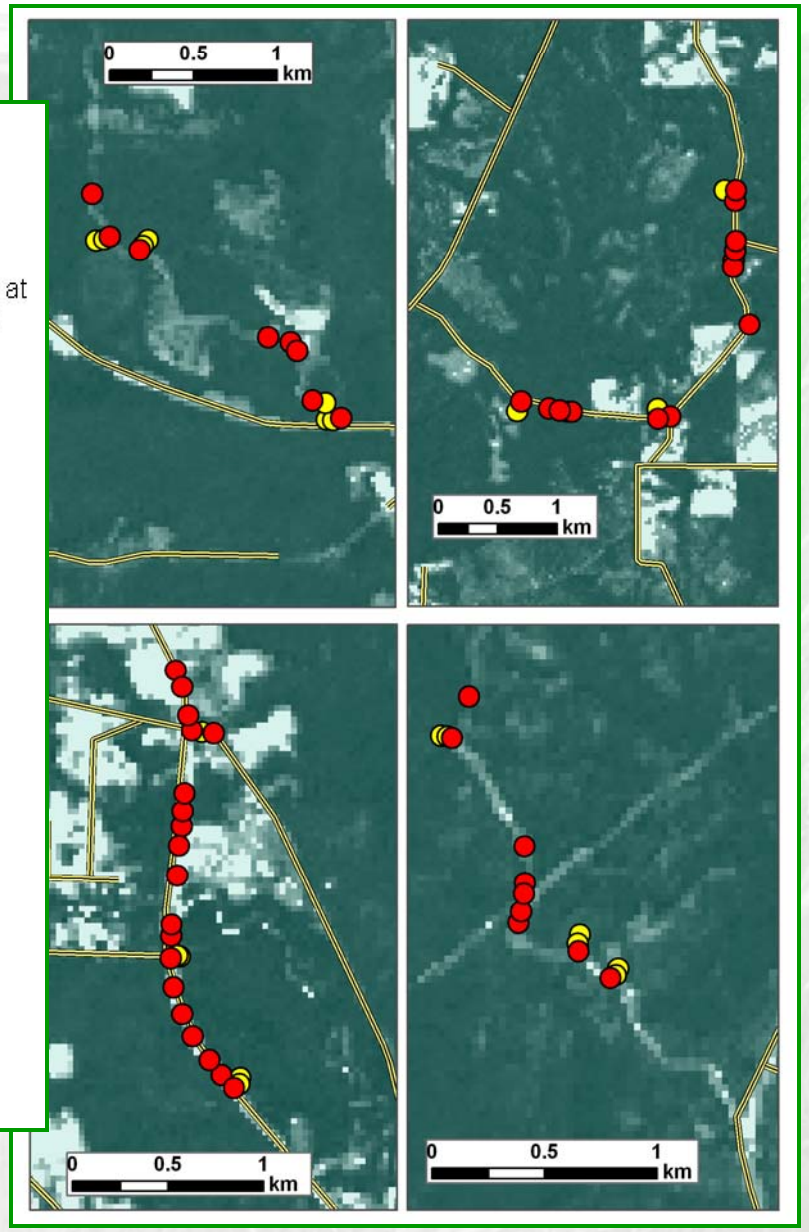
Study area



Increasing deforestation 2004-06

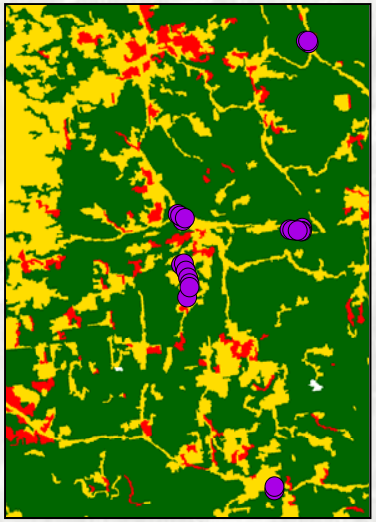
Surveys

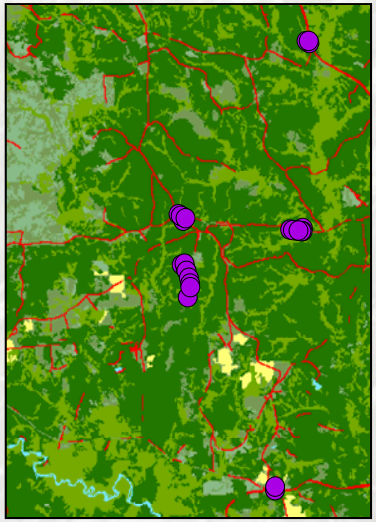

4 km
Other cogongrass mapped with size estimated and ancillary data collected.
Absence points at least 45m from cogongrass
3 km
1 km
2 km
The 90-m transect
Direction of travel


0 0.5 1 km
0 0.5 1 km
0 0.5 1 km
0 0.5 1 km

Candidate predictor variables of invasion

Disturbance	Proximity to Road	Hurricane Associated Deforestation	Forest Community	Abiotic
Fire	Far 60 - 90m	Non-Forest	Evergreen	Sand (%)
Mow	Mid 30 - 60m	Forest	Mixed	Organic Matter (%)
Soil	Near 0 - 30m	Changed	Developed (absent)	pH
Storm		(2004-2006)		Canopy Cover (%)
None				





Results

Model Step	Model Effect	Wald Chi-Square	P-value	Nagelkerke R^2	SC	AUC
-----*Effects Removed*-----						
0	Global Model	45.0254	<.0001	0.6392	222.623	0.894
1	Forest Type	0.1187	0.9424	0.6388	212.148	0.895
2	OM	0.2003	0.6545	0.6381	207.048	0.894
3	Canopy	0.4112	0.5213	0.6366	202.161	0.893
4	pH	1.4789	0.2239	0.6313	198.362	0.879
5	Deforestation	4.2242	0.1210	0.6165	191.865	0.878
-----*Effects Retained*-----						
*	Disturbance	10.1282	0.0383			
*	Prox. RD	17.2936	0.0002			
*	% Sand	4.5930	0.0321			
***	**Final Model**	**43.0960**	**<.0001**	**0.6165**	**191.865**	**0.878**

Modeling Approach

Data

***Imperata* presence-absence (360 points):**

205 presence & 155 absence from six counties in southern Mississippi

Soil (SSURGO geospatial data layers):

available water capacity, bulk density, clay & sand content, effective CEC, organic matter content, hydraulic conductivity, pH
(all mapped as "representative value" per mapping unit)

Canopy cover (from MRLC database)

Distance to roads (measured in GIS vs. primary and secondary roads)

Analyses

Correlation analyses among soil parameters to exclude correlated variables

→ resulted in 34 candidate logistic regression models

Accuracy criteria vs. training data

Parameters in model	succ	sens	spec	kappa	TSS
vs. Training data					
– Canopy	0.69	0.72	0.64	0.36	0.36
– Canopy – BDens	0.69	0.72	0.64	0.35	0.36
vs. Validation data					
– Canopy	0.76	0.79	0.72	0.51	0.51
– Canopy – BDens	0.75	0.77	0.73	0.49	0.50

Equations used to generate raster layer in GIS

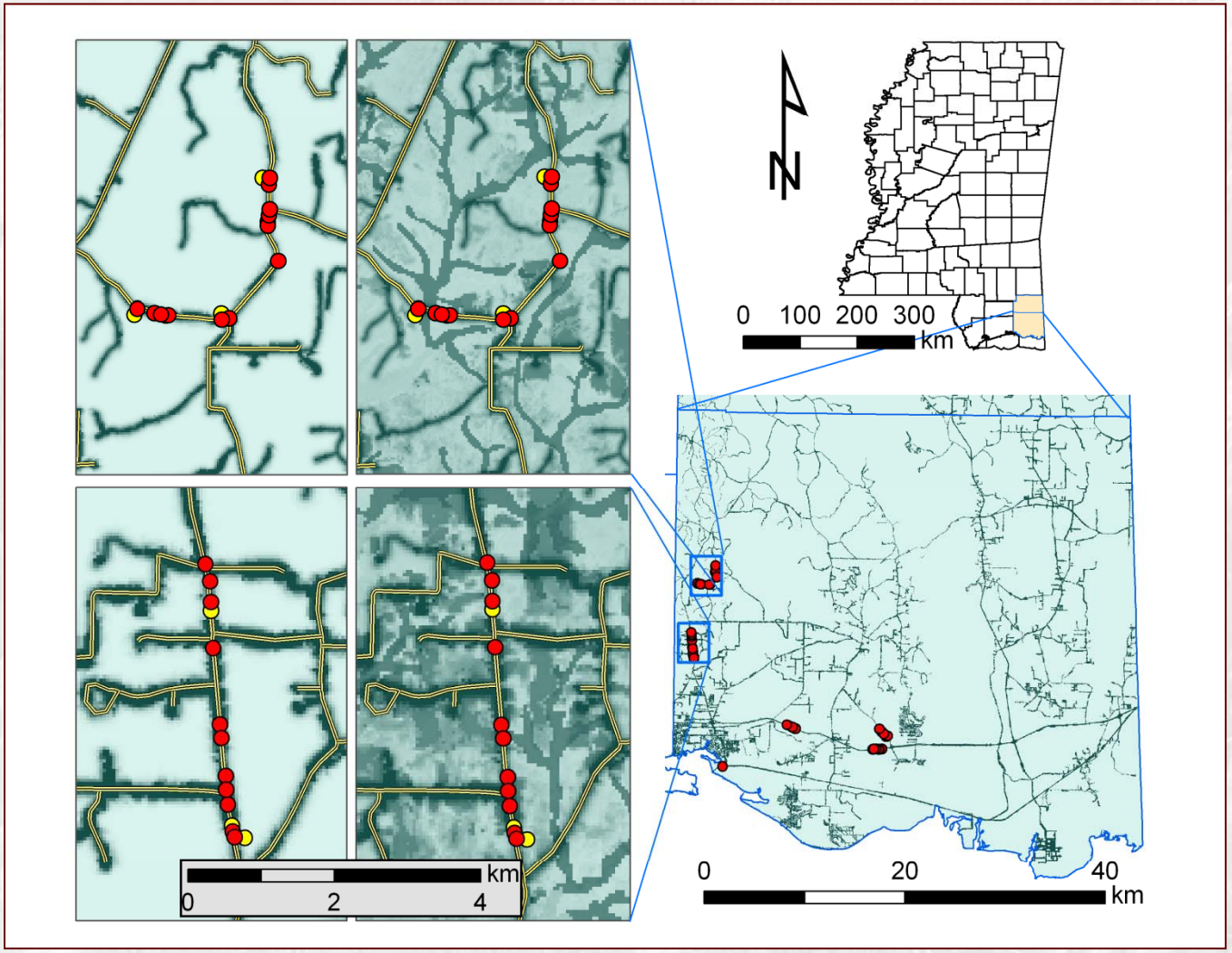
Canopy only model:

$$\textbf{Probability of occurrence} = \frac{e^{(-0.021*\text{Canopy} + 1.43)}}{1 + e^{(-0.021*\text{Canopy} + 1.43)}}$$

Canopy and bulk density model:

$$\textbf{Probability of occurrence} = \frac{e^{(-0.021*\text{Canopy} - 2.172*\text{BD} + 4.602)}}{1 + e^{(-0.021*\text{Canopy} - 2.172*\text{BD} + 4.602)}}$$

Model surfaces



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Interpreting outside a GIS environment

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Interpreting outside a GIS environment

Canopy only model:

$$\textbf{Probability of occurrence} = \frac{e^{(-0.021*\text{Canopy} + 1.43)}}{1 + e^{(-0.021*\text{Canopy} + 1.43)}}$$

Predicts ≥ 50% probability of suitable habitat at

Canopy cover of less than 70%

Interpreting outside a GIS environment

Canopy only model:

$$\textbf{Probability of occurrence} = \frac{e^{(-0.021*\text{Canopy} + 1.43)}}{1 + e^{(-0.021*\text{Canopy} + 1.43)}}$$

Predicts ≥ 50% probability of suitable habitat at Canopy cover of less than 70%

- Could be used to set target for canopy density
- Could be used to select areas for monitoring

Questions ?

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