

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

Gary N. Ervin

Department of Biological Sciences
Mississippi State University



Southeastern EPPC & Southeast SERI Joint Meeting
Chattanooga, TN – 11-13May, 2010

Getting the jump on invasives



Invasion and disturbance



Predicting susceptible areas



An example with cogongrass



Interpreting results

Getting the jump on invasives



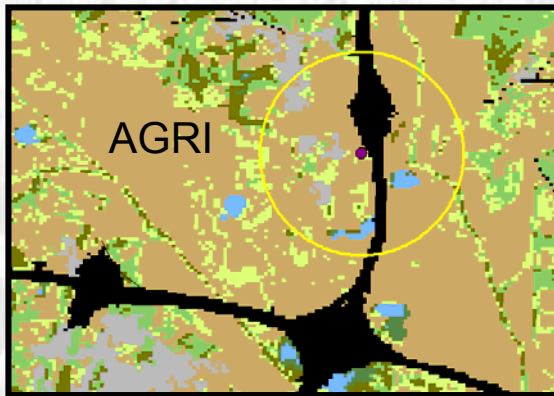
Invasion and disturbance

Predicting susceptible areas

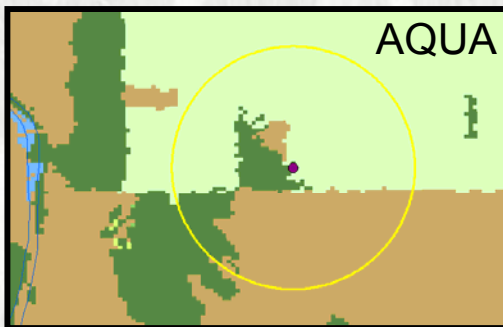
An example with cogongrass

Interpreting results

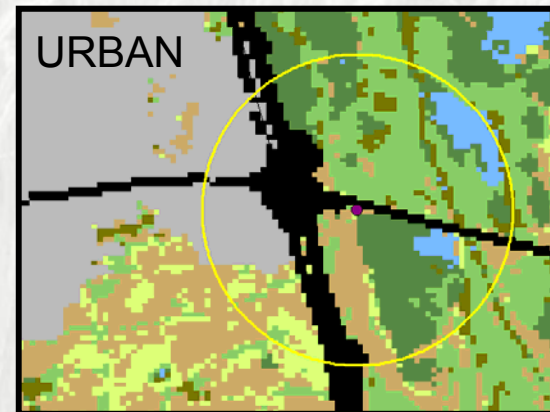
Human disturbance and exotic species in wetlands



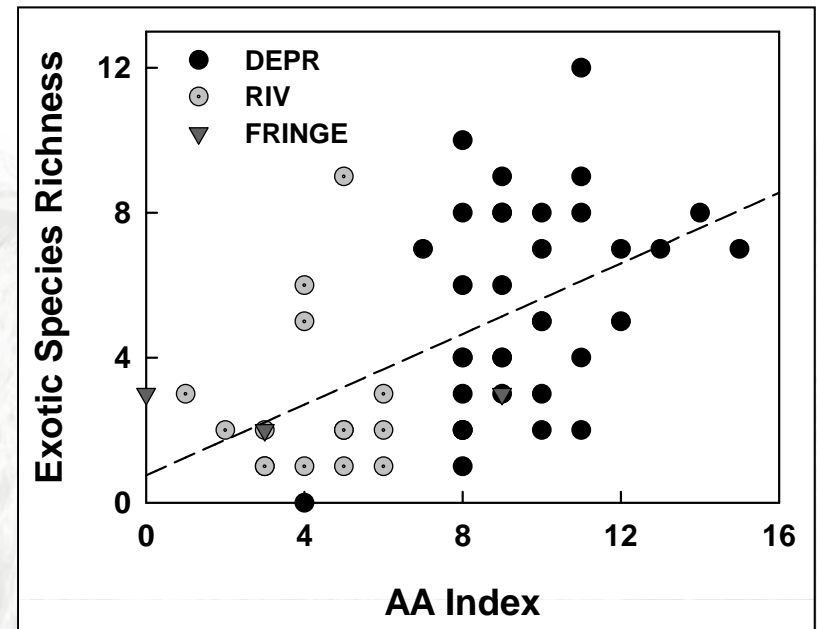
AAI = 13
41 Native
7 Exotic



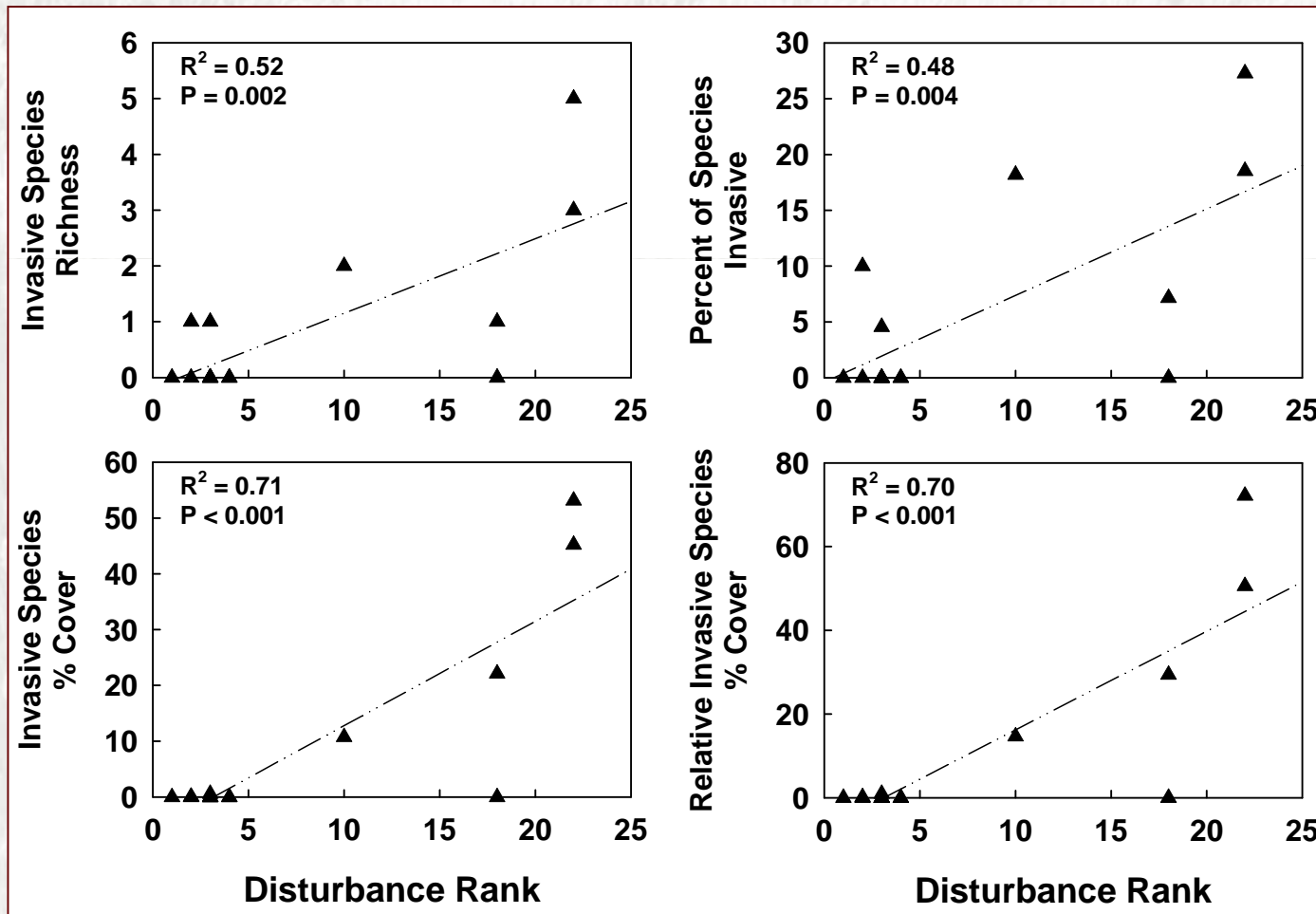
AAI = 14
37 Native
7 Exotic



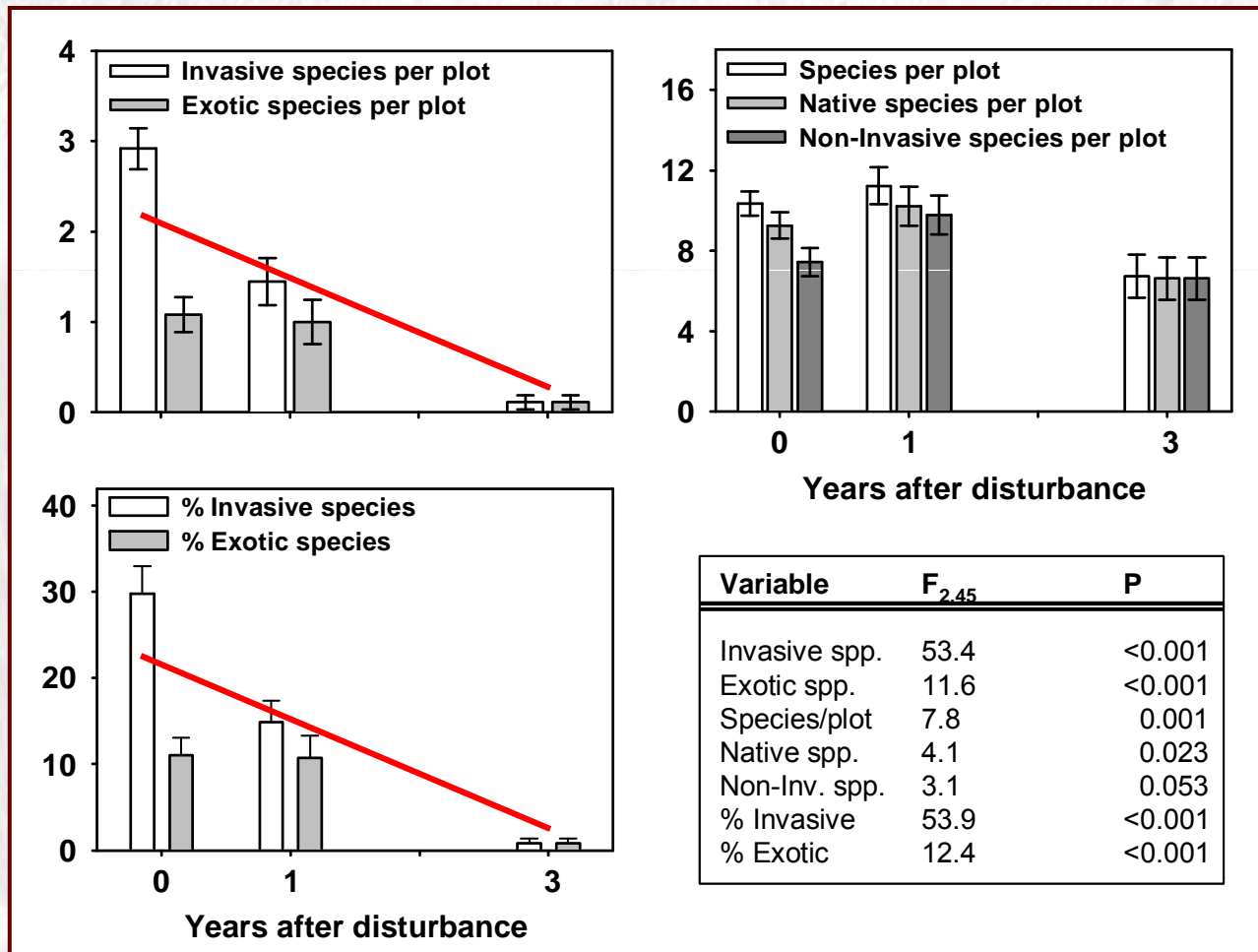
AAI = 9
39 Native
8 Exotic



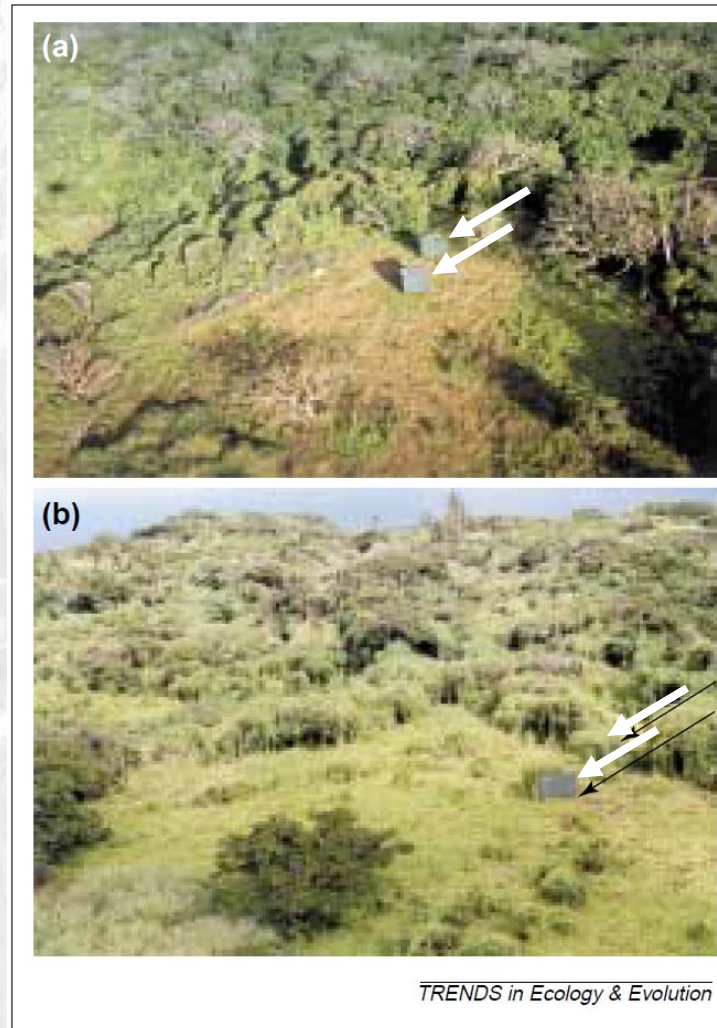
Human disturbance and exotic species in wetlands



Human disturbance and exotic species in wetlands



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

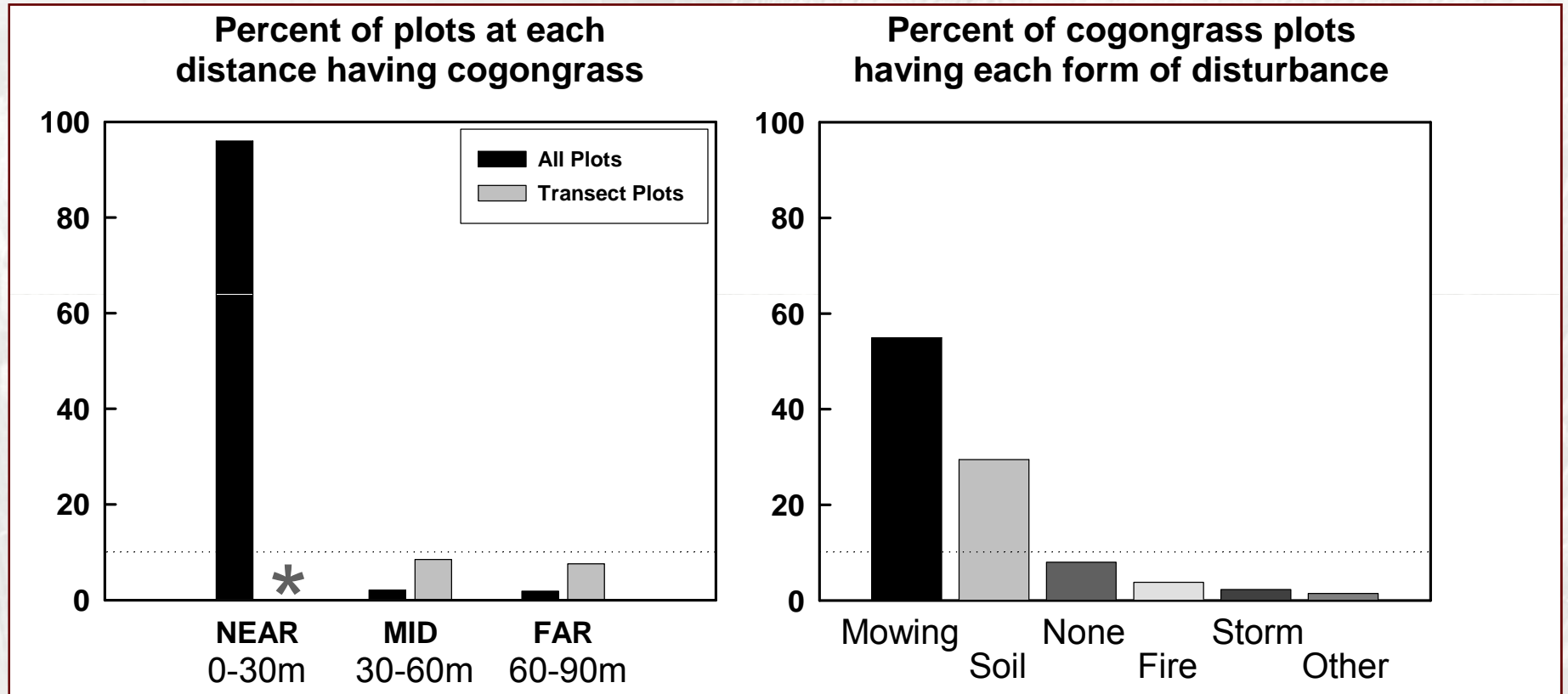


Mark Atwater, Weed Control Unlimited, Inc.
Bugwood.org

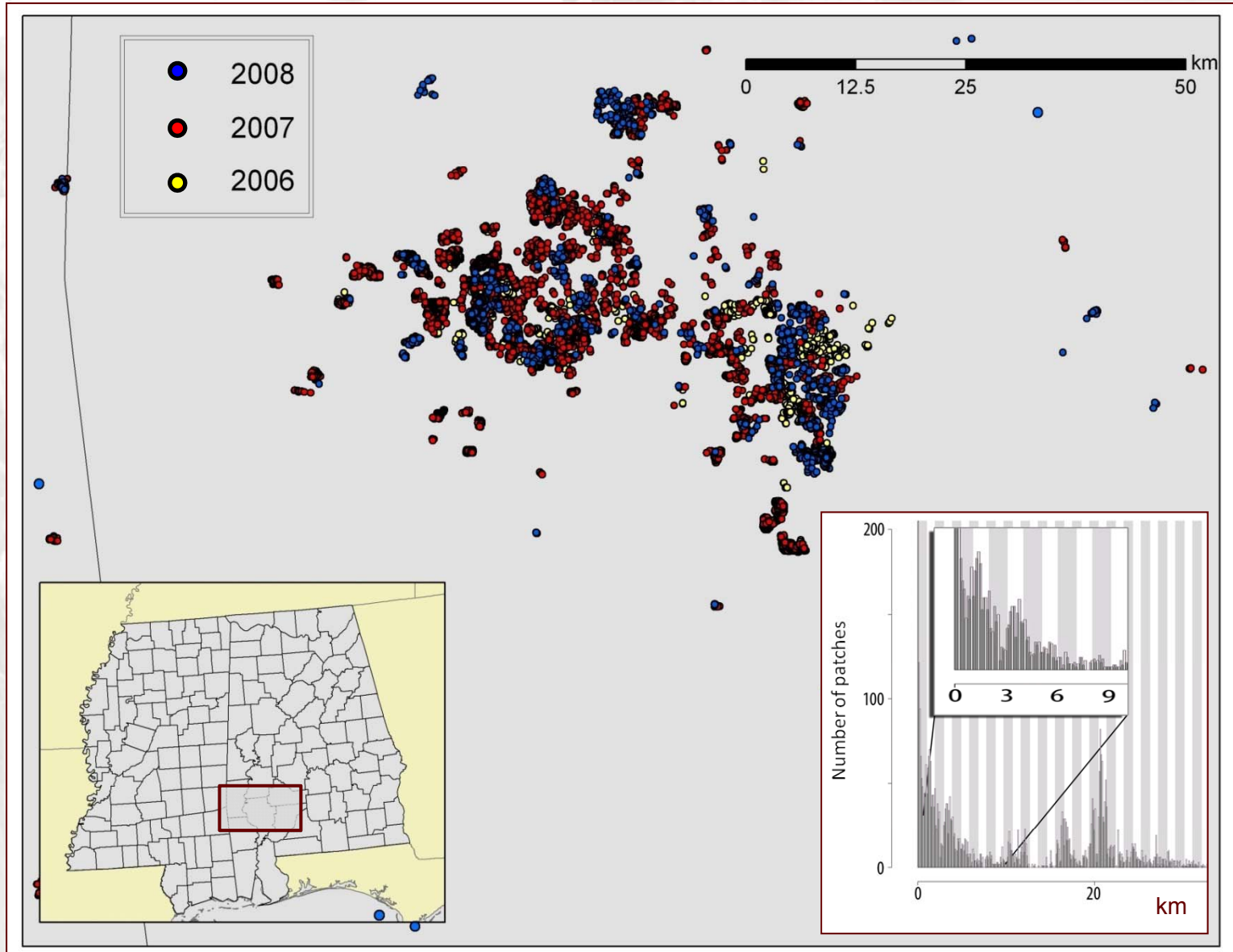


Mark Atwater, Weed Control Unlimited, Inc.
Bugwood.org

Cogongrass and disturbance



Cogongrass patch density



Getting the jump on invasives

Invasion and disturbance



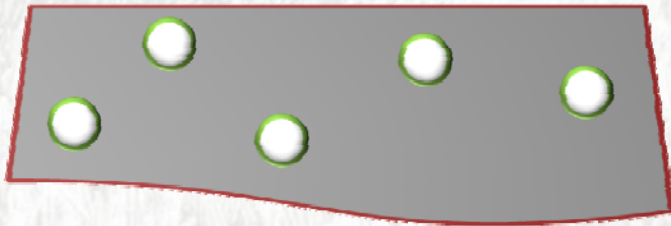
Predicting susceptible areas

An example with cogongrass

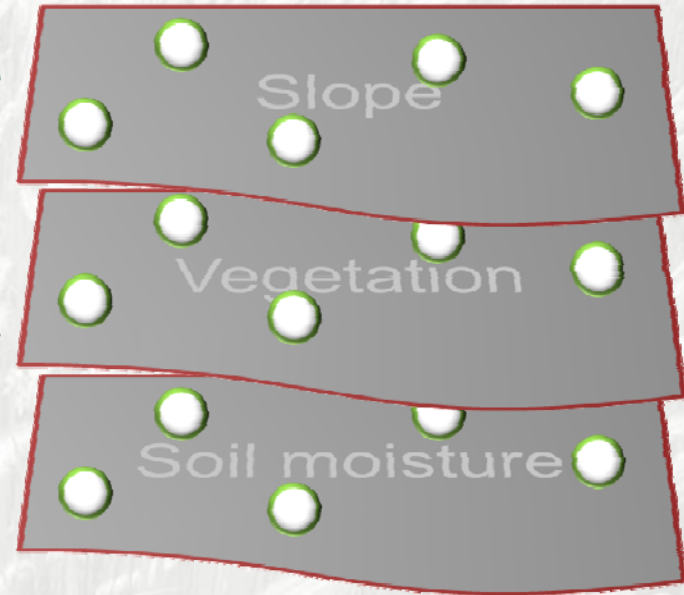
Interpreting results

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

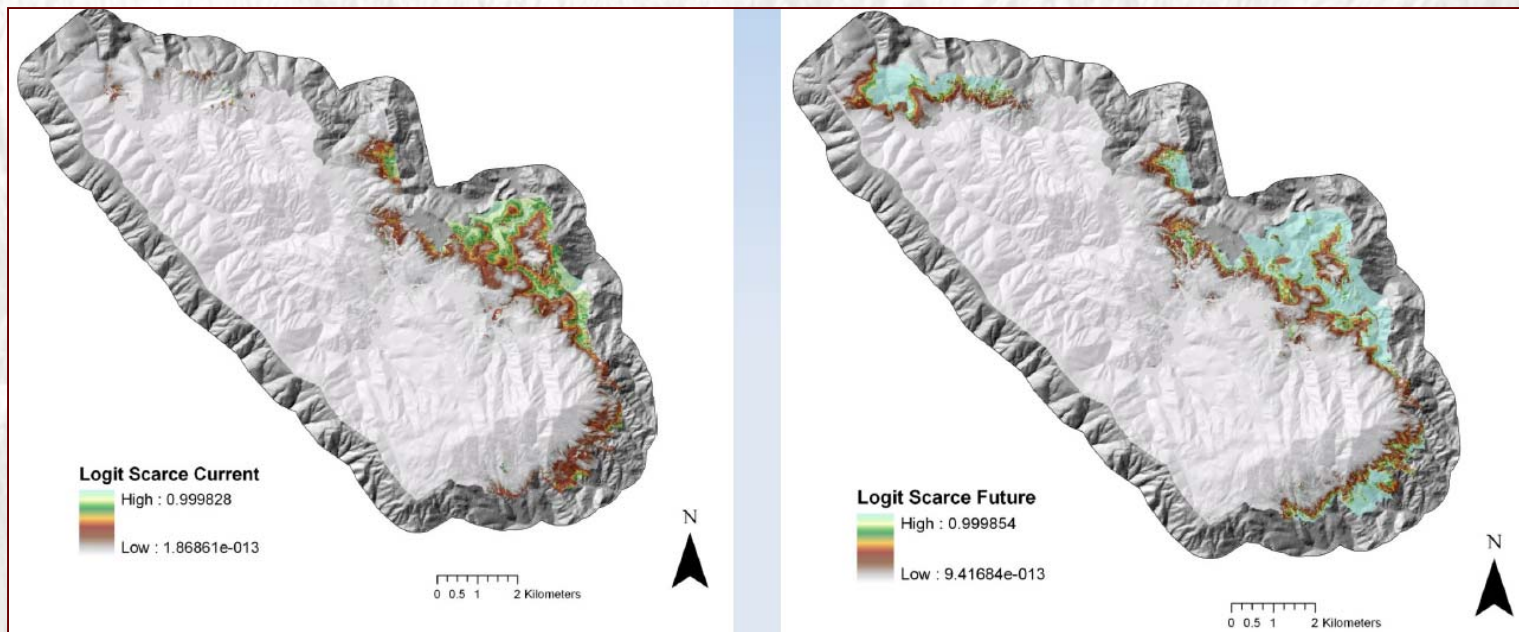
Welk 2004

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

IPAMS Invasive Plant Atlas of the MidSouth

[Home](#) [About](#) [Contact Info](#) [Register](#) [Login](#)

Species Info

Data / Maps

Early Detection & Rapid Response

Report a Sighting

Field Survey Form


Name: *Rotala rotundifolia*

Common Name: Roundleaf Toothcup

Habitat: Wetland Areas

Growth Habit: Aquatic Herb

Native Environment: Southeast Asia




A large number of invasive aquatic and terrestrial plant species have become introduced into the United States. While several agencies have developed databases for tracking the locations and status of these invaders, these agencies do not have the resources to thoroughly track the presence and locations of these species in the states, relying instead on voluntary reporting of locations.

An important component to a state and regional coordination of management efforts will be an accessible and up-to-date database of invasive species locations and actions to manage them, operated and managed at the regional level. GRI is actively mapping the locations of invasive aquatic and terrestrial plant species in the Midsouth, and entering them into our web-based database for invasive plant species.

This database will be developed in collaboration with national USGS and other agency databases and structures, and the Invasive Plant Atlas of New England (IPANE), with mechanisms and procedures in place to ensure data transmission both upward (nationally) and downward to the local level for rapid assessment and response.

IPAMS Surveys:




POWERED BY **ESRI**

EDD MapS Early Detection & Distribution Mapping System

Username:
 Password:
[Join Now \(Free\)](#) [Lost your password?](#)

[Report Sightings](#) [Distribution Maps](#) [Species Information](#) [Tools & Training](#) [My EDDMapS](#) [About](#)

Invasive Species Mapping Made Easy!



EDDMapS, started in 2005 with Southeastern U.S. focus, is now providing a picture of the distribution of invasive species across the U.S.

- ✓ Fast and easy to use - no knowledge of GIS required
- ✓ Web-based mapping of invasive species distribution to help fill gaps and identify "leading edge" ranges
- ✓ Facilitates Early Detection and Rapid Response implementation with online data entry forms, e-mail alerts and network of expert verifiers
- ✓ One Database for both local and national data
- ✓ Data can be searched, queried and downloaded in a variety of formats
- ✓ Cooperates with and aggregates data from other invasive species mapping projects
- ✓ Custom/hosted applications can be quickly and inexpensively developed

Who's Using It?

- ✓ Southeast Exotic Pest Plant Council
- ✓ Florida Exotic Pest Plant Council
- ✓ Everglades Cooperative Invasive Species Management Area
- ✓ Florida Invasive Species Partnership
- ✓ Alaska Exotic Plant Information Clearinghouse
- ✓ Mid-Atlantic Invasive Plant Council
- ✓ Invaders of Texas

Statistics

935,949 County Reports
236,614 Point Reports
1,738 Species / 1,298 Users

Recent Reports

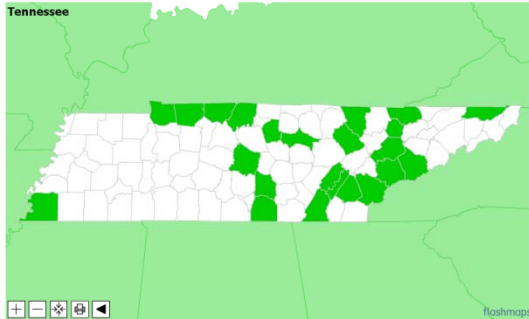
- ✓ catclaw-vine by Peter Johnson in Duval County, Florida
- ✓ Japanese honeysuckle by Peter Johnson in Duval County, Florida
- ✓ cogongrass by Katrina Noland in Polk County, Florida
- ✓ glossy privet by Peter Johnson in Duval County, Florida
- ✓ British yellowhead by Monika Chandler in Hennepin County, Minnesota


Report Images

giant reed

Arundo donax L.

Distribution Maps: County / Southeast / Points on Google Maps





catclaw-vine - *Macfadyena unguis-cati*
Report by Peter Johnson, Audubon

Getting the jump on invasives

Invasion and disturbance

Predicting susceptible areas



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

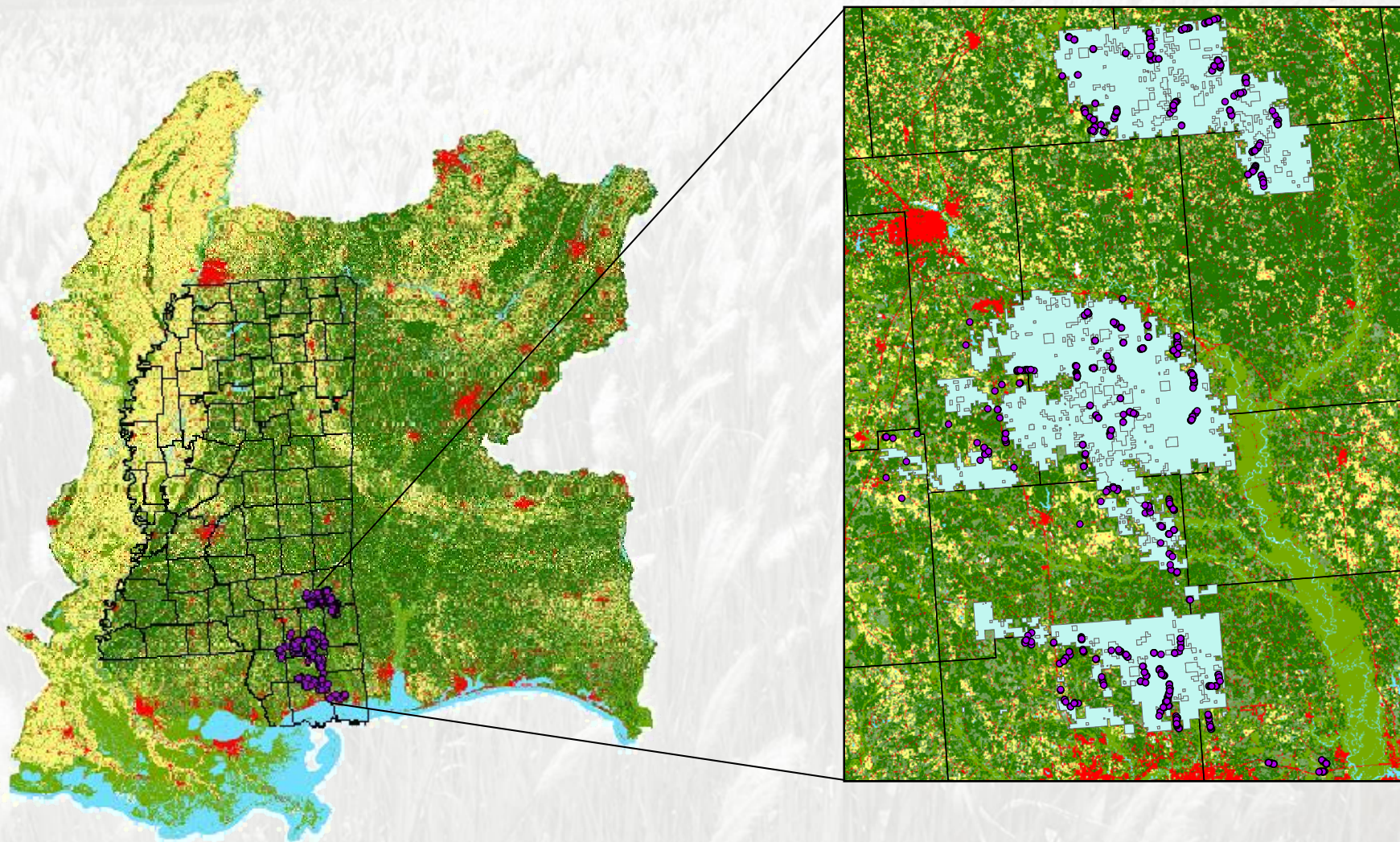
Causes significant economic costs for land managers

Threatens native biodiversity and ecosystem function

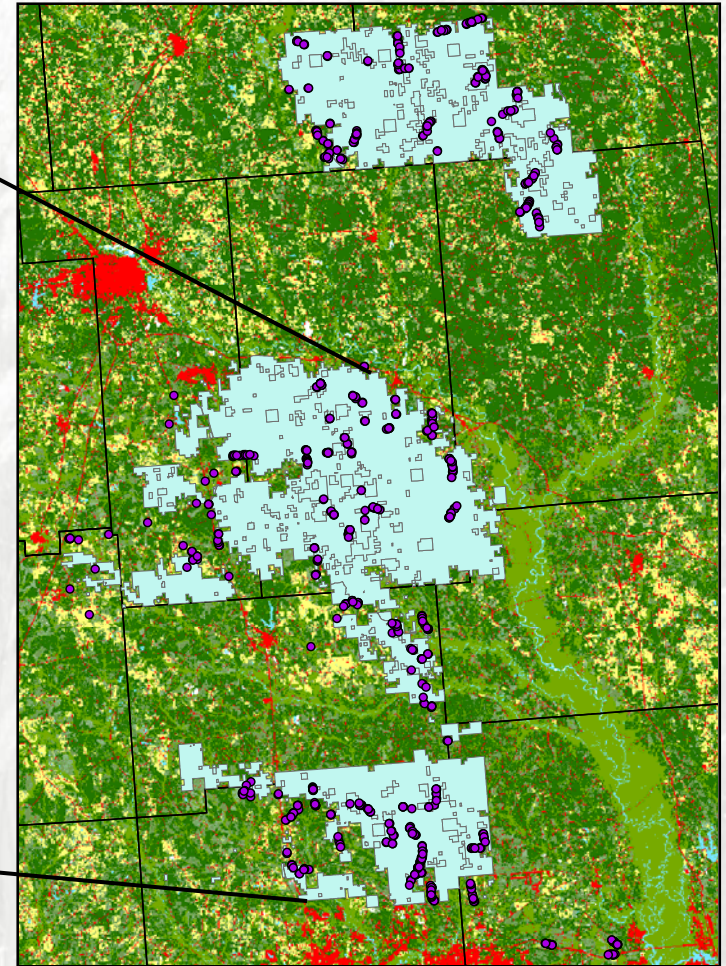
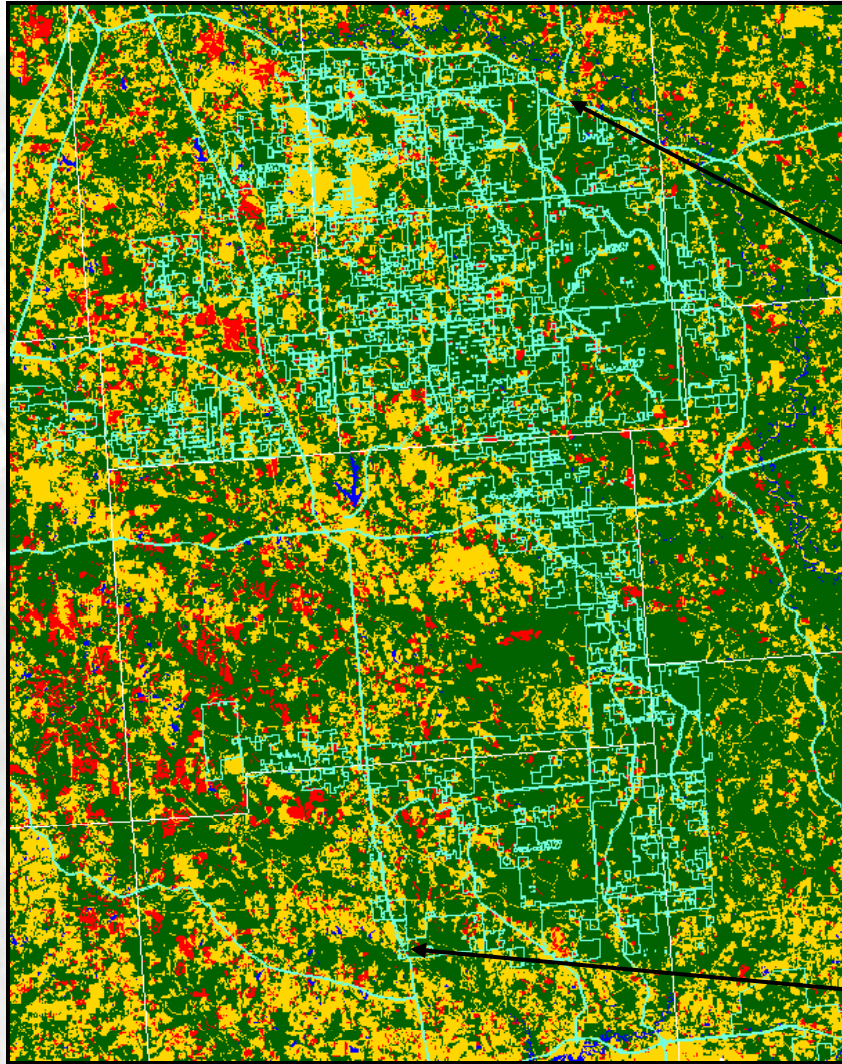
Completely alters native south MS *Pinus palustris* fire regimes



Study area

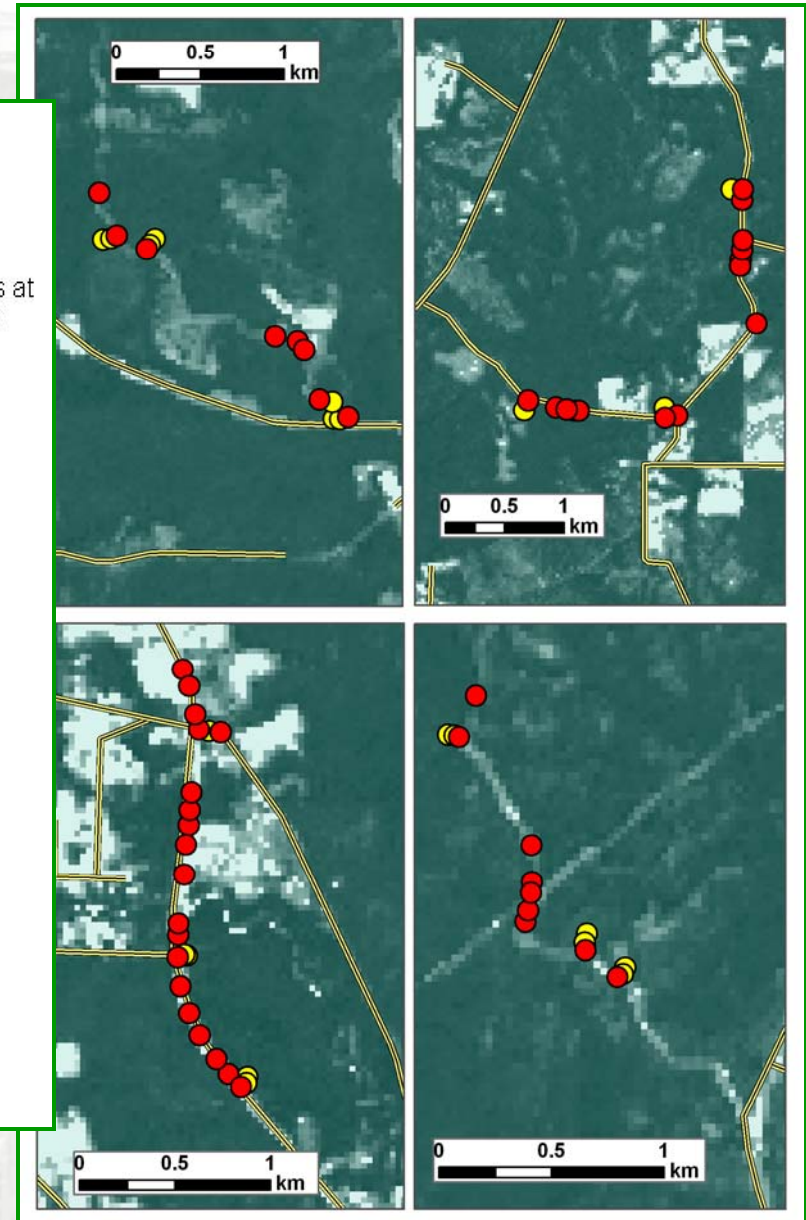
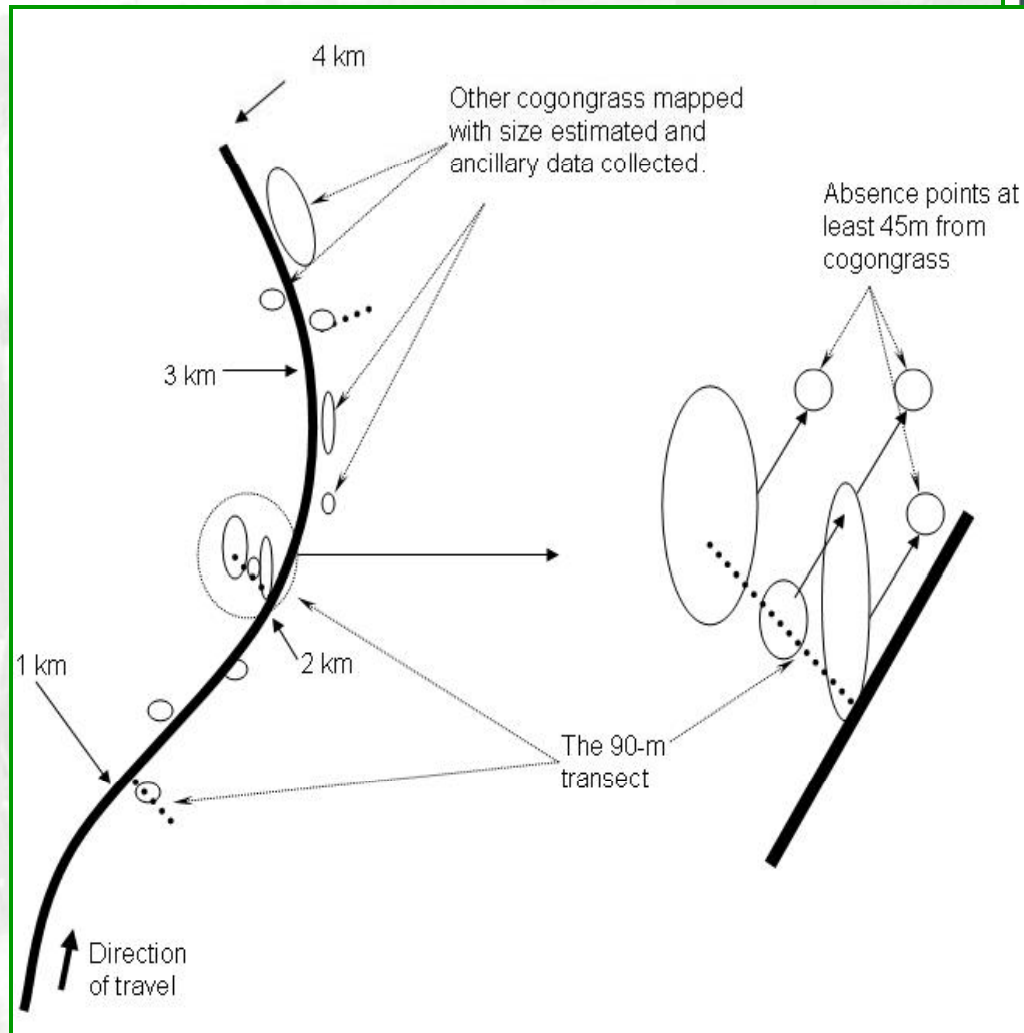


Study area



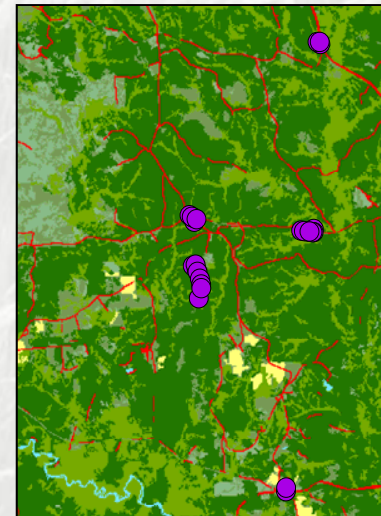
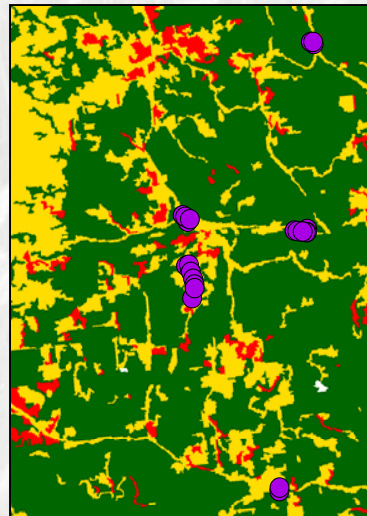
← Increasing deforestation 2004-06

Surveys



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
<i>-----Effects Removed-----</i>						
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
<i>-----Effects Retained-----</i>						
*	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

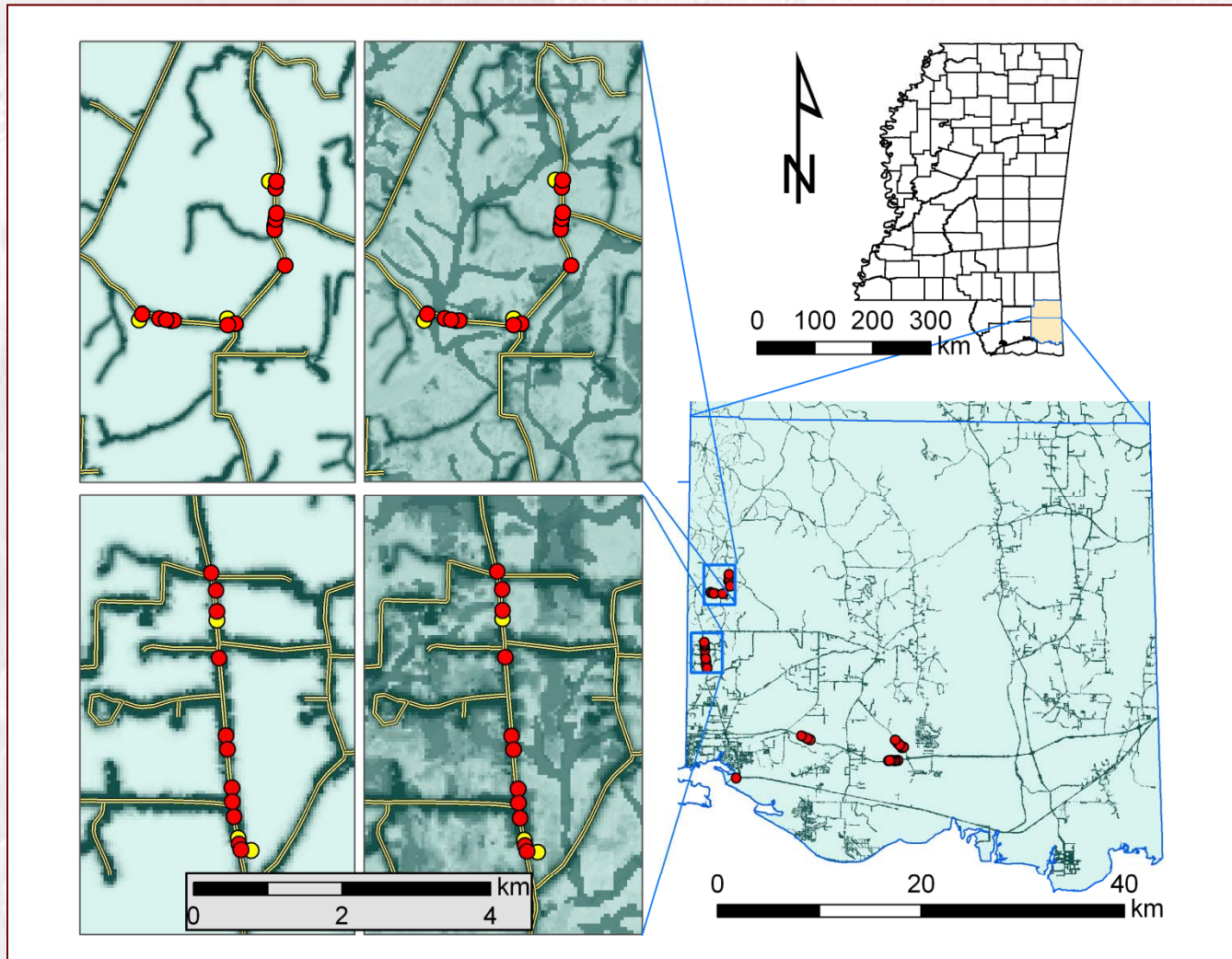
Canopy only model:

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

Canopy and bulk density model:

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

Model surfaces



Getting the jump on invasives

Invasion and disturbance

Predicting susceptible areas

An example with cogongrass



Interpreting results

Interpreting outside a GIS environment

Canopy only model:

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

Interpreting outside a GIS environment

Canopy only model:

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

Predicts $\geq 50\%$ probability of suitable habitat at
Canopy cover of less than 70%

Interpreting outside a GIS environment

Canopy only model:

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

Predicts $\geq 50\%$ 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 ?

