

Everglades Vegetation Community Analysis at the Landscape Scale

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CRMS

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Department of Geography, The University of Georgia
<http://www.crms.uga.edu>

Objectives:

Contribute to EPA's R-EMAP Phase III:

- Develop GIS vegetation databases within 1 km² area surrounding the 250 R-EMAP sampling plots (1995 and 2003/2004 air photos).
- Assess landscape-scale changes and trends in vegetation related to airboat use.



Previous U.S. National Park Service Funded Projects:

1994-1997 Vegetation Map and Digital Database of South Florida National Park Service Lands to Assess Long-Term Effects of Hurricane Andrew

1996-1998 Mapped ORV Trails in Big Cypress National Preserve

2000-2001 ORV Trail Accuracy Assessment in Big Cypress National Preserve

2004-2005 Airboat/ORV Trail Inventory for the East Everglades Addition Lands.

Everglades Vegetation Mapping Project

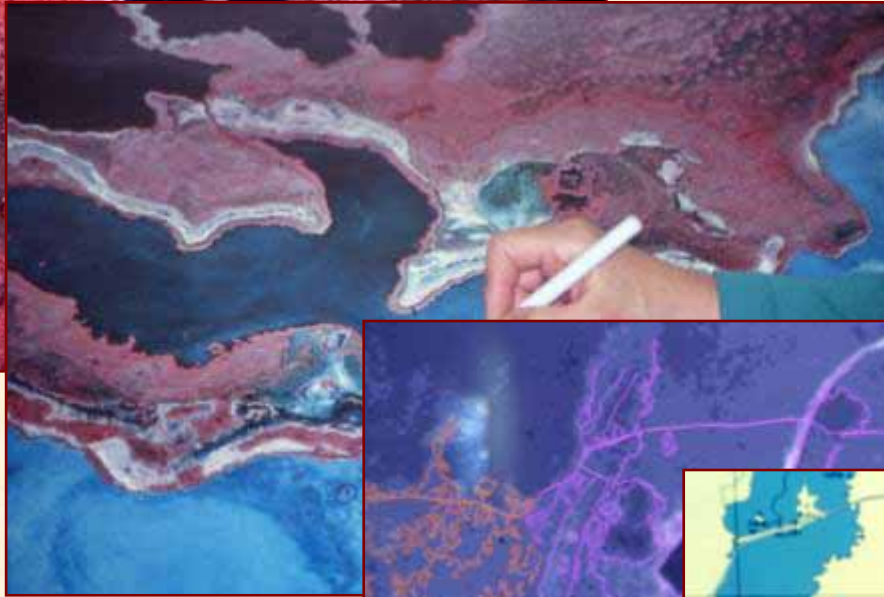


- Area over 6,000 sq. km in size.
- 120 vegetation classes
- 80 USGS quadrangles
- 275 NAPP aerial photographs

Color infrared (CIR) air photo



Photo-
interpretation

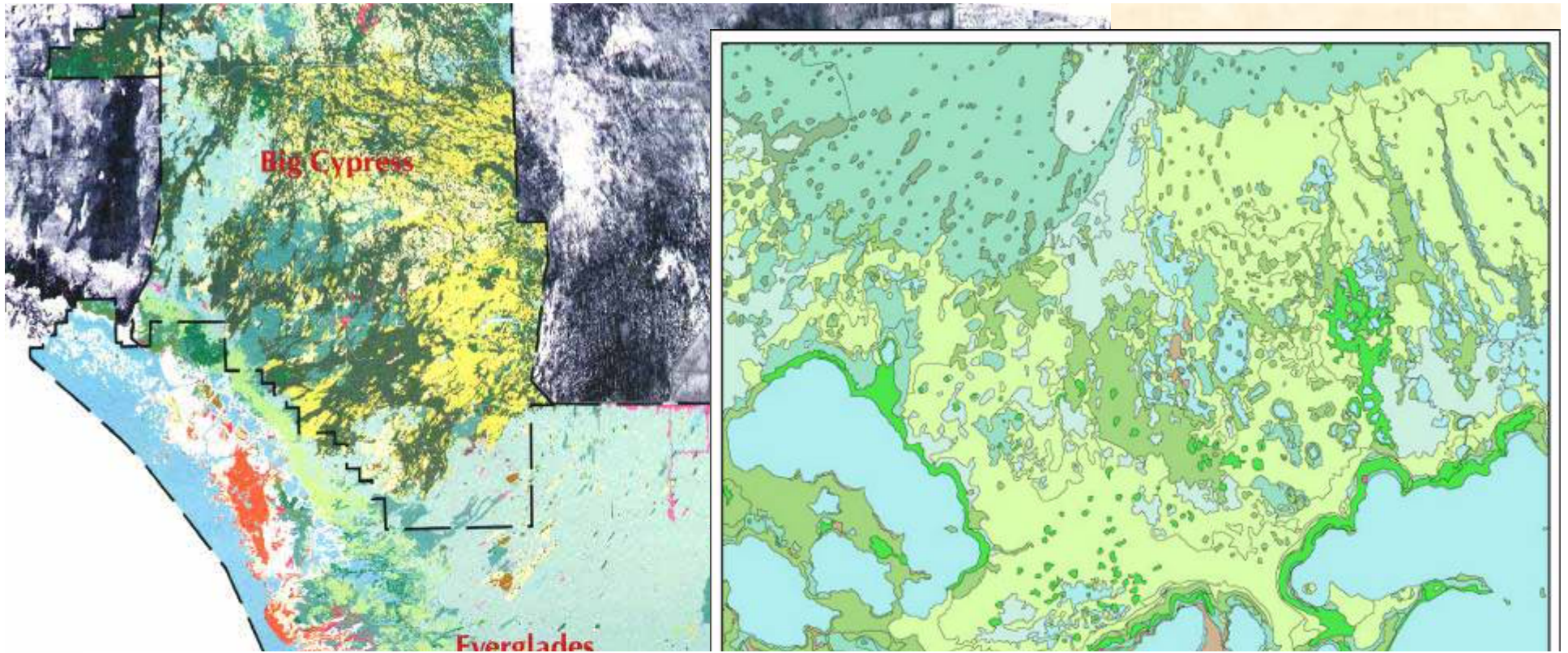


Edit/attribute digital files



Make a map →





Welch, R., M. Madden and R. Doren, 1999. Mapping the Everglades, *Photogrammetric Engineering and Remote Sensing*, 65(2): 163-170.

Madden, M., D. Jones and L. Vilchek, 1999. Photointerpretation key for the Everglades Vegetation Classification System, *Photogrammetric Engineering and Remote Sensing*, 65(2): 171-177.

Madden, M., 2004. Remote sensing and GIS methodologies for vegetation mapping of invasive exotics, *Weed Technology*, 18:1457-1463.

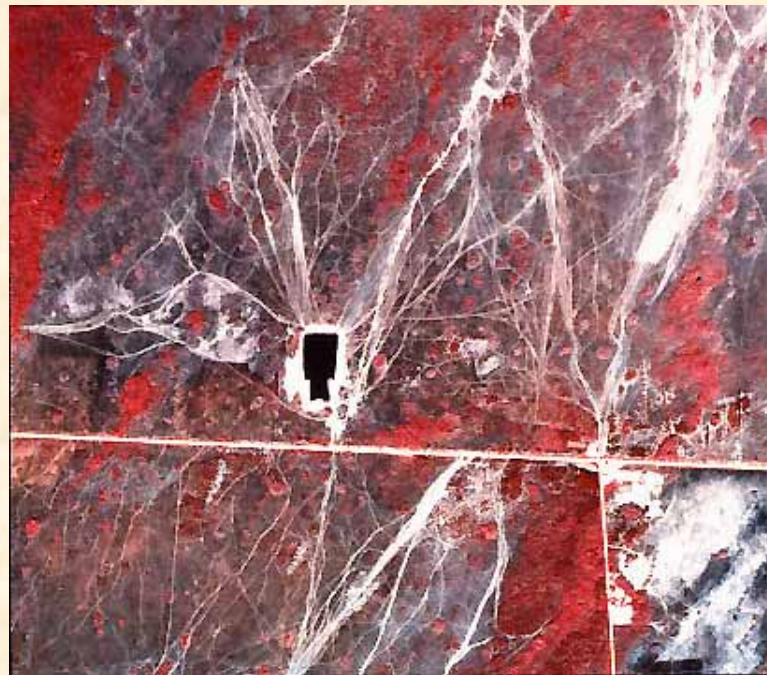


☀️ An Arc/Info ORV trail database (UTM NAD 83) was produced in 1997/1998 by the CRMS in cooperation with the NPS.

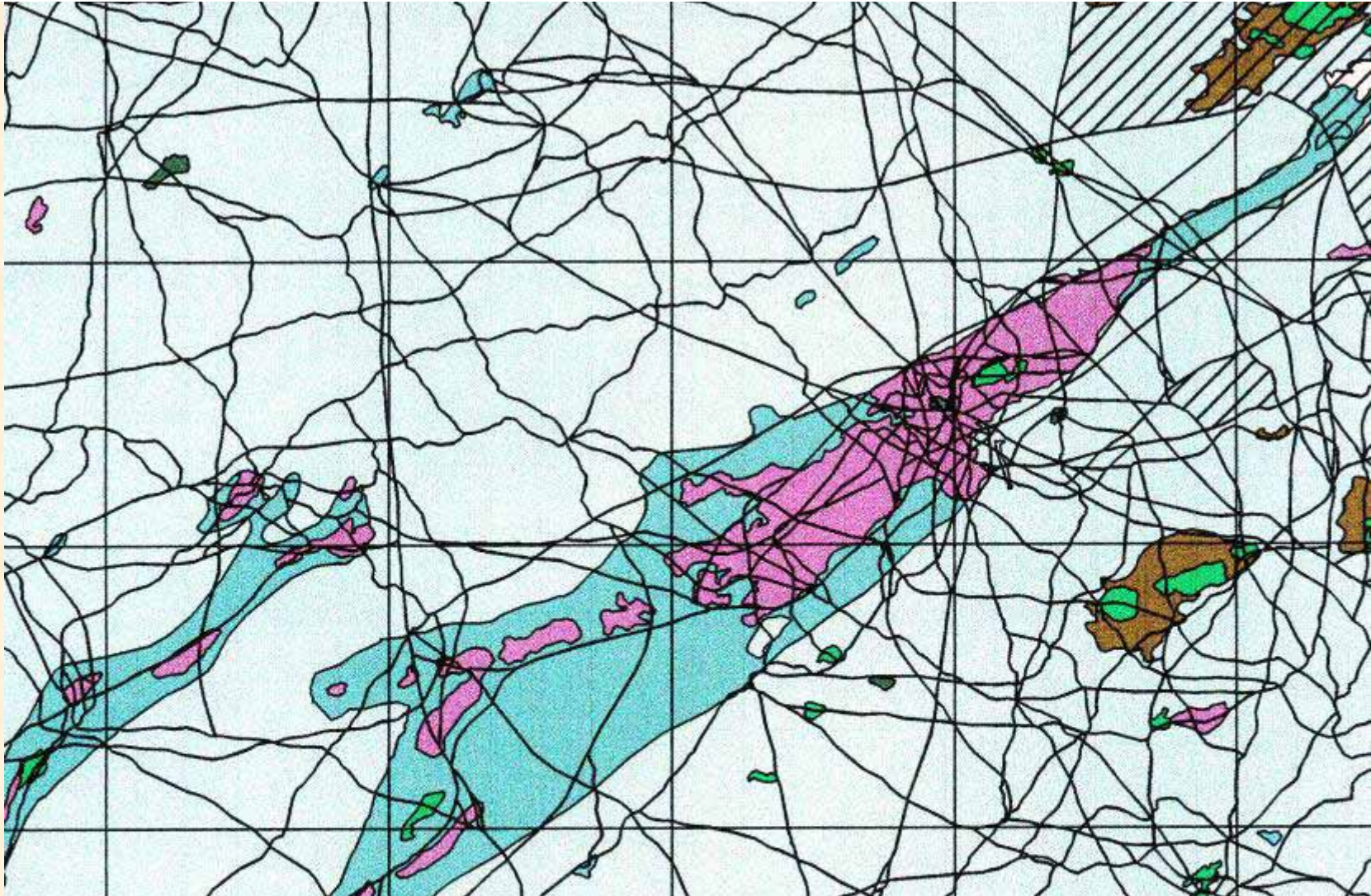
☀️ Trails were plotted at 1:15,000 scale from 1994/1995 USGS NAPP color infrared aerial photos of 1:40,000 scale enlarged to 1:10,000 scale.



Wet
Season

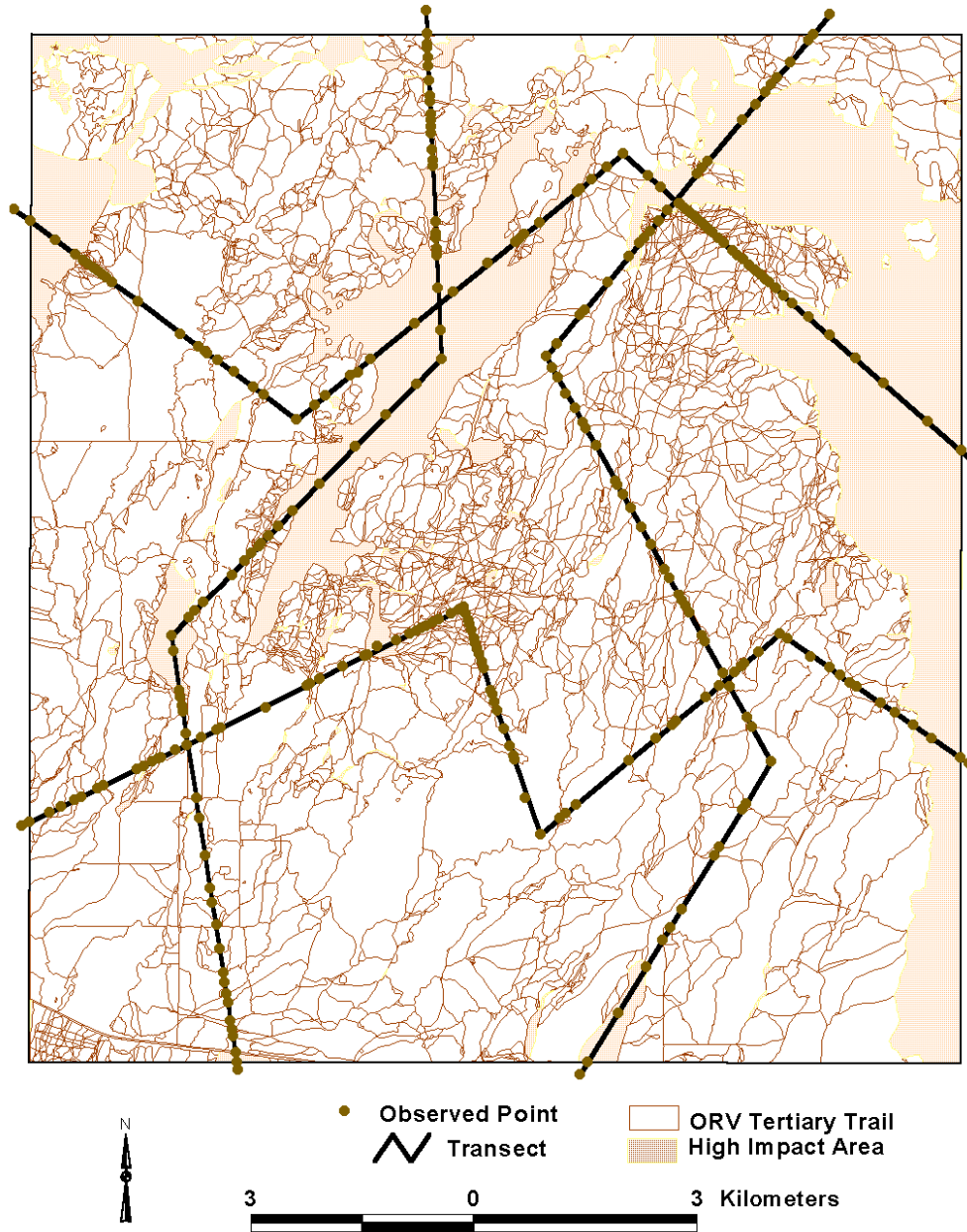


Dry
Season

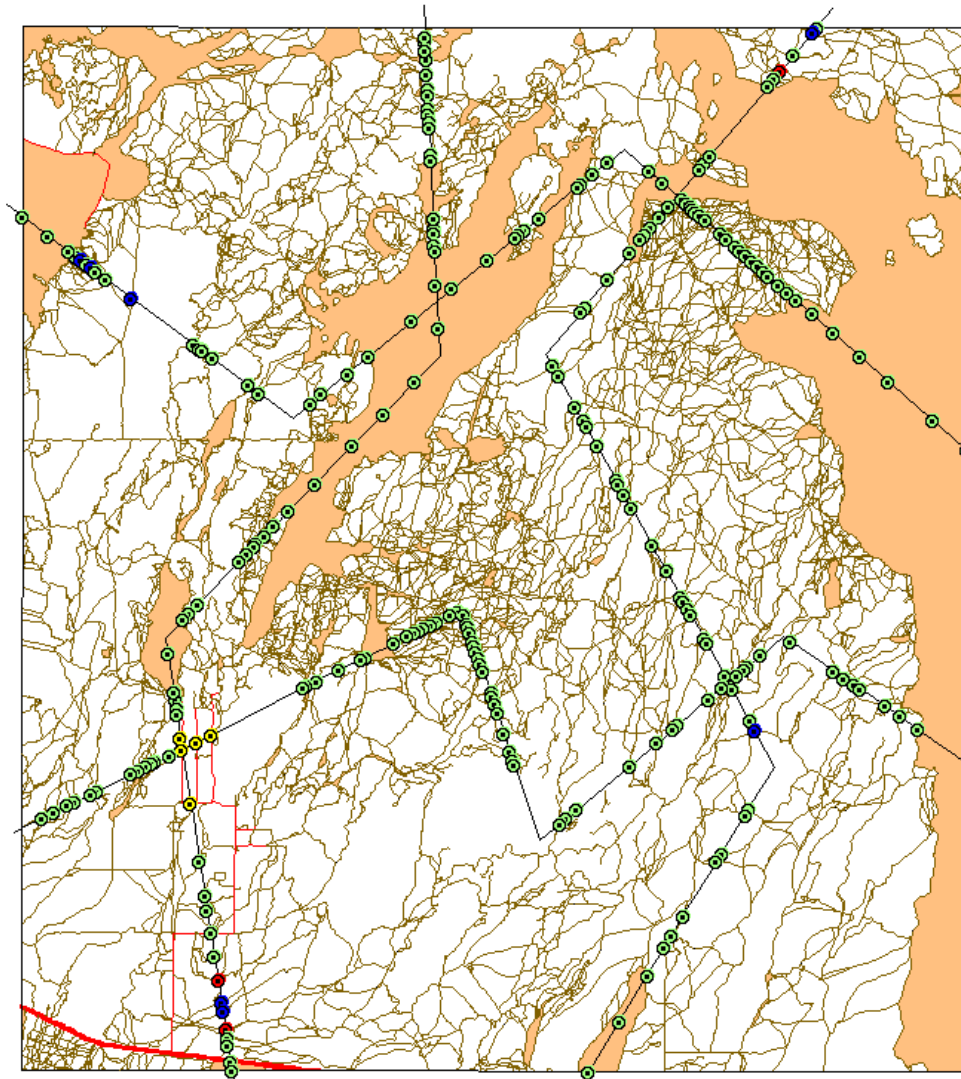


Welch, R., M. Madden, and R. F. Doren, 2002. Maps and GIS databases for environmental studies of the Everglades, Chapter 9. *In*, J. Porter and K. Porter (Eds.) *The Everglades, Florida Bay and Coral Reefs of the Florida Keys: An Ecosystem Sourcebook*, CRC Press, Boca Raton, Florida: 259-279.

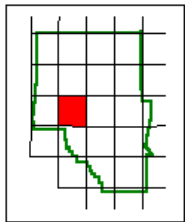
ORV Transects Across Burns Lake



Areas with ORV
access averaged
82.4 % correct



Big Cypress Locator Map



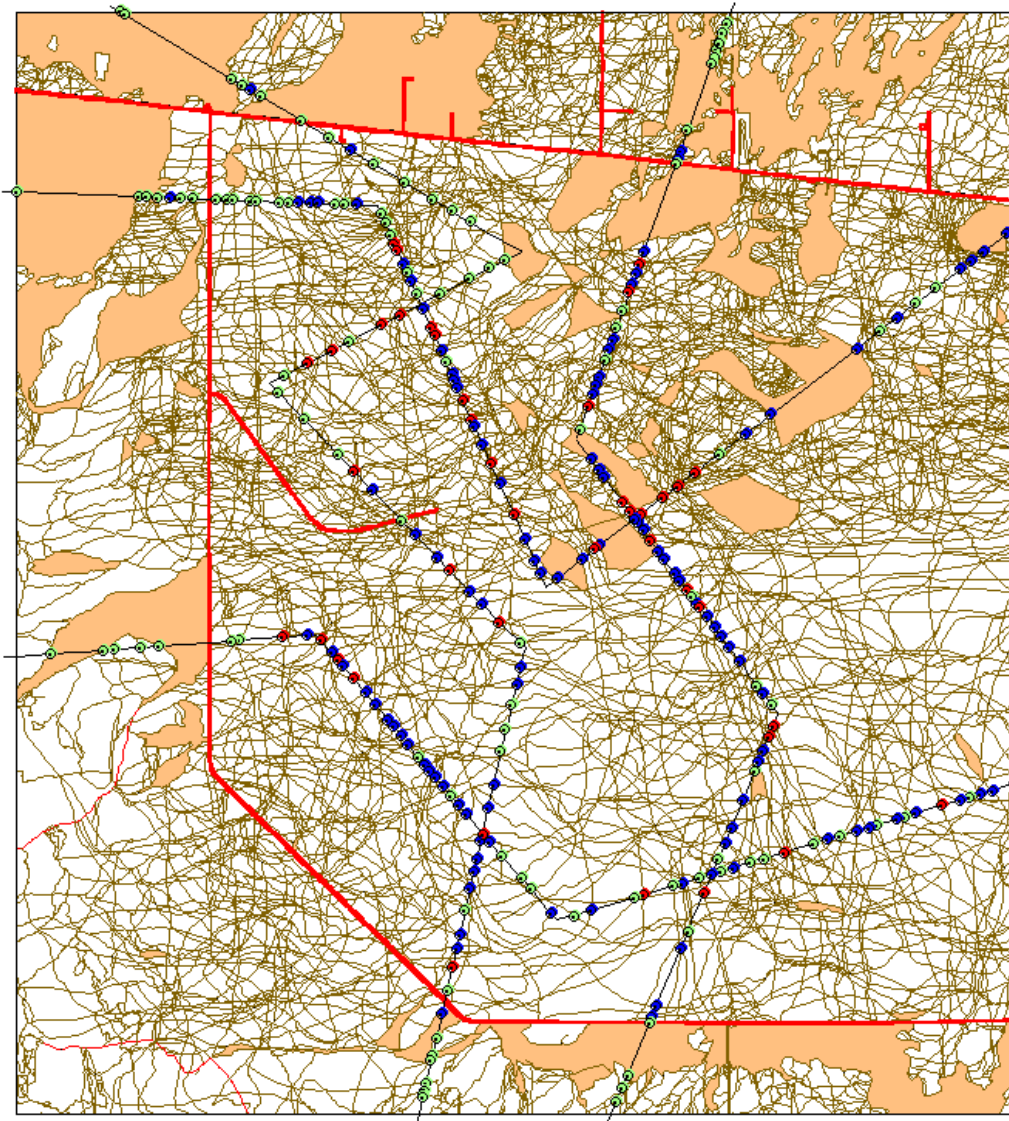
ORV Trail Accuracy Assessment Burns Lake

1000 0 1000 2000 Meters



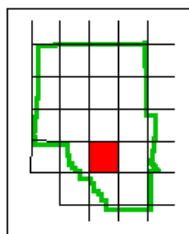
UGA - CRMS 5/2000

- - ORV Trail
- - Road used by ORVs
- - Other Trail
- - No Trail
- ∧ - Transect
- ∧ - Primary ORV Trail
- ∧ - Secondary ORV Trail
- ∧ - Tertiary ORV Trail
- - Potential High Impact
- - High Impact Area

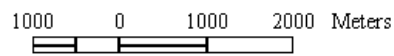


Areas closed to ORV access averaged 44.9 % correct

Big Cypress Locator Map



**ORV Trail Accuracy Assessment
Monroe Station**



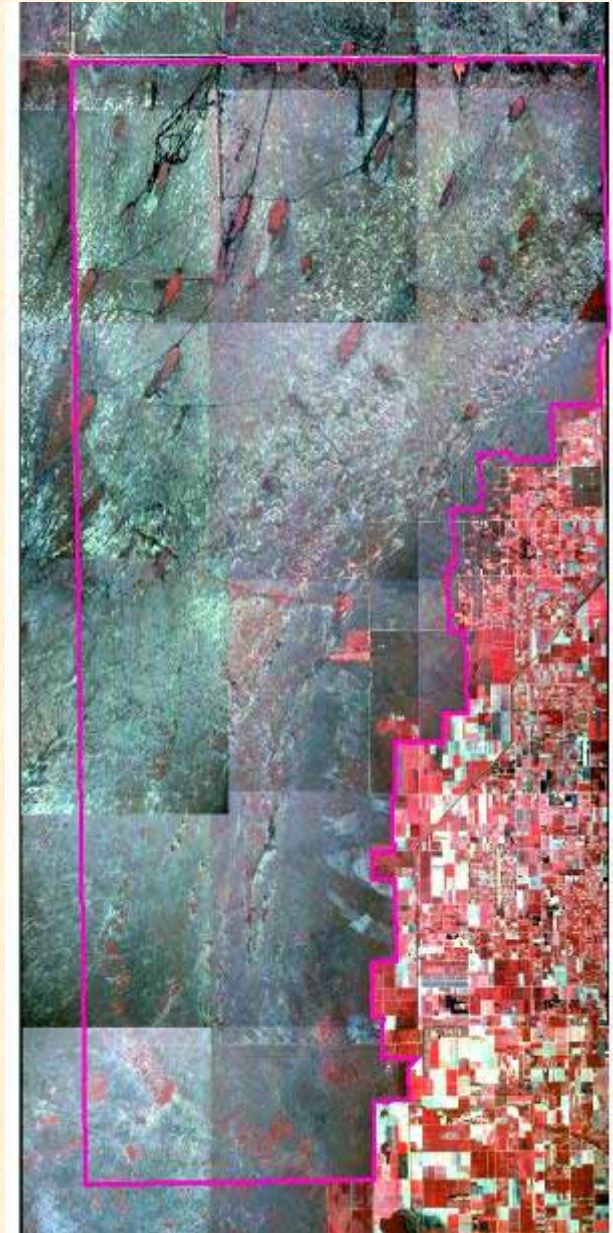
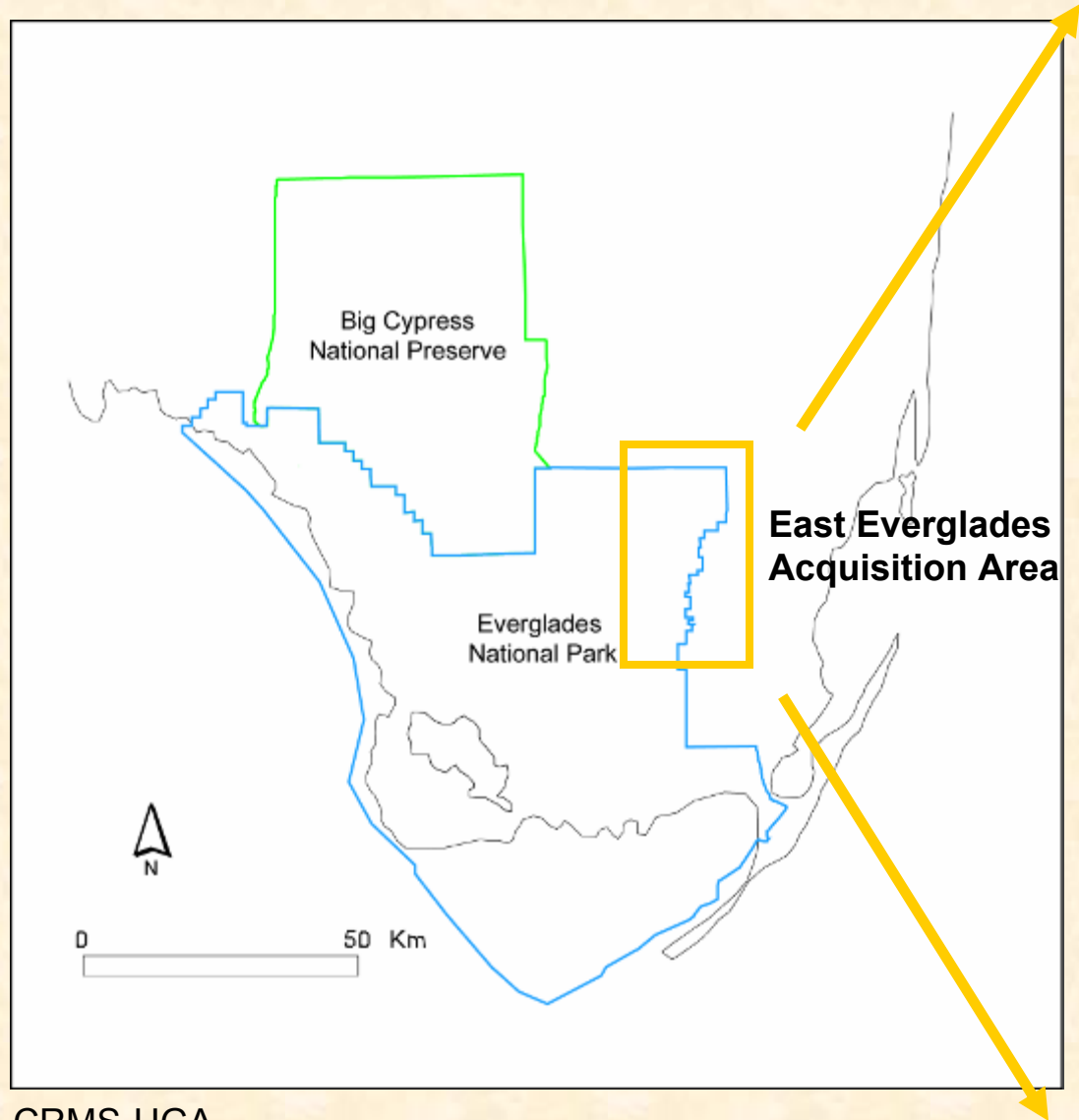
UGA - CRMS 5/2000

- - ORV Trail
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- ∧ - Transect
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- ∧ - Tertiary ORV Trail
- - Potential High Impact
- - High Impact Area

CRMS

GEER 2008, Naples, Florida

Airboat Trail Assessment in Everglades National Park, NPS



Commercial Airboats

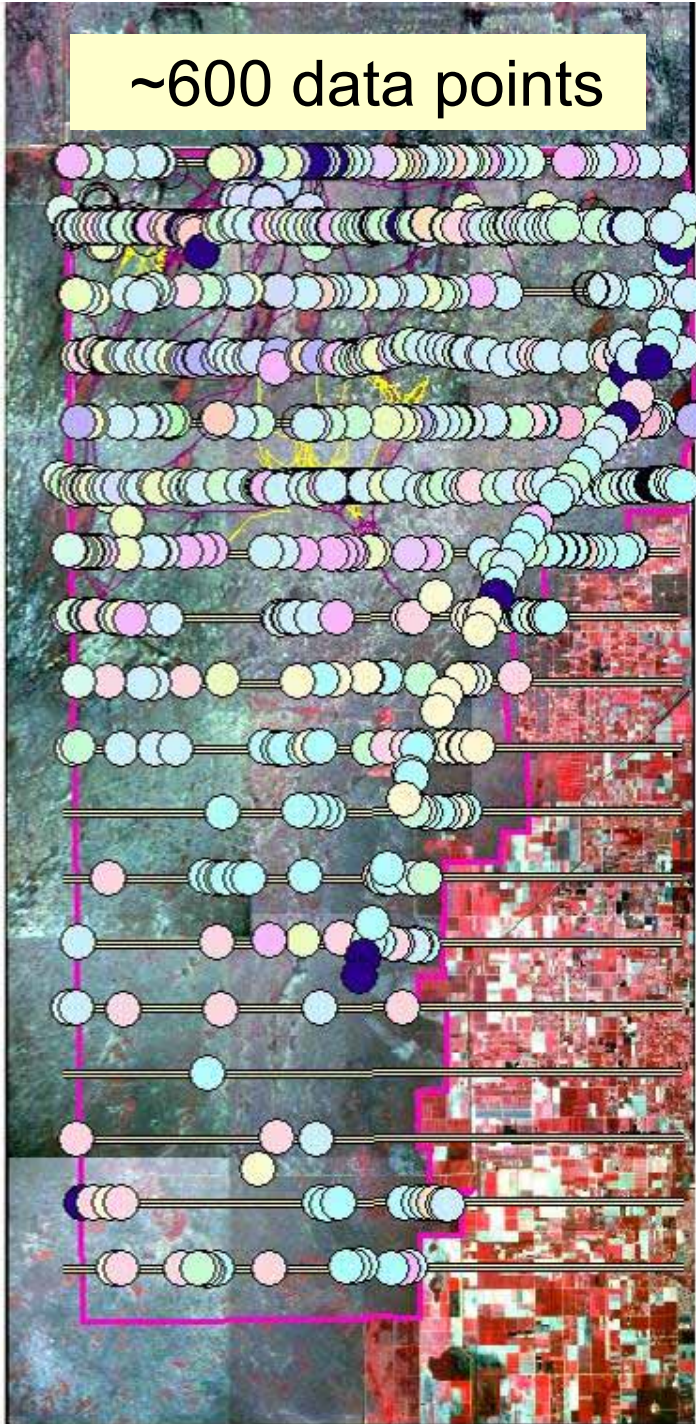


Private Airboats



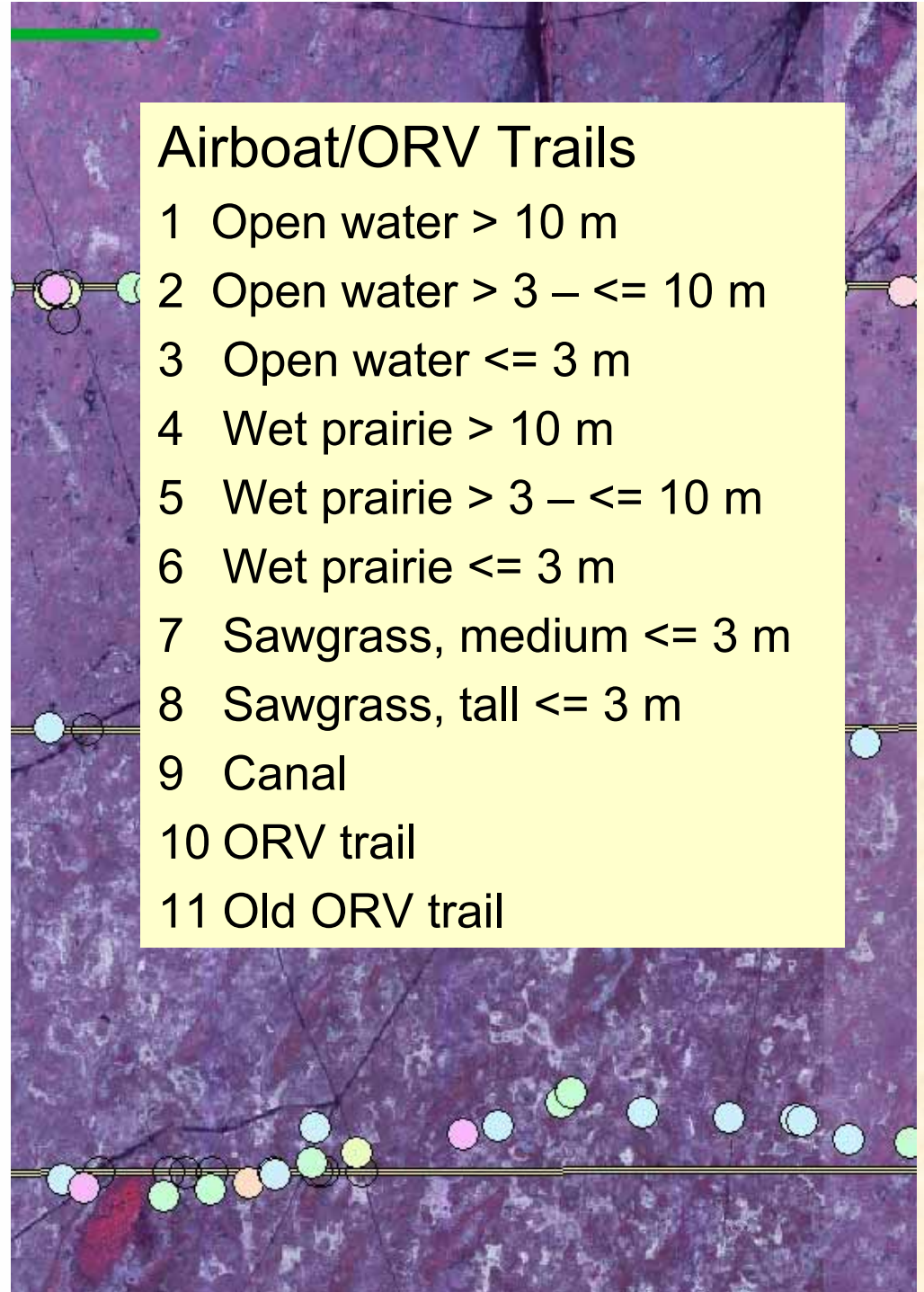


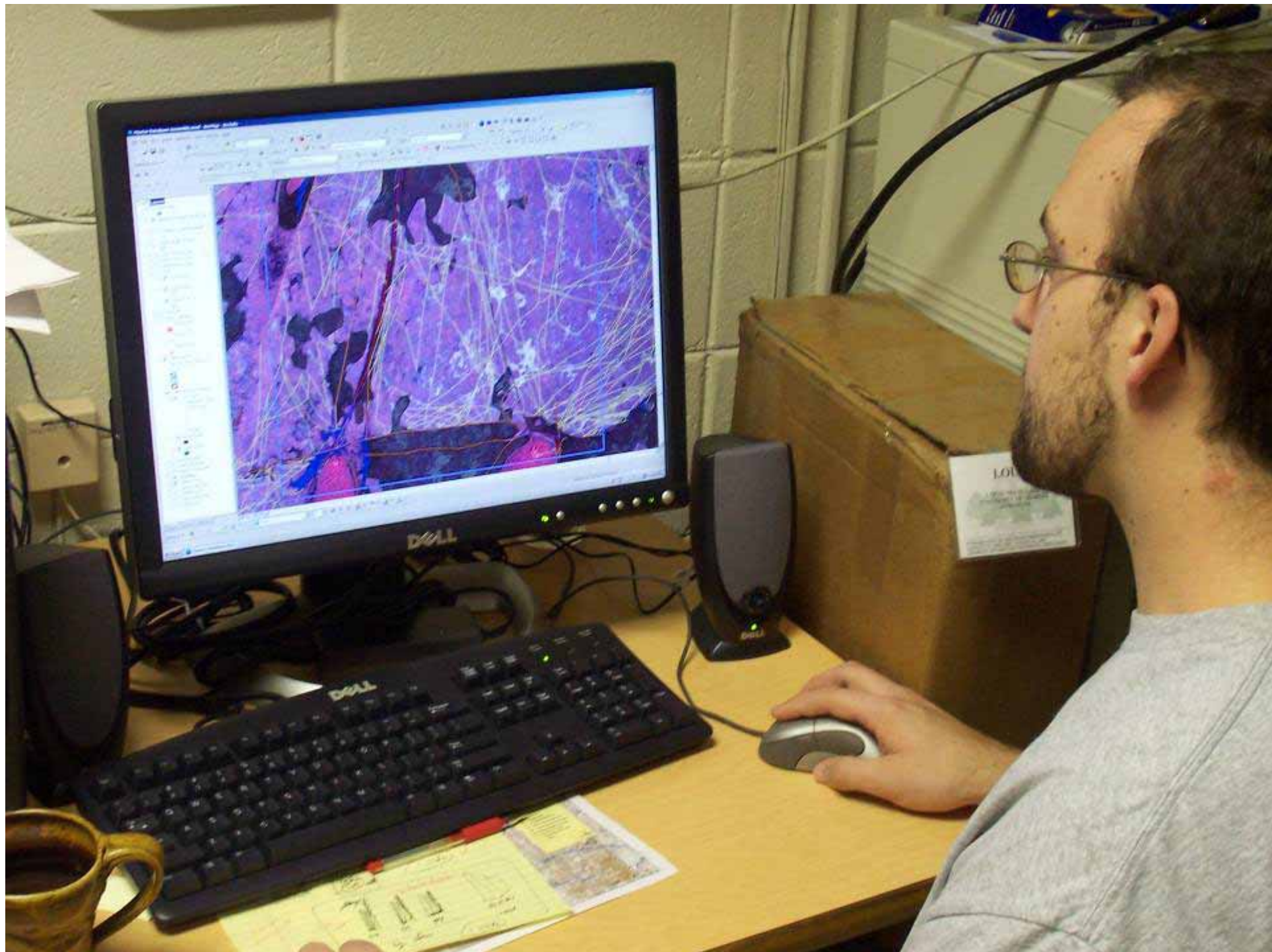
~600 data points

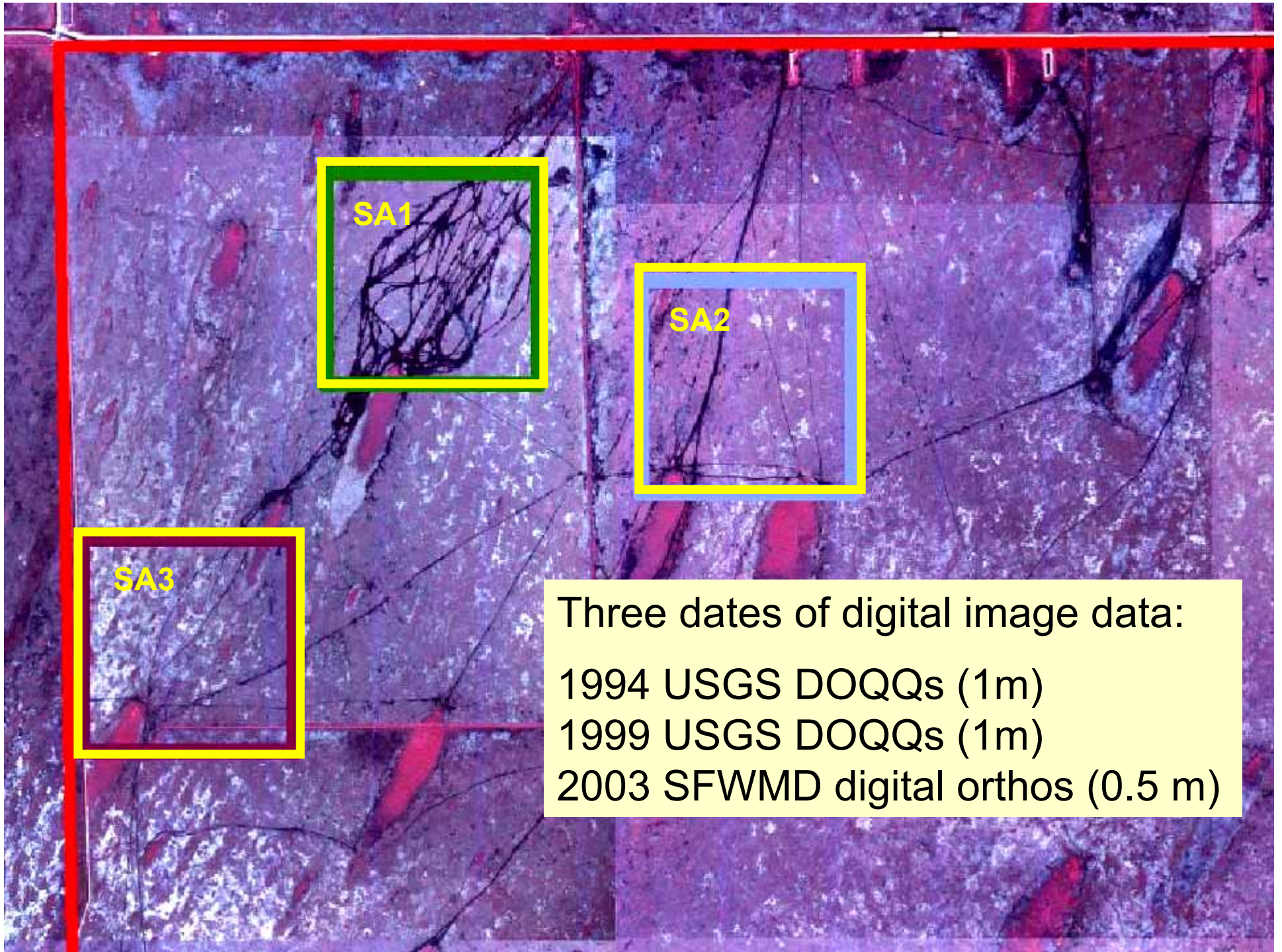


Airboat/ORV Trails

- 1 Open water > 10 m
- 2 Open water > 3 – <= 10 m
- 3 Open water <= 3 m
- 4 Wet prairie > 10 m
- 5 Wet prairie > 3 – <= 10 m
- 6 Wet prairie <= 3 m
- 7 Sawgrass, medium <= 3 m
- 8 Sawgrass, tall <= 3 m
- 9 Canal
- 10 ORV trail
- 11 Old ORV trail







SA1

SA2

SA3

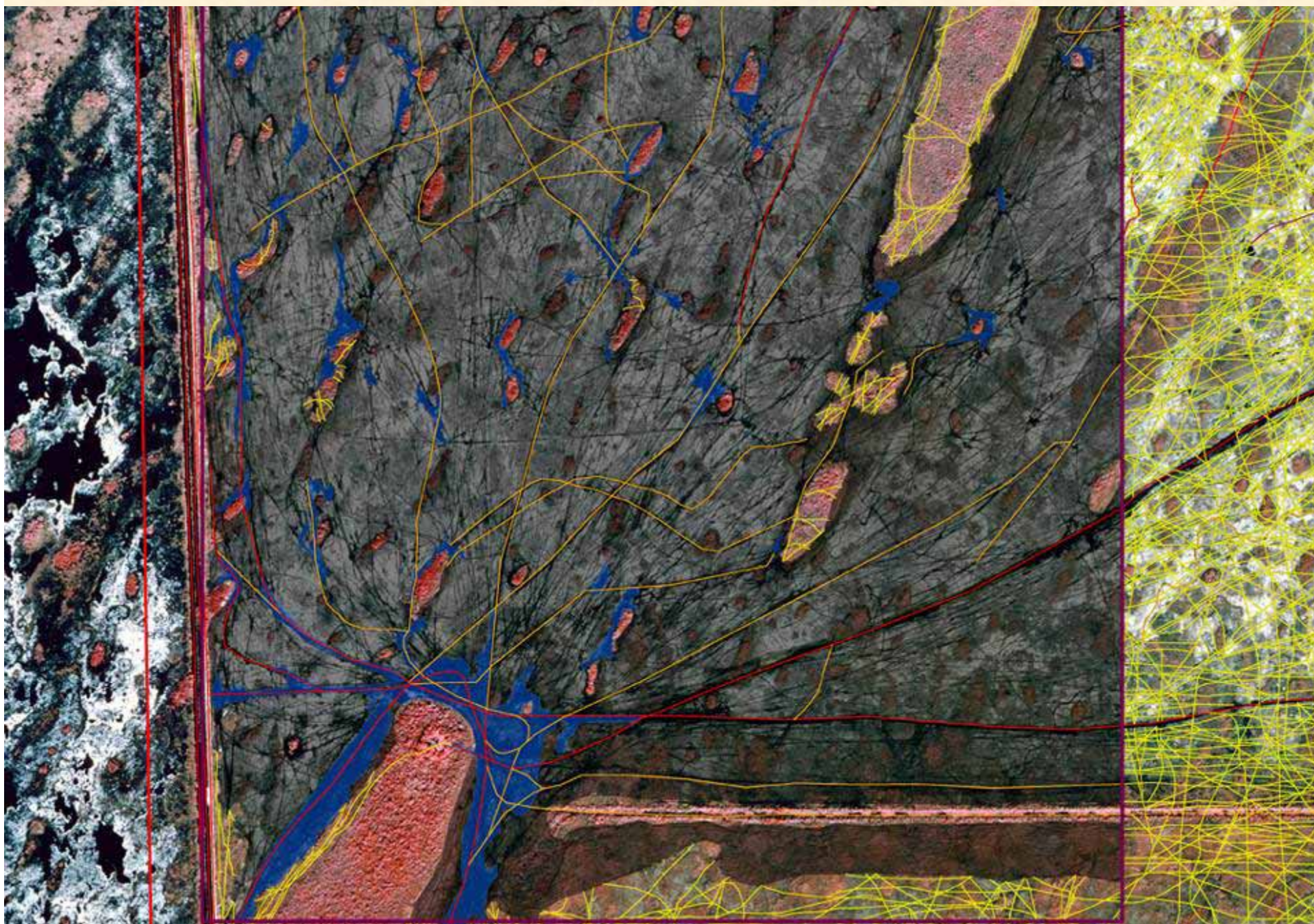
Three dates of digital image data:

1994 USGS DOQQs (1m)

1999 USGS DOQQs (1m)

2003 SFWMD digital orthos (0.5 m)

Study Area 3 – 1994 (Private Airboats)

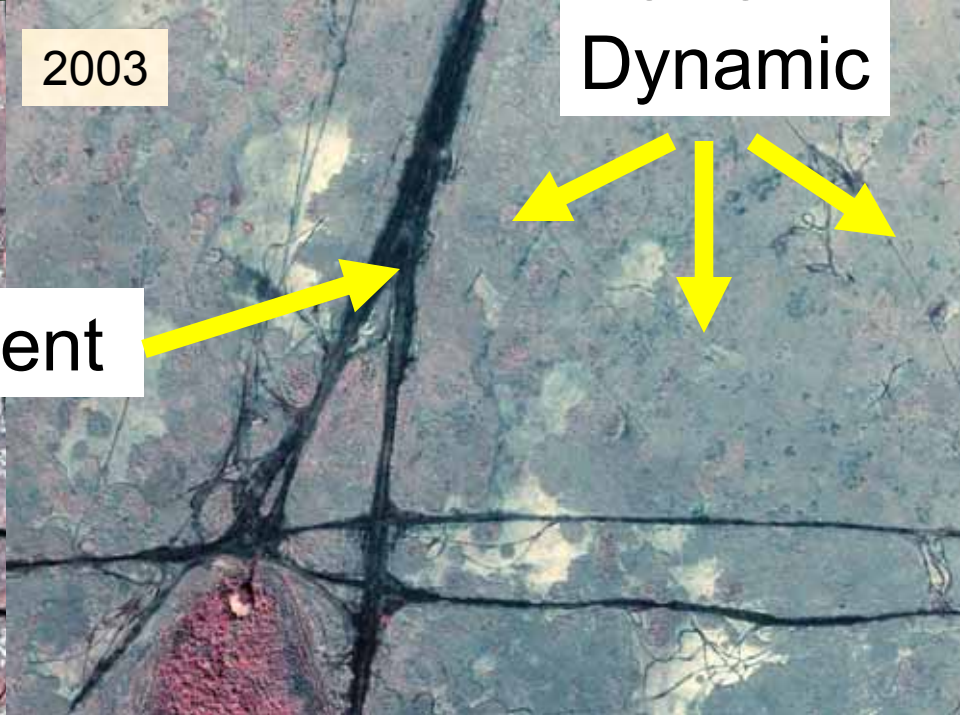
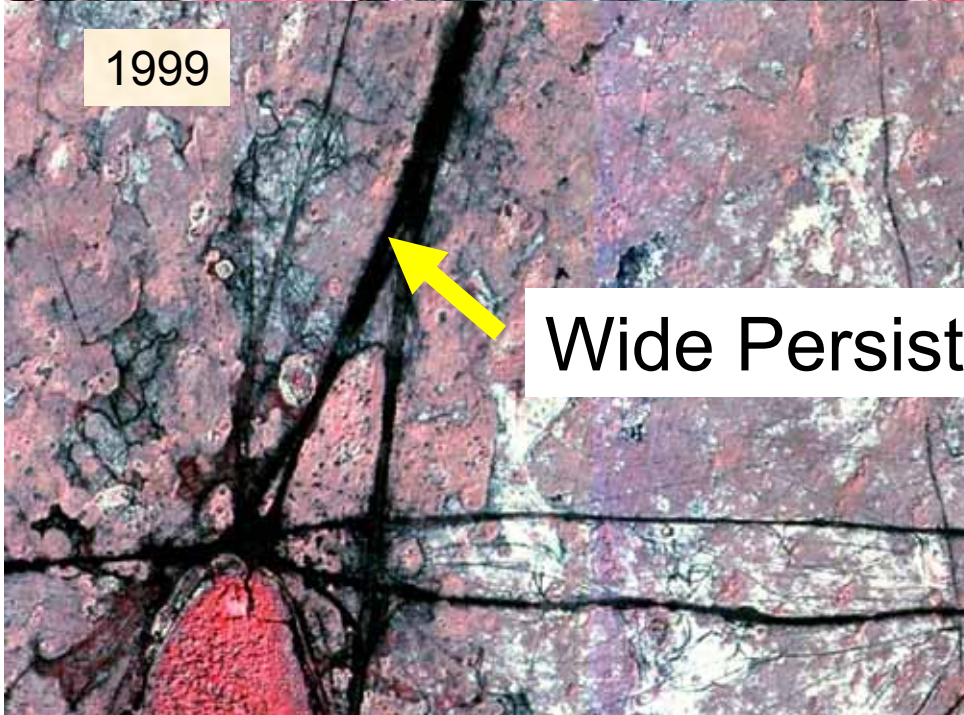
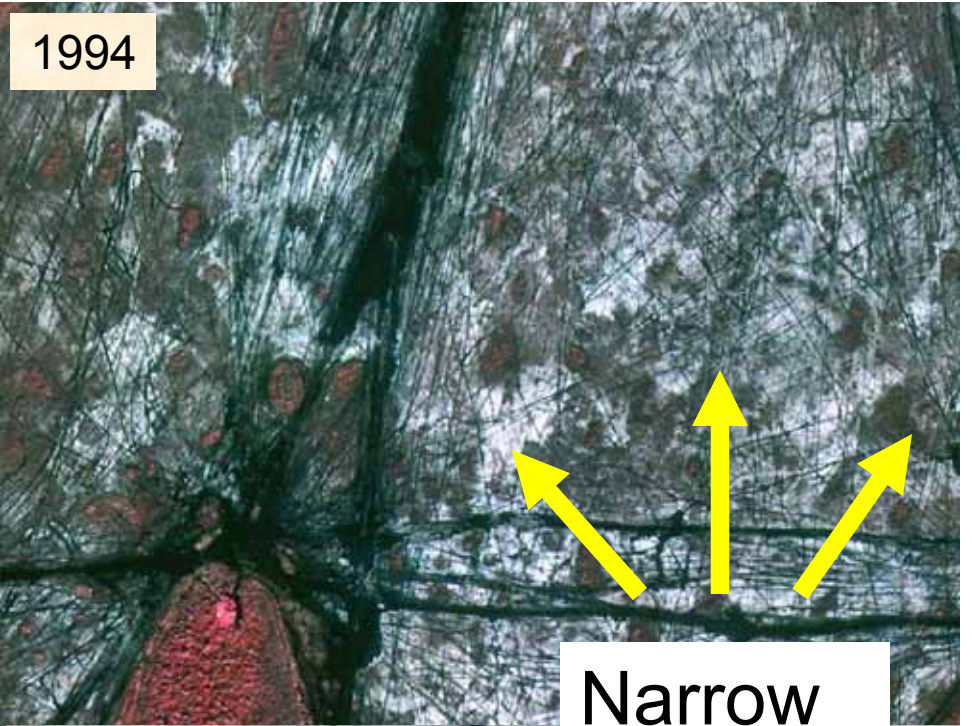
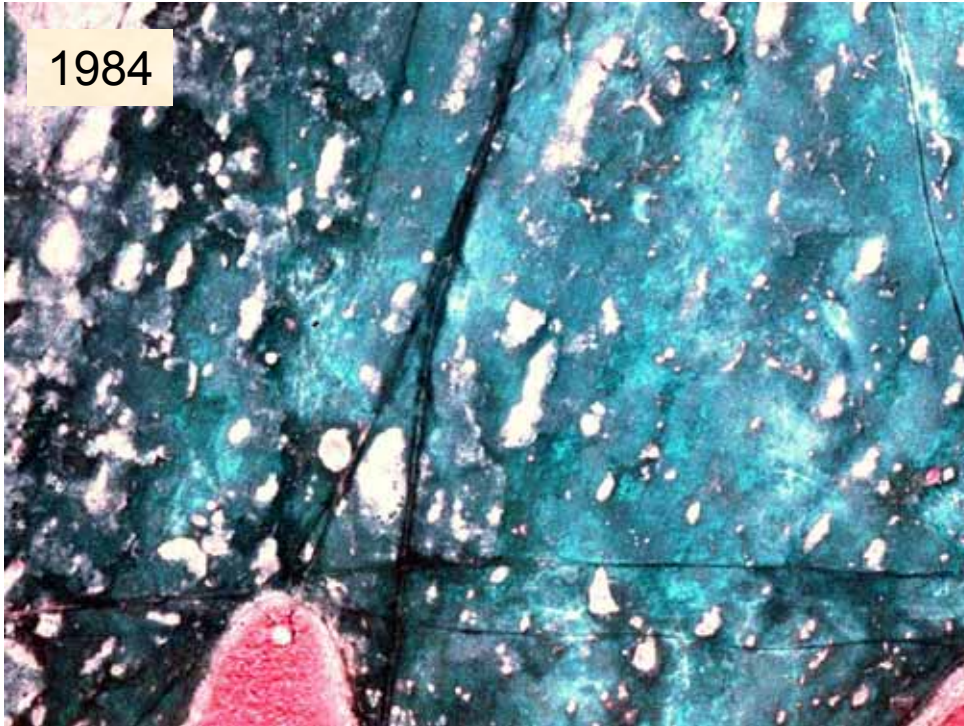


Study Area 3 – 1999 (Private Airboats)



Study Area 3 – 2003 (Private Airboats)

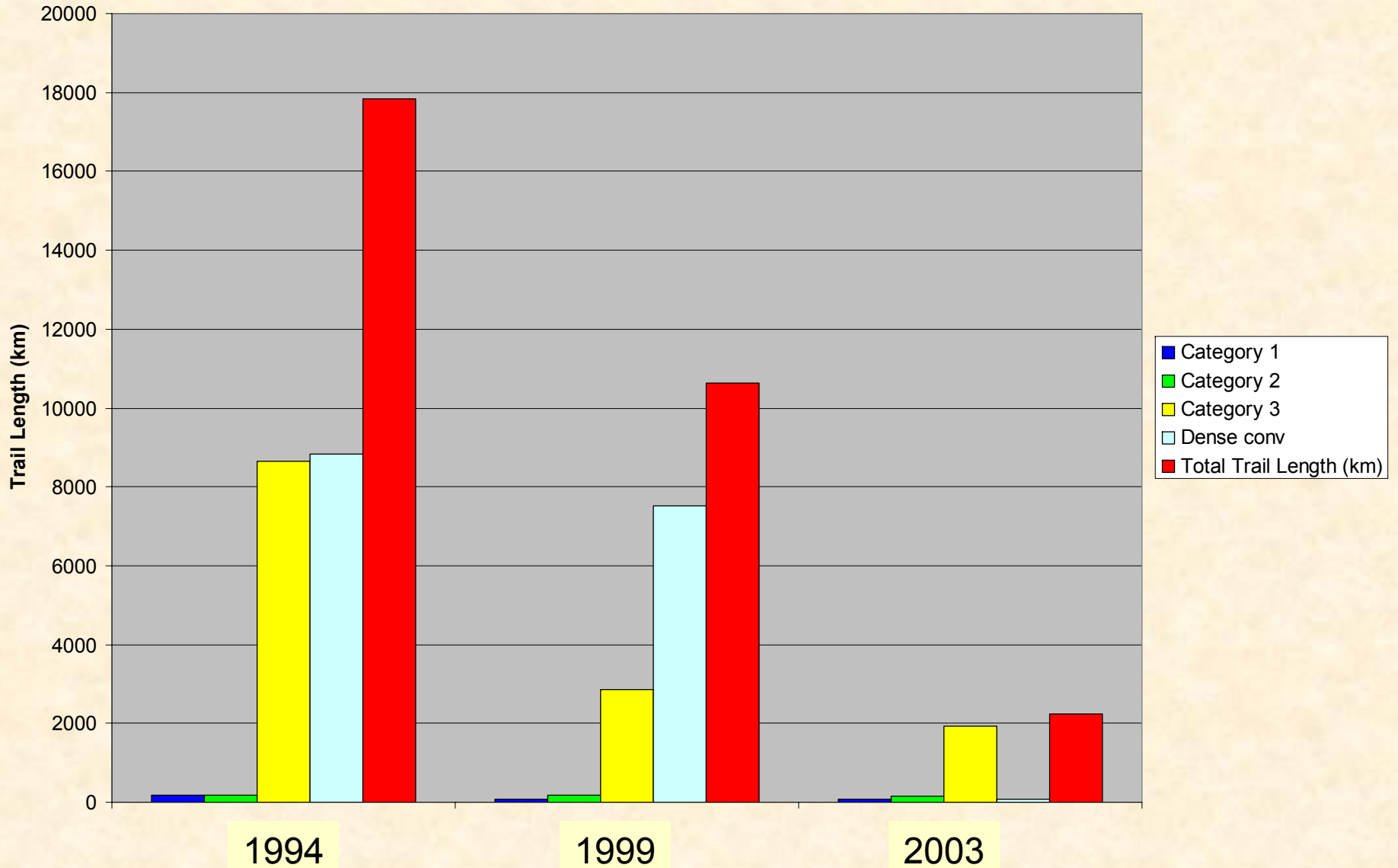




Narrow
Dynamic

Wide Persistent

Total Trails in East Everglades Expansion Area



87% reduction in total trail length for the period: 1994-2003

Category 1 Trails
>10 m wide



57%



Category 2 Trails
3-10 m wide



Category 3 Trails
<3 m wide



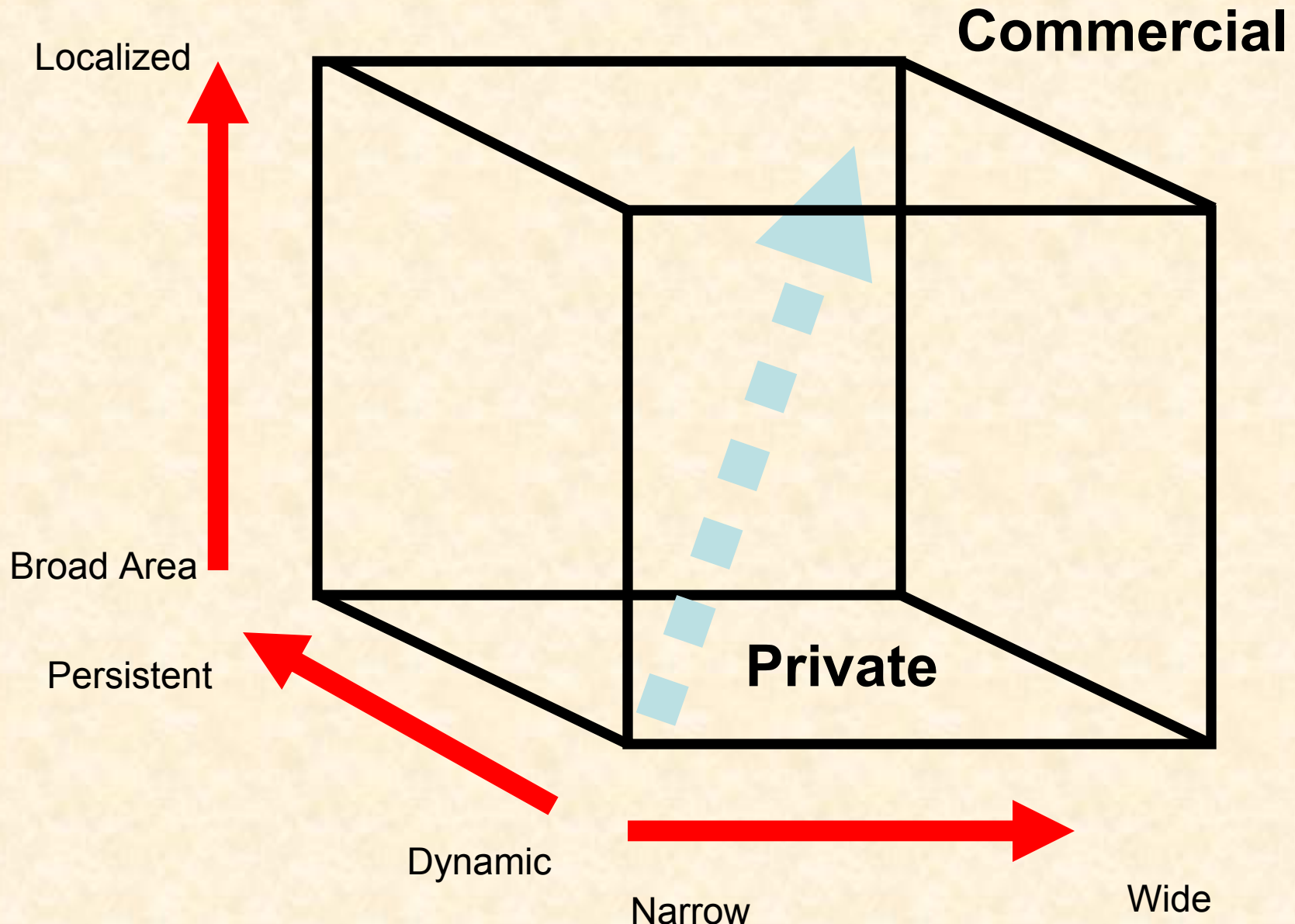
91%



Category 1 Trails: declined 57% while the commercial airboat business has been growing implying airboat tour companies are following consistent routes.

Category 2 Trails: remained fairly static in location and length indicating that these trails are subject to persistent use by private and limited commercial tours

Category 3 Trails: 91% reduction indicates that as private airboat use has declined in the East Everglades, the grasses are able to recover from occasional, dispersed use.



A satellite-style map of South Florida, showing the state's coastline and major water bodies. The map is overlaid with a yellow text box containing project information. The background image shows various colors representing different land and water features, with a dark blue area on the right side.

U.S. Environmental Protection Agency and Florida Department of Environmental Protection Funded Projects:

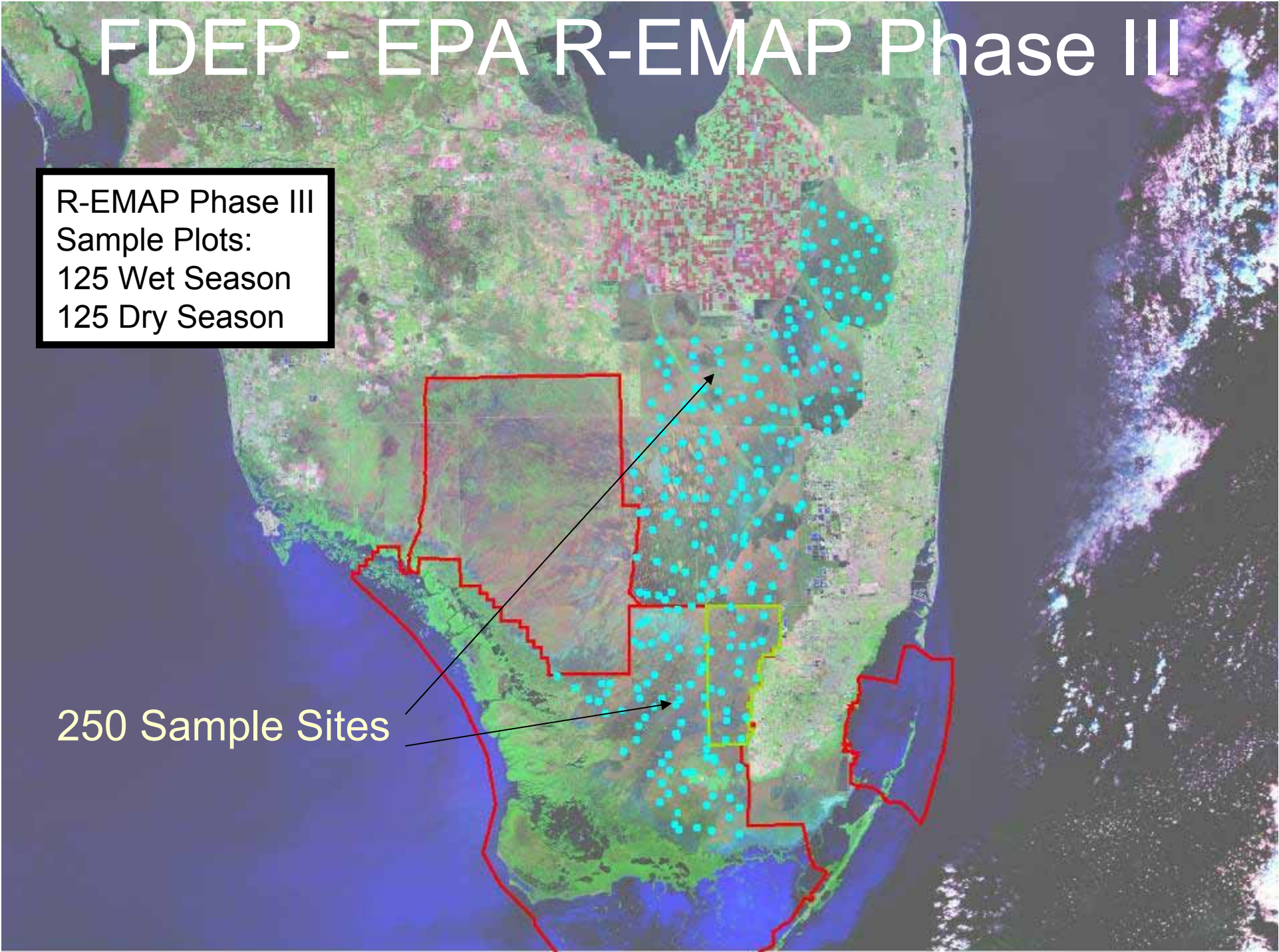
1999-2000 EPA, South Florida Ecosystem Assessment:
R-EMAP Phase I/II – Everglades Stressor Interactions:
Hydropatterns, Eutrophication, Habitat Alteration and
Mercury Contamination

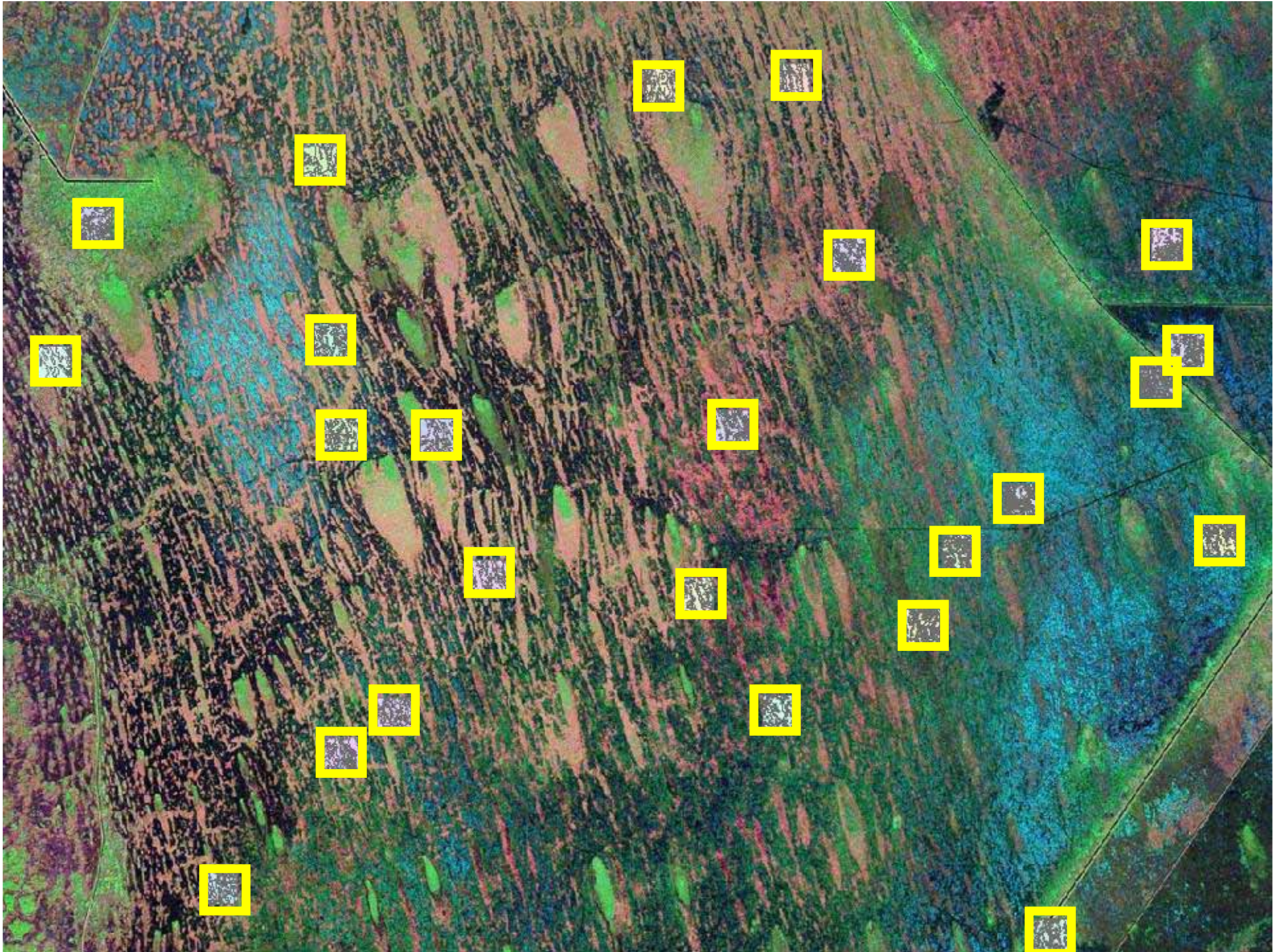
2004-2006 FDEP, South Florida Ecosystem Assessment:
R-EMAP Phase III – Everglades Stressor Interactions:
Hydropatterns, Eutrophication, Habitat Alteration and
Mercury Contamination

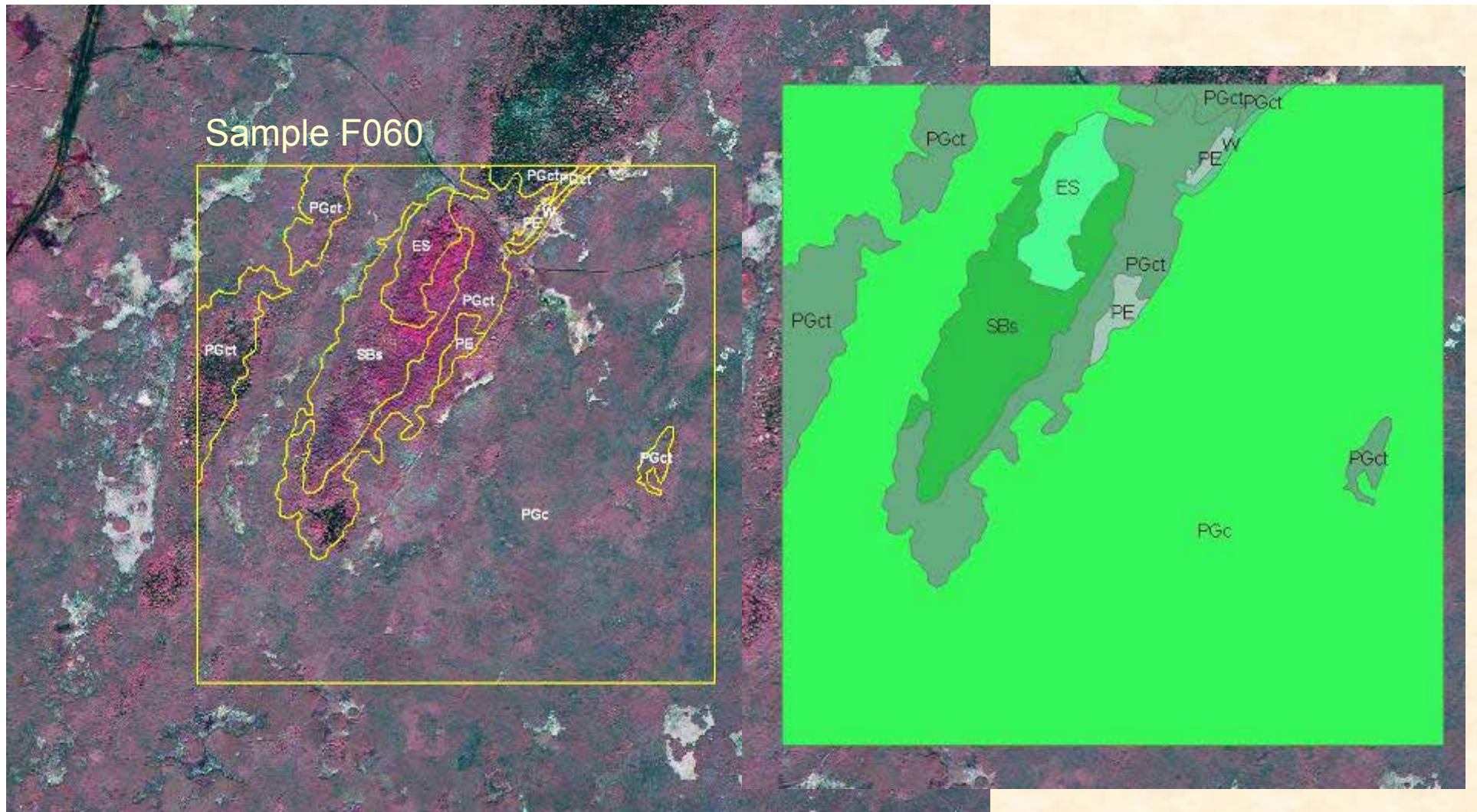
FDEP - EPA R-EMAP Phase III

R-EMAP Phase III
Sample Plots:
125 Wet Season
125 Dry Season

250 Sample Sites


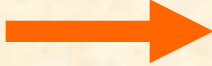
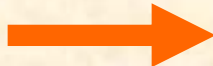


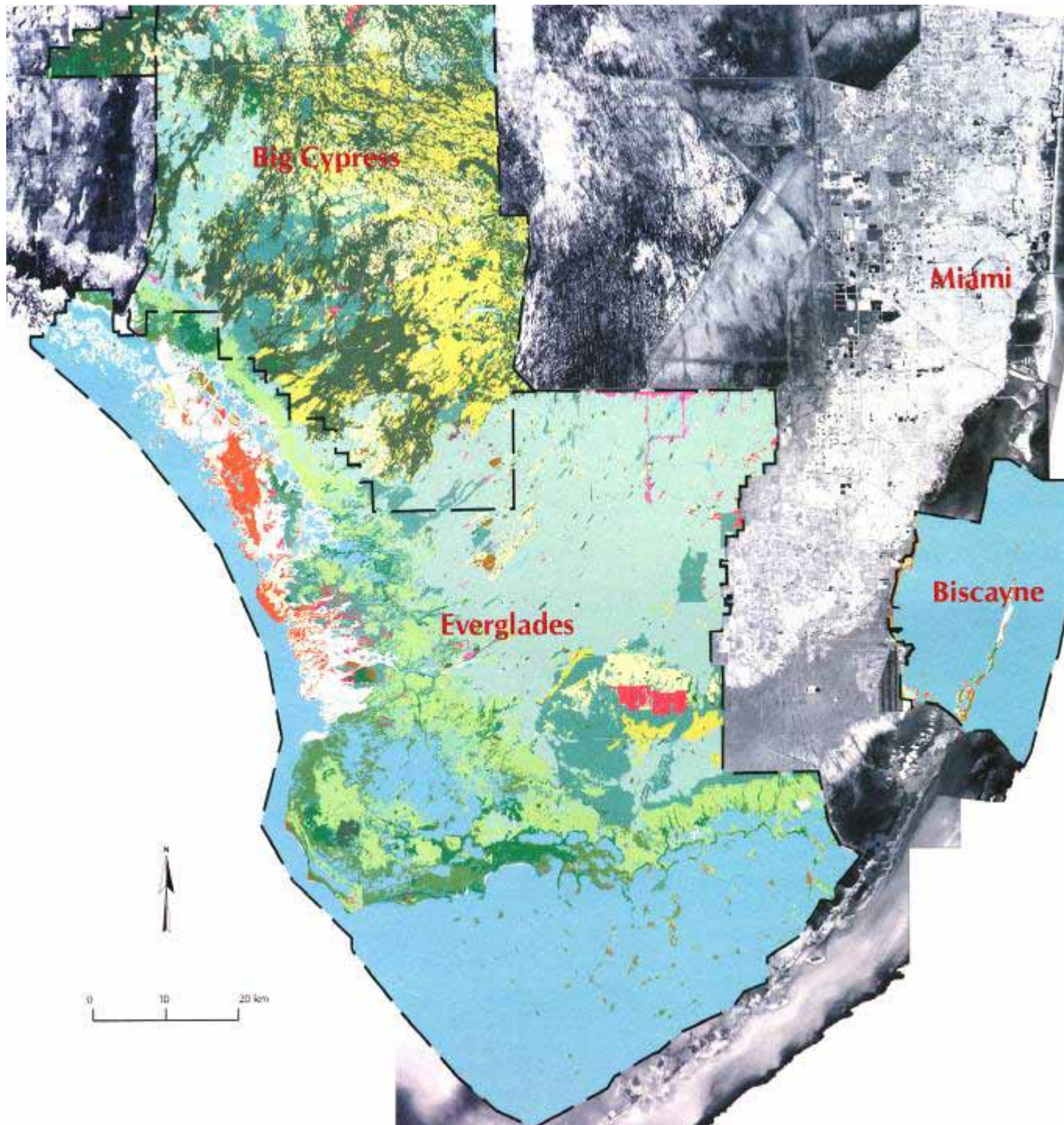




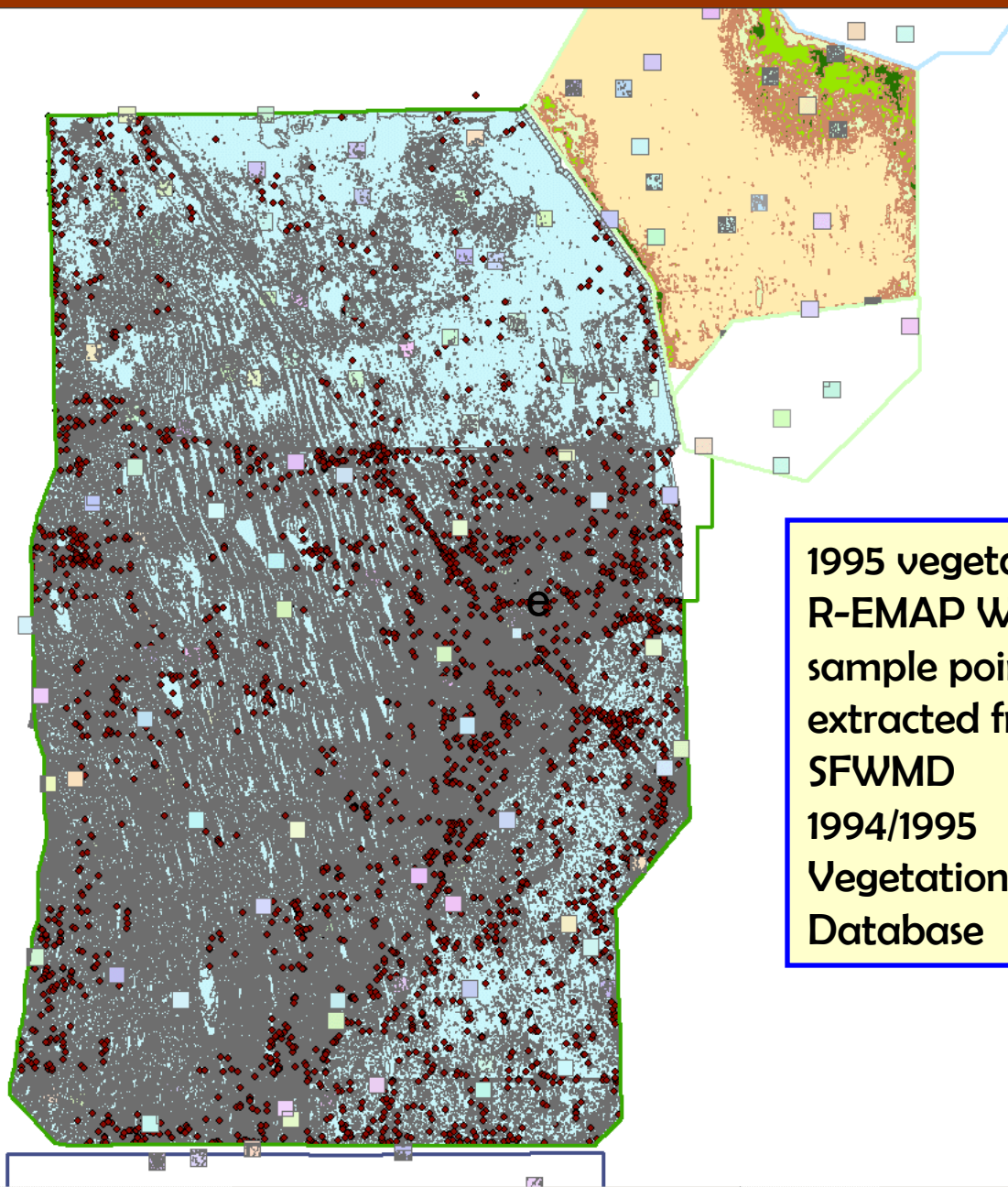
Rutchey, K., T.N. Schall, R.F. Doren, A. Atkinson, M.S. Ross, D.T. Jones, M. Madden, L. Vilchek, K.A. Bradley, J.R. Snyder, J.N. Burch, T. Pernas, B. Witcher, M. Pyne, R. White, T.J. Smith III, J. Sadle, C.S. Smith, M.E. Patterson, and G.D. Gann, 2006. *Vegetation Classification for South Florida Natural Areas*, U.S. Geological Survey, Open-File Rpt 2006-1240, Saint Petersburg, Florida, 142 p.

P PRAIRIES AND MARSHES

	PG	Graminoid Prairie/Marsh
	PGjs PGjf	Salt water species of <i>Juncus</i> such as Black rush (<i>Juncus roemerianus</i>) Fresh water species of <i>Juncus</i> such as Soft Rush (<i>Juncus effusus</i>)
	PGc PGci PGcc PGcci	Sawgrass (<i>Cladium jamaicense</i>) Sawgrass with Bayhead Sawgrass-Shrub Sawgrass-Shrub with Bayhead
	PGm	Muhly Grass (<i>Muhlenbergia filipes</i>)
	PGs	Cordgrass (<i>Spartina</i> spp.)
	PGe	Spike Rush (<i>Eleocharis cellulosa</i>)
	PGp	Common Reed (<i>Phragmites</i> spp.)
	PGa	Maidencane (<i>Panicum hemitomon</i>)
	PGi	American Cupscale-grass (<i>Sacciolepis striata</i>)
	PGz	Giant Cut Grass (<i>Zizaniopsis miliacea</i>)
	PGw	Wet Prairie-Slough
	PGwi PGwc	Wet Prairie-Slough with Bayhead Wet Prairie with Shrub



1995 vegetation for
R-EMAP ENP
sample points
extracted from the
NPS-CRMS South
Florida Vegetation
Database



1995 vegetation for
R-EMAP WCA3
sample points
extracted from the
SFWMD
1994/1995
Vegetation
Database

2402 field points in WCA3 collected 1996-2002 by SFWMD

Identify Results

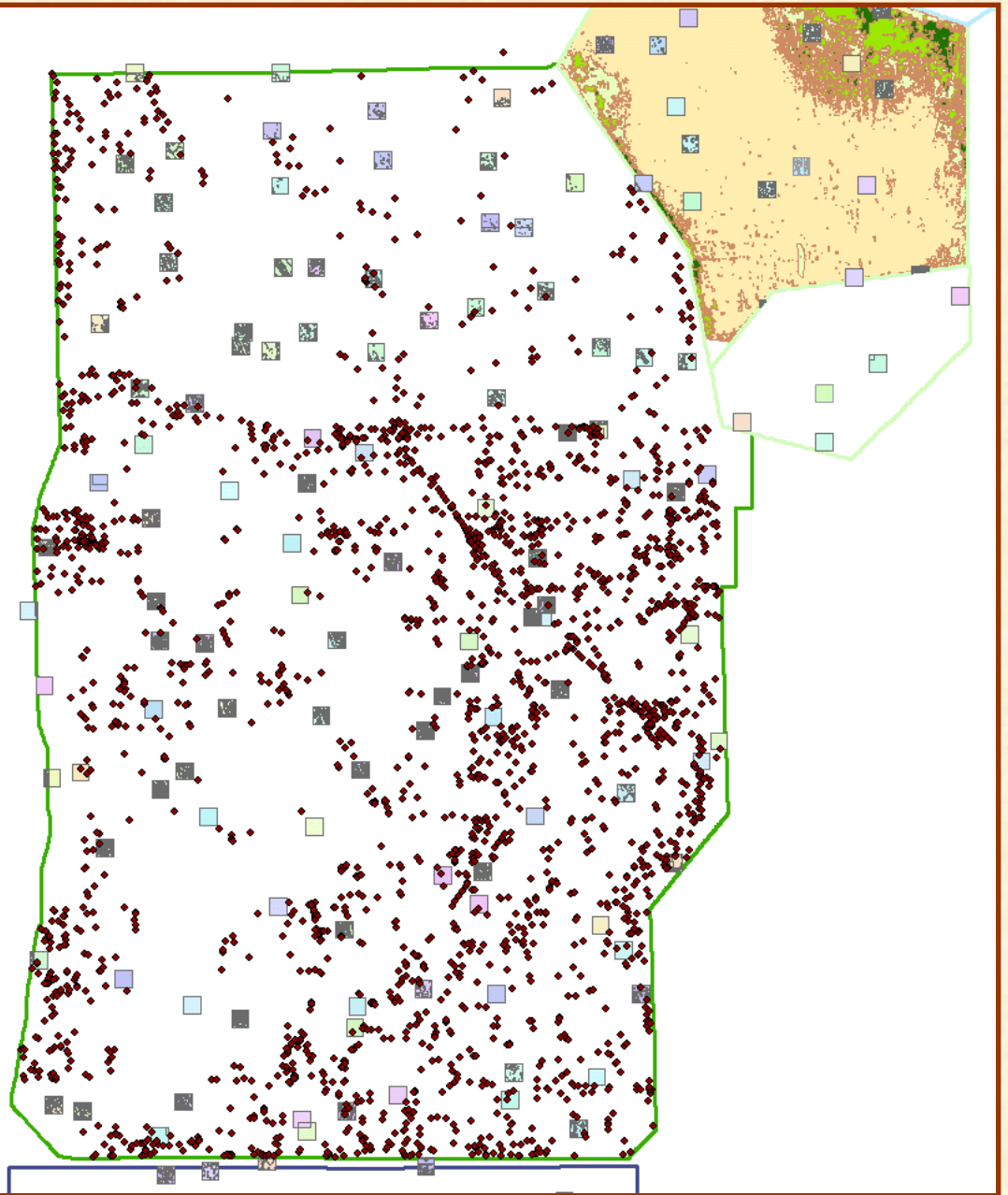
Layers: <Top-most layer>

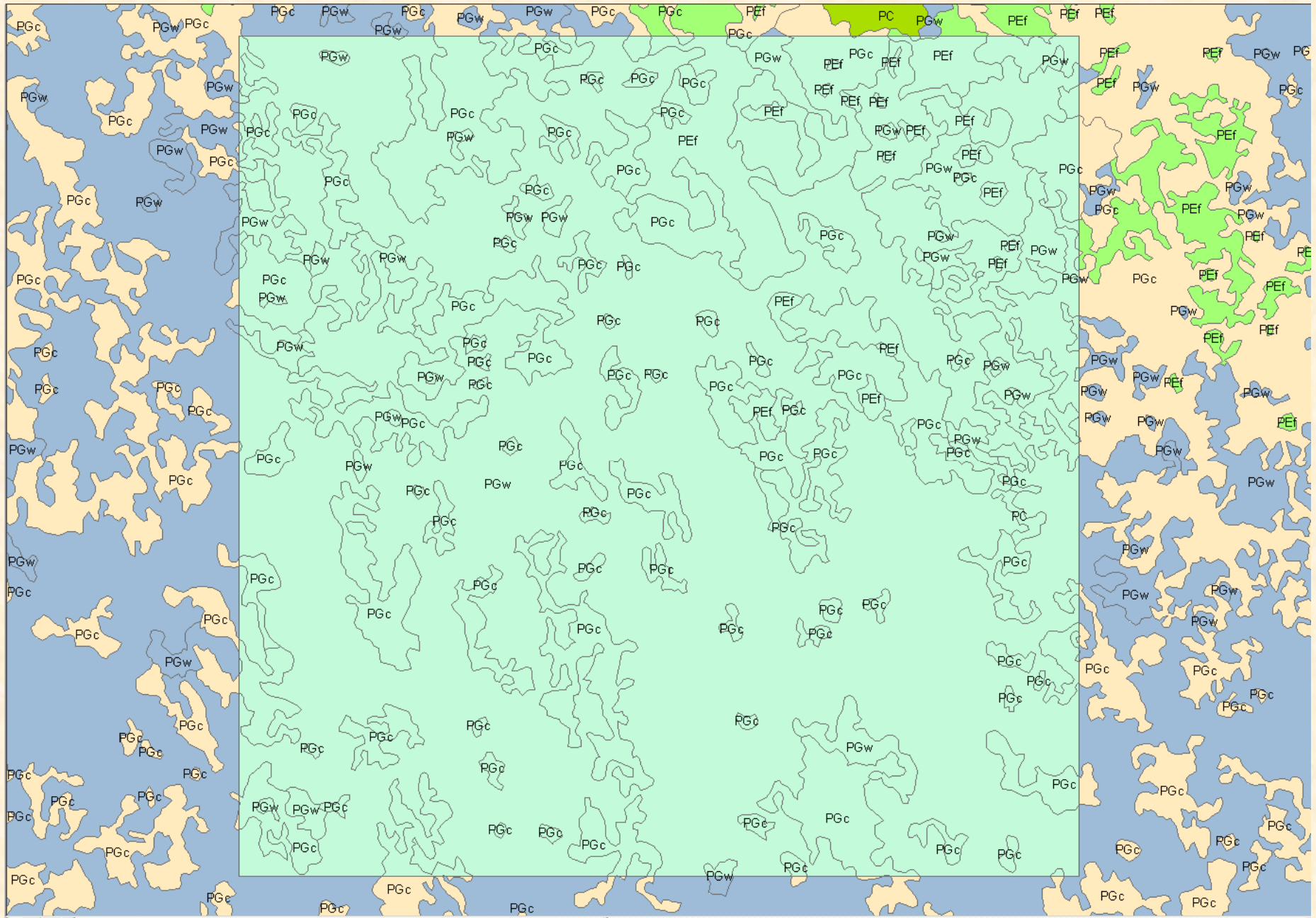
Field_Data

2000-Oct

Location: {531316.538685 2869589.763551}

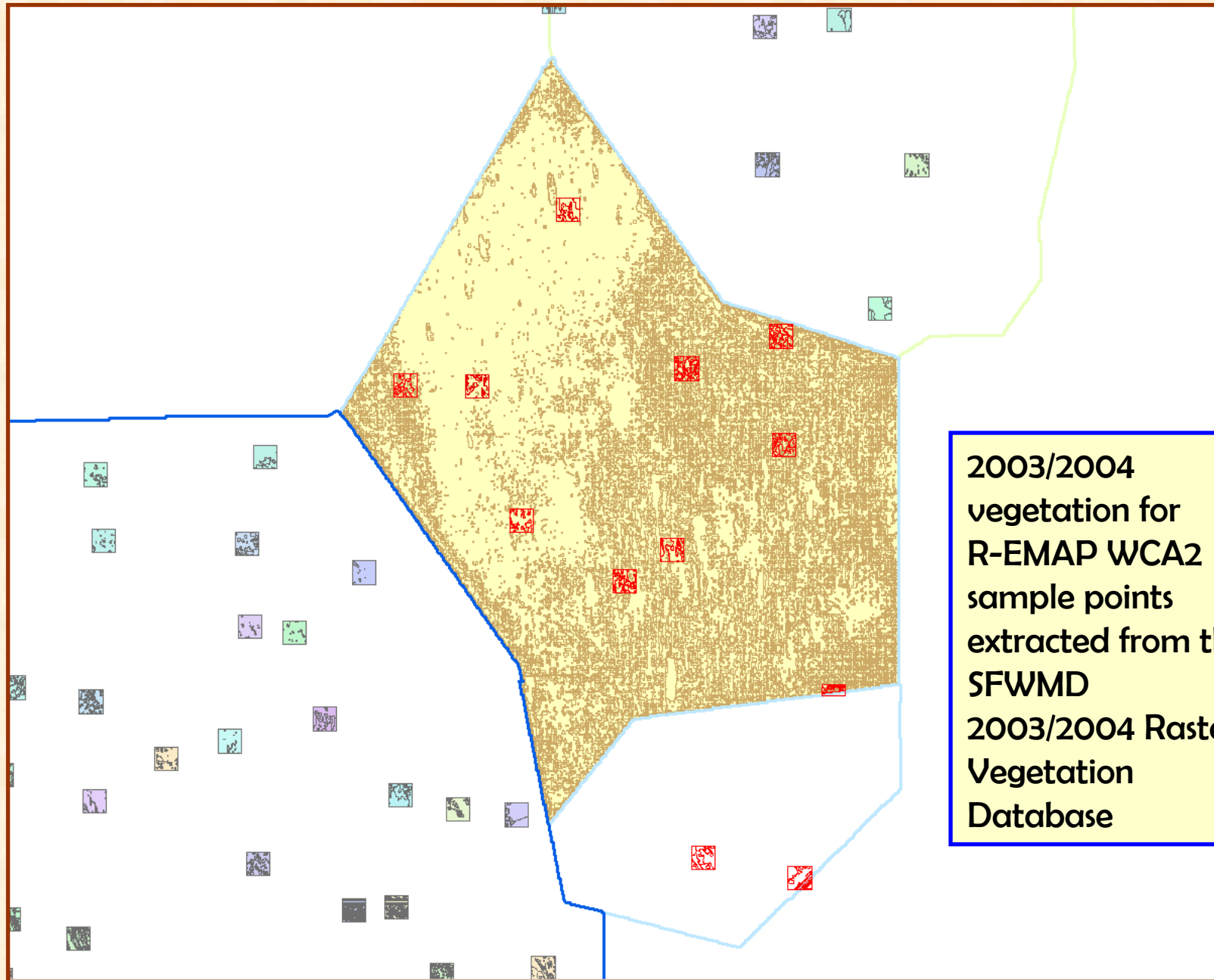
Field	Value
OBJECTID	1772
Shape	Point
INDEX_	1772
SITE	1625
DATE_	2000-Oct
PHOTO	526
YEAR_	1995
WCA_	3A
DESCRIPTIO	small island of saw, pont, crinum, nym, royalfem
Xutm	531350
Yutm	2869438



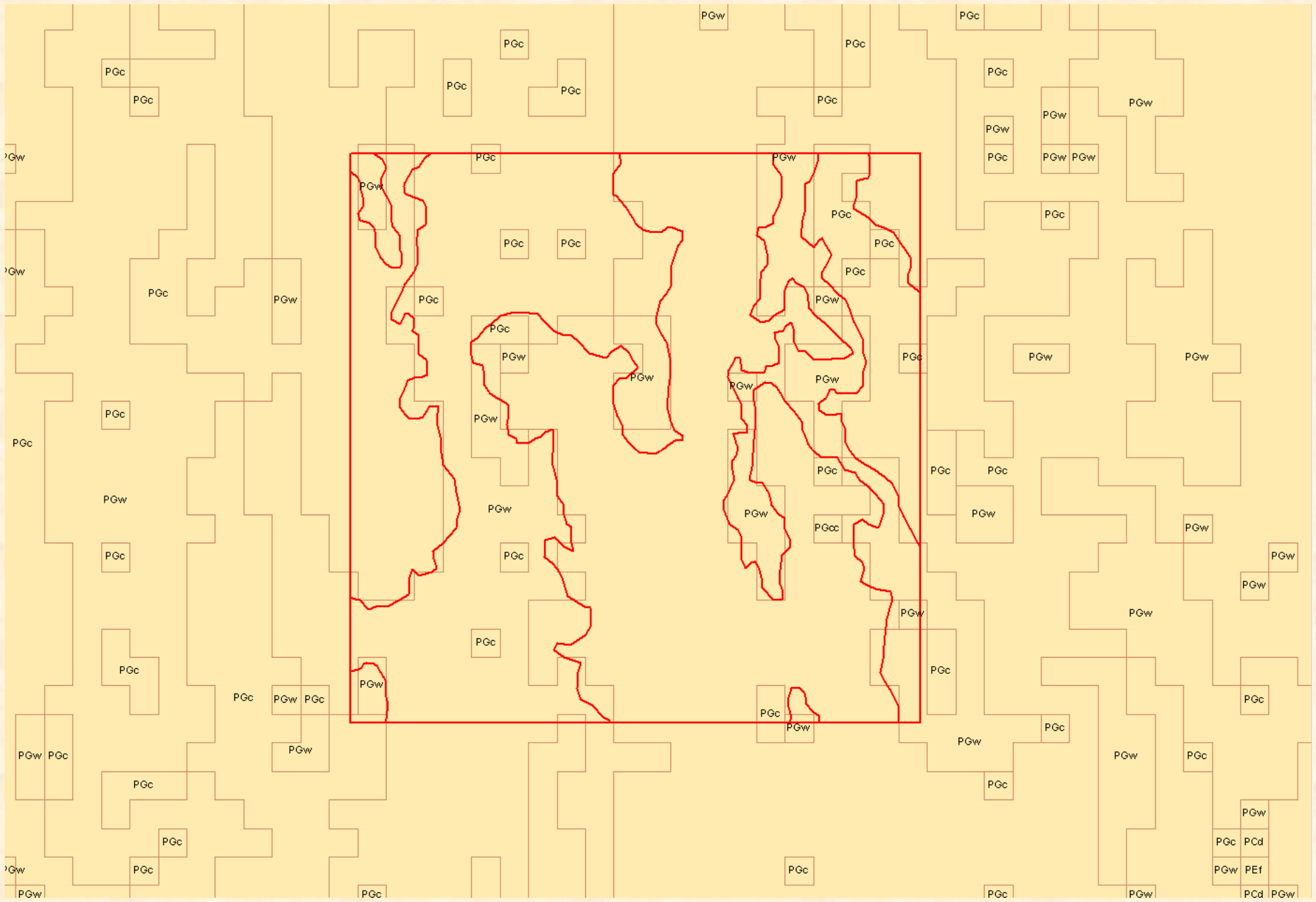


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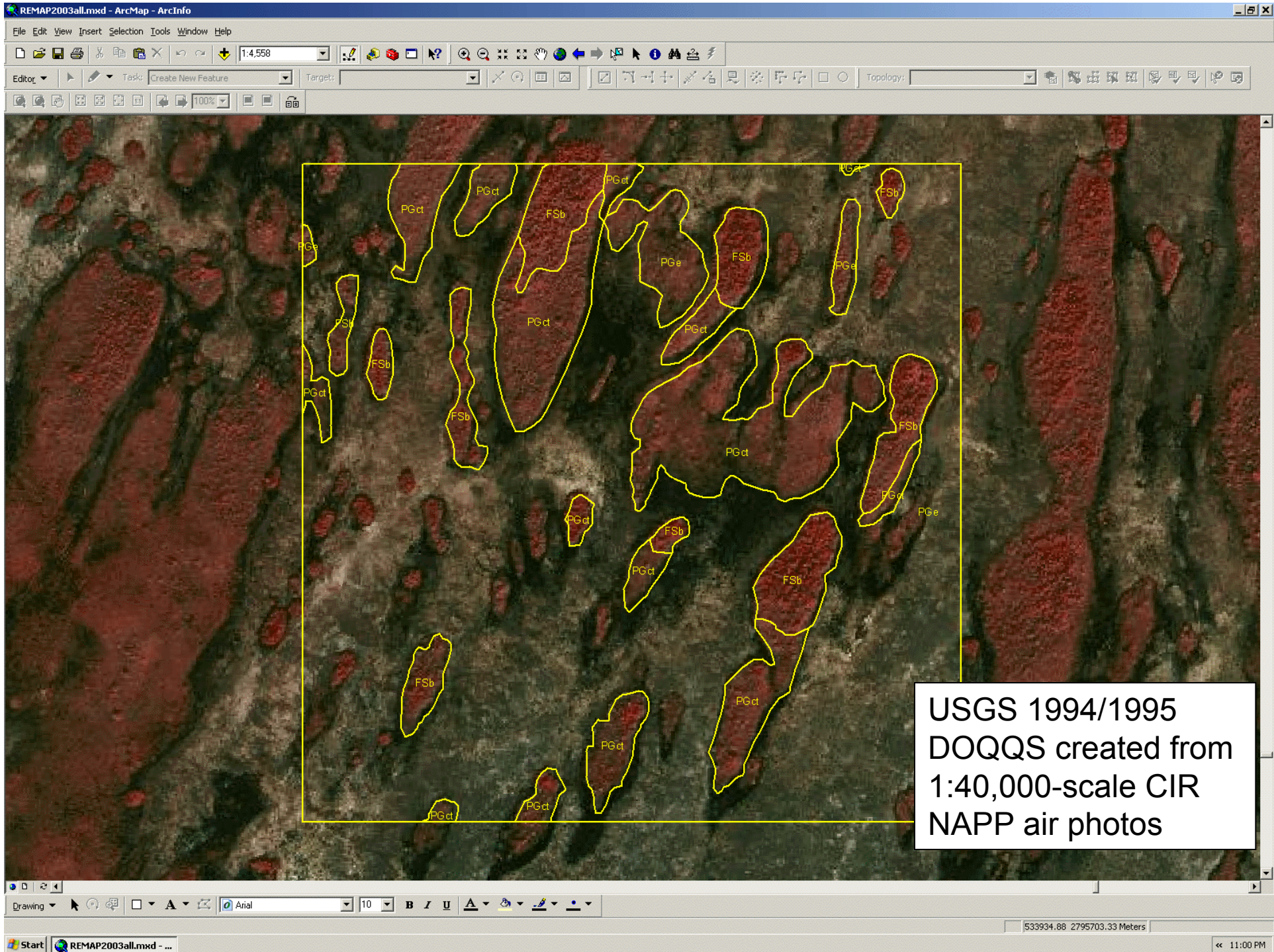


**2003/2004
vegetation for
R-EMAP WCA2
sample points
extracted from the
SFWMD
2003/2004 Raster
Vegetation
Database**

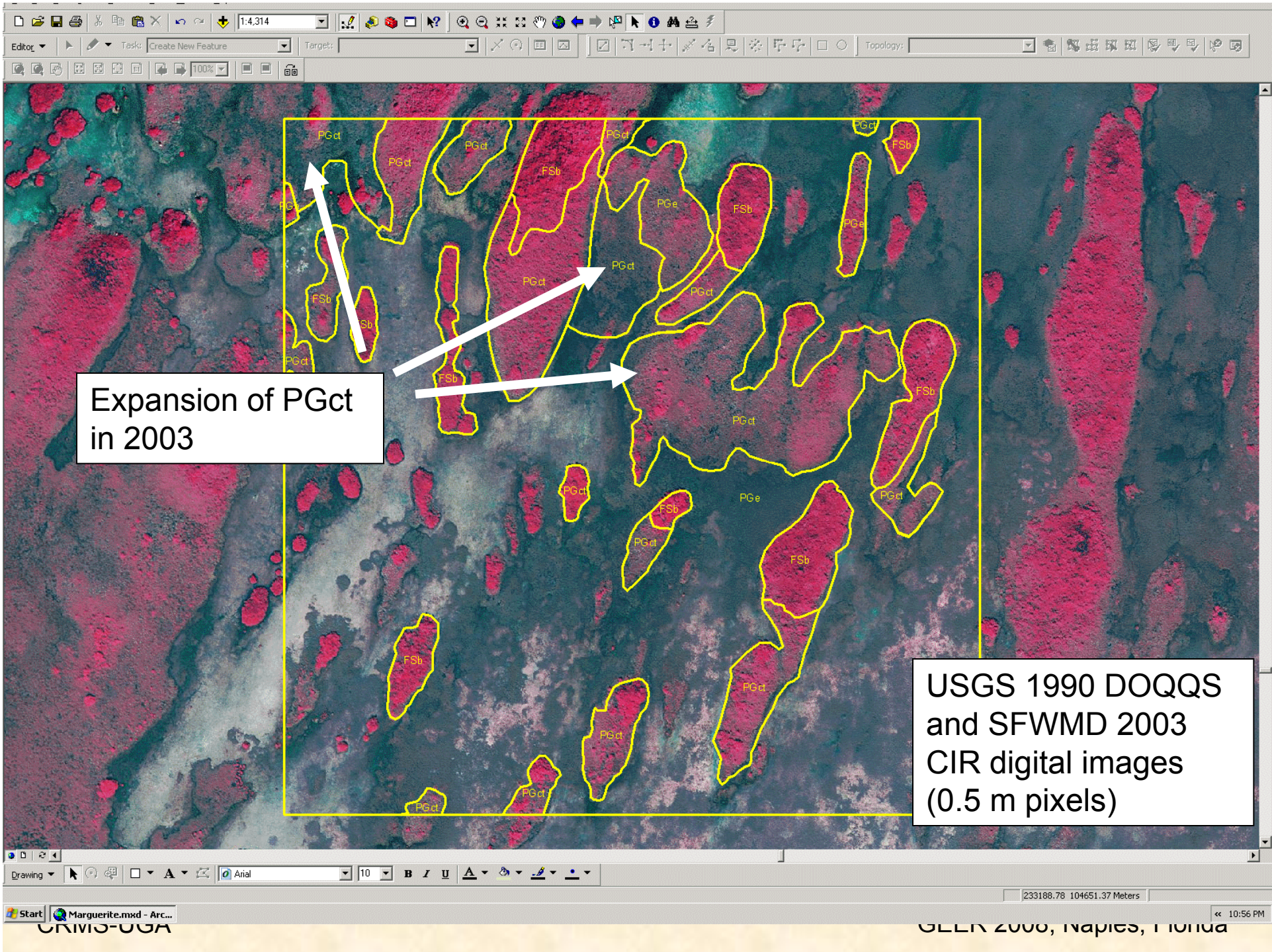


CRMS-UGA

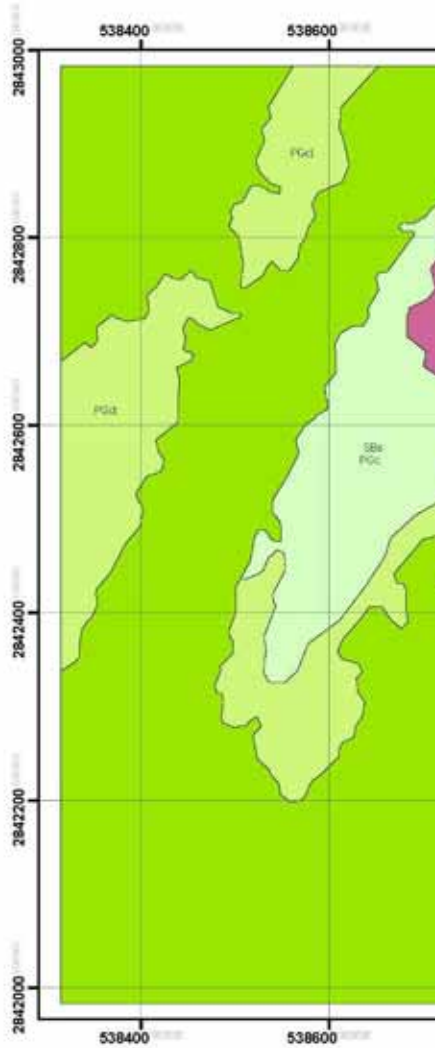
GEER 2008, Naples, Florida



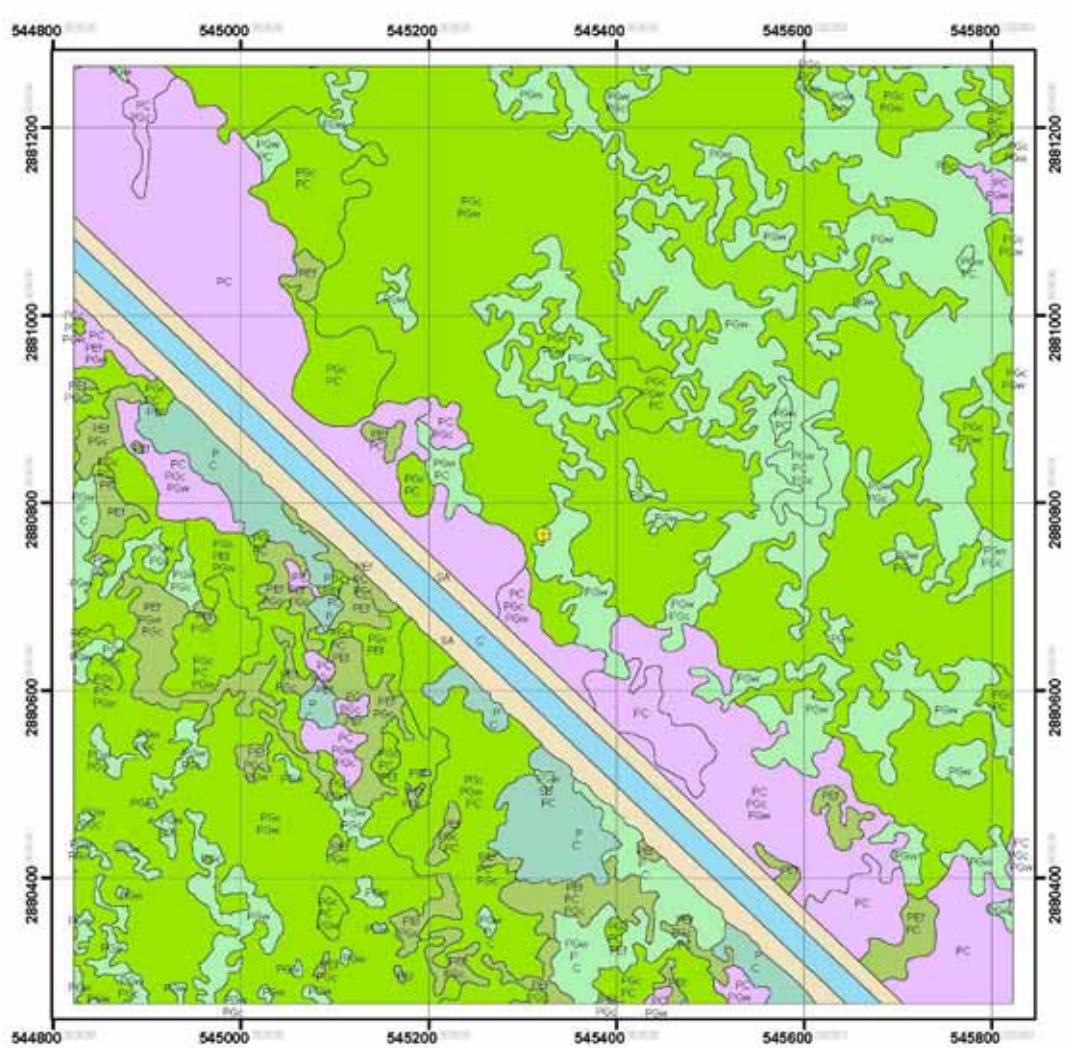
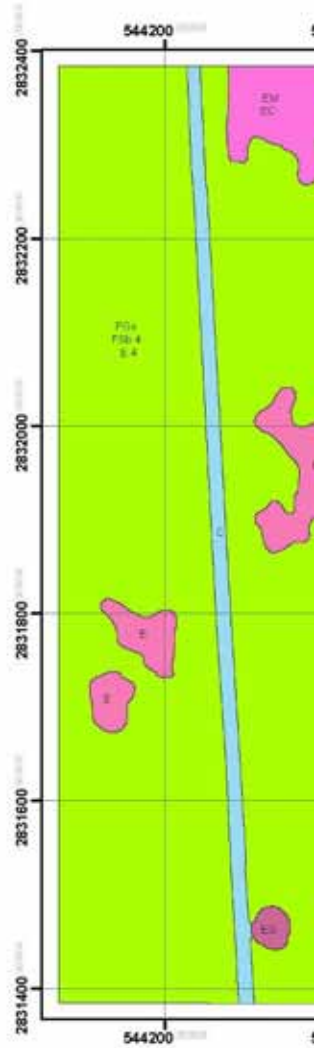
USGS 1994/1995
DOQQS created from
1:40,000-scale CIR
NAPP air photos



Vegetation	Fall 1995-2003	Spring 1995-2003
Cattail	+278 ha 48%	+1437 ha 79%
Sawgrass	+471 ha 7%	+1672 ha 20%
Wet Prairie	+1263 ha 105%	+3666 ha 76%
Exotics	+12 ha 37%	+79 ha 78%



Stat
REM.



Station 191 - WCA 3
REMAP - Phase III

Station Locator Map



0 50
201
North

Find
Sample
ID
U
Glen
RUB
CRIB

Station Locator Map



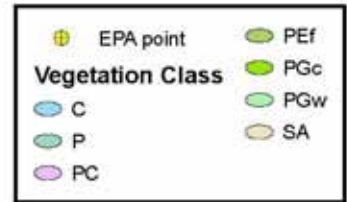
Station Locator Map

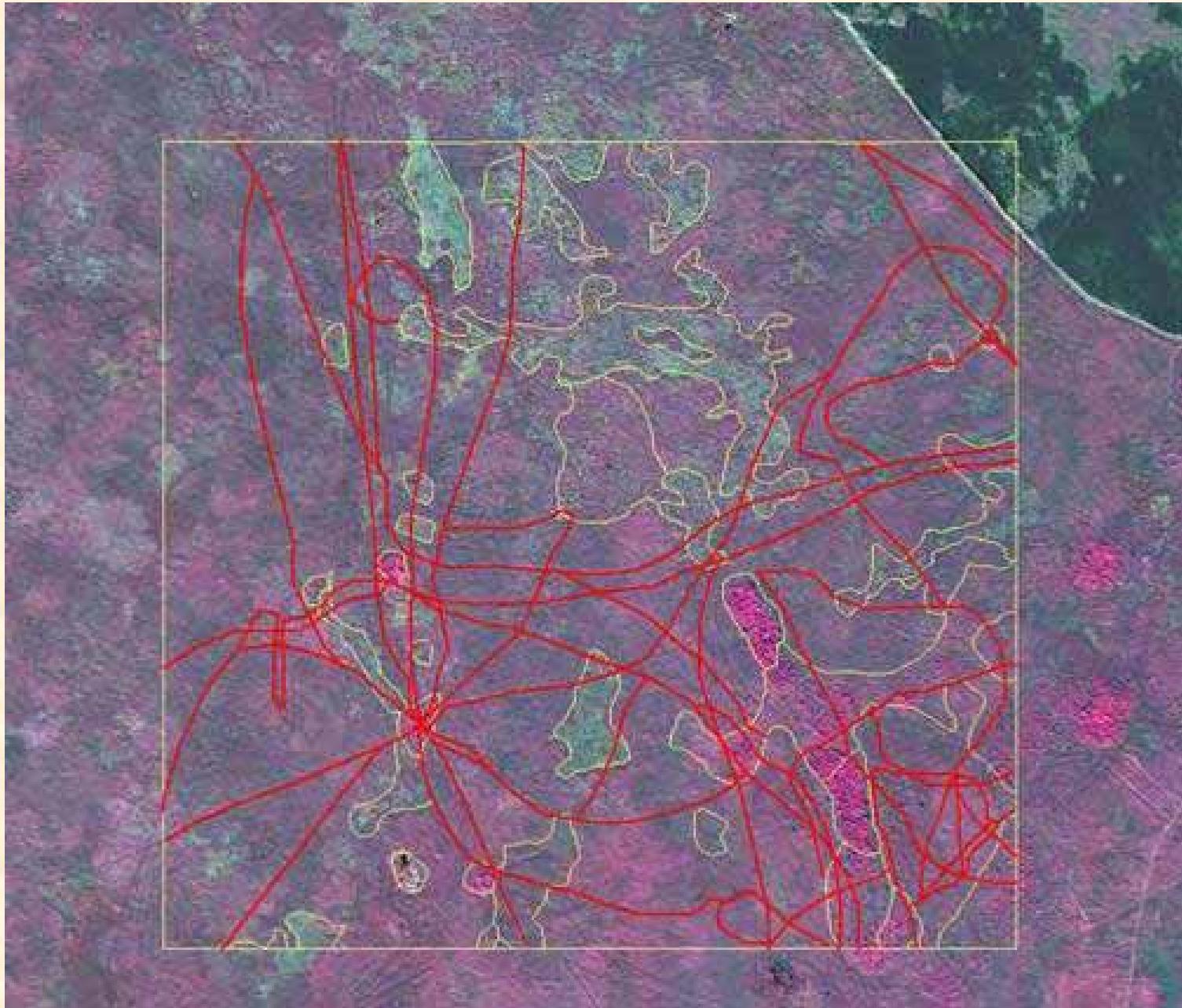


0 50 100 200
Meters

Produced by the Center for Remote
Sensing and Mapping Systems (CRMS),
Department of Geography, The
University of Georgia, Athens,
Georgia, from U.S. Geological Survey
(USGS) 1999 1:12,000-scale Digital
Orthophoto Quarter Quads (DOQQ's).

Map printed on August 19, 2005





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Airboat Buffer Analysis

- Stratify airboat trails by width class.
- Create 100-m buffer around airboat trails.
- Reclass and dissolve vegetation communities to 4 classes (Exotics, Cattail, Sawgrass and Other)
- Intersect vegetation and airboat buffer
- Summarize area of vegetation within buffer area
- Export summary statistics to SPSS for analysis

Three airboat trail width classes :

- Class 1 airboat trails (>10 m)
- Class 2 airboat trails (3 - 10 m)
- Class 3 airboat trails (< 3 m)

Four vegetative categories were of interest:

Exotic vegetation
Cattail (*Typha latifolia*)
Sawgrass (*Cladium jamaicense*)
Other

Spatial Correlation Questions

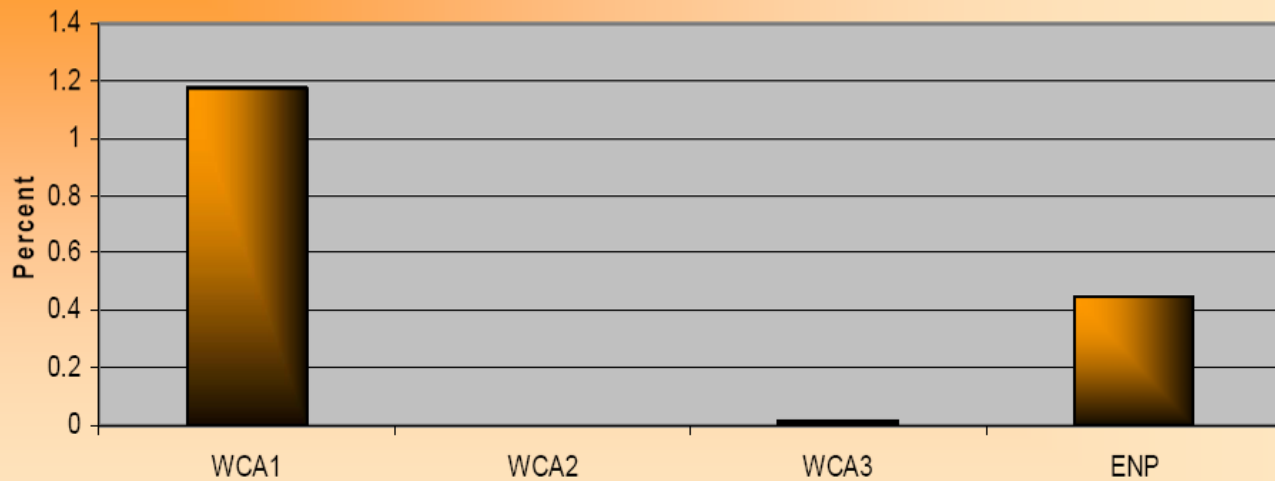
- 1) Between the total length of airboat trails and the total area of vegetation in a 1km² sample site
- 2) Between the total lengths of airboat trail width classes and total area of vegetation inside a 1km² sample site
- 3) Comparison of percent area of vegetation by region with the average total airboat trail lengths; and
- 4) Difference between the percent vegetation within 100 m of an airboat trail and the percentage of vegetation further than 100 m of an airboat trail.

Descriptive Statistics

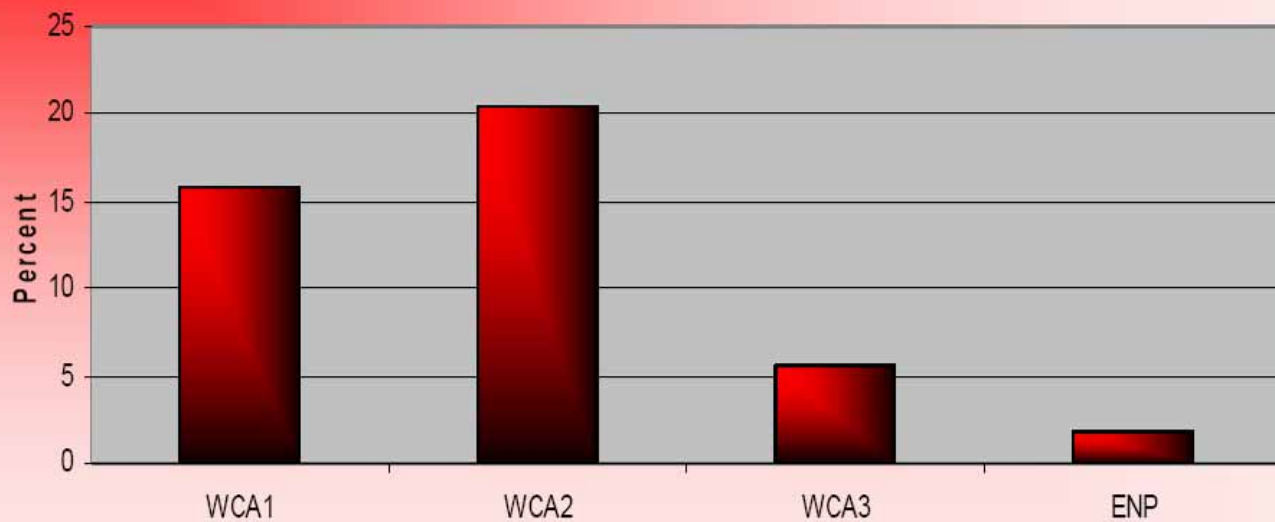
No. Sample Sites	
224	Total sample sites
131	Sample sites with airboat trails
654	Total airboat trails
10	Sites with Class 1 trails
17	Sites with Class 2 trails
131	Sites with Class 3 trails

No. Sample Sites	
16	with Exotic Vegetation
9	with Exotics and Airboat Trails
135	with Cattail
67	with Cattail and Airboat Trails
131	with Sawgrass and Airboat Trails
131	with Other Vegetation and Airboat Trails

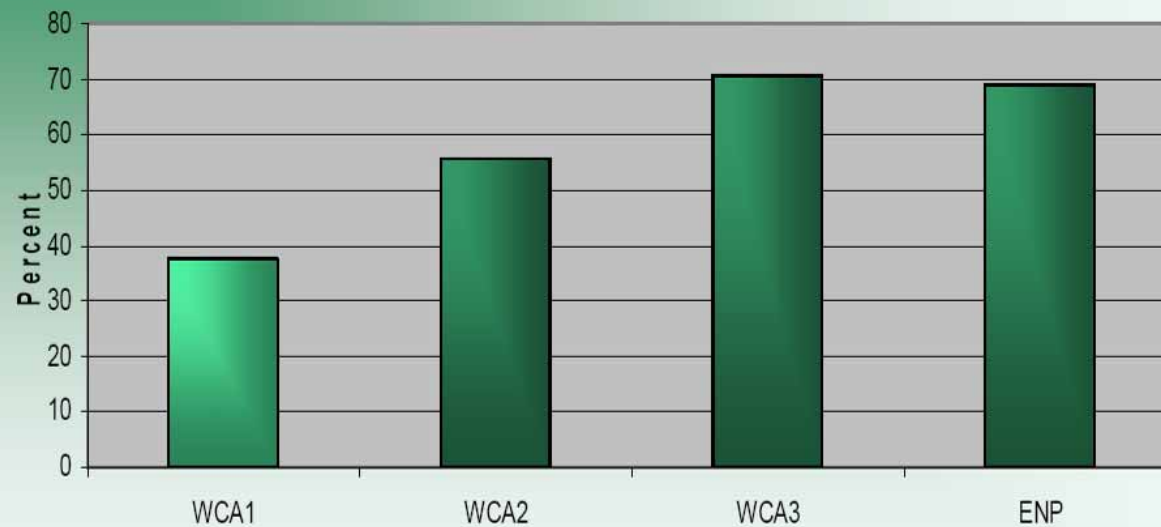
Percent Area of Exotics



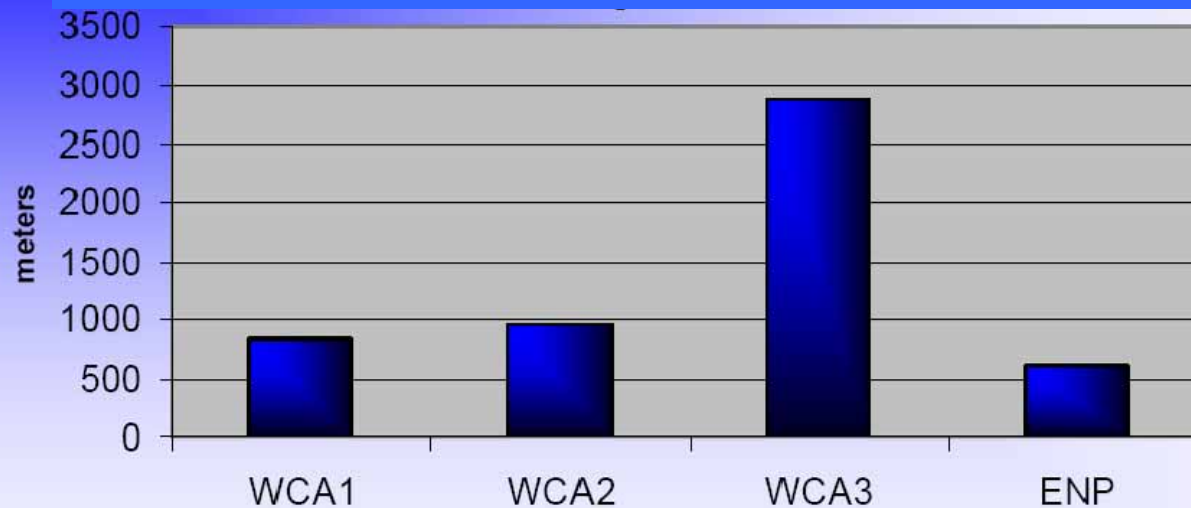
Percent Area of Cattail

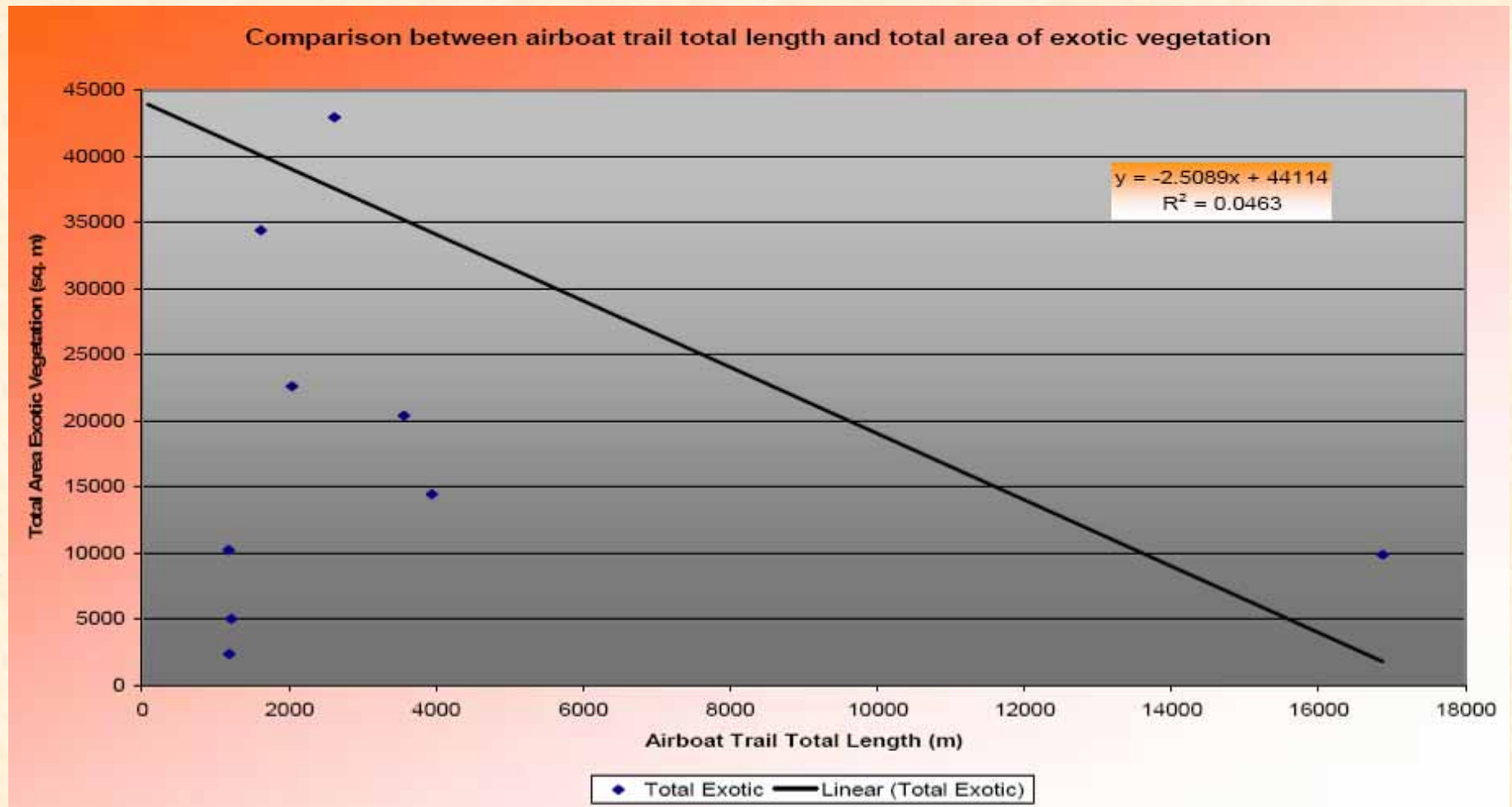


Percent Area of Sawgrass



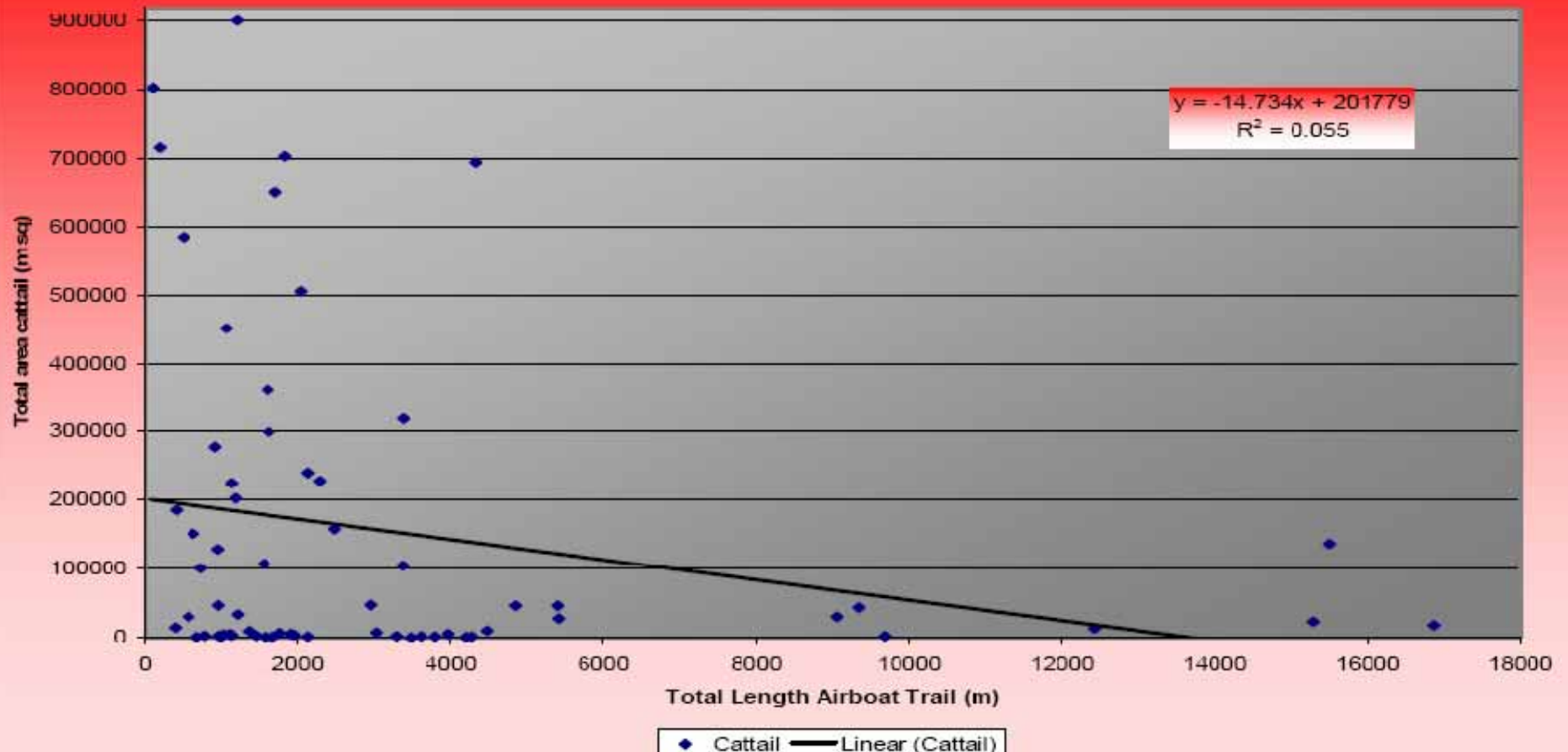
Average Airboat Trail Length per Sample Site



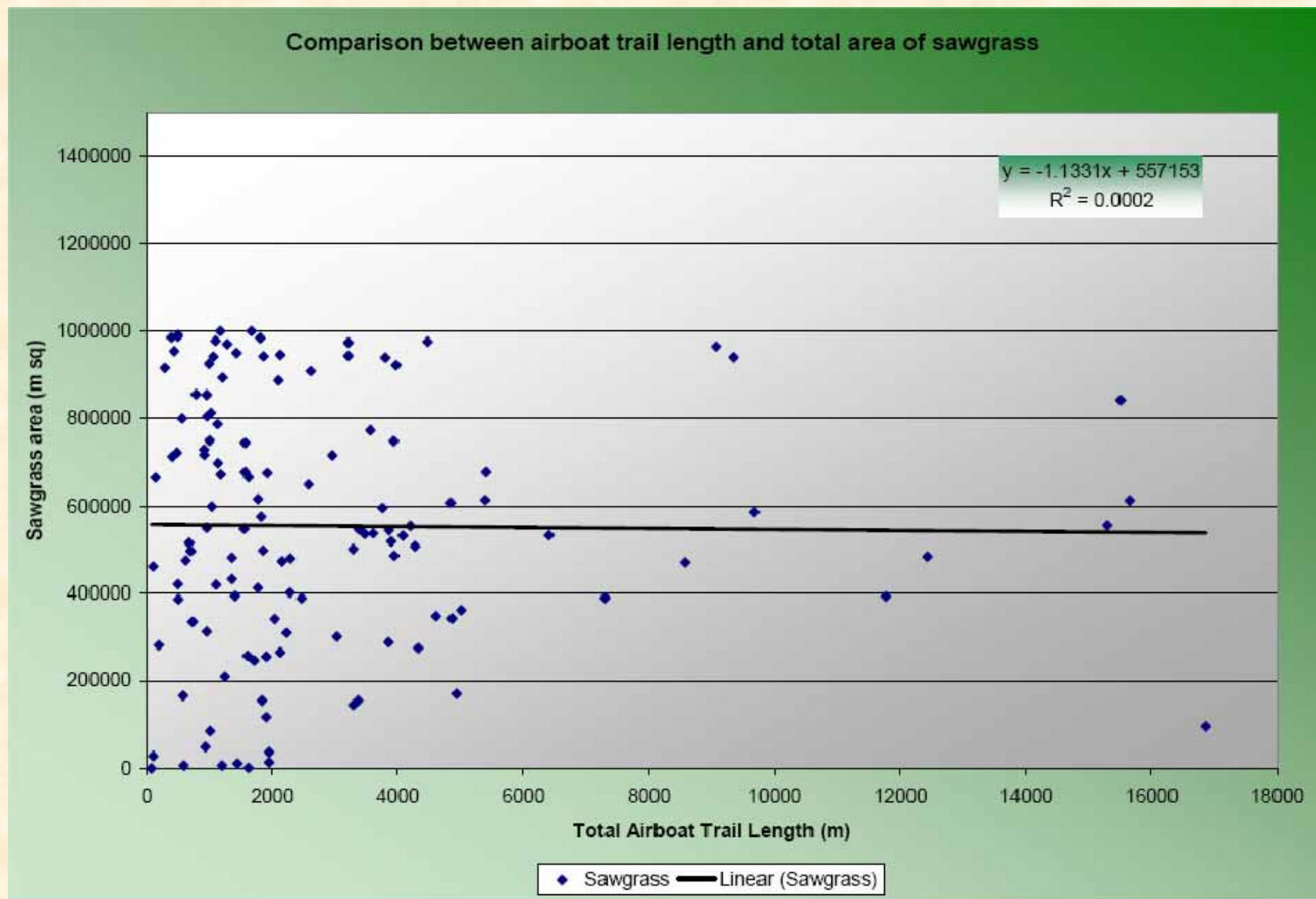


No correlation between total airboat trail length and total area of **Exotic Vegetation** with linear regression. $R^2 = 0.046$

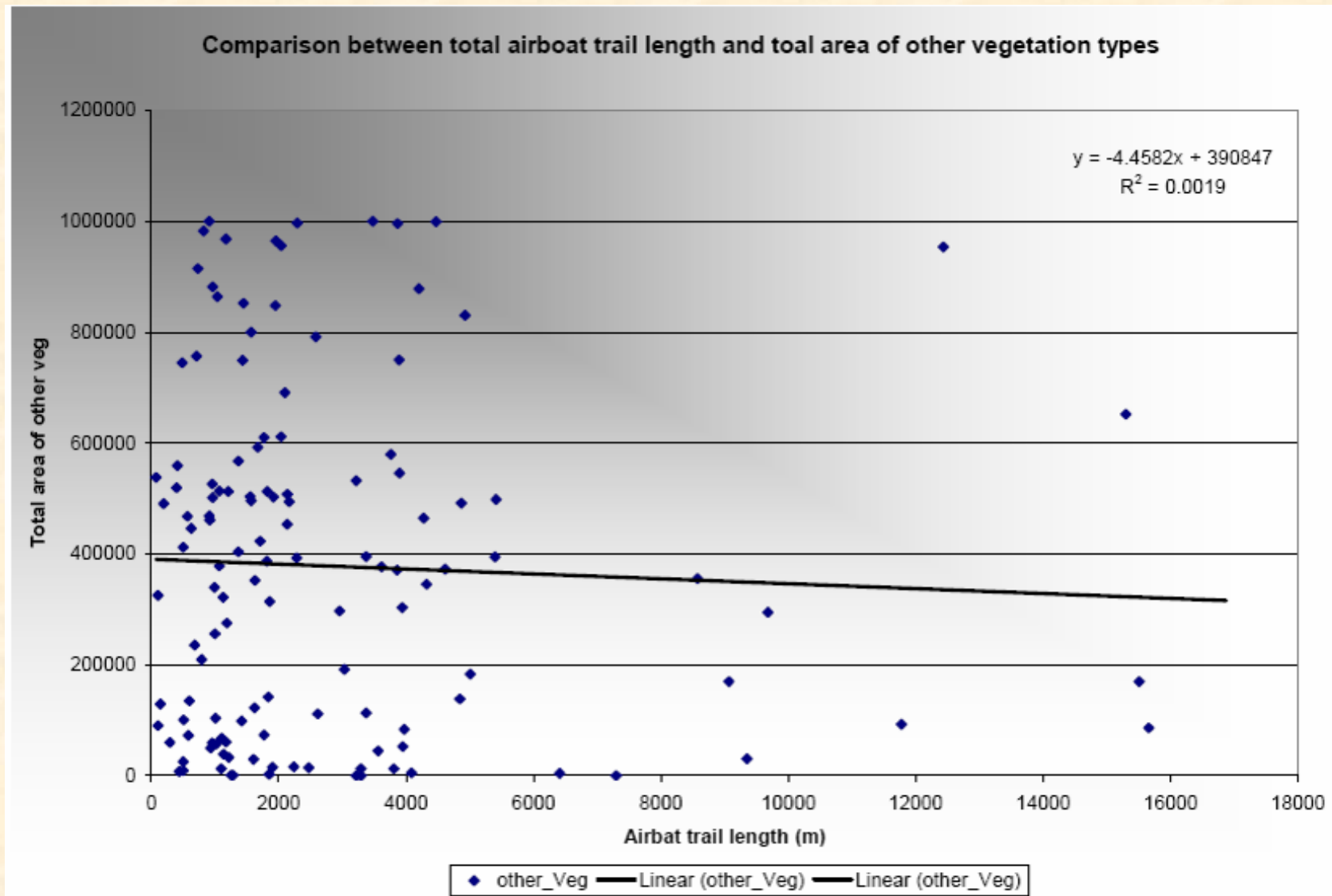
Comparison between airboat trail total length and total area of cattail



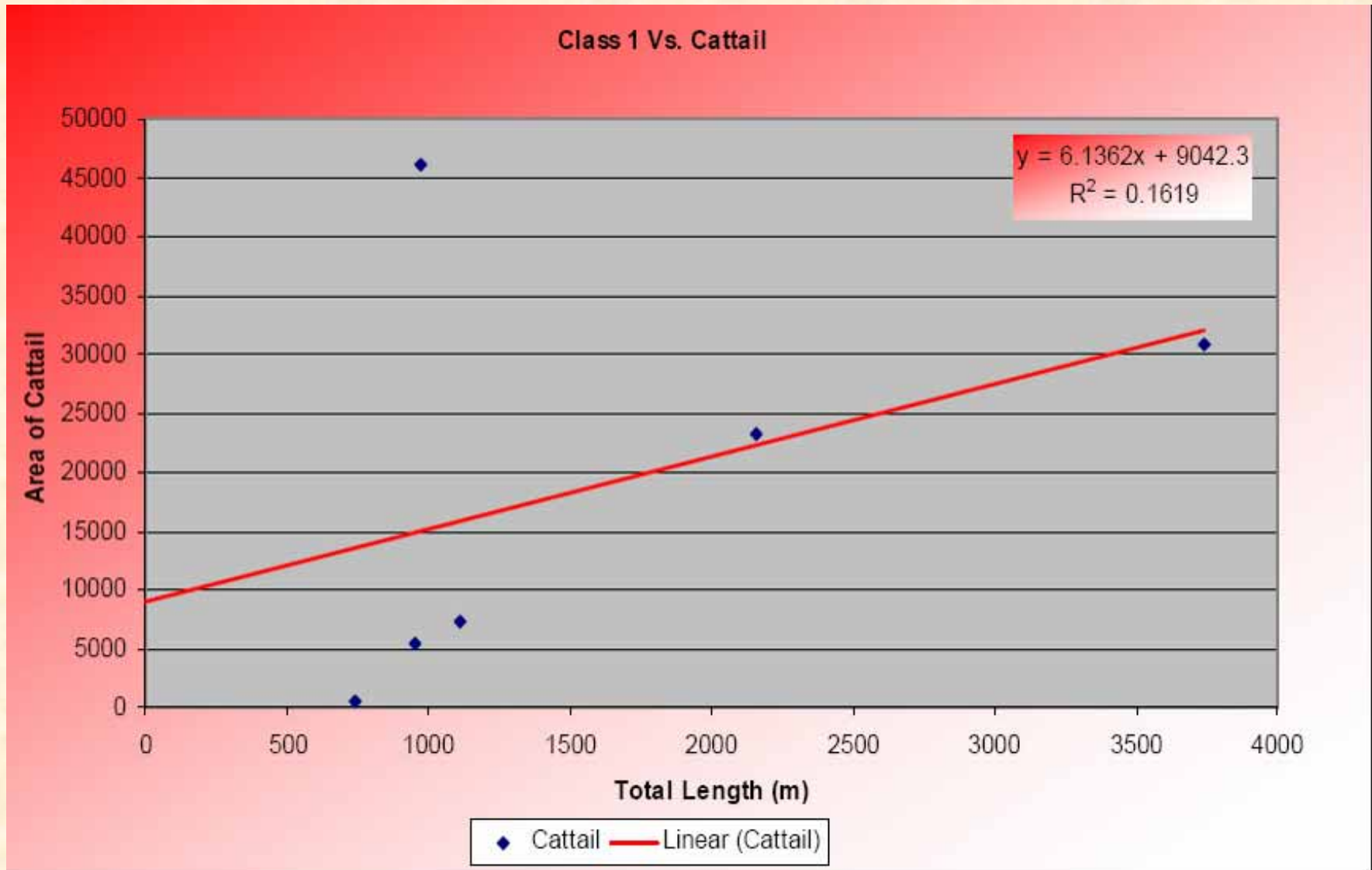
No correlation between total airboat trail length and total area of **Cattail** with linear regression. $R^2 = 0.055$



No correlation between total airboat trail length and total area of **Sawgrass** with linear regression. $R^2 = 0.0002$

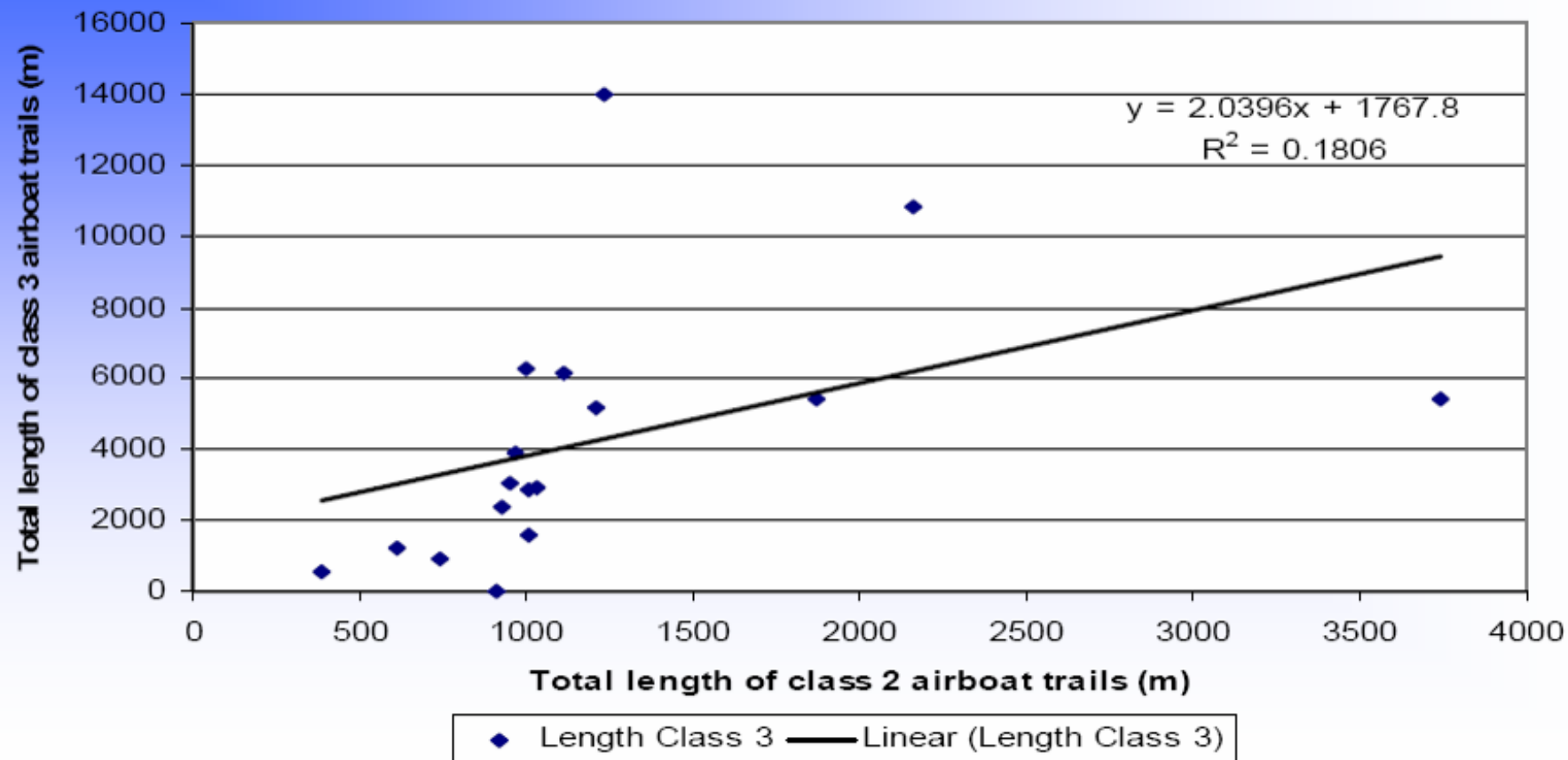


No correlation between total airboat trail length and total area of **Other Vegetation** with linear regression. $R^2 = 0.0019$



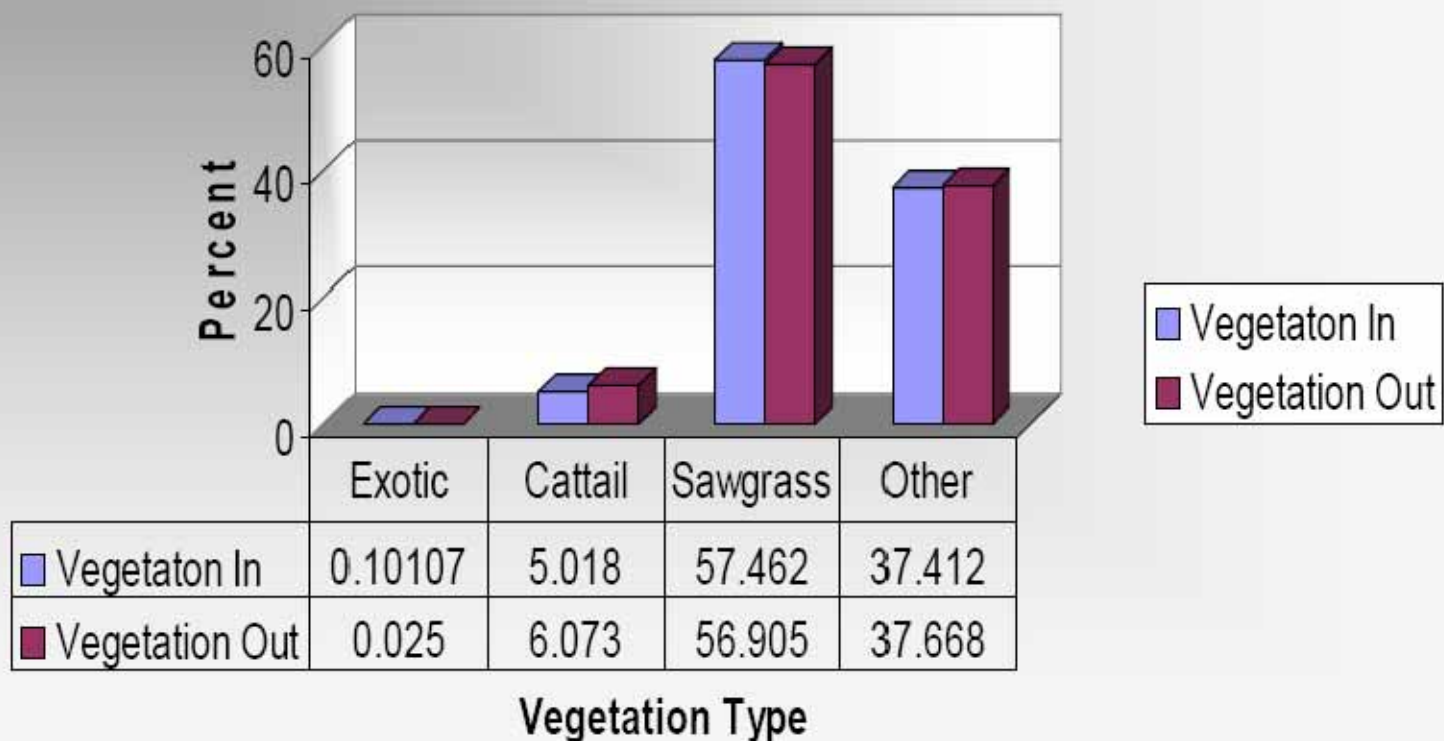
Linear correlation between total Class 1 airboat trail length and total area of **Cattail**. $R^2 = 0.1619$

Relationship between Class 2 and Class 3 airboat trails



Linear correlation between total Class 2 and Class 3 airboat trail length. $R^2 = 0.1806$

Percentage of Vegetation In and Out of a 100m Buffer



Paired t tests indicated there was no difference between vegetation type within and beyond 100 m of airboat trails.

exotic vegetation, $t(119) = -1.493$, $p = 0.138$, cattail, $t(119) = -0.569$, $p = 0.570$, sawgrass, $t(119) = 0.834$, $p = 0.406$ and other vegetation $t(119) = -0.534$, $p = 0.595$

Summary Statistics

- WCA 3 had the highest average airboat trail length per sample site (2,882 m) and the highest percentage of sawgrass (70.5%).
- WCA 2, a northern region had the highest percentage of cattails (20.4%) and the second highest average airboat trail length per sample site (963.8 m).
- ENP had the lowest percentage of cattail (1.9%), second highest percentage of sawgrass (68.9%) and lowest average airboat trail length (612 m).

Summary of Spatial Correlations

- A positive correlation between Class 1 airboat trails and total area of cattail and between Class 1 and Class 3 trails.
- No correlation was found between the length of Class 2 and Class 3 airboat trails when compared to the total area of cattail
- Percentages of total area cattail increased in close proximity to Class 2 airboat trails possibly due to channelization caused by high frequencies of airboats introducing elevated levels of nutrients.
- No correlations were found among exotic vegetation or sawgrass with the increase of total length of airboat trails.

Conclusions:

- Mapping Everglades vegetation communities for 1 km² subsets surrounding R-EMAP sample points provides efficient landscape-scale data for inventory, monitoring and change assessment.
- Hoped these data will provide a bridge for scaling between sample plot data and the landscape to model Everglades restoration success.

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