Introduced-Fish Studies in Southern Florida Natural Areas

William F. Loftus

USGS-Florida Integrated Science Center
Everglades National Park Field Station
Homestead, FL

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Collaborators

NPS

- Jeff Kline – Everglades N.P.

University

- Joel Trexler; Tim Collins - FIU

NGO

- Jerry Lorenz; Jenn Rehage; Krissy Dunker – National Audubon Society

USGS

- Leo Nico; Shawn Smith – Florida Integrated Science Center

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ISSUE: Dozens of Tropical Freshwater Fishes Have been Introduced into South Florida

What are they?
How did they arrive here?
What are their effects?
Why are they successful here?
Can anything be done about them?

Introduced Fishes in South FL

31 introduced species reproducing in Florida's waters (Shafland 2002); most are freshwater.

Most are from tropical Asia, South America, and Africa.

Native freshwater fishes originate from temperate North America (35 spp.).

15 introduced species in So. FL natural areas; most in family **Cichlidae**.

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Major Sources of Introductions

- Planned Introductions

Photo Credit: Leonard Lovshin

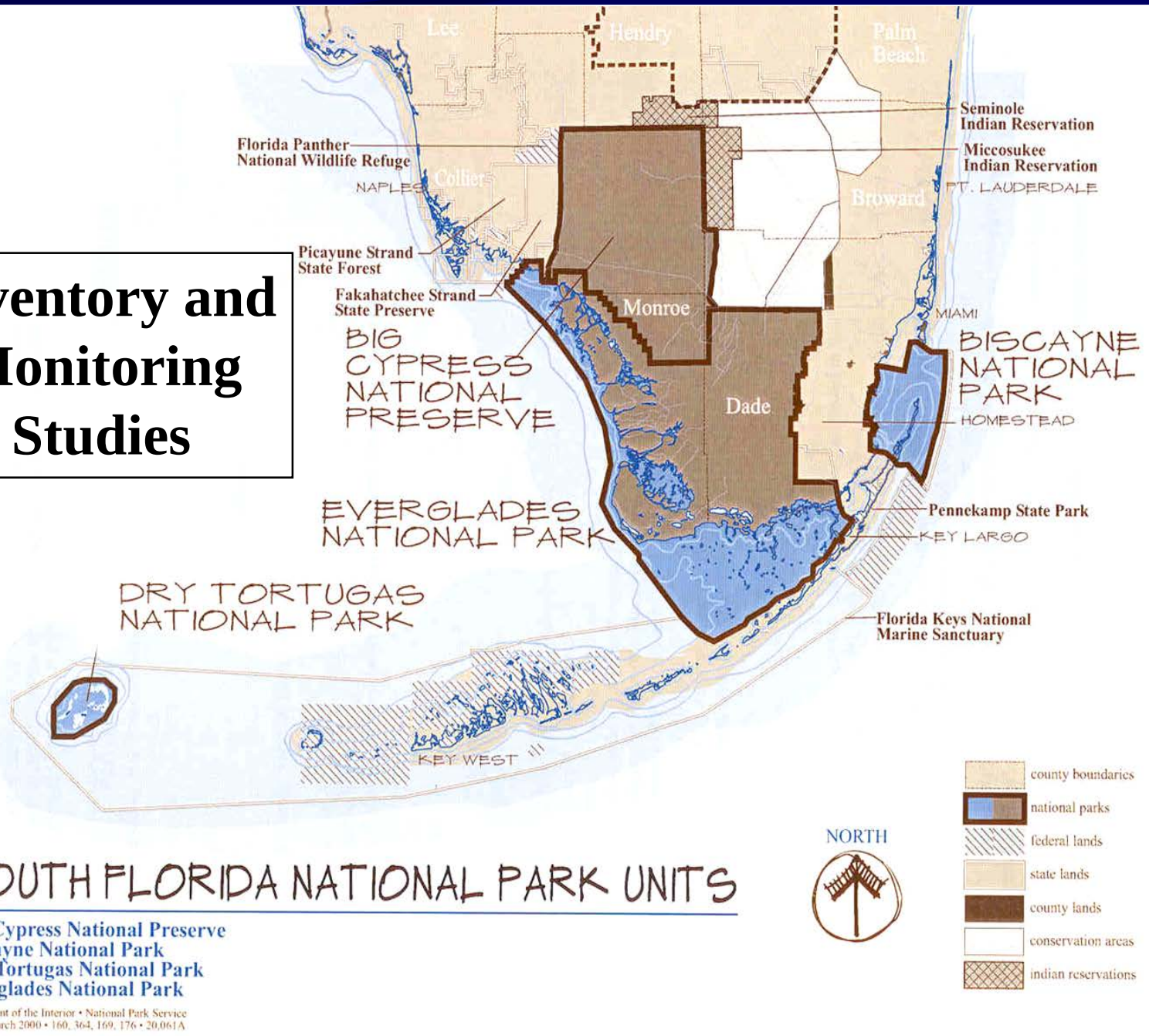
- Food-fish Introductions

- Illegal or Accidental Introductions

Howard Jelks

- Unknown Source

Inventory and Monitoring Studies



SOUTH FLORIDA NATIONAL PARK UNITS

Big Cypress National Preserve
Biscayne National Park
Dry Tortugas National Park
Everglades National Park

Department of the Interior • National Park Service
DSC • March 2000 • 160, 364, 169, 176 • 20,061A

Sampling Methods

Throw Trap

Minnow Trap

Electrofishing

Visual

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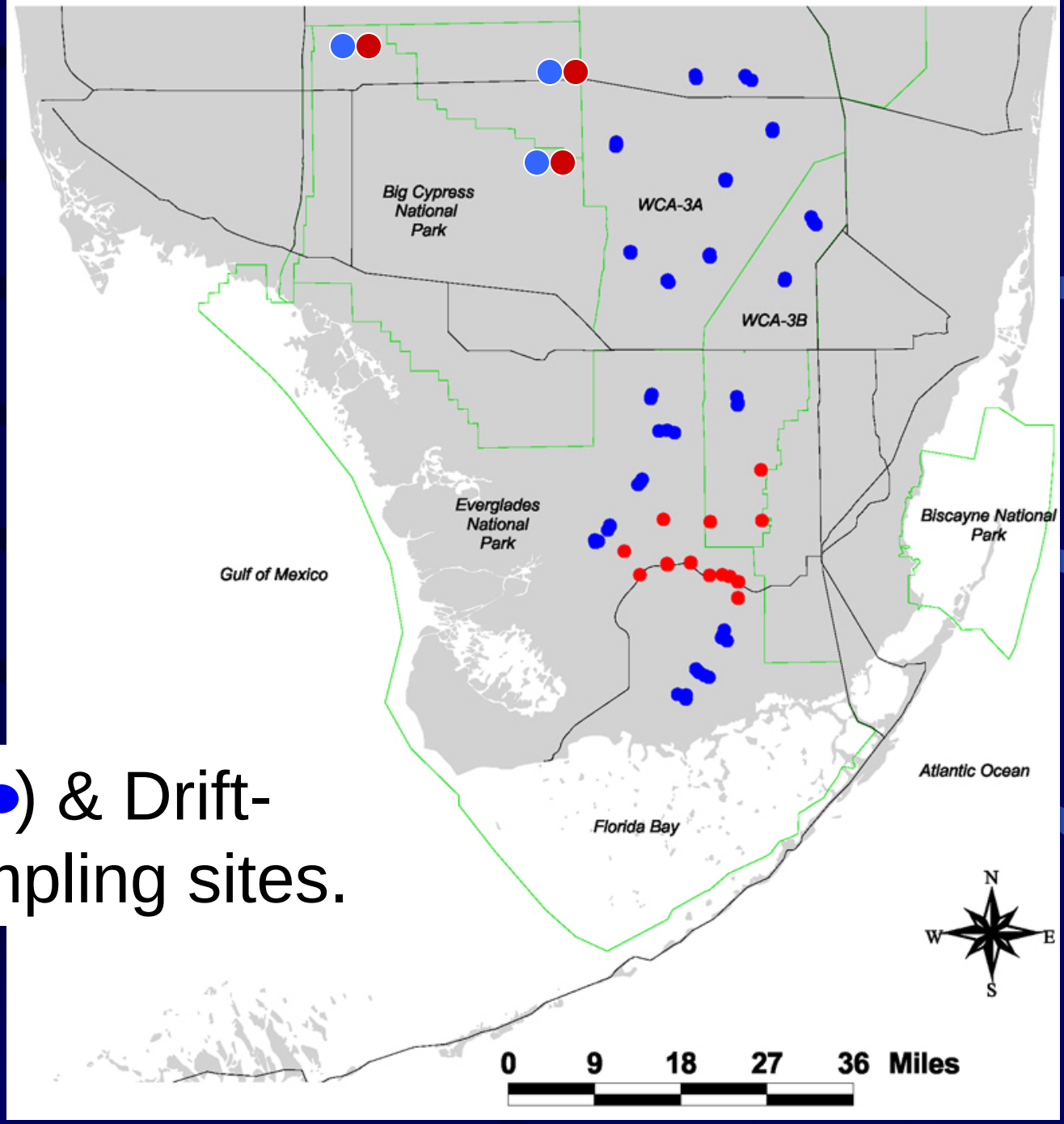

Throw-trap (●) & Drift-fence (●) sampling sites.

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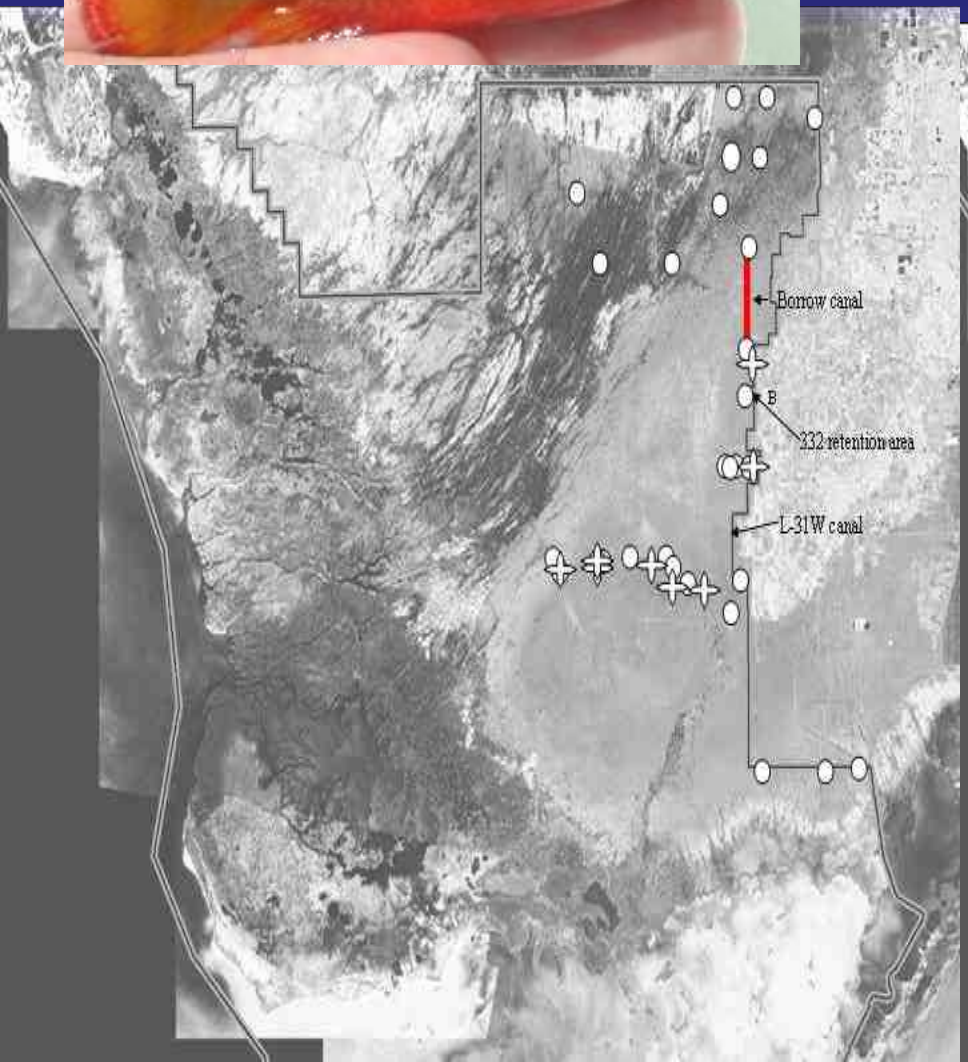
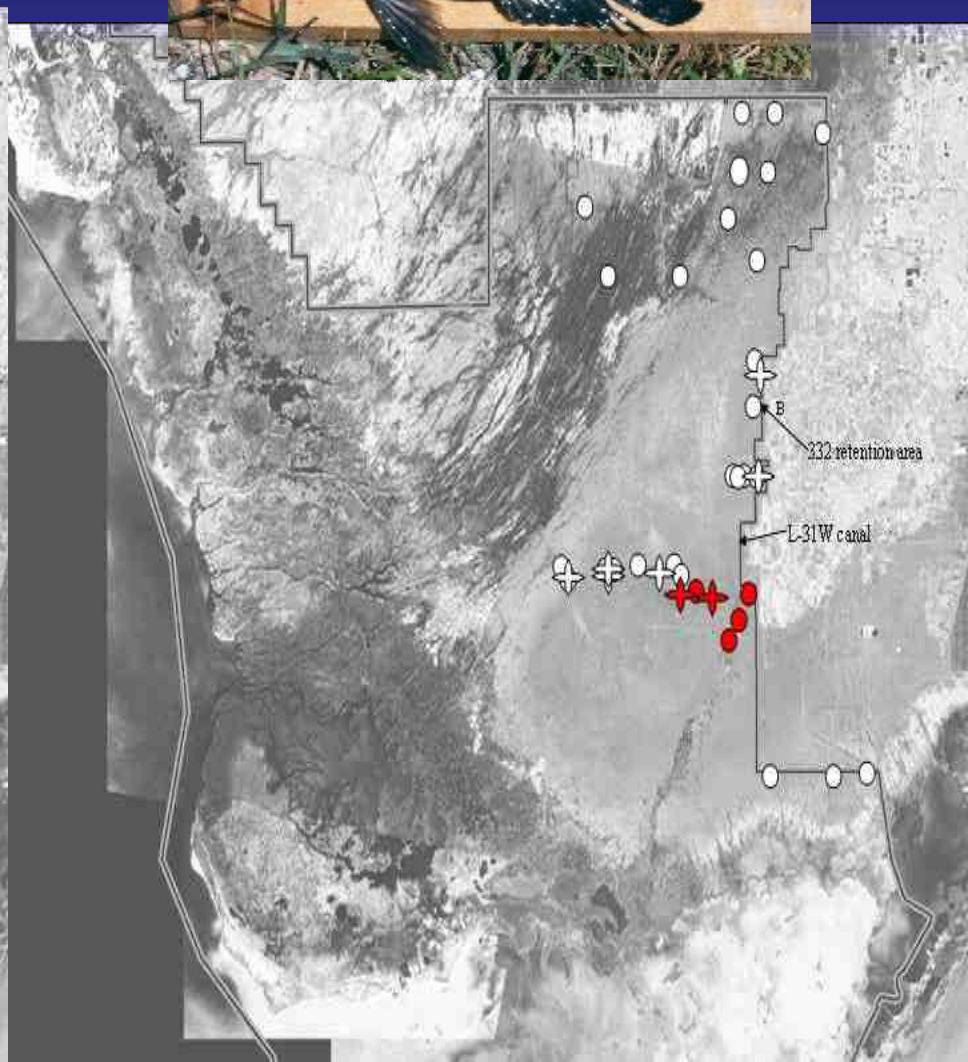
2001

Jewel cichlid

Jaguar cichlid

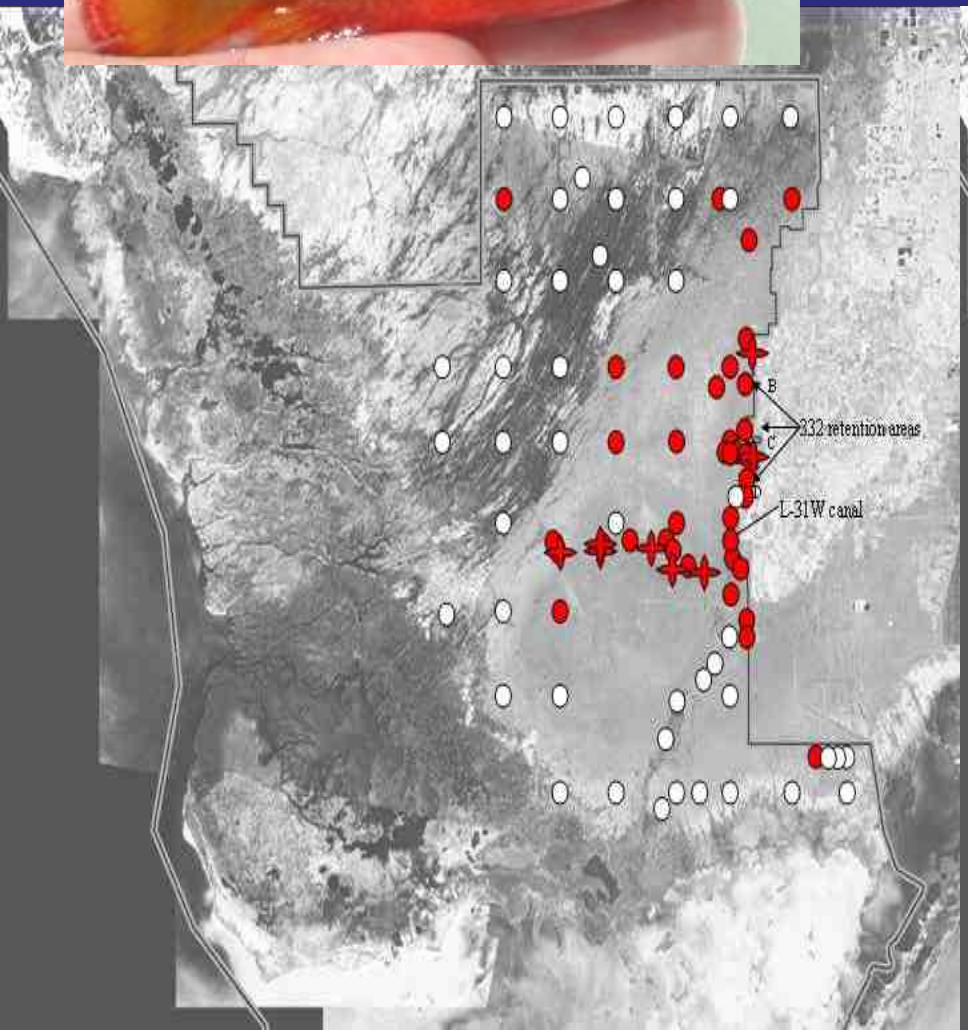


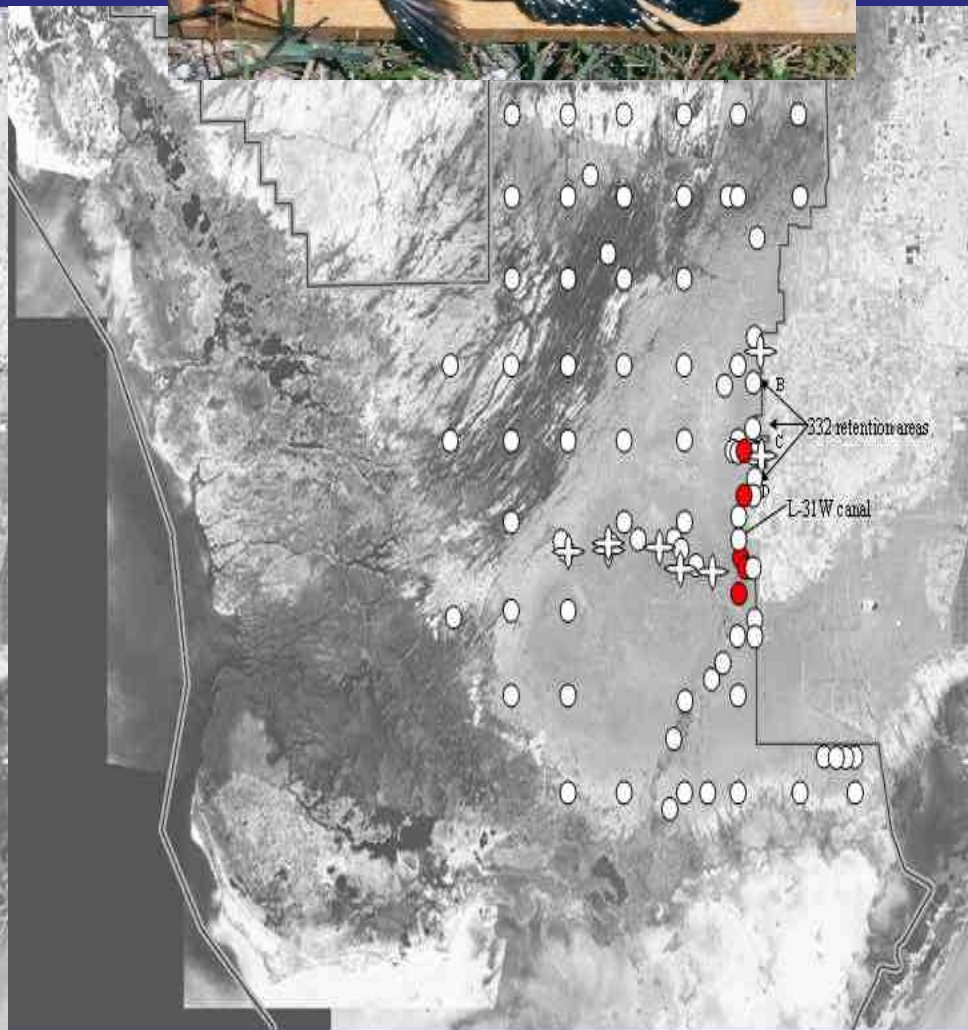


2004

Jewel cichlid

Jaguar cichlid

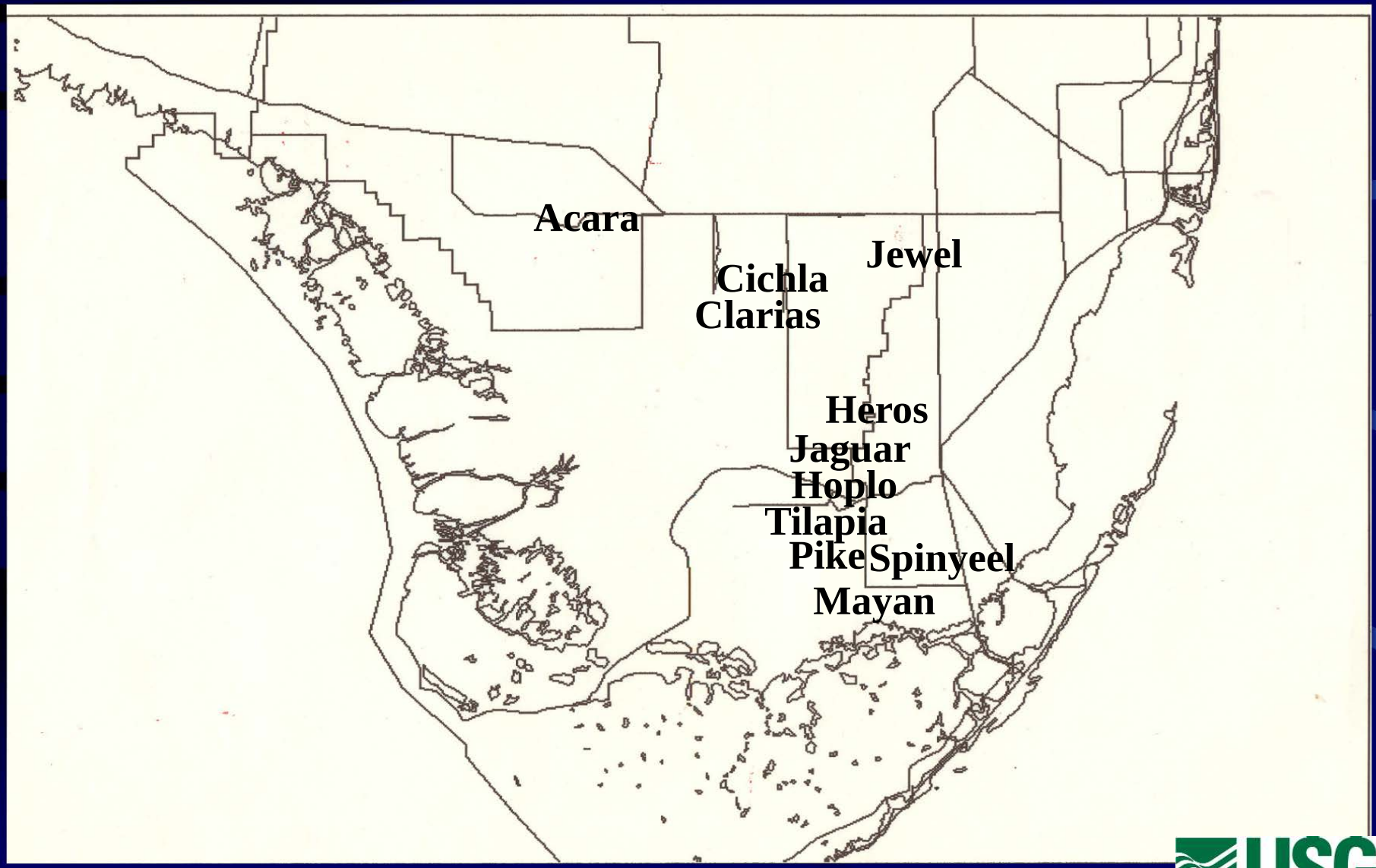




Temporal Colonizations of the Everglades Region

1960s:	Black acara.
1970s:	Oscar, walking catfish, spotted tilapia, blue tilapia.
Mid-1980s:	Mayan cichlid, pike killifish, peacock bass, Mozambique tilapia.
Late 90s-00s:	Jewel cichlid, jaguar cichlid, brown hoplo, banded cichlid, spotfinned spiny eel.

First-record Locations in ENP



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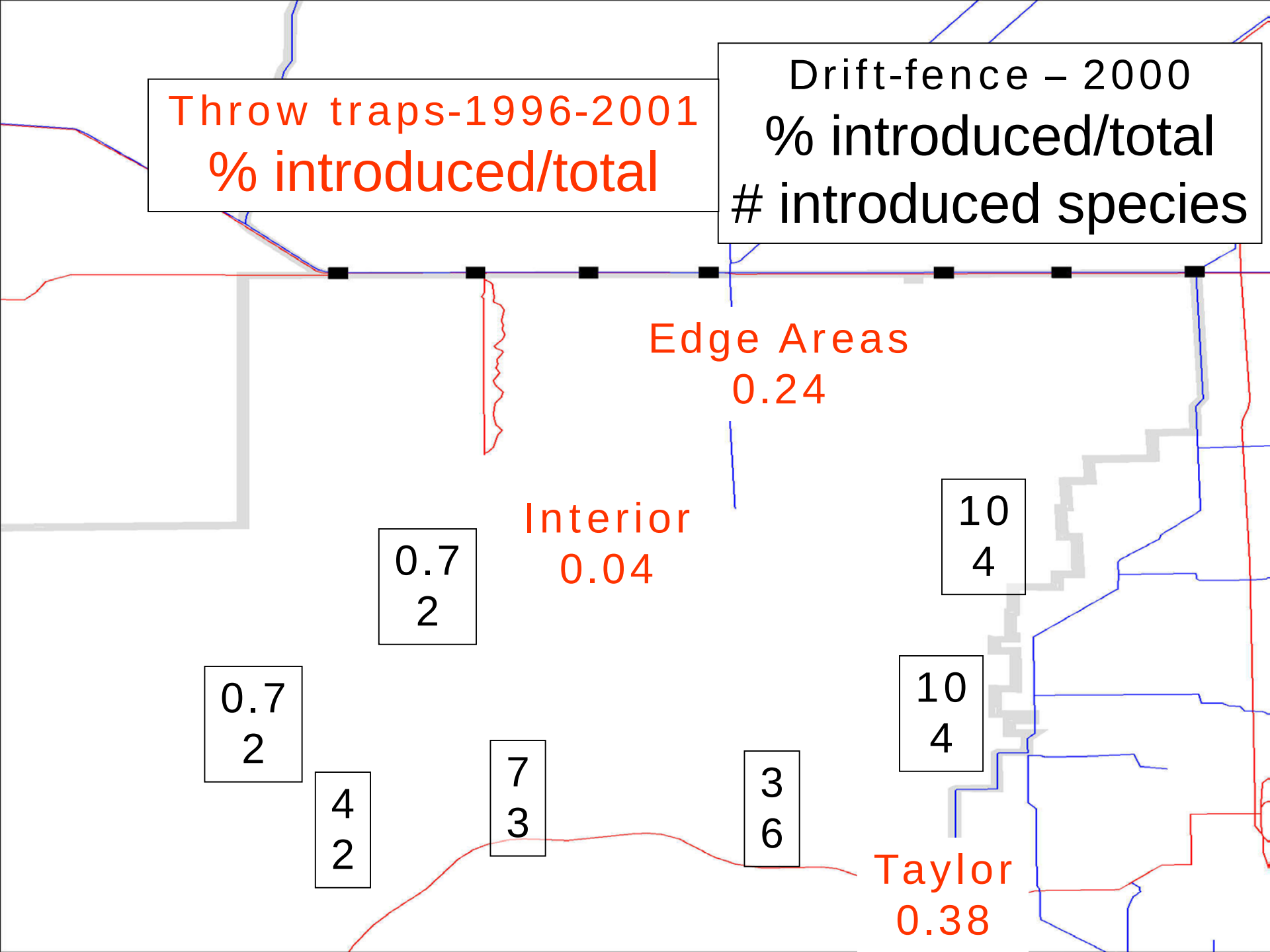
Throw traps-1996-2001
% introduced/total
Drift-fence – 2000
% introduced/total
# introduced species
Edge Areas
0.24
Interior
0.04
Taylor
0.38
0.7
2
0.7
2
4
2
7
3
3
6
10
4
10
4

Canals are sites of introduction, dispersal, and refuge for non-indigenous biota

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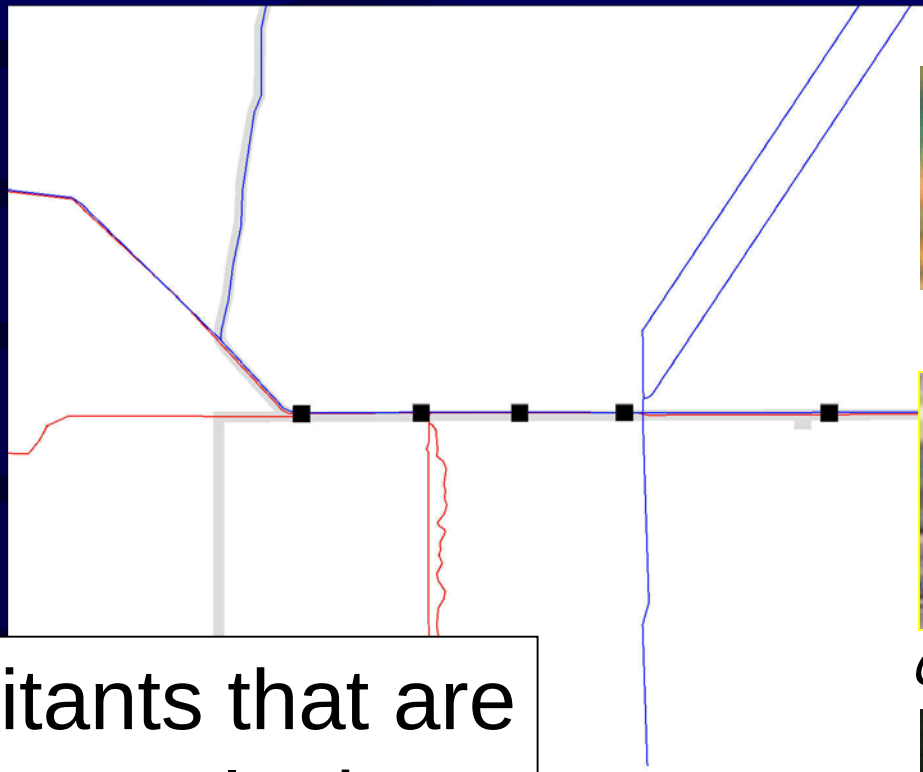

Canal inhabitants that are potential future colonizers of the Everglades.

C. salvini

C. marulius

O. mossambicus

Monopterus sp.

C. citrinellum

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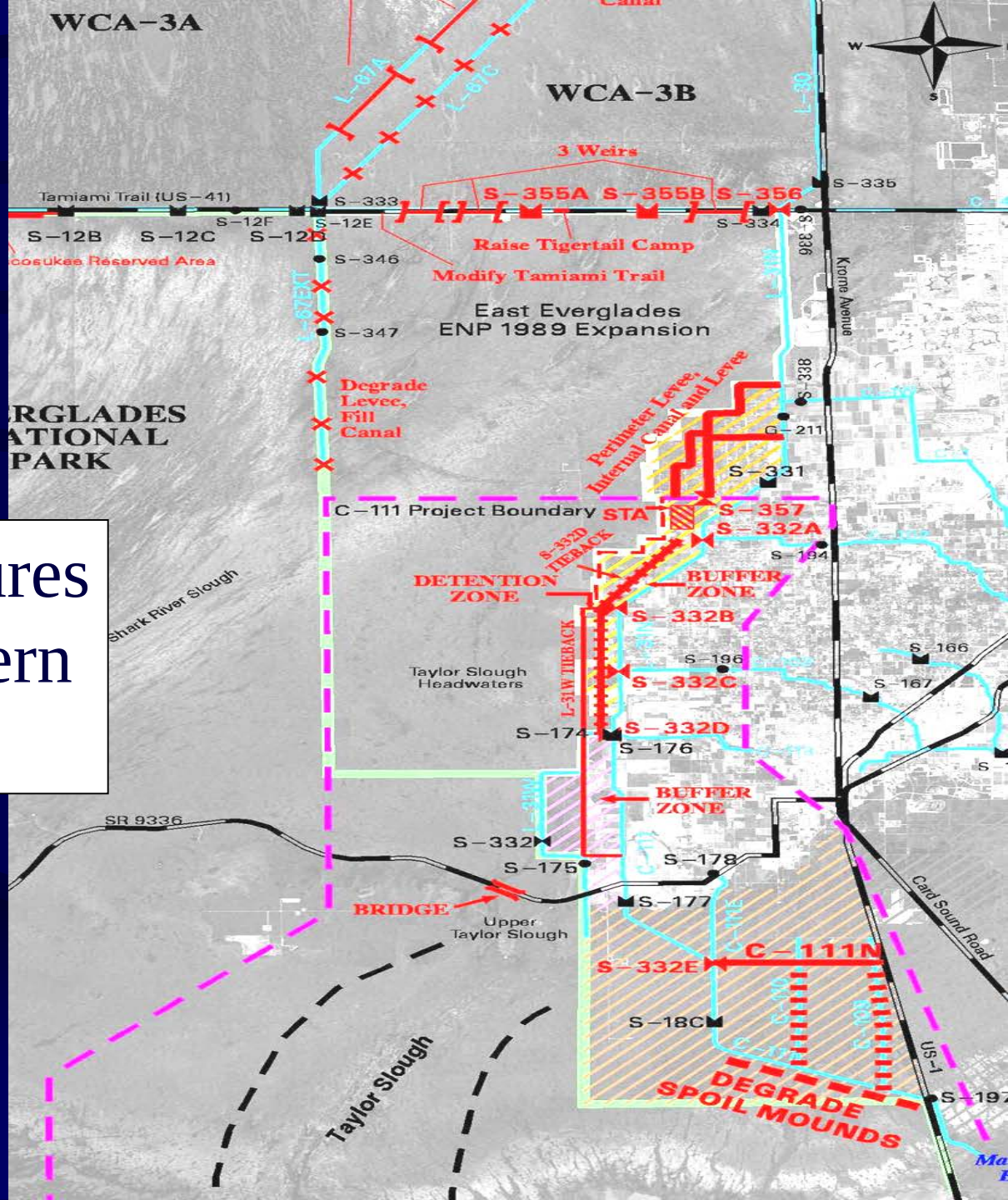
CERP Project features affecting the southern Everglades



Risk Assessment

Preventing future introductions rests in identifying potential problems in advance

- Perform taxonomic/life-history/ecology research to understand risks and vulnerabilities.
- Model biology of existing pests to screen future introductions
- Identify new introduction vectors.

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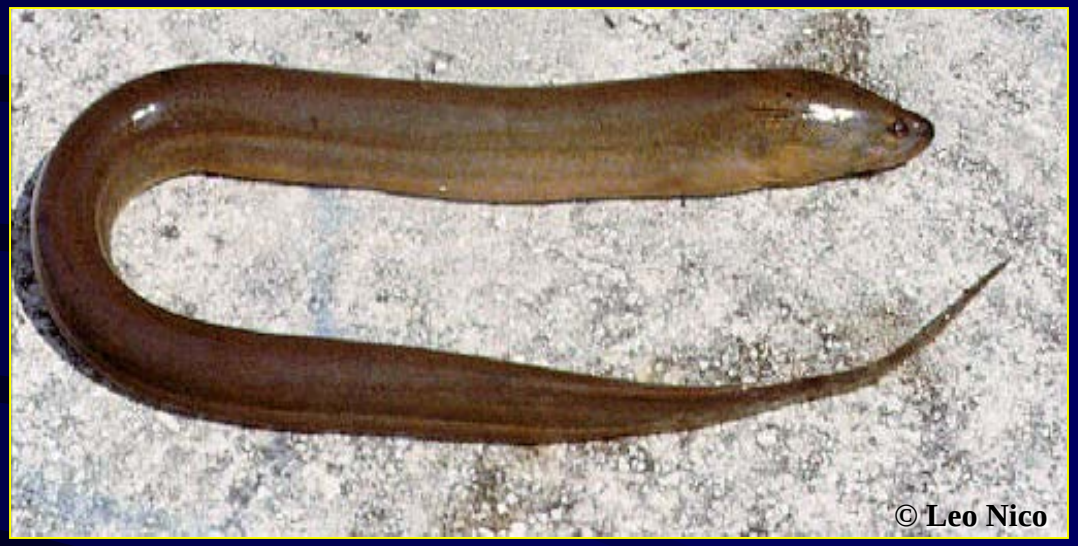
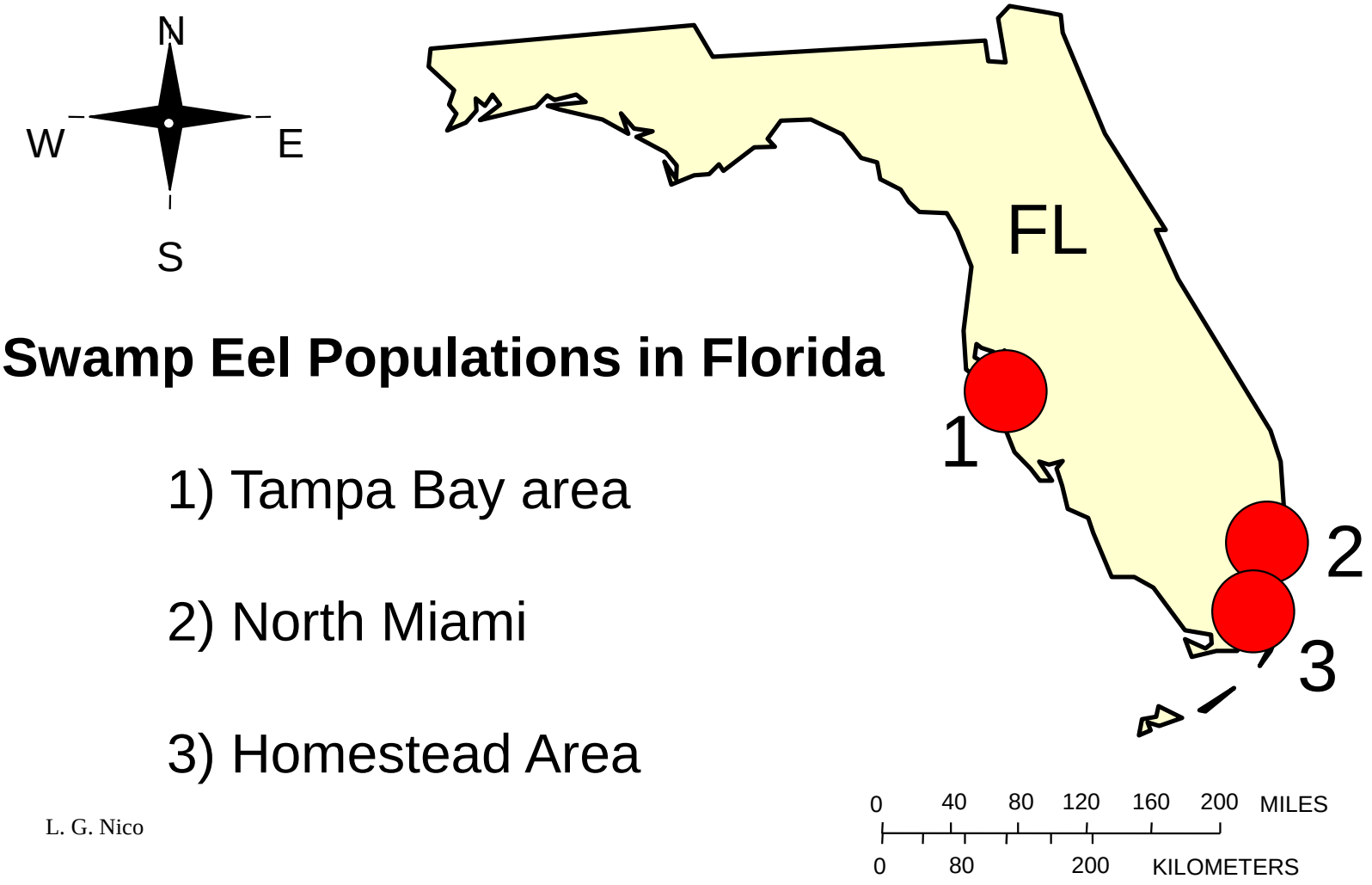
Single-species Studies

Monopterus albus – Asian Swamp Eel



Genetics and life-history studies of diet, salinity tolerance, and reproduction.



Swamp Eel Populations in Florida

1) Tampa Bay area

2) North Miami

3) Homestead Area

L. G. Nico

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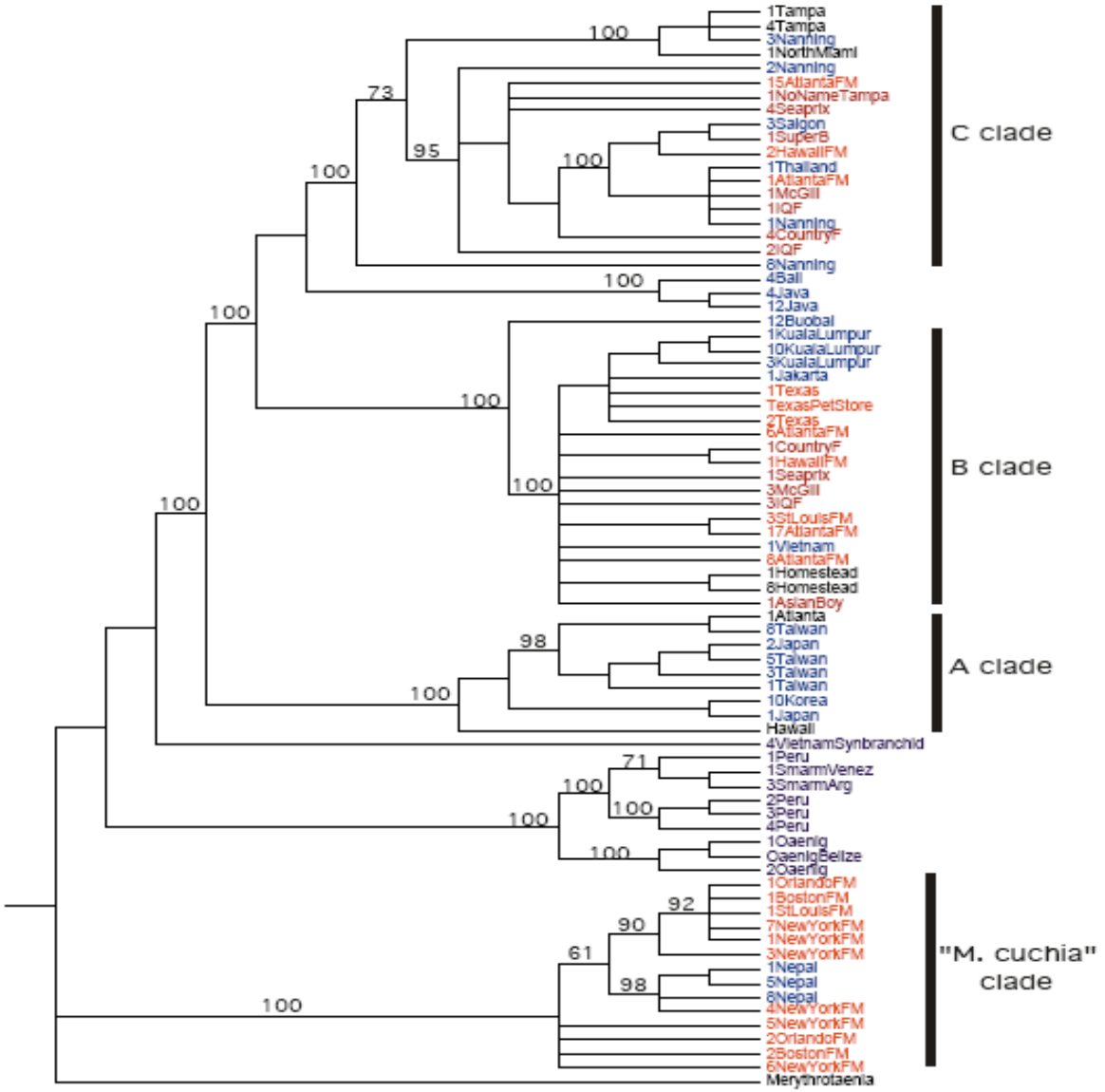
Swamp-eel Cladogram (Collins et al. 2002)

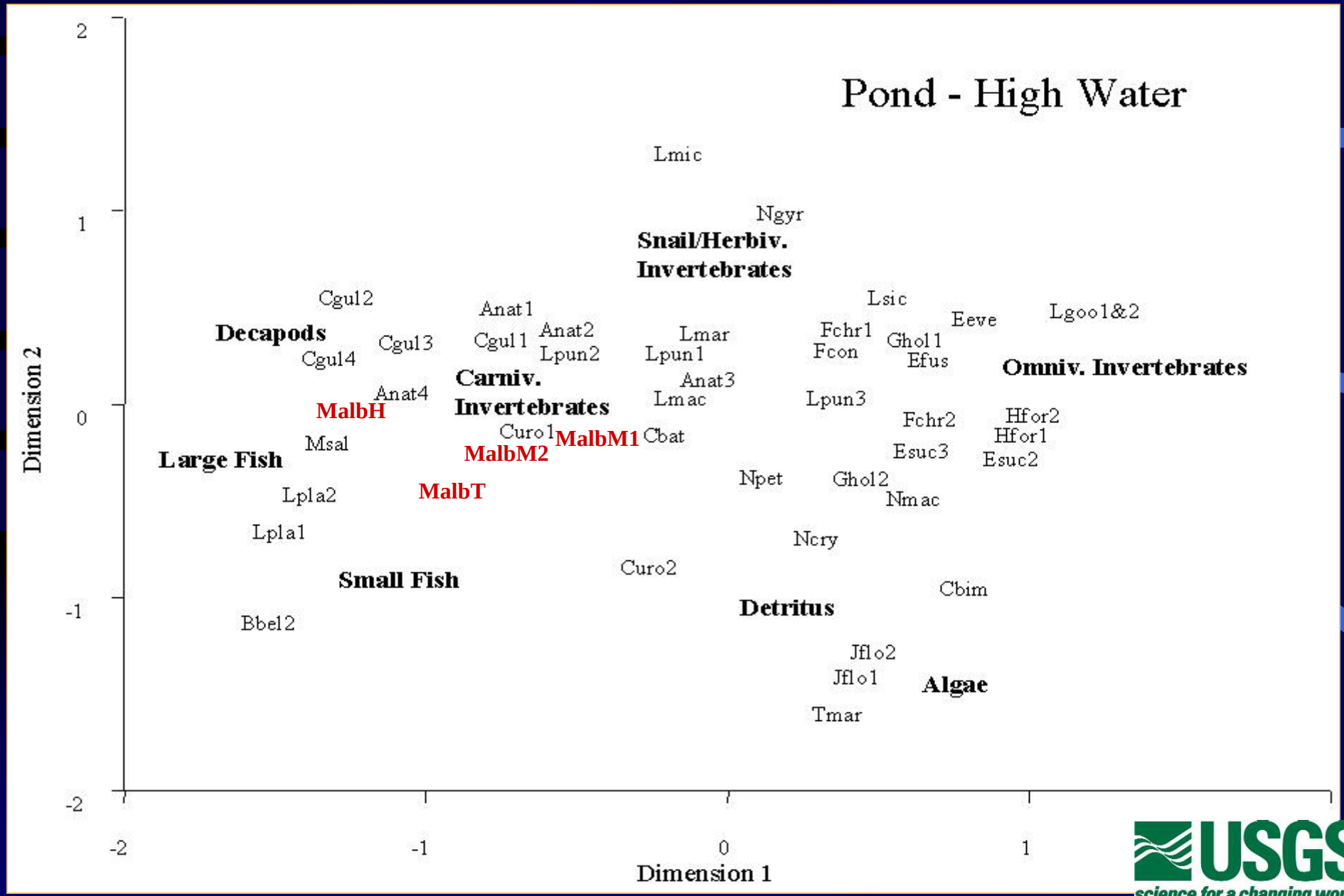


Results of Bayesian analysis of combined 16S, 12S, LDHA6 intron, and RAG2 sequence for introduced (black), native range (blue), fish market (orange), and commercially available frozen (red) swamp eels. Purple samples represent additional synbranchid taxa included in the analysis. Values on tree represent posterior probablities of nodes. Mastacembelus erthyrotaenia is included as the outgroup.

Eel Diet Results - % Volume

Major Prey % by Volume (- = < 5%)				
	Homestead	Miami 1998	Miami 2001	Tampa
Oligochaeta	-	9.1	10.6	
Amphipoda	-	-	-	-
Palaemonetes paludosus	-	18.0		5.0
Odonata	6.0	11.2	19.4	-
Belostoma sp.	9.6			
Other Invertebrates	-	7.0	-	-
Fundulus chrysotus			19.8	
Lucania goodei			9.5	
Gambusia holbrooki		28.8	5.0	16.5
Heterandria formosa		5.8		-
Poecilia latipinna				15.6
Monopterus albus			26.3	
Centrarchidae	80.4			21.8
Fish Ova		-		-
Unidentified Fishes		12.9	-	34.5
Total Fishes	80.4	47.6	62.7	90.6

Eel Life History – Food-Web Simulation



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Community Effects

Problem: Difficult to demonstrate effects in field with highly variable native fish populations. Effects may be lost in system "noise".

Field and mesocosm experiments will help understand mechanisms that give rise to patterns seen in field collections.

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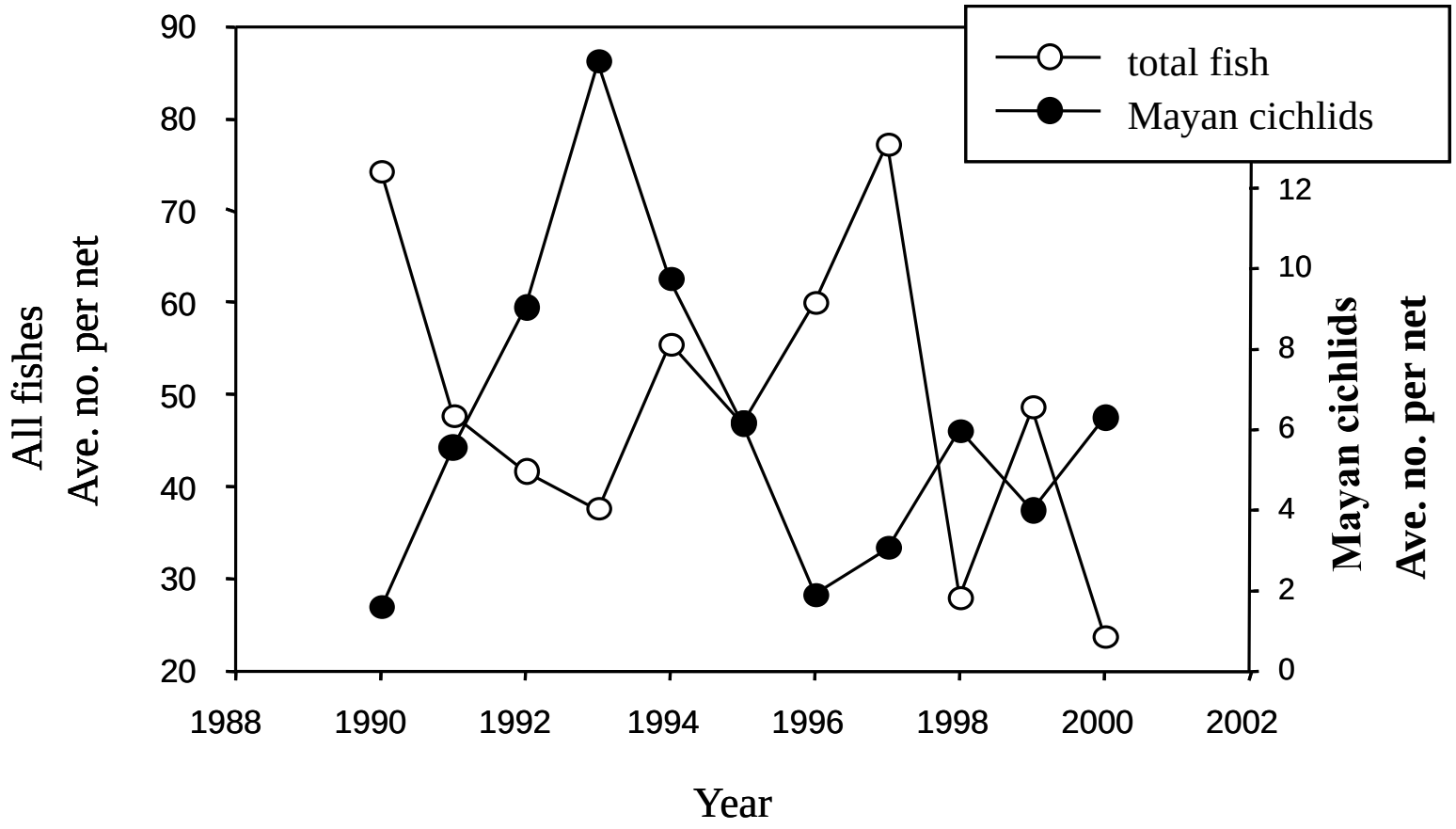
Nesting Patterns Following Introductions

Anhinga Trail
Percent of Total Nests

	Pre-Introduction			Post-Introduction				
SPECIES	**1978**	**1979**	**1980**	**1986**	**1987**	**1989**	**1990**	**1991**
Sunfishes	81	54	85	2	8	3		15
Lgemouth bass	19	46	15	17	35	3	6	
Blue tilapia				79	50	88	28	9
Spotted tilapia					1			1
Mayan cichlid				2	6		66	74
Oscar					1	6		1
No. of nests	145	46	103	47	142	33	112	78

Inverse Relationship of Native and Introduced Fish Catch, Indicating Predation Effects



Catch per unit effort of all fishes and Mayan cichlids from 1990 to 2000 from drop traps in the mangroves north of Florida Bay (Trexler et al. 2000).

Introduced Fishes in Short-hydroperiod Wetlands: Evaluation of Sampling, Status, and Potential Effects

- Use field studies and mesocosm experiments to test the effects of introduced fishes on native fauna.
- Tests for predation, nesting disturbance, and indirect effects of introduced species in disrupting native fish behavior.

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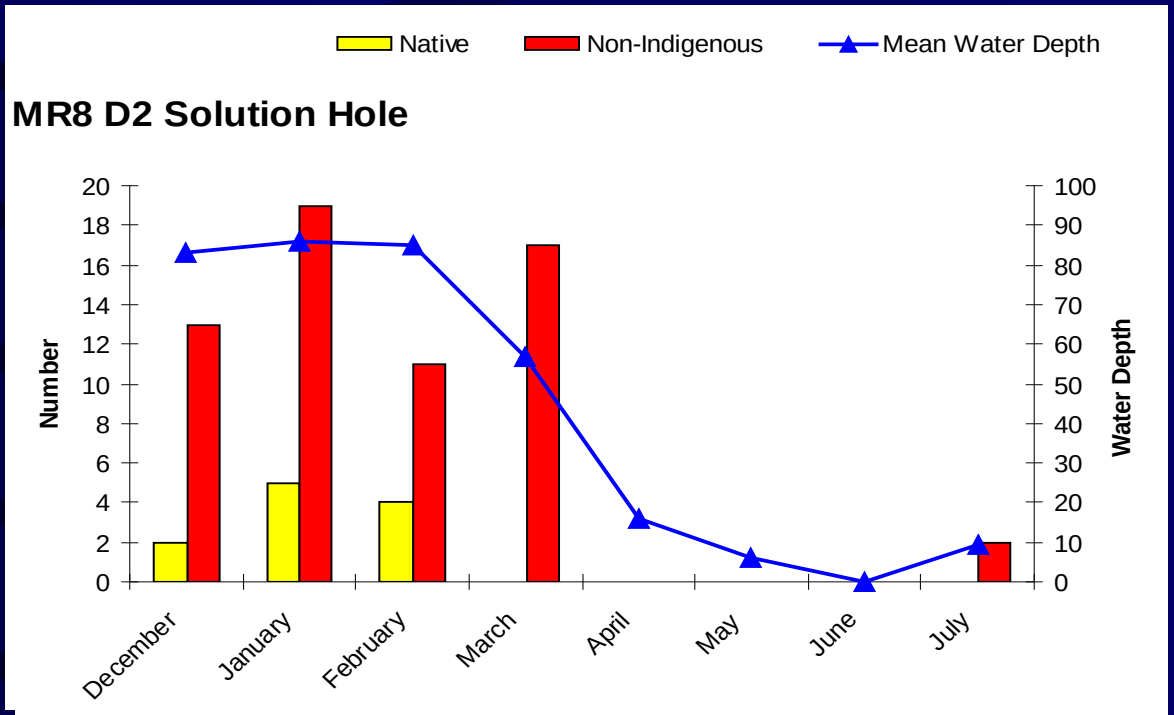
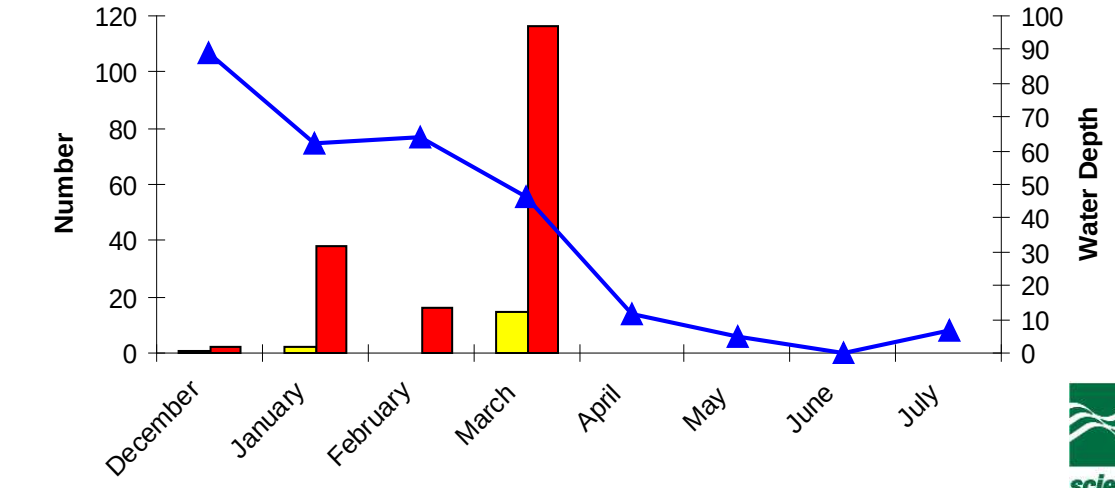
Fish CPUE in Rocky Glades Solution Holes





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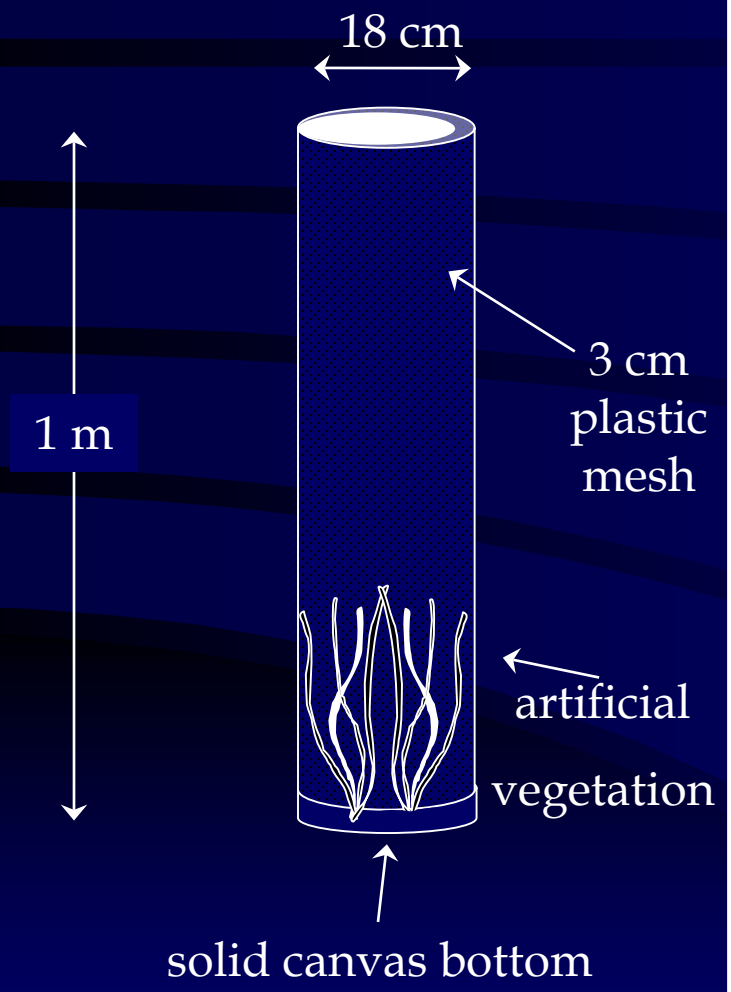
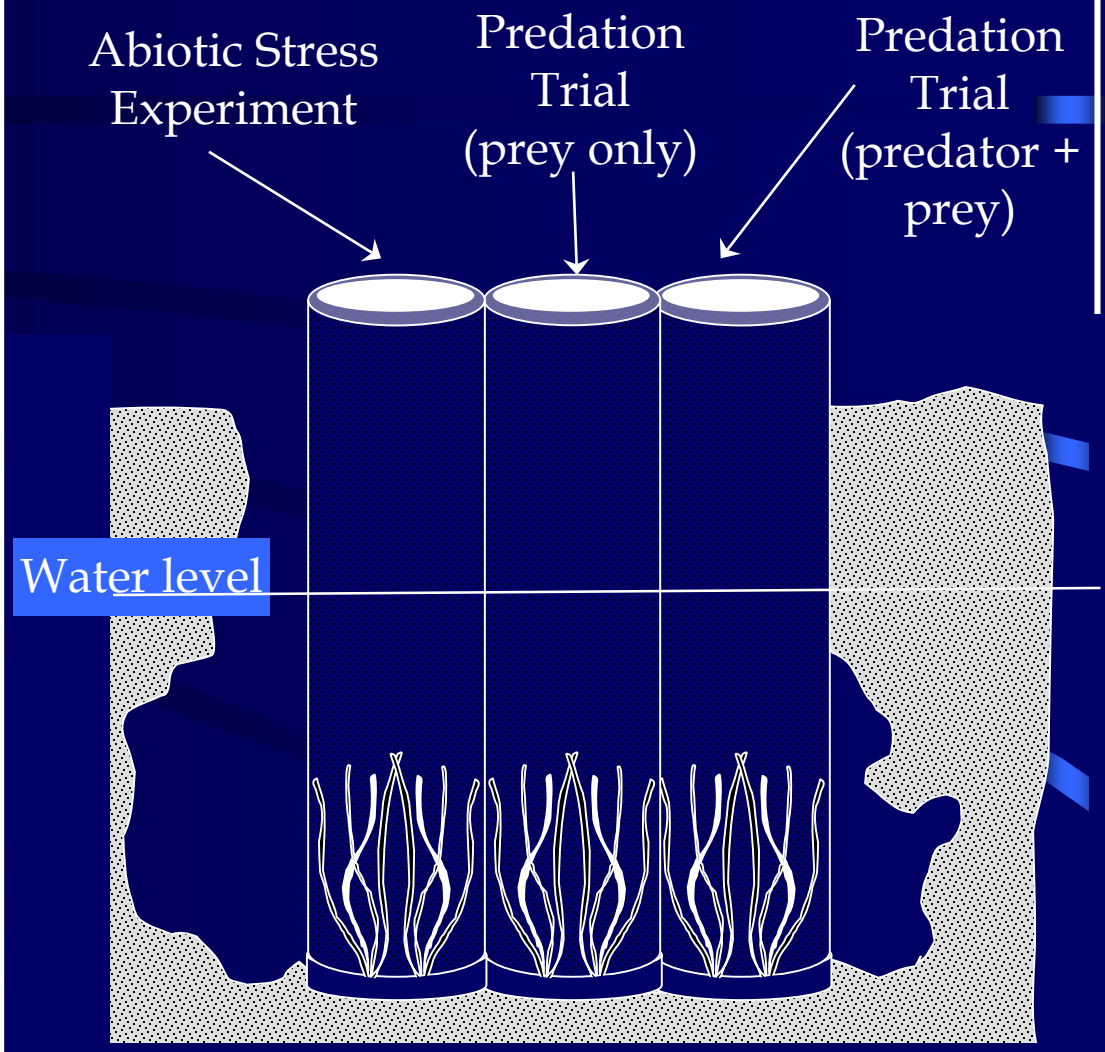
Experimental Design: *Hemichromis* Predation

A. Cage Design



B. Experimental Set-up



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Control

Existing control methods are ineffective in the open Everglades wetlands with connections to “reservoirs” of colonists.

Eradication is presently impossible except in isolated water bodies.

Research on innovative control methods is needed!

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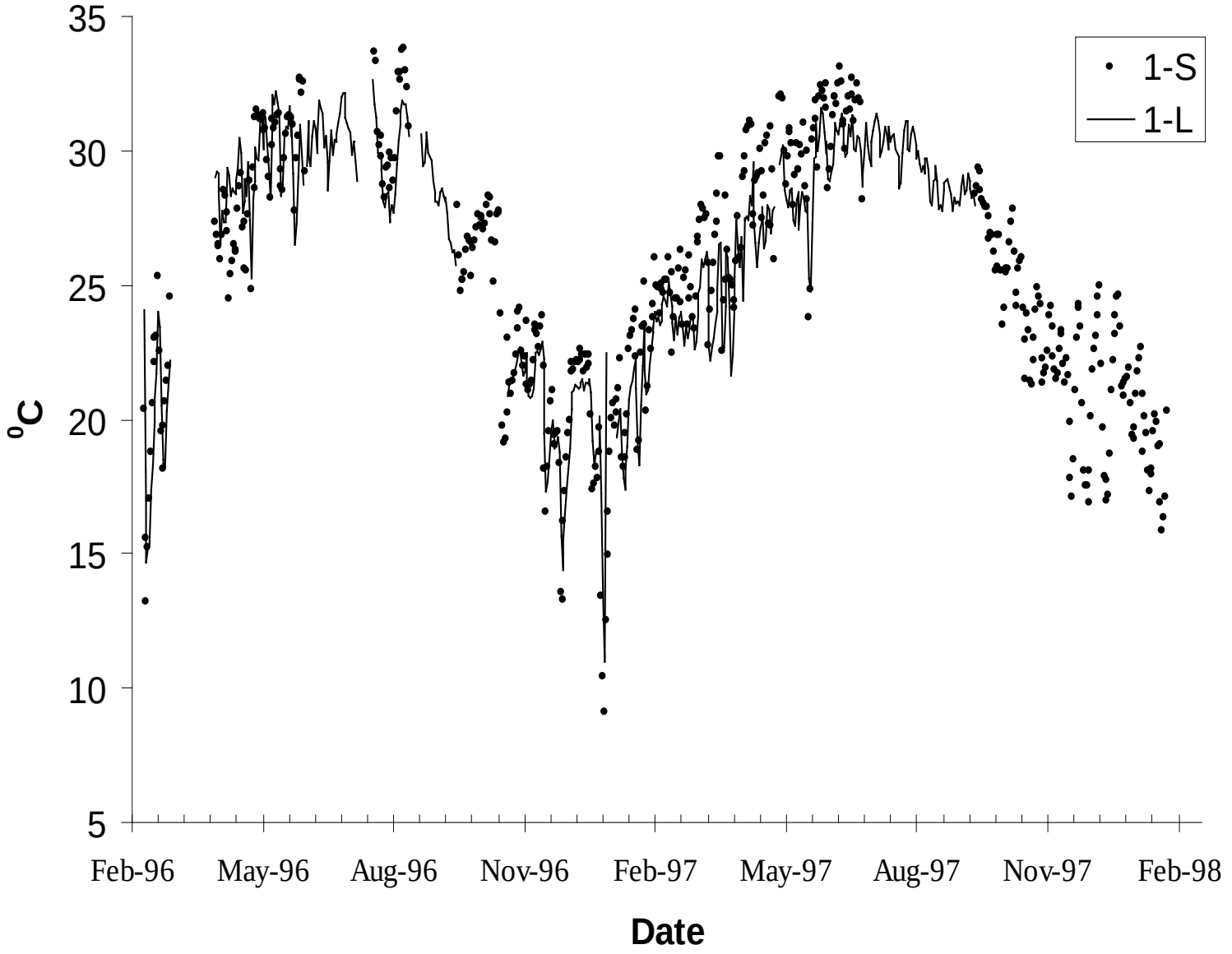
Original wetland system a seasonal savanna or forested wetland, with shallow sloughs and strands that held water much of the year.

Deepest habitats were alligator holes

ENP Marsh Water Temperatures



Winter Kill of Jaguar Cichlids

Pro-active Measures

- Educate public to discourage releases.
- Fund effective, coordinated monitoring.
- Engineer delivery structures that impede access to wetlands.
- Research innovative control methods, as with plants/insects.
- Understand biotic interactions and ecology by experimentation.
- Model existing pests to screen future introductions.