CLIMATE CHANGE VULNERABILITY ASSESSMENT AND ADAPTATION OPPORTUNITIES FOR SALT MARSH TYPES IN SOUTHWEST FLORIDA

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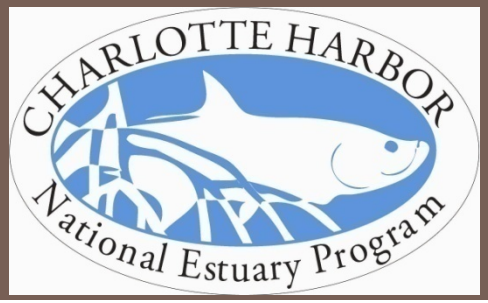
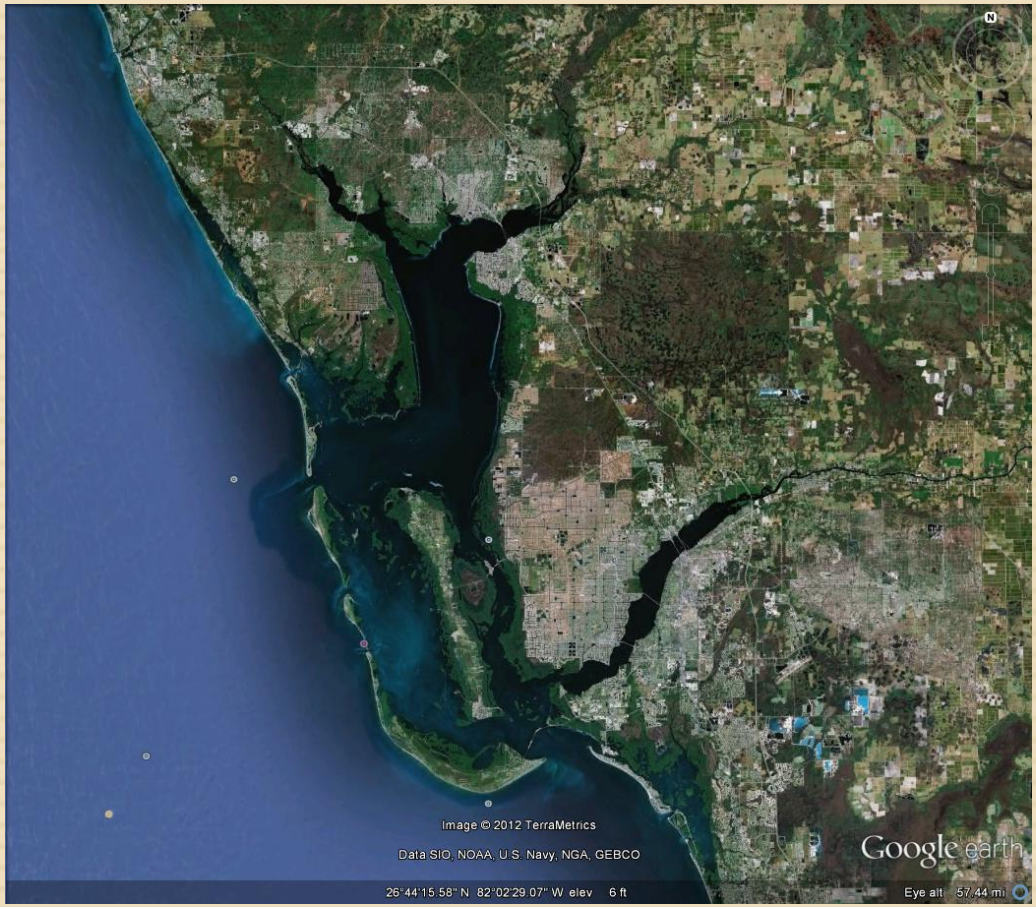
Southwest Florida Regional Planning Council
Lisa Beever
Charlotte Harbor National Estuary Program

Myakka River Coordinating Council
October 5, 2012



Along tidal rivers and creeks, in bays and estuaries



CHNEP Study Area

Coastal Salt Marshes in Sarasota, Charlotte, and Lee Counties

Includes the Myakka, Peace, and Tidal Caloosahatchee Rivers, Charlotte Harbor, and Estero Bay

Salt Marsh Study Goals

AMMA:

Avoidance

Minimization

Mitigation

Adaptation

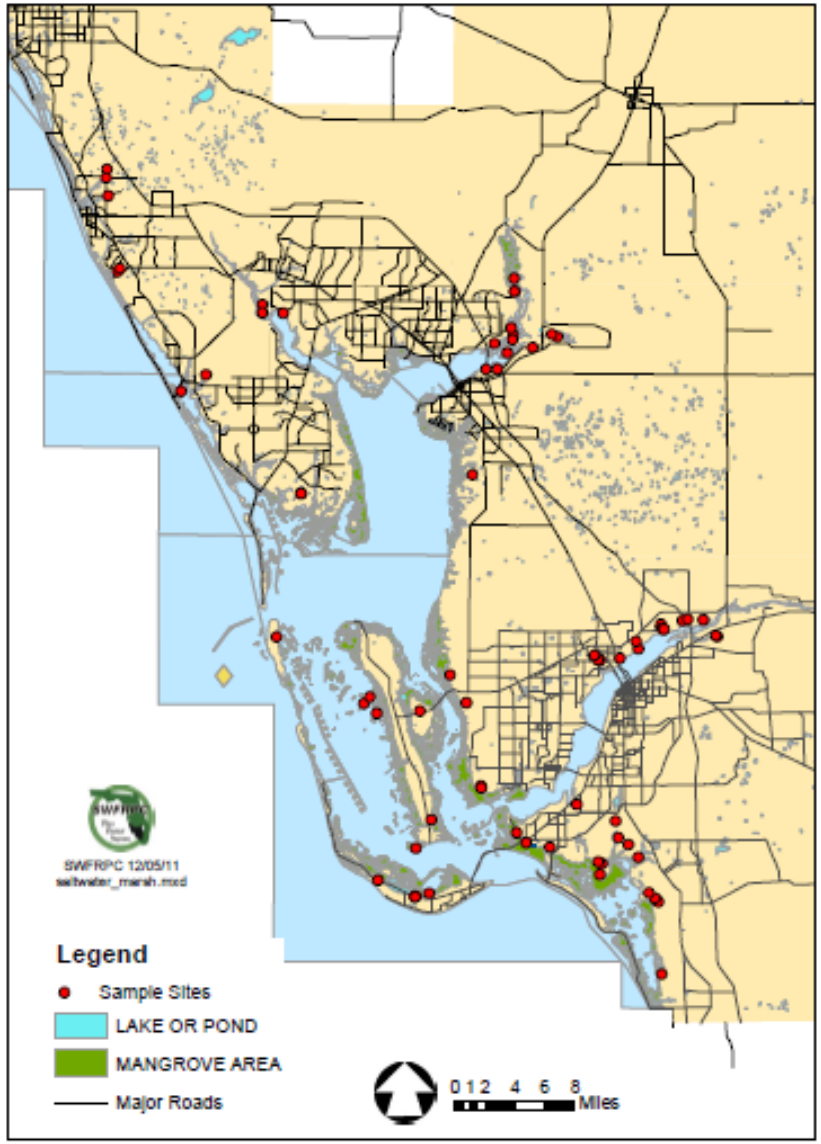
- Inventory and determine the areal extent of twelve types of salt marsh in the study area.
- Determine the vulnerability of the salt marsh types to climate change.
- Identify opportunities/needs for AMMA.
- Develop strategies to implement AMMA options.

Climate Change Vulnerability Assessment and Adaptation Opportunities for Salt Marsh Types in Southwest Florida

Project Completed

Work began in January of 2010 and finished in June 2012.

Salt Marsh Field Visit Sites

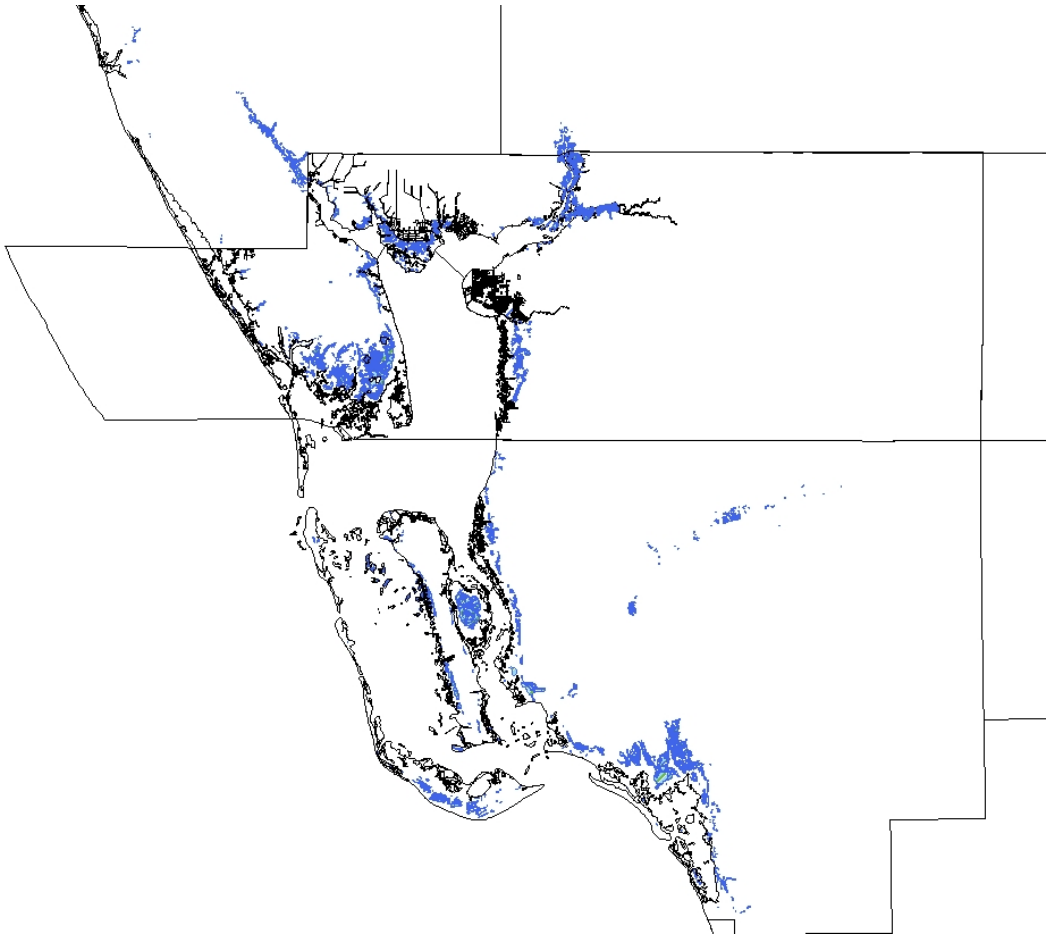


Salt Marsh Locations 2011- 2012

Charlotte Harbor Salt Marshes

Mapped by Type

Ground-Truthed

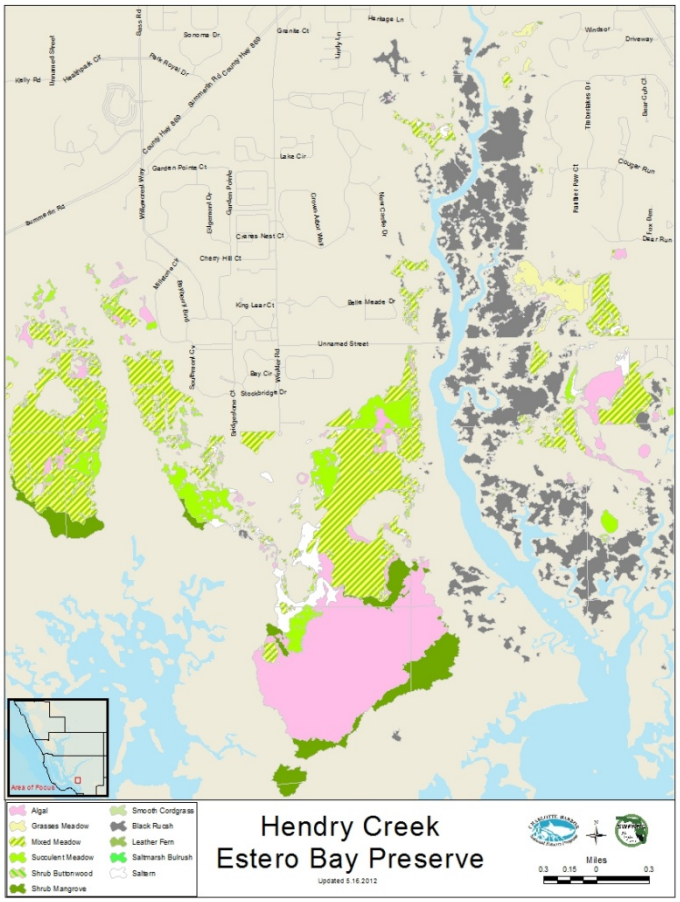


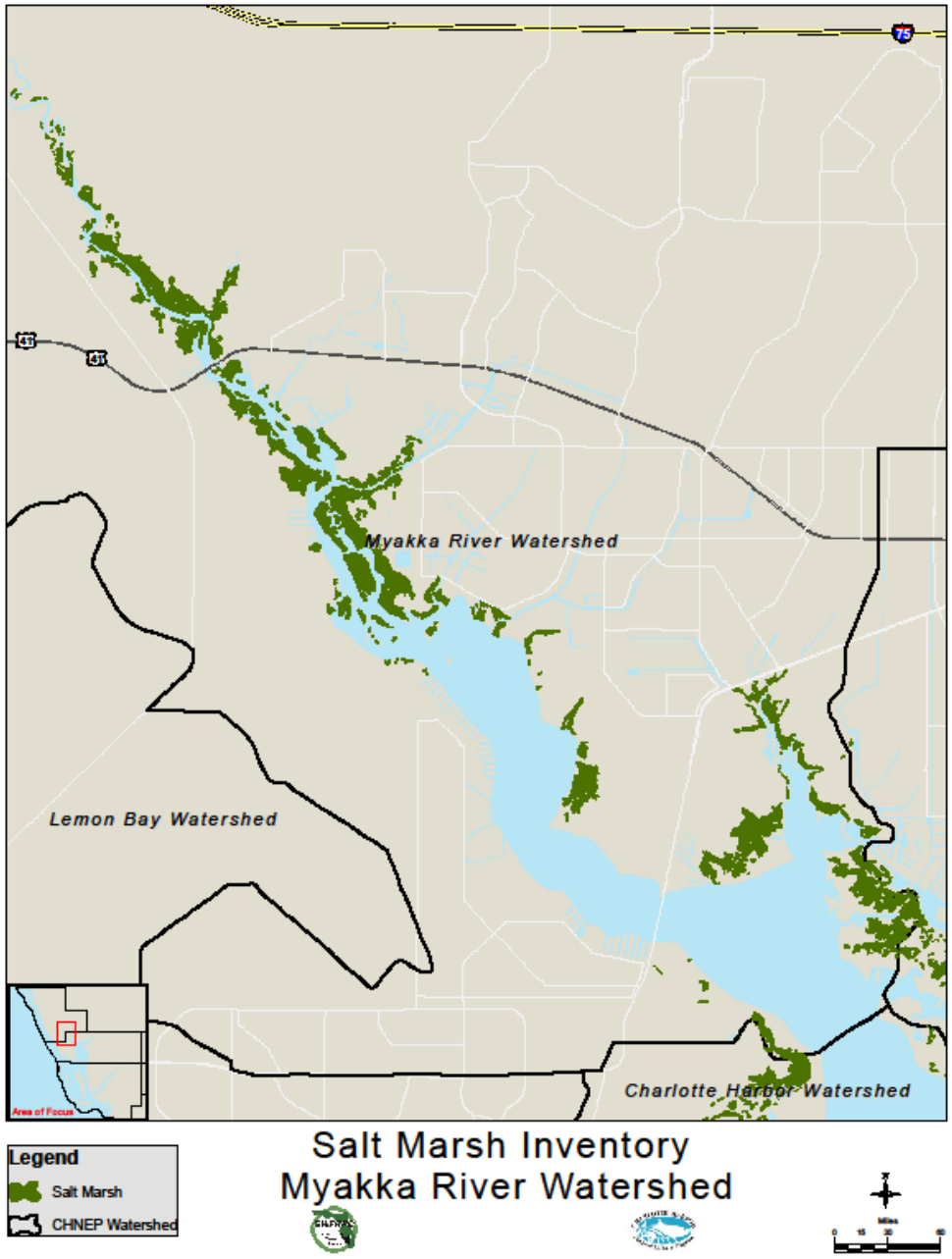
Salt Marshes Mapped to Type

First Salt Marsh Map of Types

Atlas of Maps

By Section

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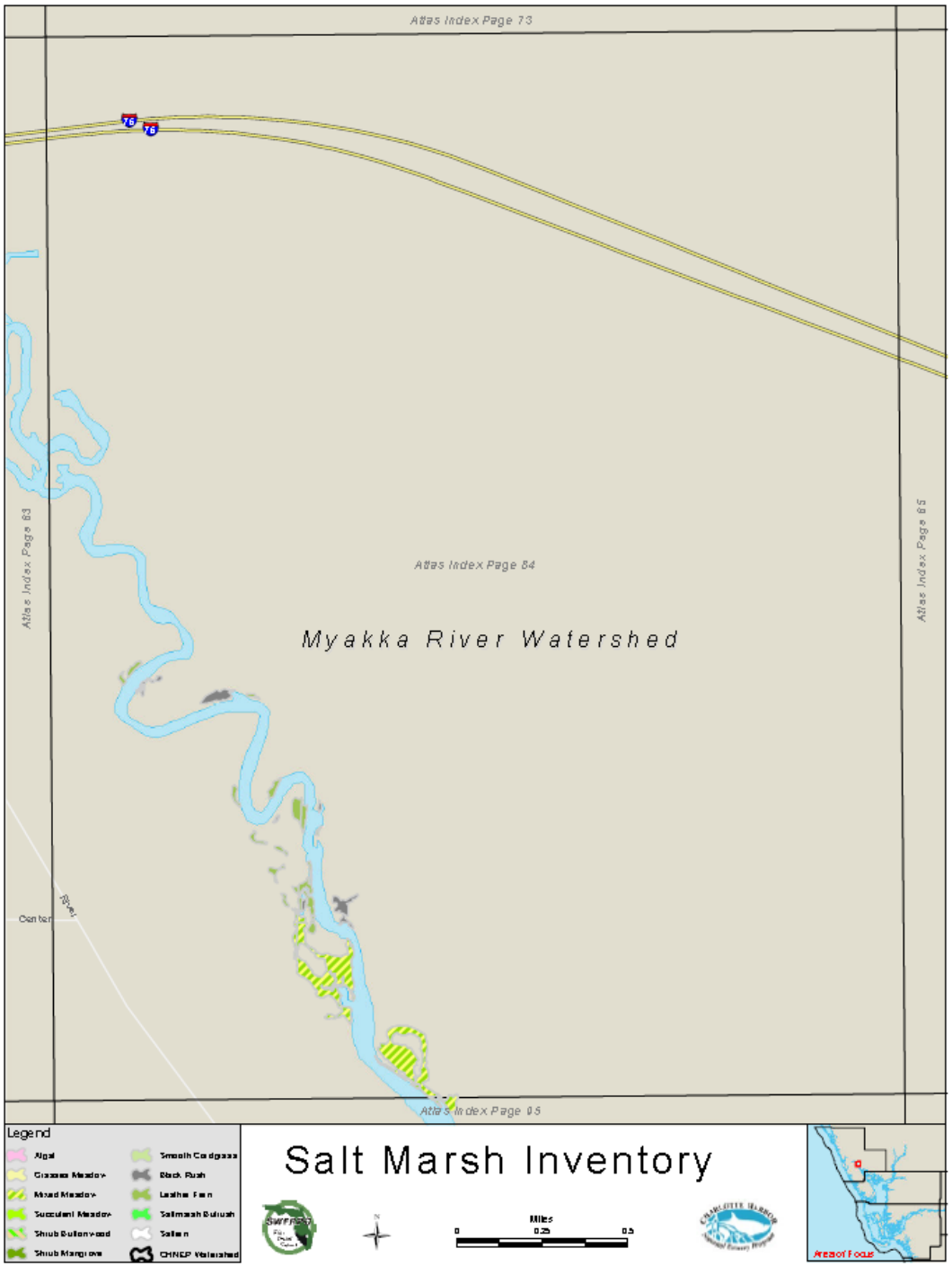
Myakka River Watershed
Lemon Bay Watershed
Charlotte Harbor Watershed
Area of Focus
Legend
Salt Marsh
CHNEP Watershed
Salt Marsh Inventory
Myakka River Watershed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Myakka River Watershed
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Mixed Meadow
Succulent Meadow
Shrub Buttonwood
Shrub Mangrove
Smooth Cordgrass
Black Rush
Leather Fern
Saltmarsh Bulrush
Saltwort
CHNEP Watershed
Salt Marsh Inventory
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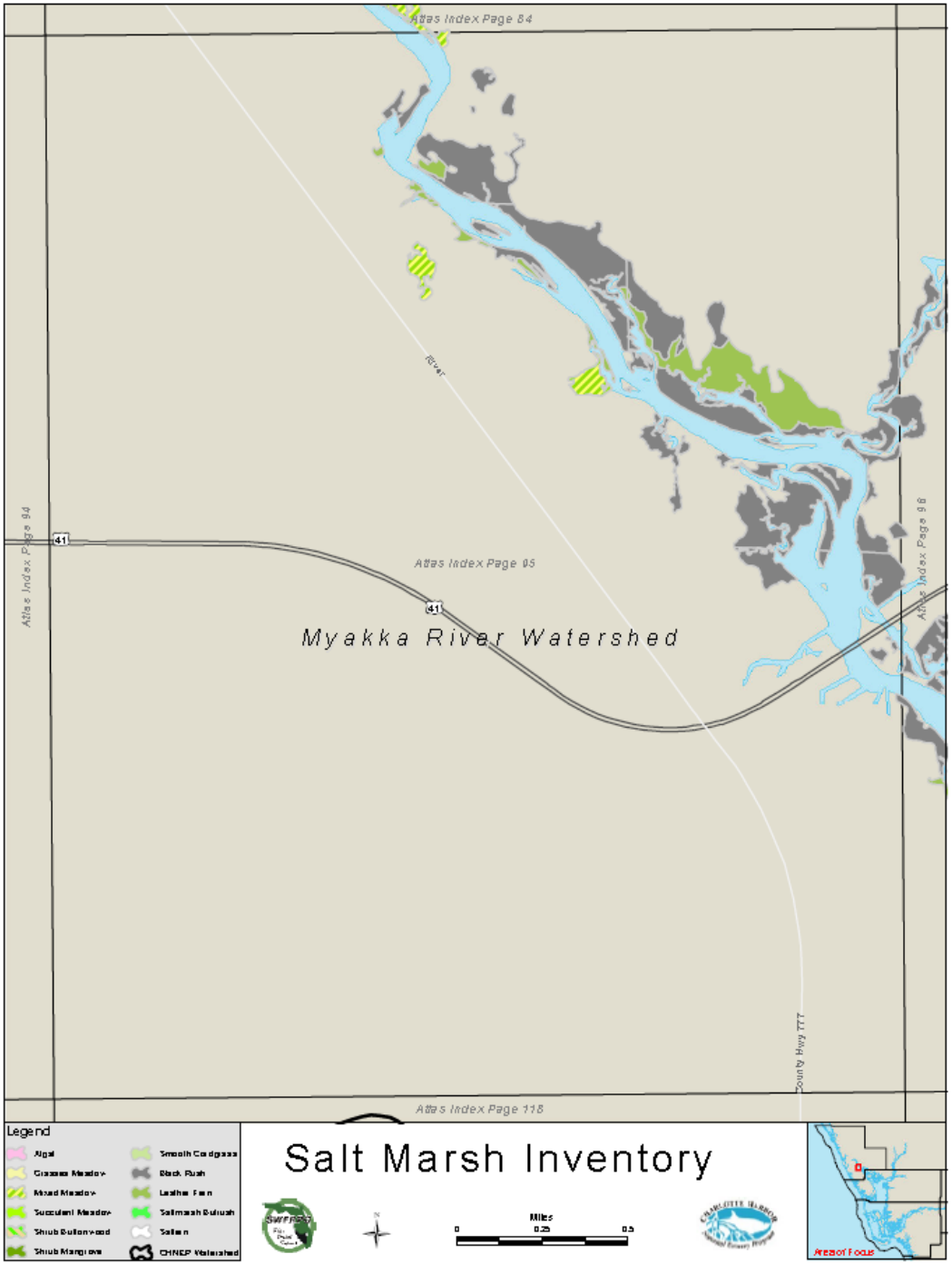
Area of Focus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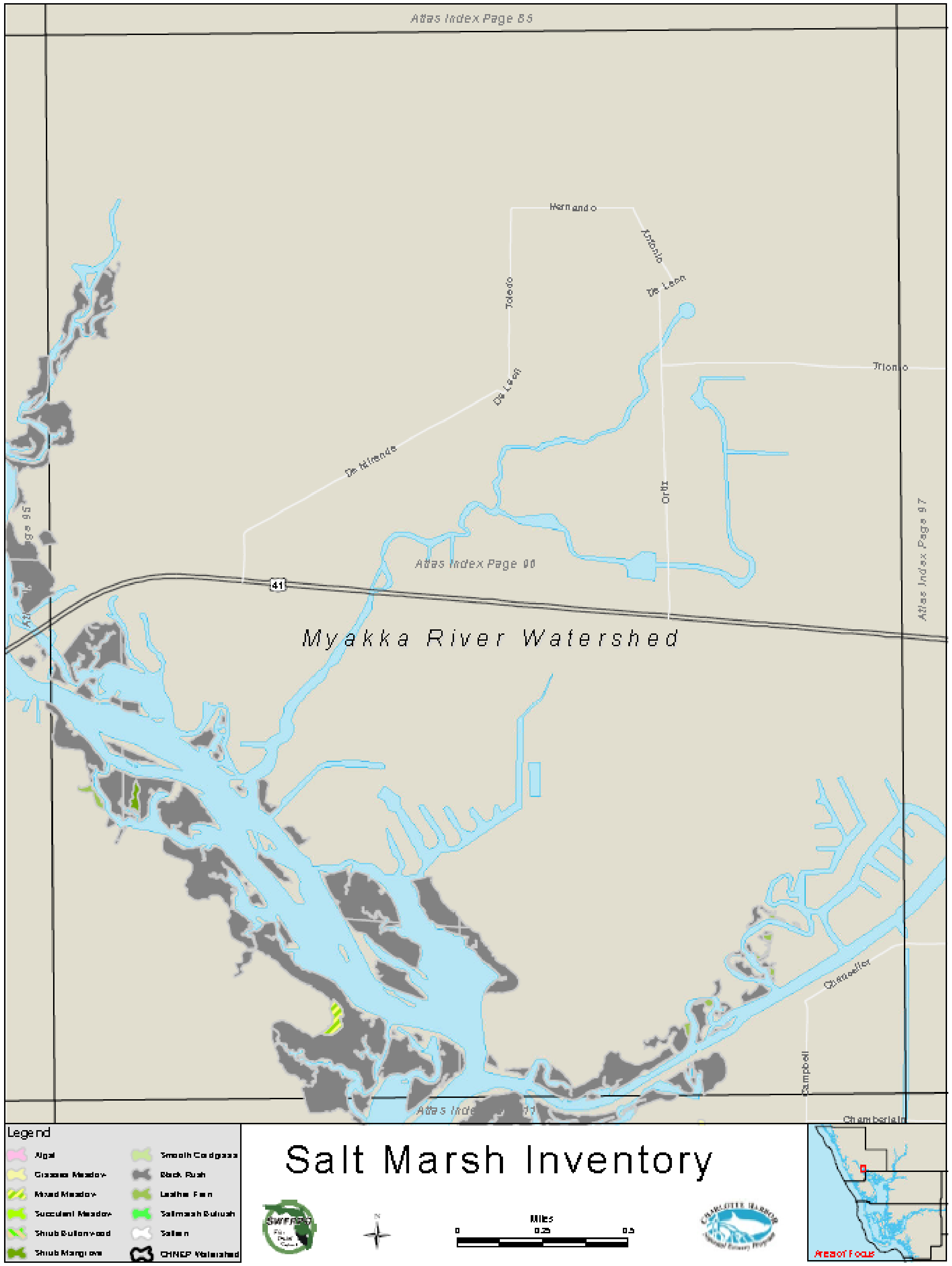
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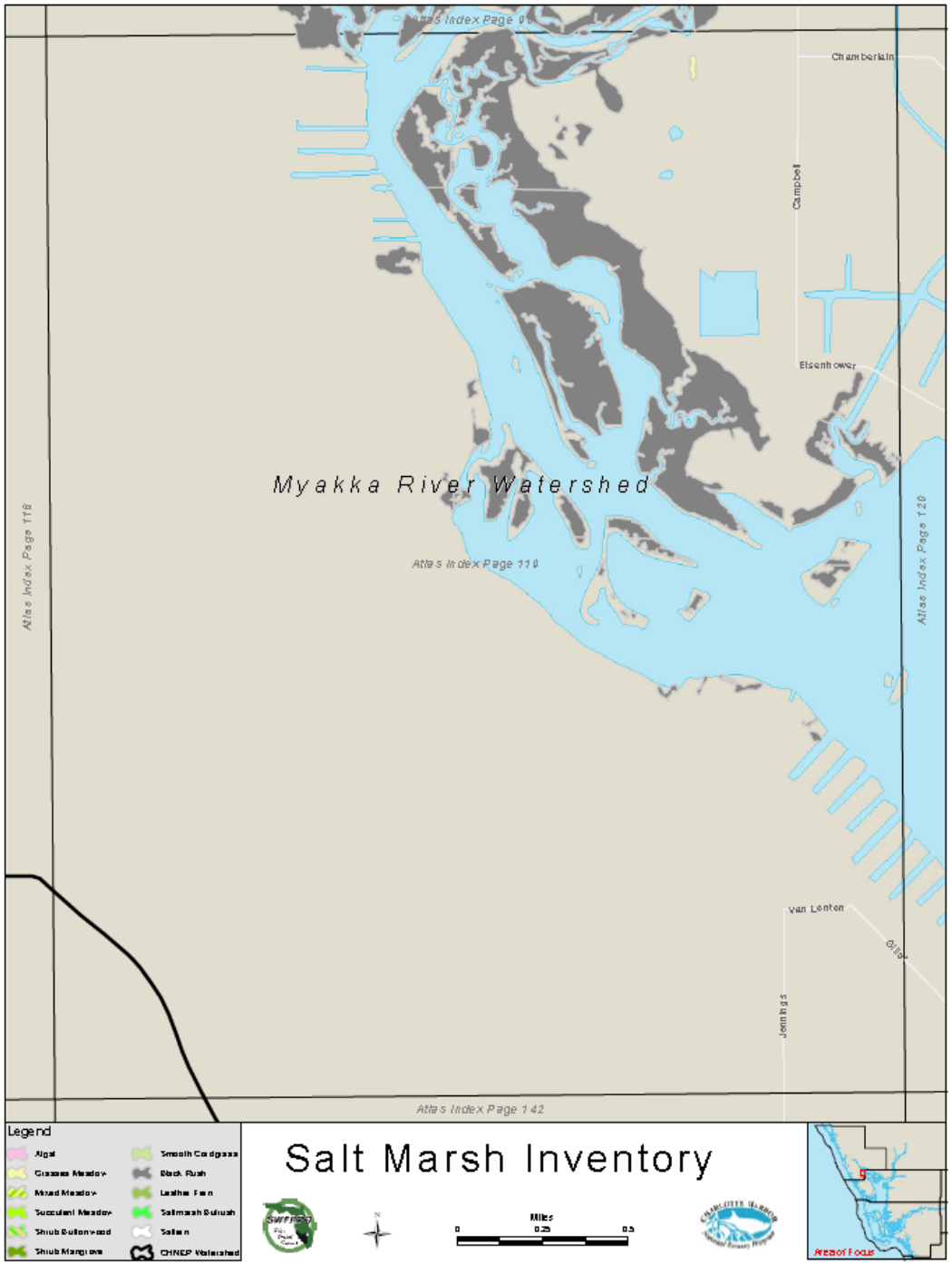
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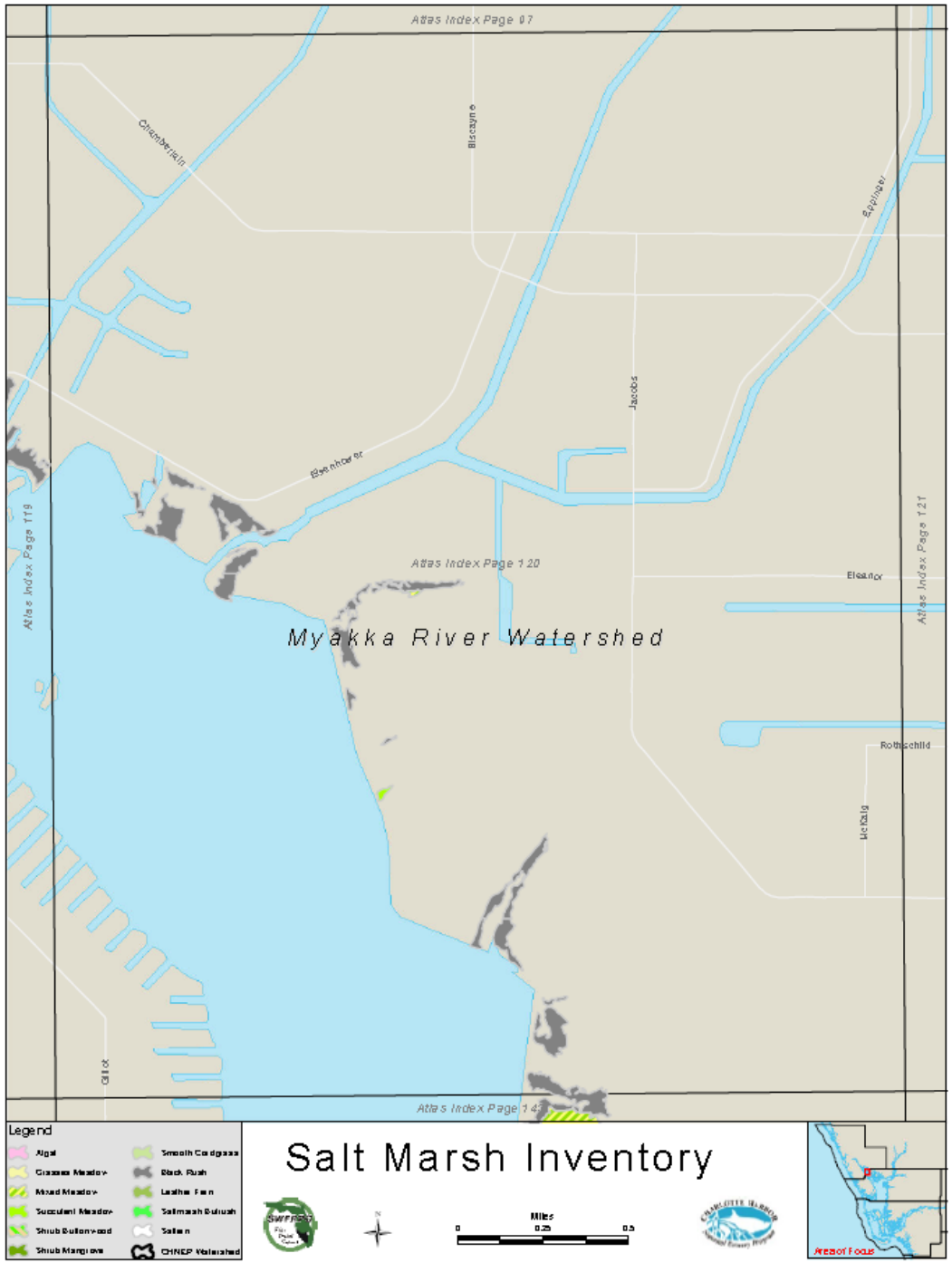
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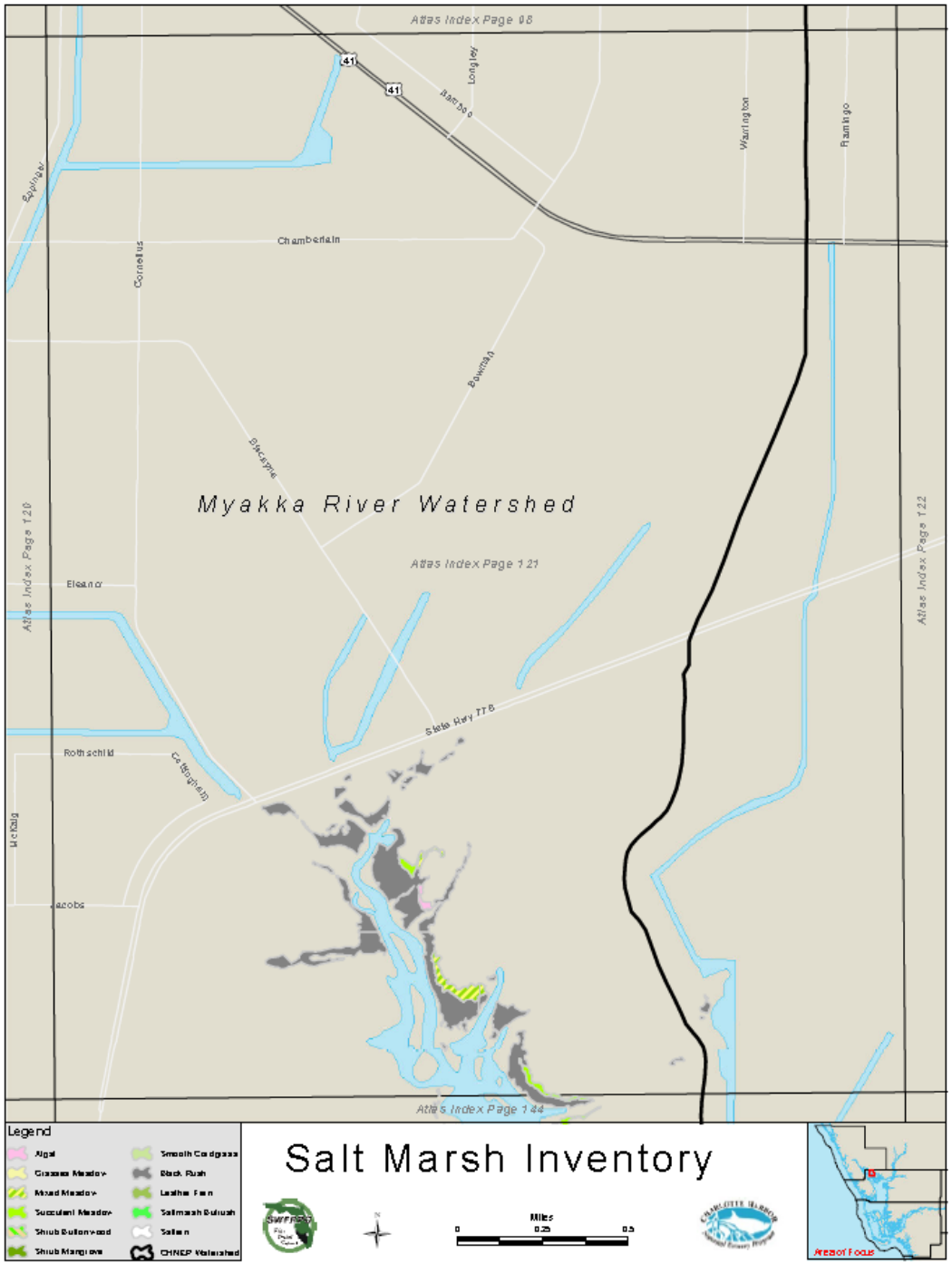
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Mixed Meadow
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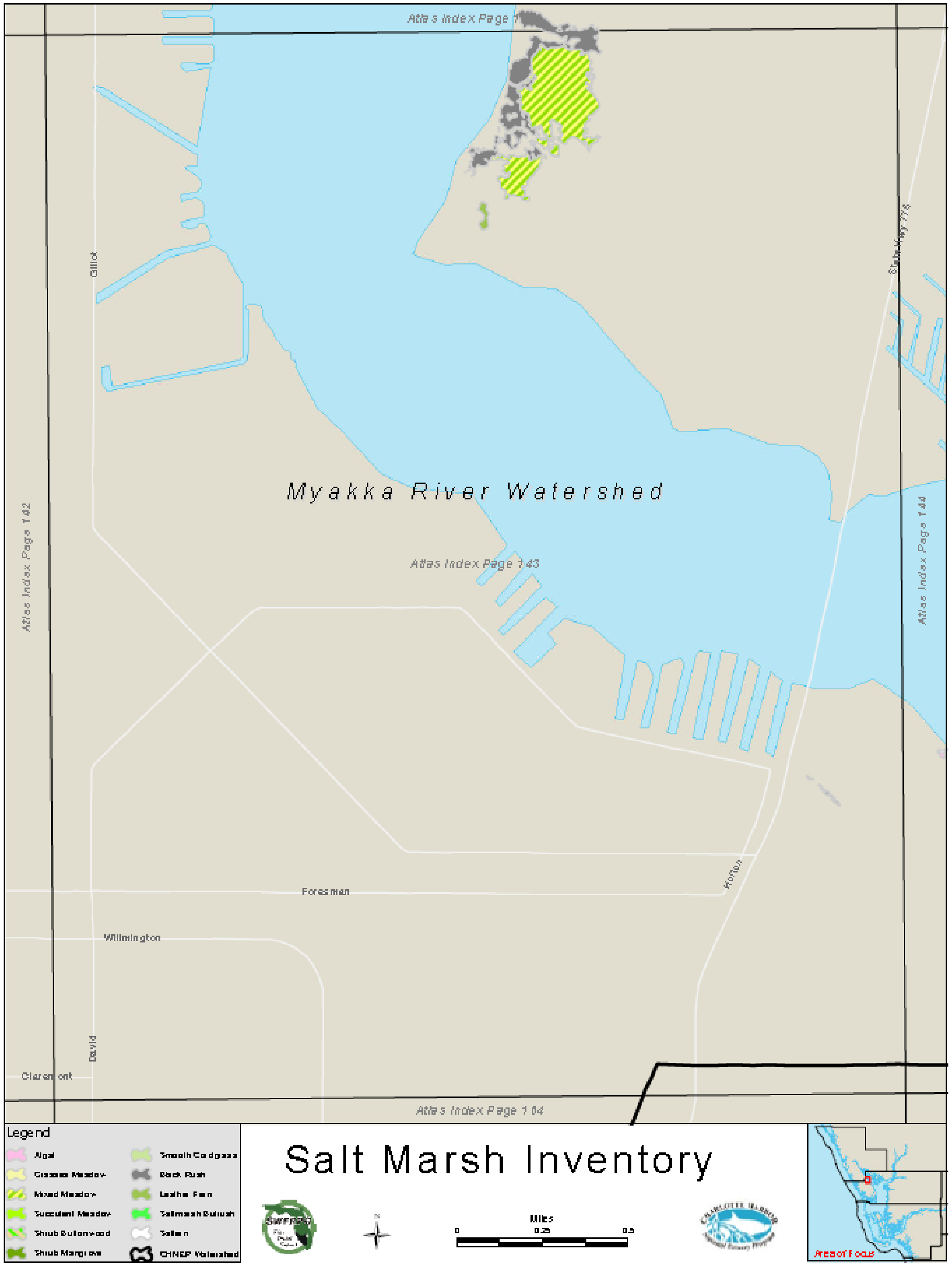
Charlotte Harbor
Project Focus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Claremont
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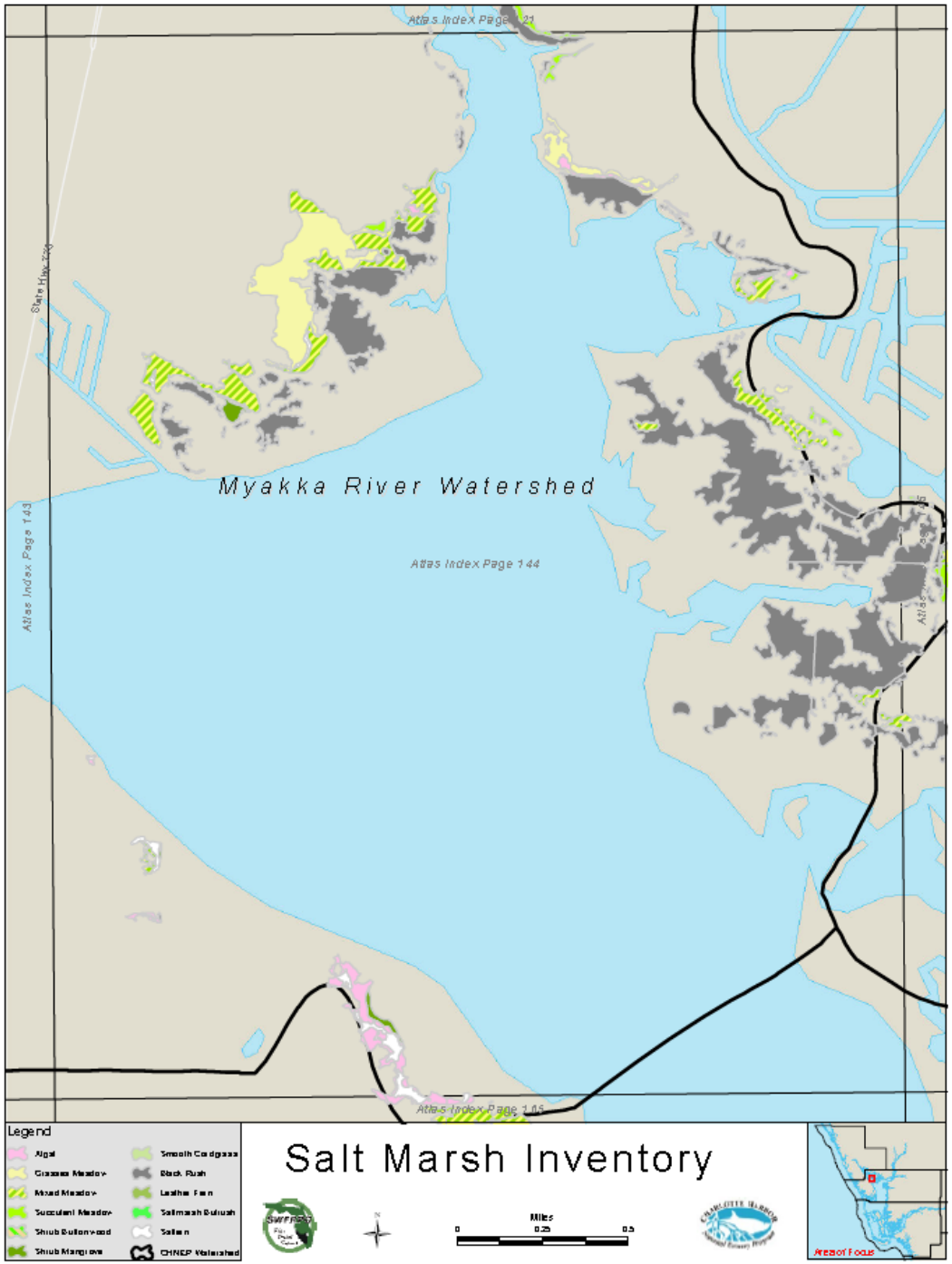
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CHNEP Watershed
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Project Focus

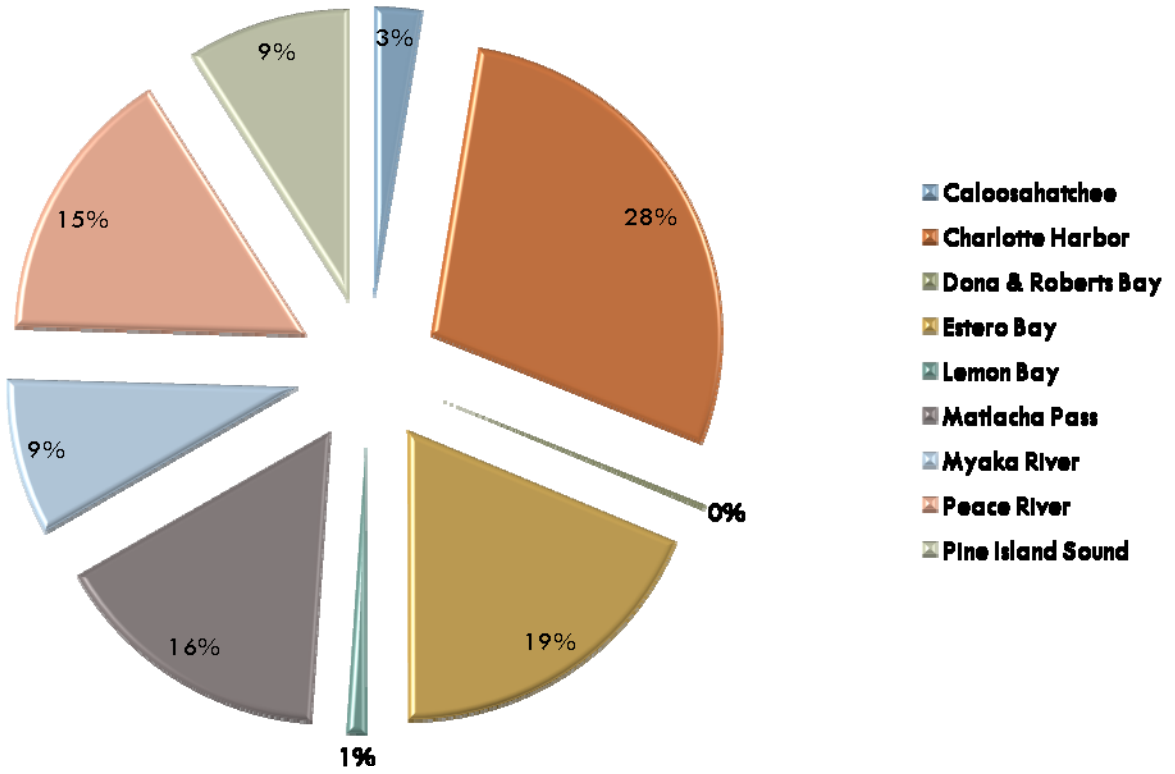
Acres of Salt Marsh of All Types in the CHNEP

Watershed	Acres
Caloosahatchee	389.3
Charlotte Harbor	4,222.7
Dona & Roberts Bay	35.7
Estero Bay	2,773.9
Lemon Bay	162.2
Matlacha Pass	2,332.7
Myakka River	1,291.7
Peace River	2,301.6
Pine Island Sound	1,346.2
Total	14,846.2

Relative proportion of salt marshes in the CHNEP Study Area

2011

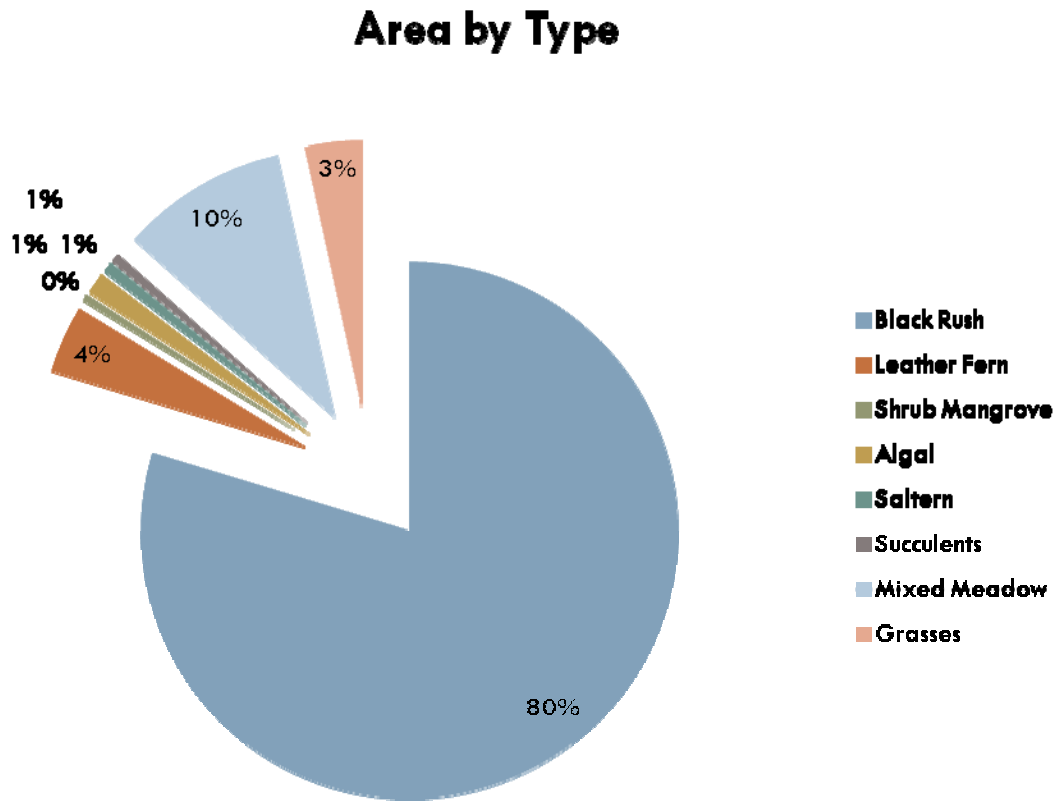
This Study



Relative proportion of salt marshes in the Myakka River Watershed

2012

This Study



Types of Salt Marsh Studied: Smooth Cordgrass

Low Marsh – Smooth Cordgrass

2.81 acres

FLUCCS code:

6421

FLUCCS description:

Cordgrass

- **Dominated by *Spartina alterniflora***
- **Inundated at all tides**

Pine Island Sound

Types of Salt Marsh Studied: Black Needle Rush

Low to High Marsh – Black Needle Rush

3,593.67 acres

FLUCCS code:

6442

FLUCCS description:

Needlerush

- **Dominated by *Juncus roemerianus***
- **Inundated regularly**

Hendry Creek

Types of Salt Marsh Studied: Leather Fern

Low to Mid Marsh – Leather fern

464.69 acres

FLUCCS code:

none

FLUCCS description:

none

- **Dominated by *Acrostichum danaeifolium***
- **Inundated regularly**
- **Most examples along Caloosahatchee River and tributaries**

Caloosahatchee Creek

Types of Salt Marsh Studied: Saltmarsh Bulrush

Low to Mid Marsh – Bulrush

337.37 acres

FLUCCS code: 641

FLUCCS description:

Freshwater Marsh

- **Dominated by *Schoenoplectus robustus* (syn. *Scirpus robustus*)**
- **Inundated regularly**
- **Most examples along Peace River River and S**

Shell Creek

Types of Salt Marsh Studied: Shrub Mangrove

High Marsh – Shrub Mangrove

1,206.1 acres

FLUCCS code:

6122

FLUCCS description:

Black Mangrove

- **Dominated by mangroves less than 2m**
- **Inundated infrequently**
- **May have areas of varying elevation**

Estero Bay

Types of Salt Marsh Studied: Algal High Marsh

Low to High Marsh – Algal

1,245.42 acres

FLUCCS code: 650

FLUCCS description: Tidal Flats, Shorelines, Intermittent Ponds

- **Microscopic algae infuse sediments, giving a pink or grey hue**
- **Inundated infrequently**

Estero Bay

Types of Salt Marsh Studied: High Marsh Saltern

High Marsh – Saltern

657.79 acres

FLUCCS code:

720

FLUCCS description:

Sand other than

- **Bare or nearly bare sand**
- **Inundated very infrequently**
- **Plant life herbaceous if present**

Estero Bay

Types of Salt Marsh: High Marsh Meadow

High Marsh – Meadow Succulents

943.73 acres

FLUCCS code:

643

FLUCCS description:

Wet Prairie

- **Dominated by *Salicornia/Sarcocornia, Batis, Sesuvium, and Blutaparon***
- **Inundated infrequently**

Estero Bay

Types of Salt Marsh: High Marsh Mixed Meadow

High Marsh – Mixed Meadow

5,783.81 acres

FLUCCS code:

643

FLUCCS description:

Wet Prairie

- **Dominated by herbaceous vegetation of mixed grasses, forbs, and succulents**
- **Inundated very infrequently**

Estero Bay

Types of Salt Marsh: High Marsh Grasses

High Marsh – Meadow Grasses

601.08 acres

FLUCCS code:

643

FLUCCS description:

Wet Prairie

- **Dominated by *Distichlis*, *Sporobolus*, etc.**
- **Inundated very infrequently**

Charlotte Harbor State Buffer Preserve State Park

Types of Salt Marsh: High Marsh Baker's Cordgrass

High Marsh – Baker's Cordgrass or Sand Cordgrass

FLUCCS code: 642

FLUCCS description: Salt Marsh

- **Dominated by *Spartina bakeri* and *Acrosticum danaeifolium***
- **Tidal inundated very infrequently, more frequent precipitation input.**

Sanibel-Captiva Conservation Foundation

Types of Salt Marsh: Shrub Buttonwood

High Marsh – Shrub Buttonwood

40.2 acres

FLUCCS code:

6124

FLUCCS description:

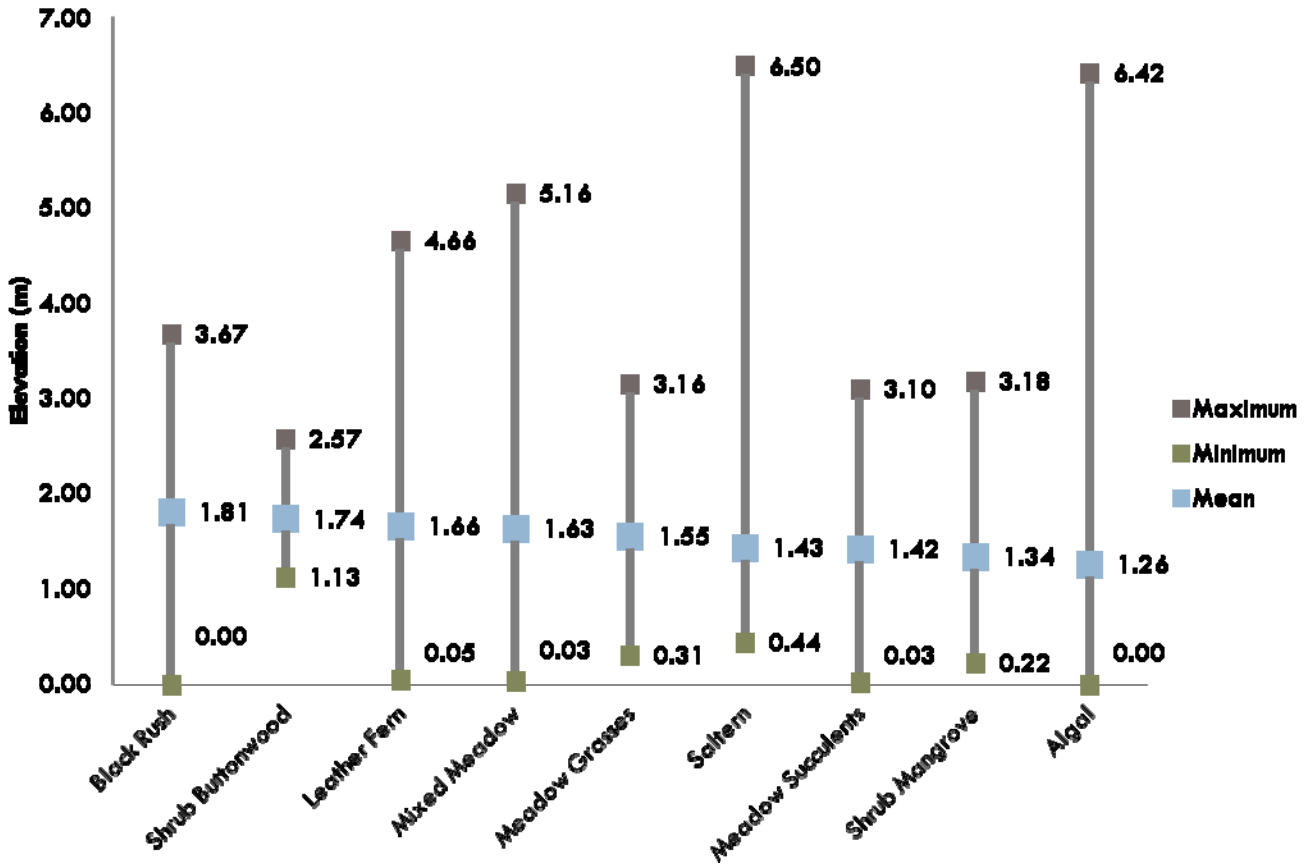
Buttonwood

- **Dominated by *Conocarpus erectus* ≤ 2m**
- **Inundated very infrequently**

Cape Coral Spreader Canal

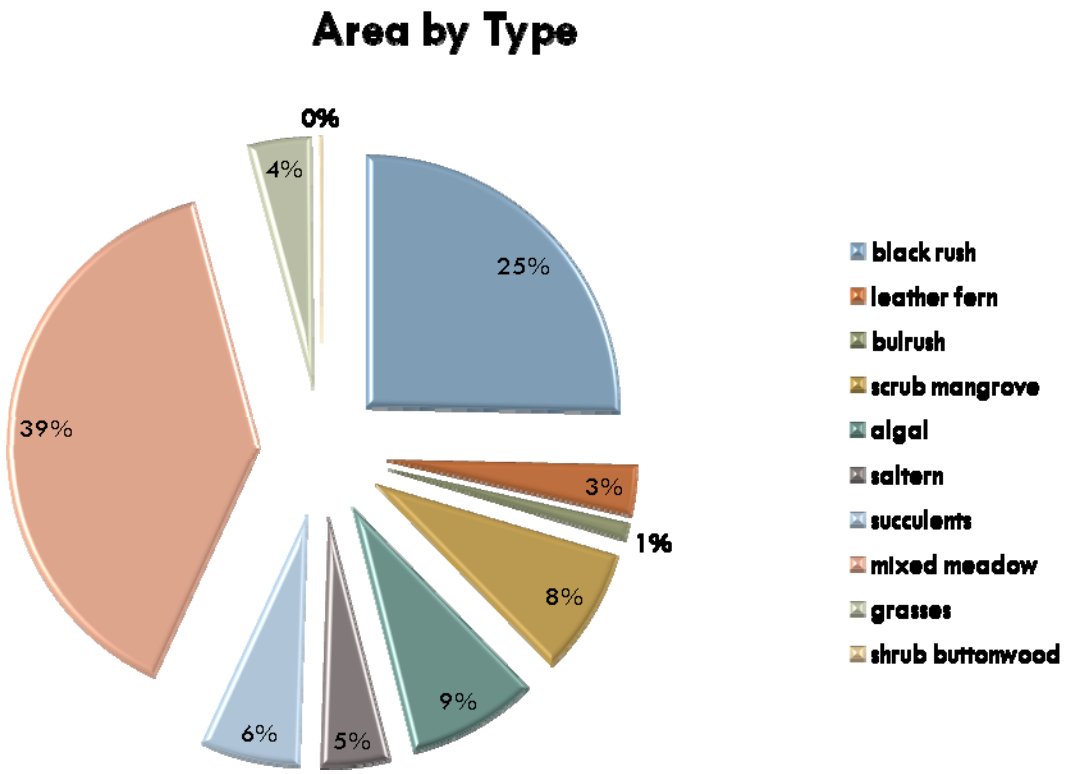
Salt Marsh Types Occur Over a Range of Elevations

Different Marsh Types Have a Range of Elevations They Occur In With Different Landscape Contexts

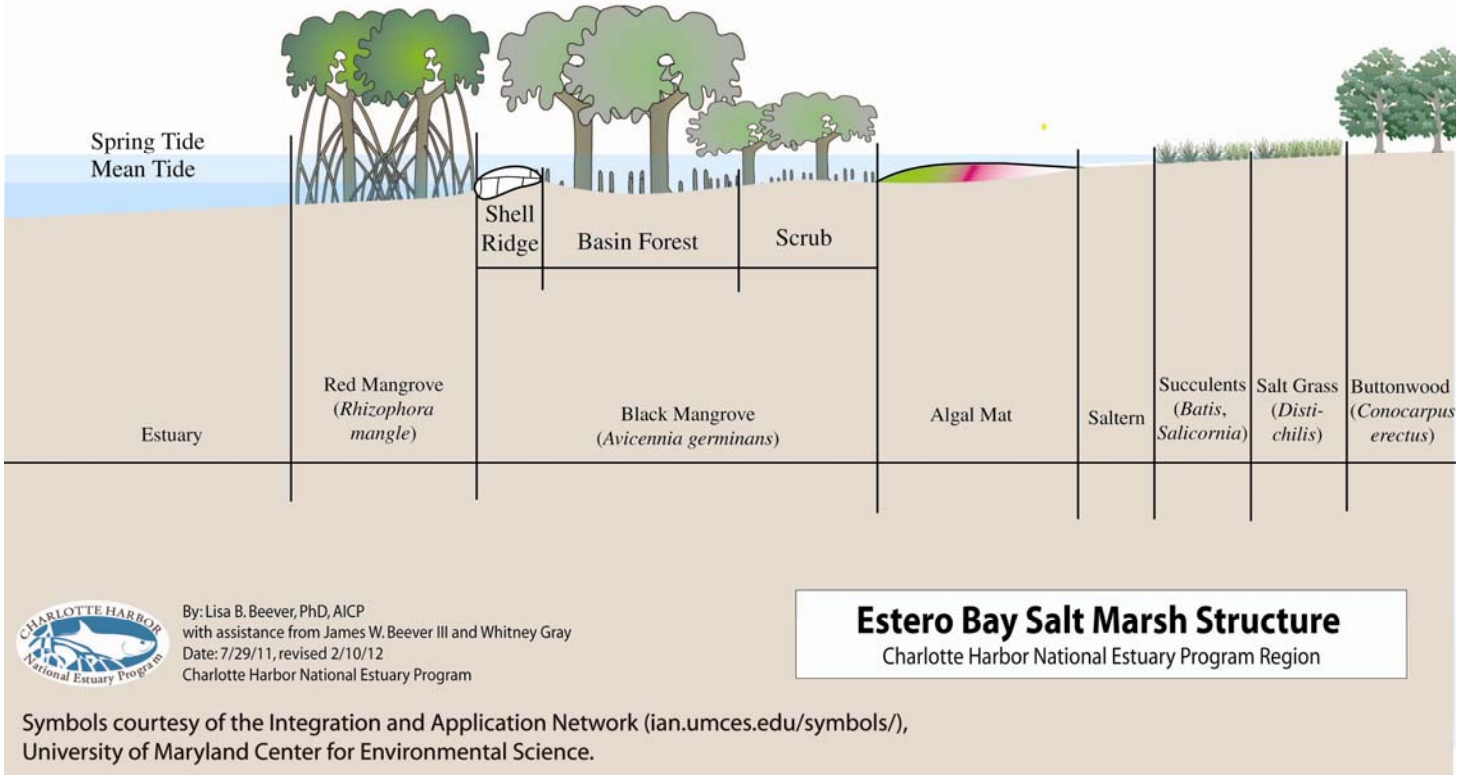


Salt Marsh Area By Type in the CHNEP 2011

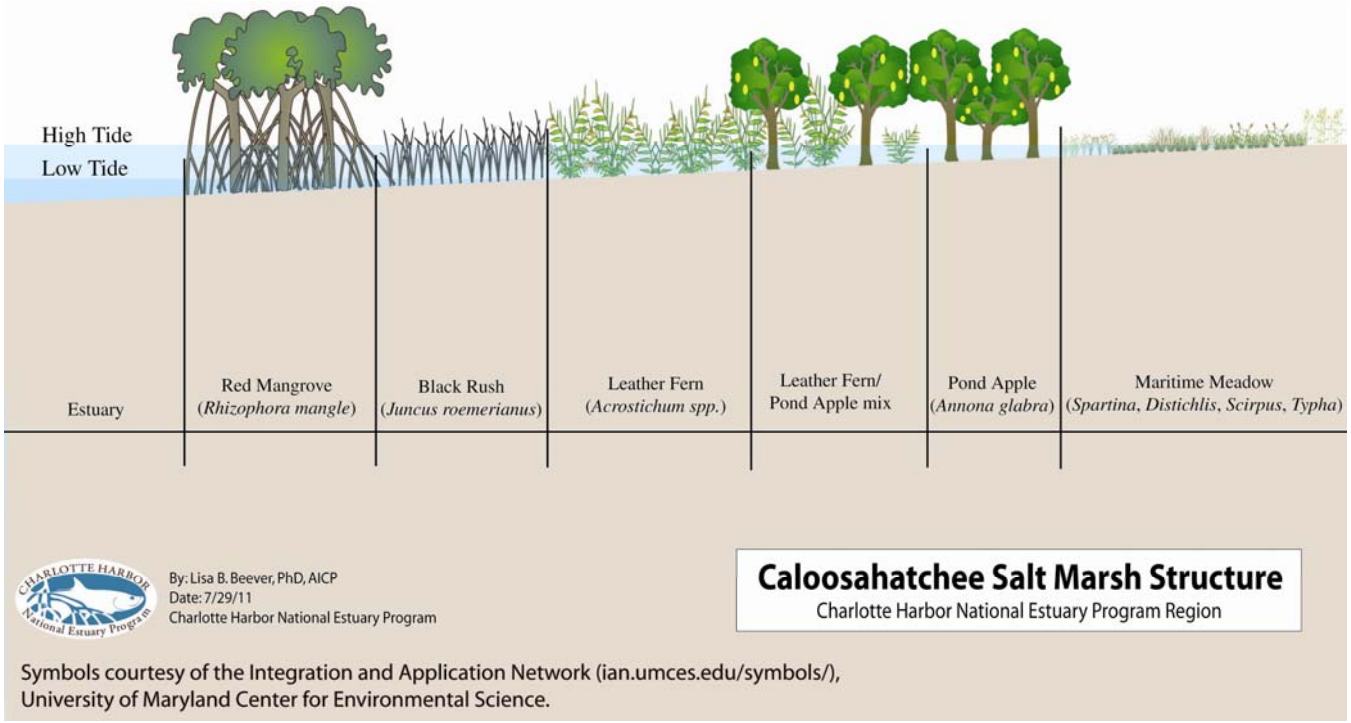
- Mixed High Meadow
- Black Rush
- Algal
- Shrub Mangrove
- Succulents
- Saltern
- Saltmarsh Bulrush
- Leather Fern
- High Grasses



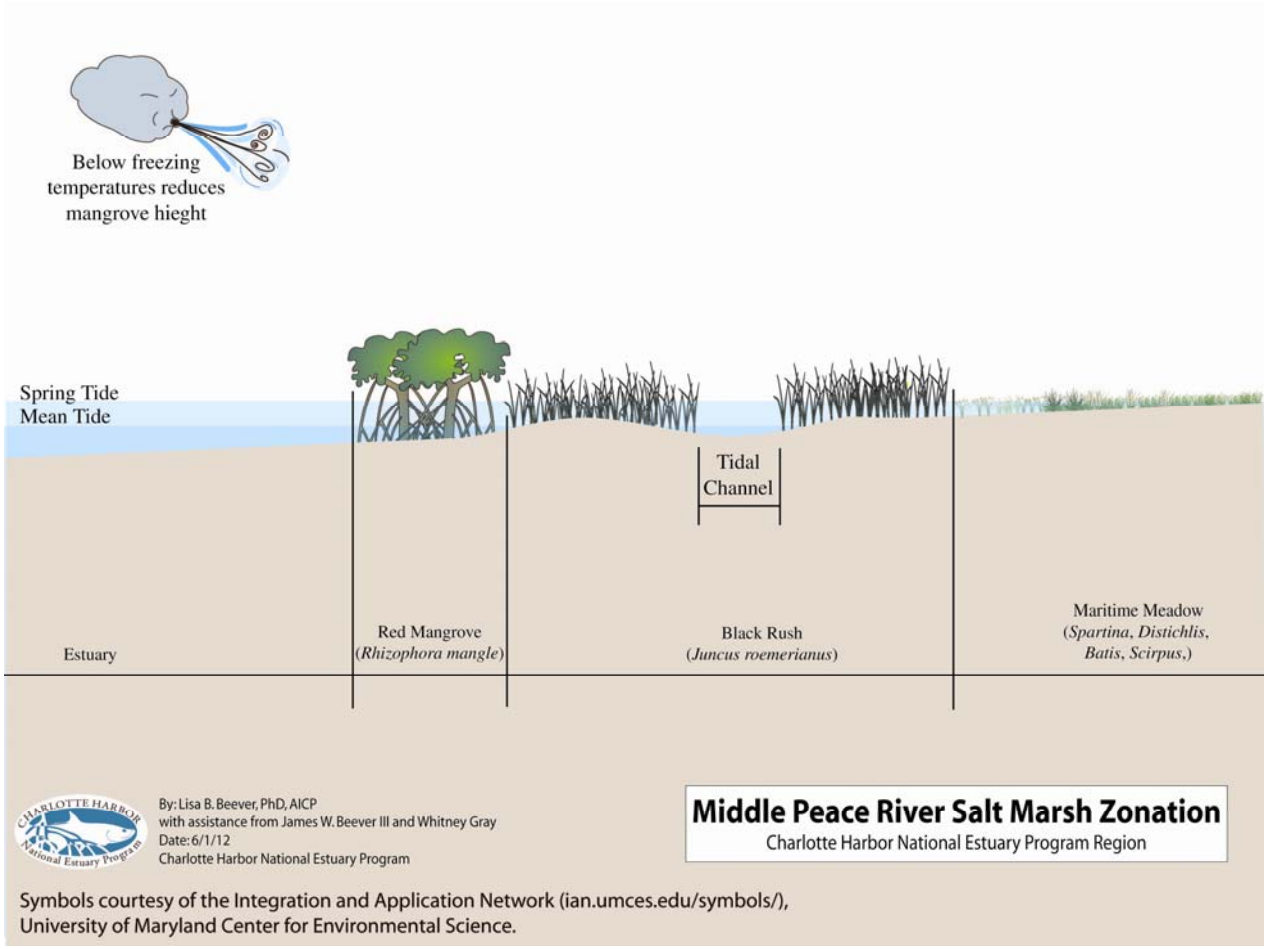
Estero Bay and Pine Island Sound Salt Marsh Zonation



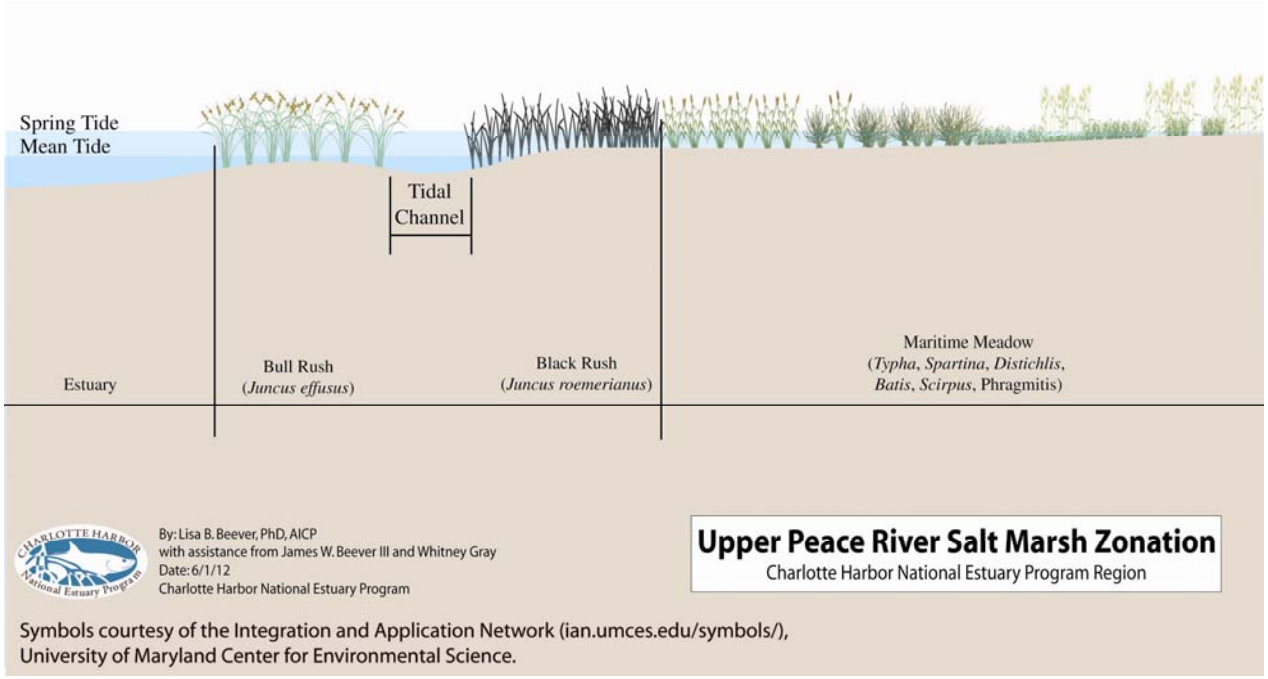
Caloosahatchee Salt Marsh Zonation



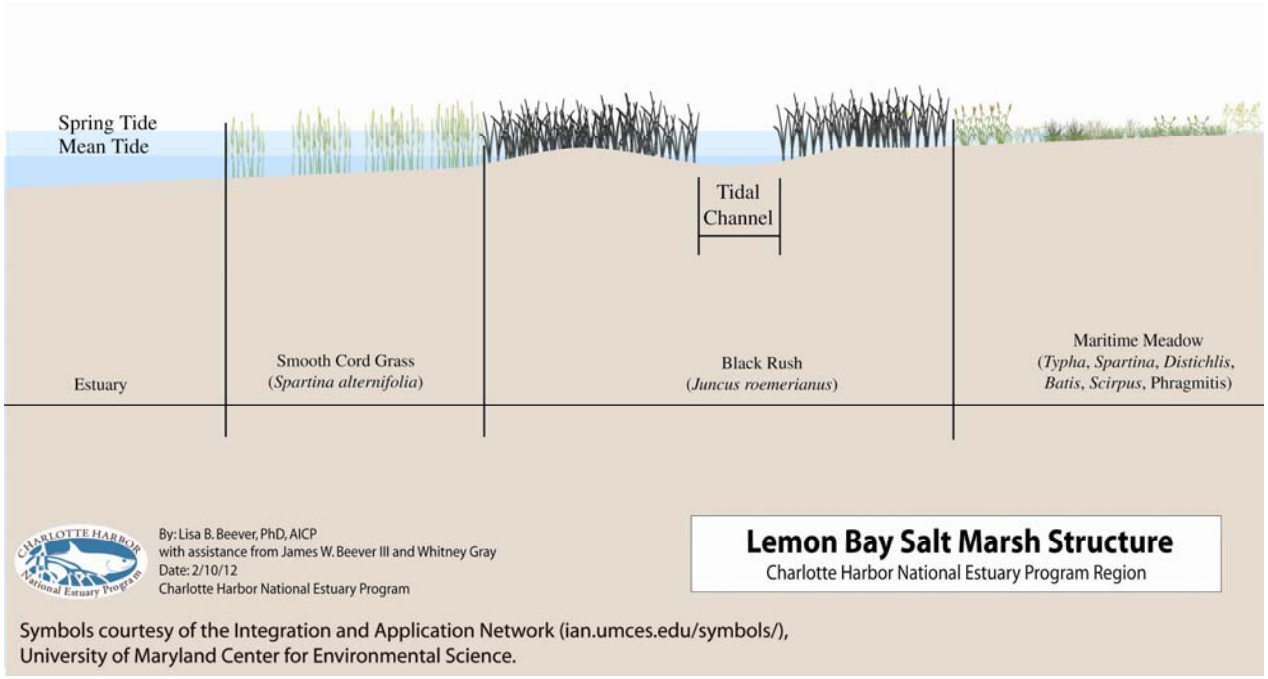
Middle Peace River Salt Marsh Zonation



Upper Peace River Salt Marsh Zonation



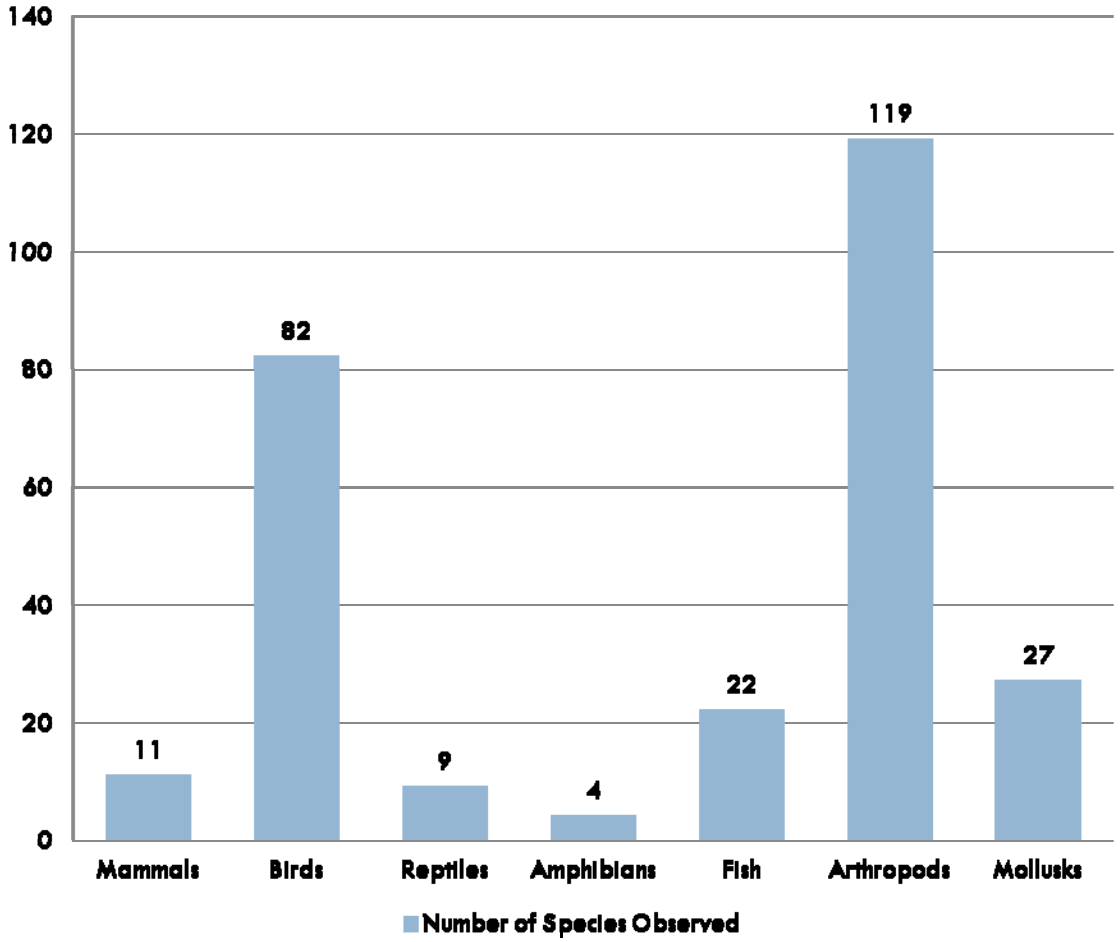
Lemon Bay Salt Marsh Zonation



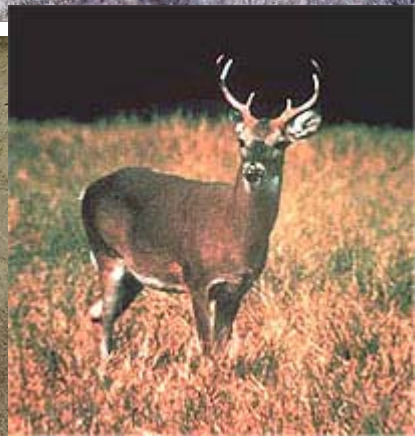
Salt Marsh Animals: 273 Species Observed

Black-necked Stilt

Eastern Pygmy Blue



Evidence of Mammals

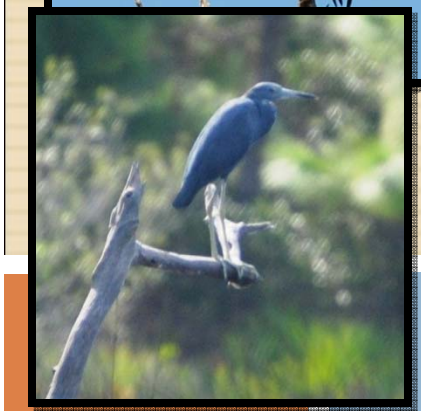


Mammals

11 Species

Visual, tracks, scat and/or evidence of predation

Common Name	*Genus*	*Species*
raccoon	*Procyon*	*lotor*
marsh rabbit	*Sylvilagus*	*palustris*
feral hog	*Sus*	*scrofa*
river otter	*Lontra*	*canadensis*
bottle-nosed dolphin	*Tursiops*	*truncatus*
West Indian manatee	*Manatus*	*trichechus*
hispid cotton rat	*Sigmodon*	*hispidus*
white-tailed deer	*Odocoileus*	*virginianus*
domestic dog	*Canis*	*familiaris*
Virginia opossum	*Didelphis*	*virginiana*
bobcat	*Felis*	*rufus*



Brown pelican	*Pelecanus occidentalis*	SSC
Least tern	*Sterna antillarum*	T
Little blue heron	*Egretta caerulea*	SSC
Osprey	*Pandion haliaetus*	SSC
Roseate spoonbill	*Platalea ajaja*	SSC
Snowy egret	*Egretta thula*	SSC
Tricolored heron	*Egretta tricolor*	SSC
White ibis	*Eudocimus albus*	SSC
Wood stork	*Mycteria americana*	E

Birds

82 species found; highest number of different species found in high marshes on Estero Bay near Bunche Beach and Hendry Creek

Reptiles: 9 Species

Reptiles

Common Name	Genus	Species
green anole	*Anolis*	*caroliniana*
brown anole	*Anolis*	*sagrei*
banded water snake	*Nerodia*	*fasciata*
mangrove salt marsh snake	*Nerodia*	*clarkii compressicaida*
alligator	*Alligator*	*mississippiensis*
black racer	*Coluber*	*constrictor priapus*
Florida banded water snake	*Nerodia*	*fasciata cyclas*
Corn snake	*Elaphe*	*guttata elapsoides*
Florida box turtle	*Terrapene*	*carolina bauri*

Amphibians: 4 Species

Common Name	*Genus*	*species*
Southern Leopard Frog	*Rana*	*sphenocephala*
Green Tree Frog	*Hyla*	*cinerea*
Cuban Tree Frog	*Osteopilus*	*septentrionalis*
Pig Frog tadpoles	*Rana*	*grylio*

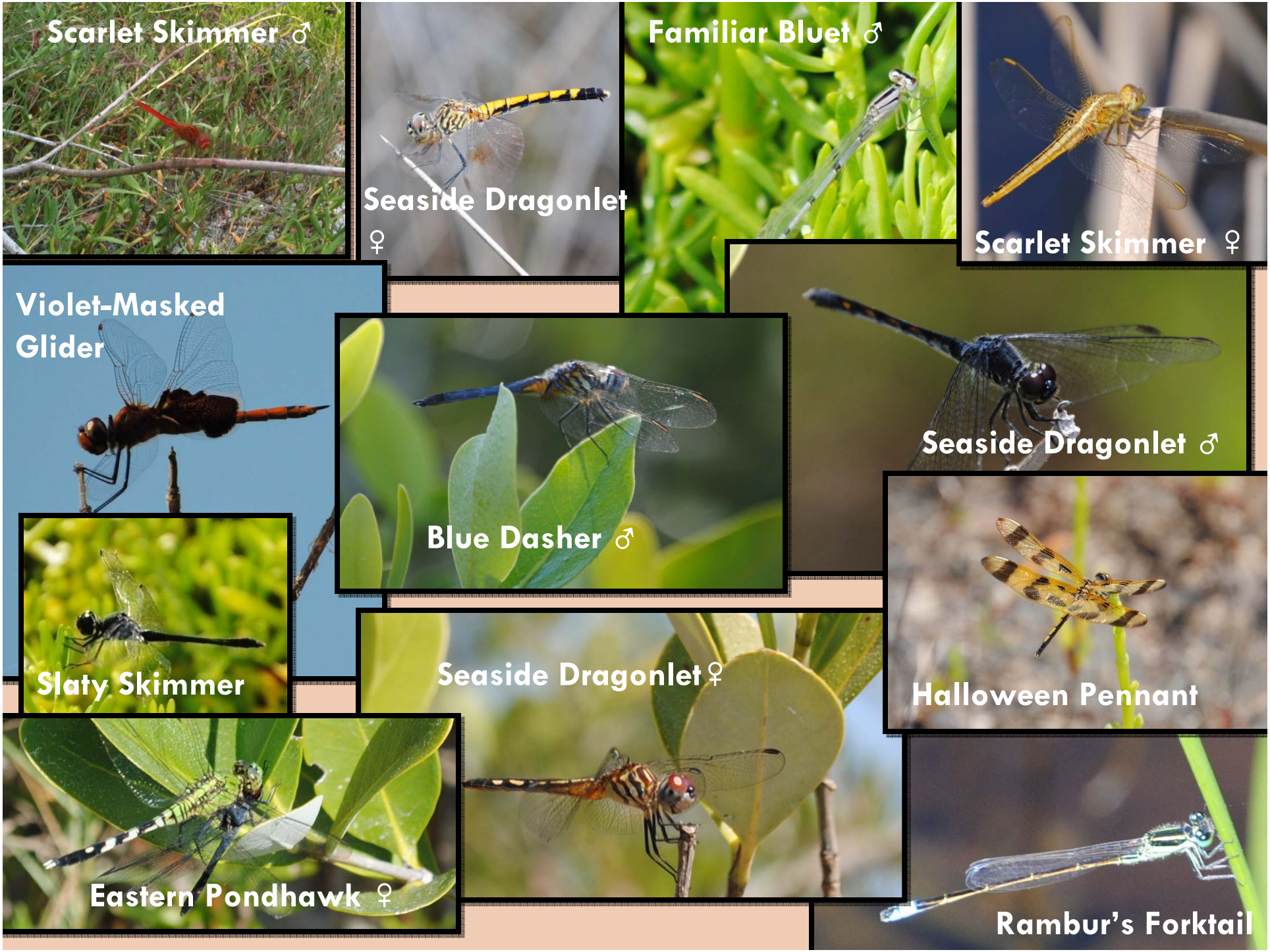
Fish

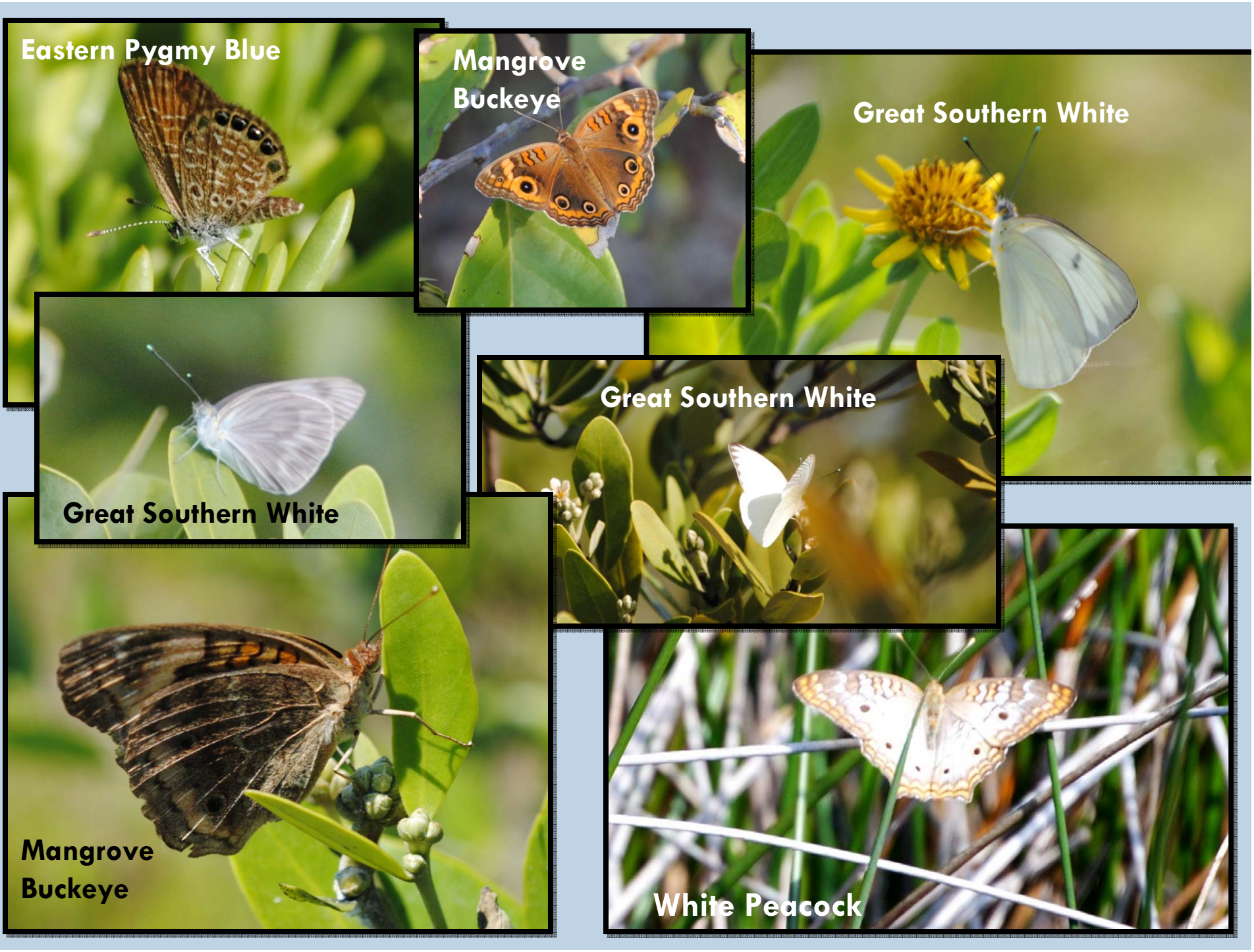
22 species; mosquitofish most often seen; one exotic, African jewelfish (*Hemichromis letourneauxi*) confirmed

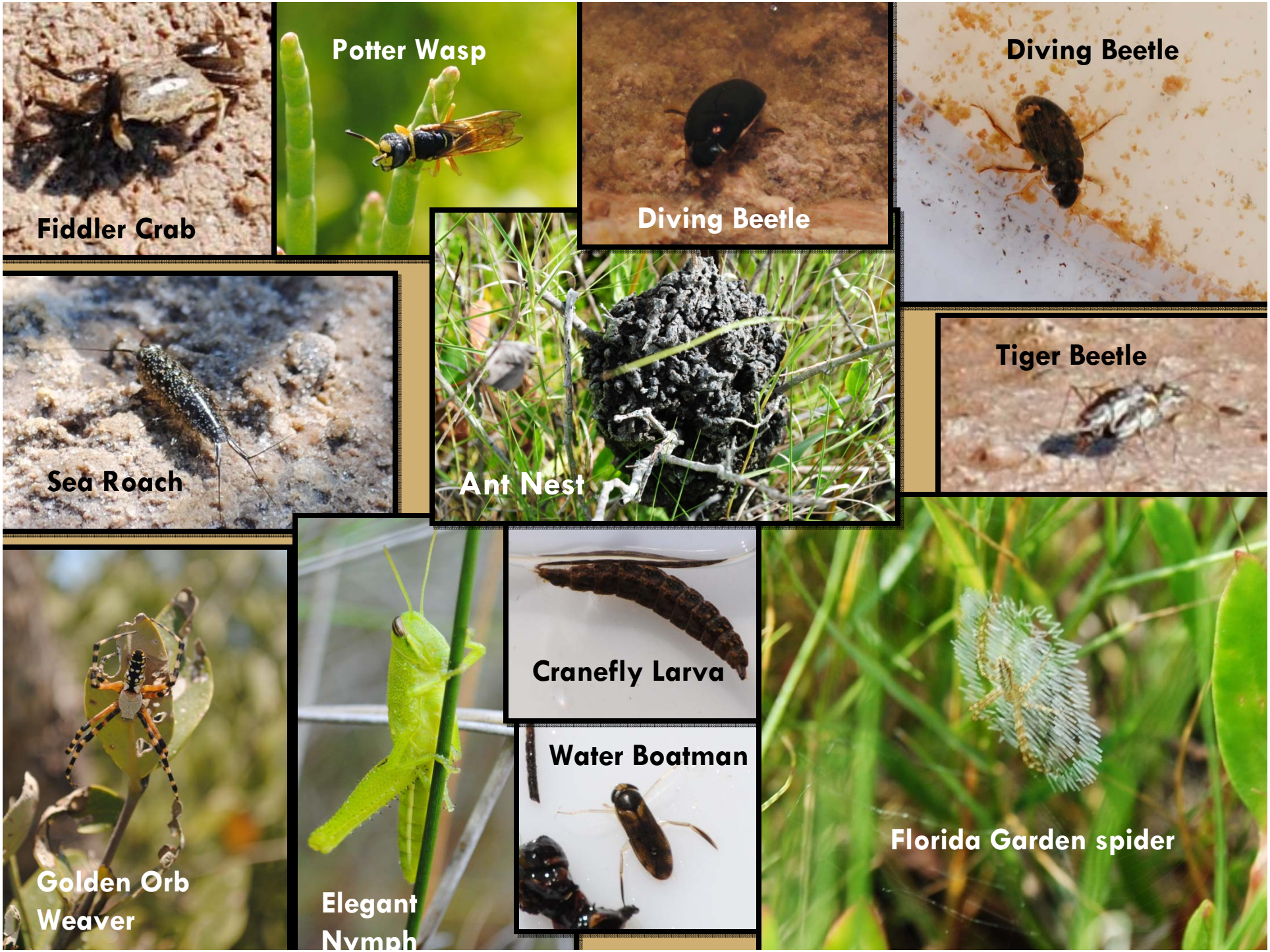
Fish

Arthropods: 112 Species

Butterflies	• 9 species observed • *Batis*, *Avicennia*, and *Laguncularia* frequent host plants
Dragonflies and Damselflies	• 18 species observed • More utilization of salt marsh than noted in literature
Bees and Wasps	• 8 species observed • Green-eyed bee, honey bee, paper wasp, potter wasp
Other Insects	• 40 species observed • Ants, grasshoppers, aquatics, deer flies, larvae, lovebugs, aphids, etc.
Crustaceans	• 18 species observed • Fiddler crabs seen most often
Arachnids	• 19 species observed • *Argiope* most commonly seen


Scarlet Skimmer ♂
Seaside Dragonlet ♀
Familiar Bluet ♂
Scarlet Skimmer ♀
Violet-Masked Glider
Blue Dasher ♂
Seaside Dragonlet ♂
Slaty Skimmer
Seaside Dragonlet ♀
Halloween Pennant
Eastern Pondhawk ♀
Rambur's Forktail


Eastern Pygmy Blue
Mangrove Buckeye
Great Southern White
Great Southern White
Great Southern White
Mangrove Buckeye
White Peacock

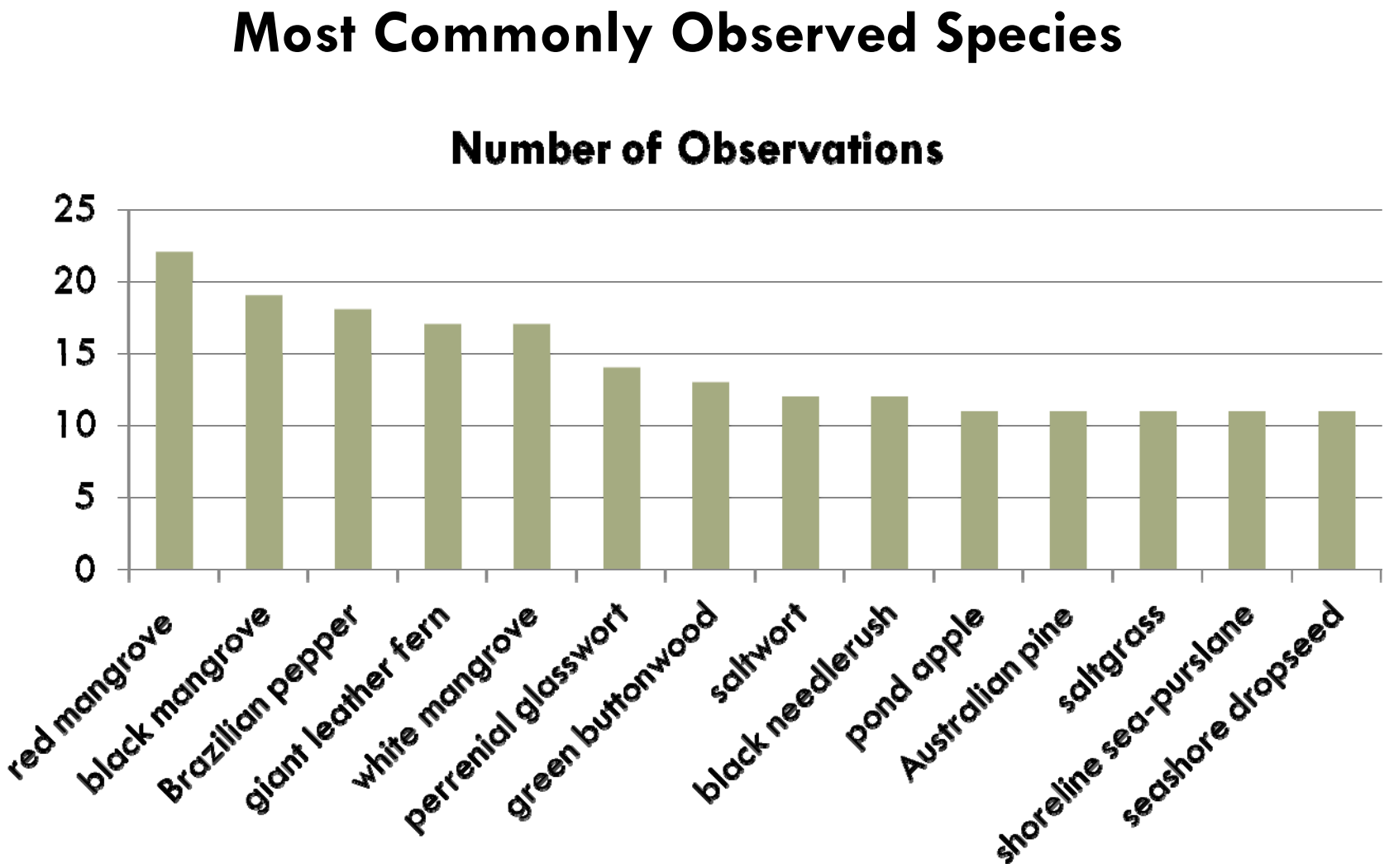

Fiddler Crab
Potter Wasp
Diving Beetle
Diving Beetle
Sea Roach
Ant Nest
Tiger Beetle
Golden Orb Weaver
Elegant Nymph
Cranefly Larva
Water Boatman
Florida Garden spider

Mollusks

26species found

Common Name	*Genus*	*species*
Ladder Horn Snail	*Cerithidea*	*scalariformis*
Eastern Melampus	*Melampus*	*bidentatus*
Florida Melampus	*Melampus*	*floridanus*
Banded Tulip	*Fasciolaria*	*lilium hunteria*
Costate Horn Snail	*Cerithidea*	*costata*
Chalky Pitar	*Pitar*	*simpsoni*
Crown Conch	*Melongena*	*corona*
Lightning Whelk	*Busycon*	*contrarium*
Coffee Melampus	*Melampus*	*coffeus*
Marsh Ram's Horn Snail	*Planorbella*	*trivolvis intertexta*
Marsh Periwinkle	*Littorina*	*irrorata*
Stout Tagelus	*Tagelus*	*plebeius*
Carolina Marsh Clam	*Polymesoda*	*maritima*
Pointed Venus	*Anomalocardia*	*cuneimeris*
Atlantic Rangia	*Rangia*	*cuneata*
Southern Quahog	*Mercenaria*	*campechiensis*
Southern Ribbed Mussel	*Geukensia*	*granosissima*
Southern Horse Mussel	*Modiolus*	*squamosus*
Eastern Oyster	*Crassostrea*	*virginicus*

Salt Marsh Flora: 119 Species Confirmed

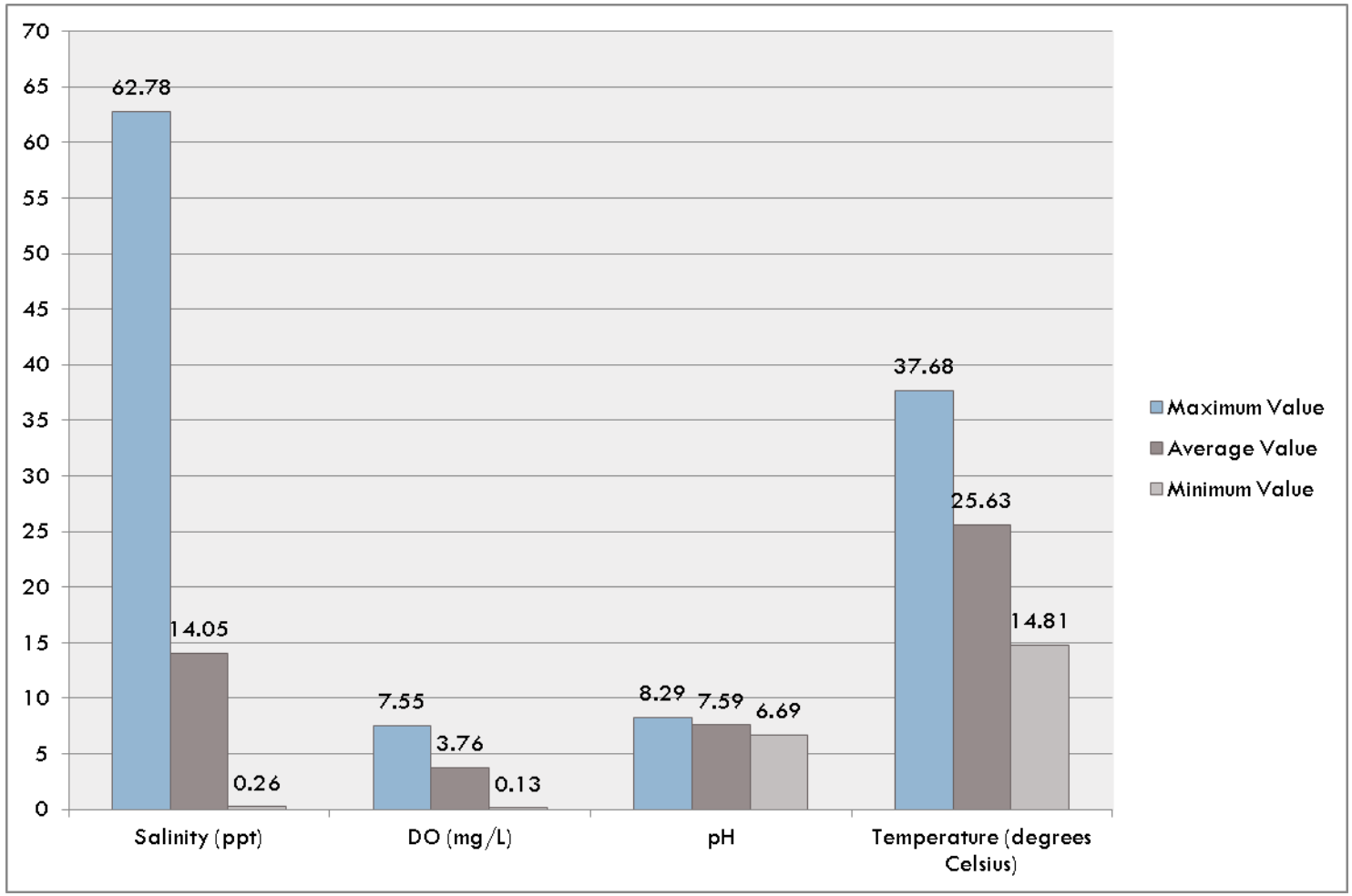


Saltgrass

Sea Purslane

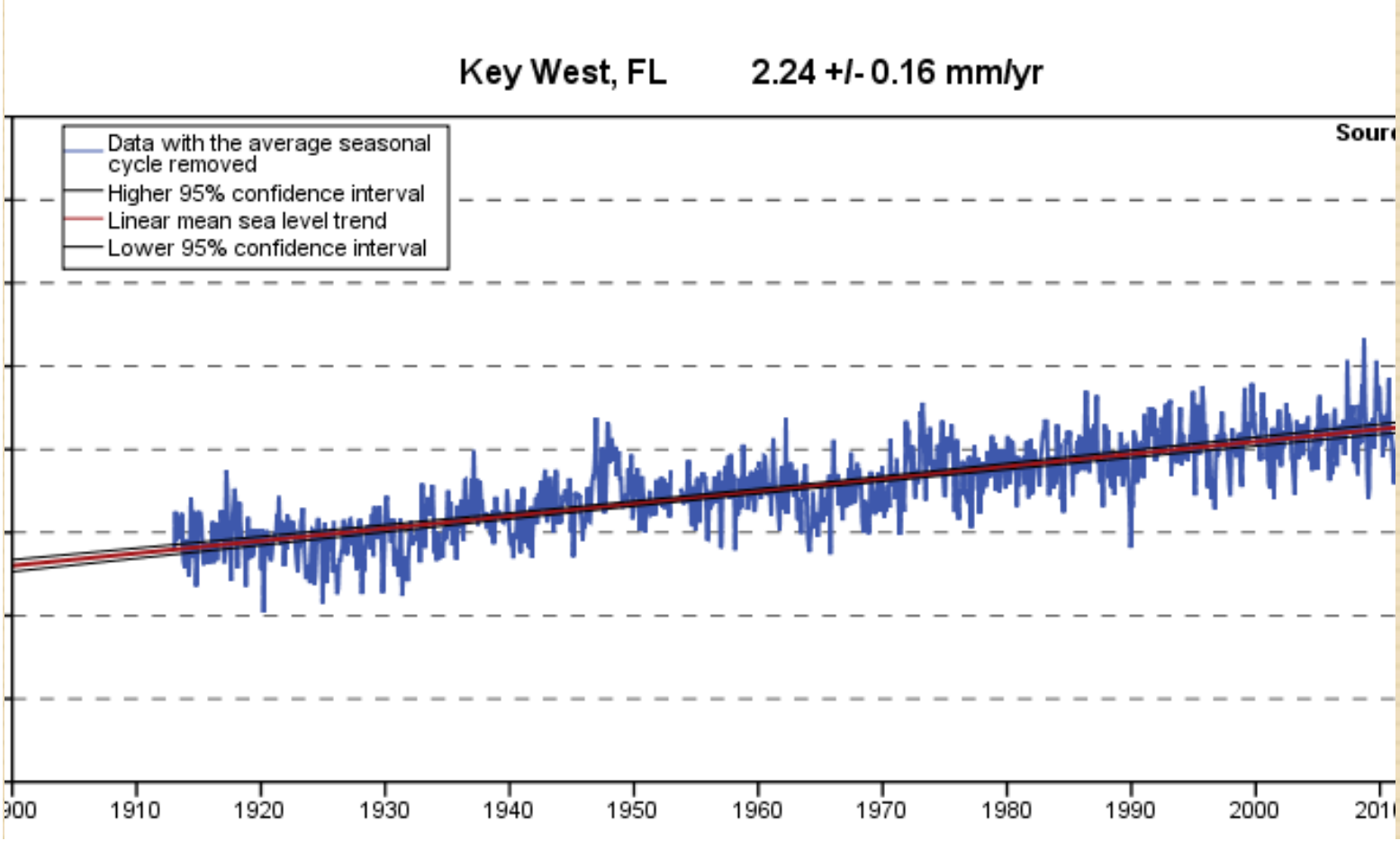
Black Needlerush

Water Quality Data



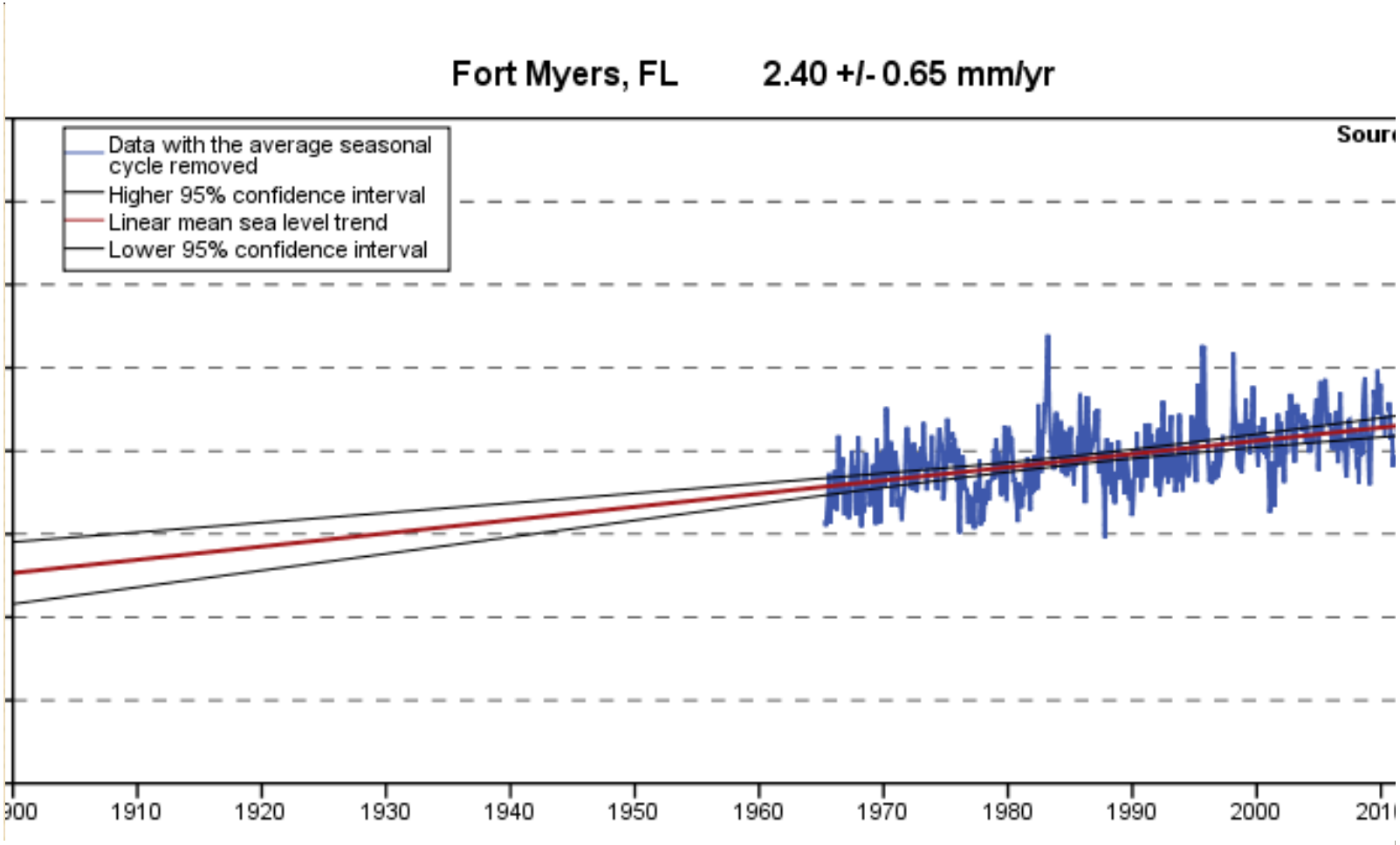
Observed Effects of Climate Change on Salt Marsh in the CHNEP

- Migration Landward
- Conversion to Another Marsh Type
- Drowning in Place
- Freezing
- Expansion of Invasive Plants and Animals



Relative Sea Level at the Key West Tide Station

8” of sea level rise locally since 1910

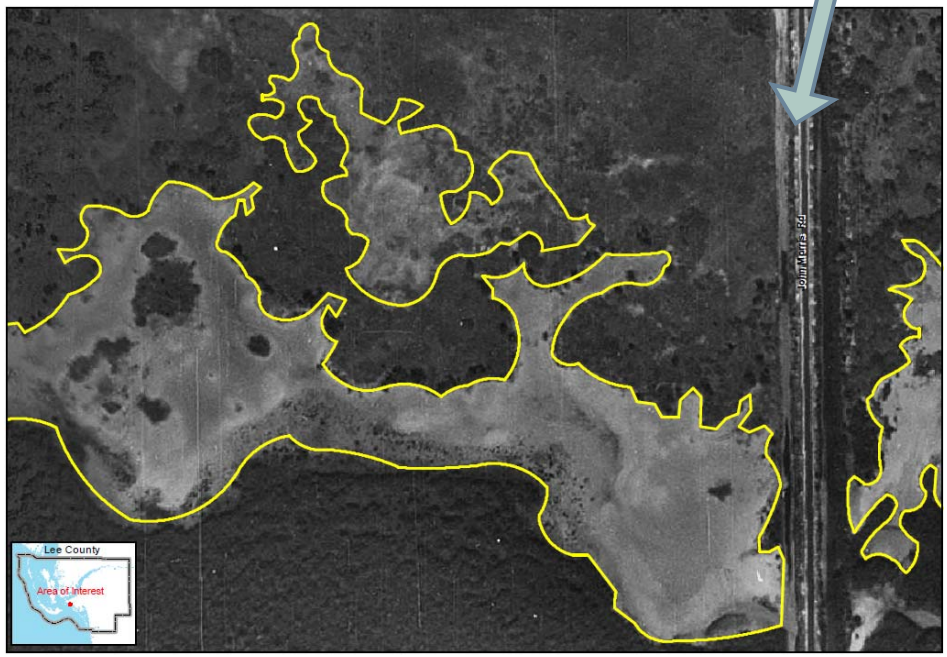


Relative Sea Level at the Fort Myers Tide Station

9” of sea level rise locally since 1910

The Marshes Have Moved and Are Moving

John Morris Road

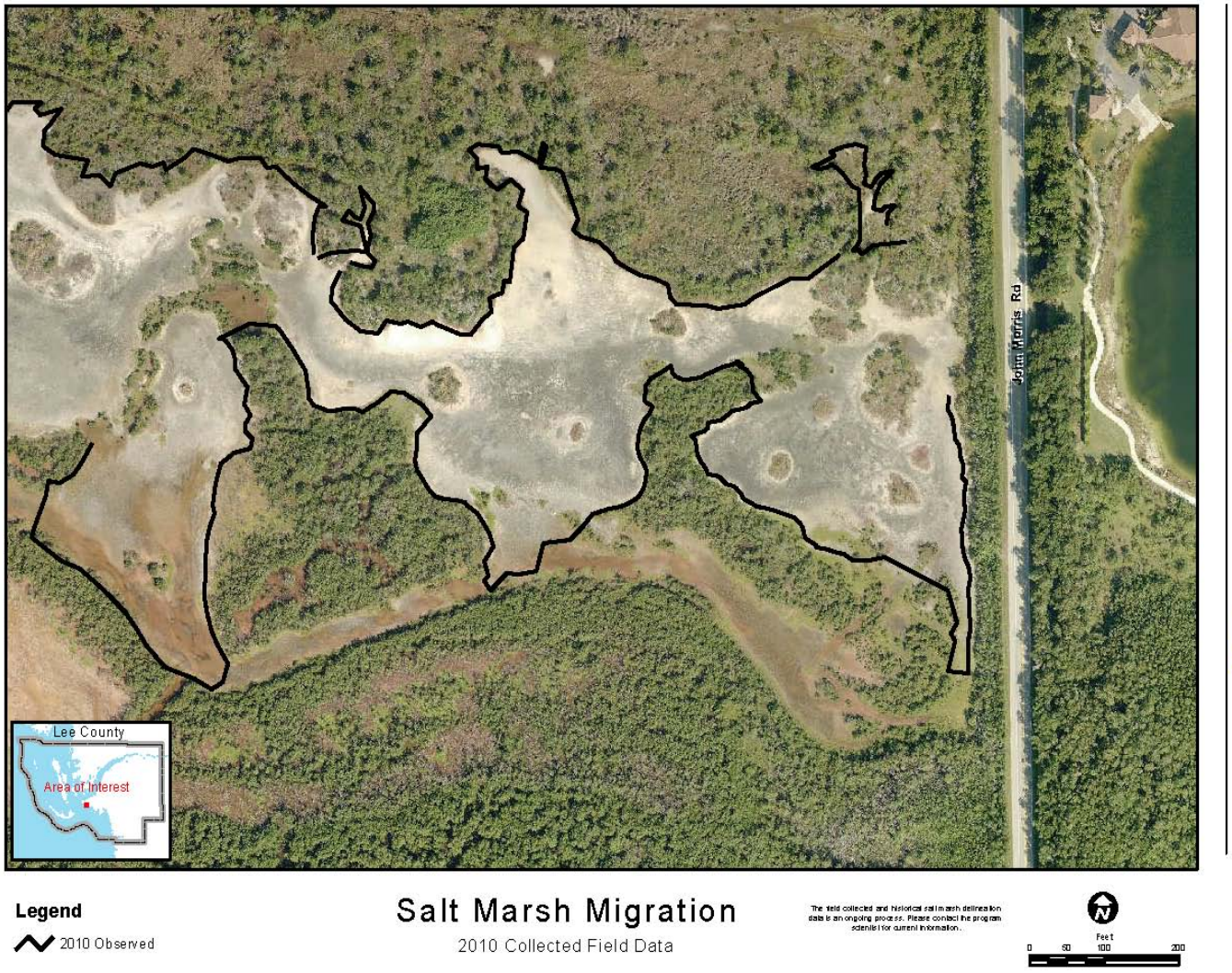


1953

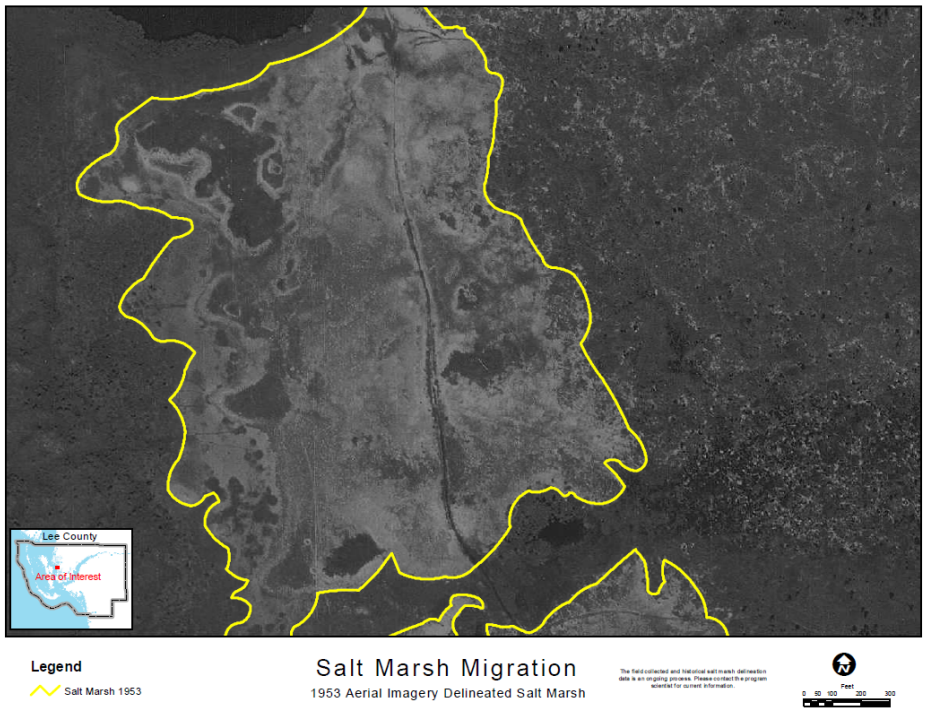
2010

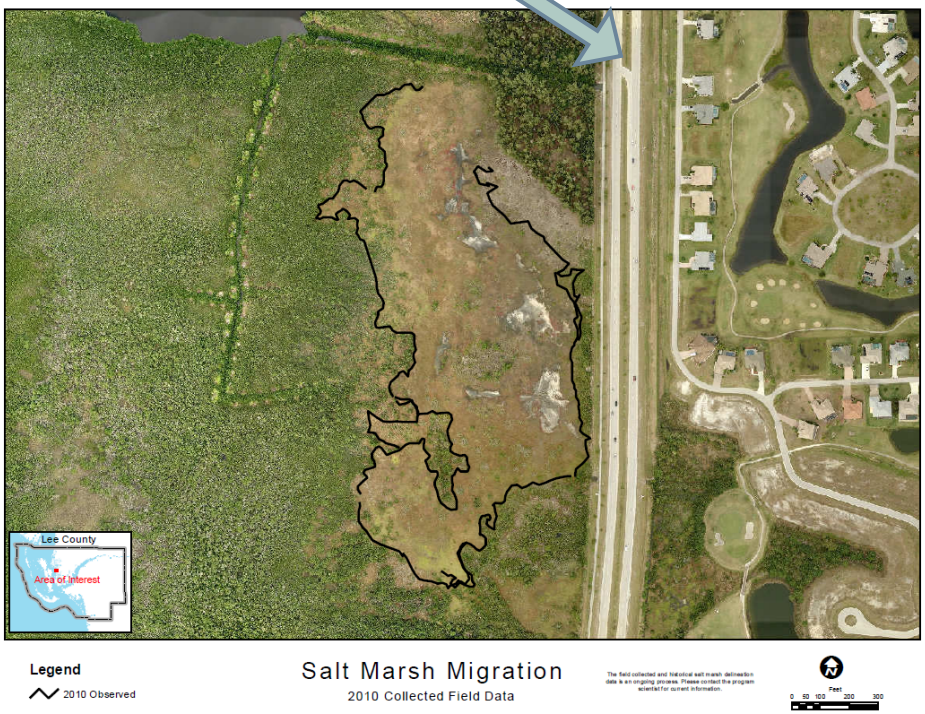
Migration – Estero Bay

- 1953
- 2010



Veteran's Parkway



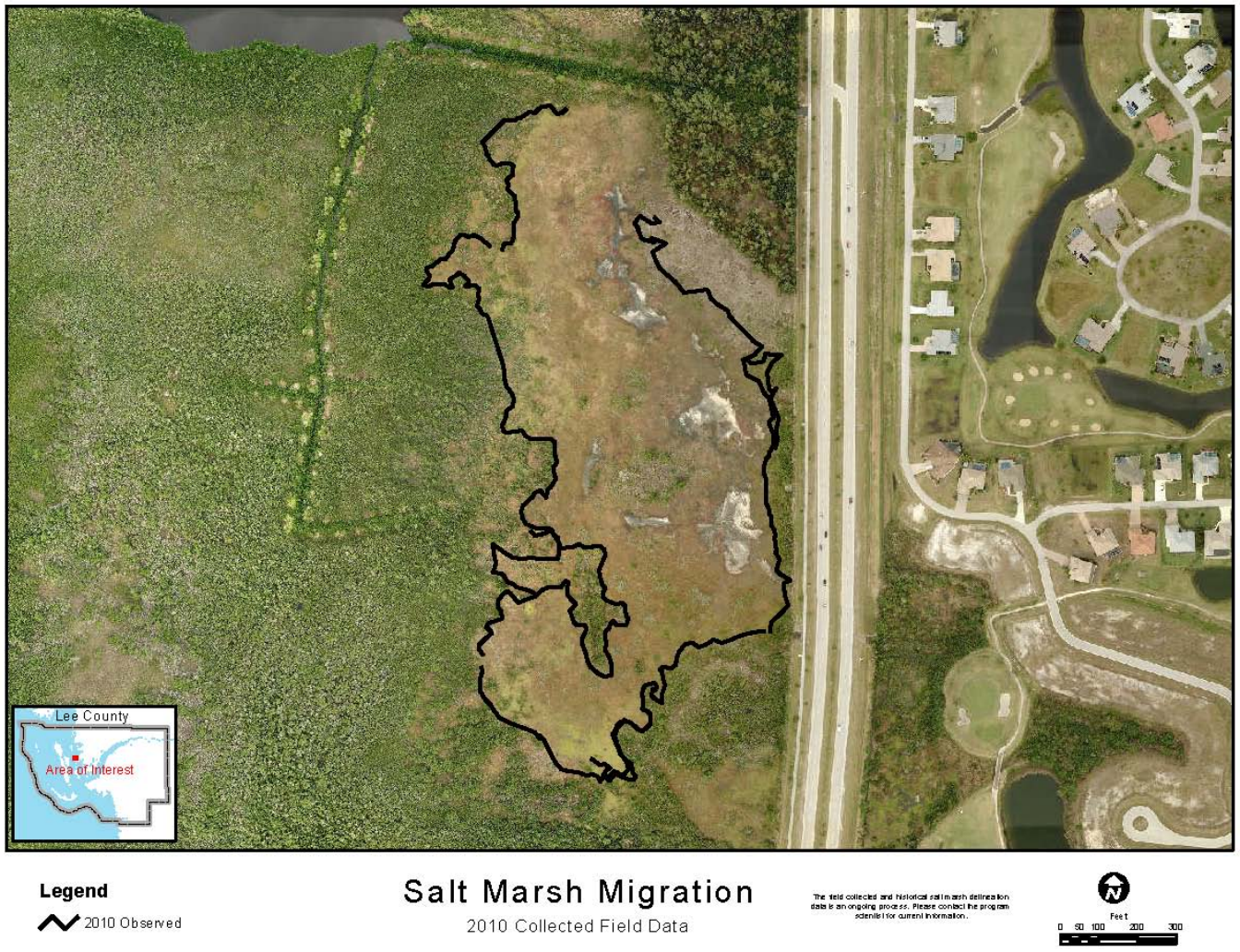


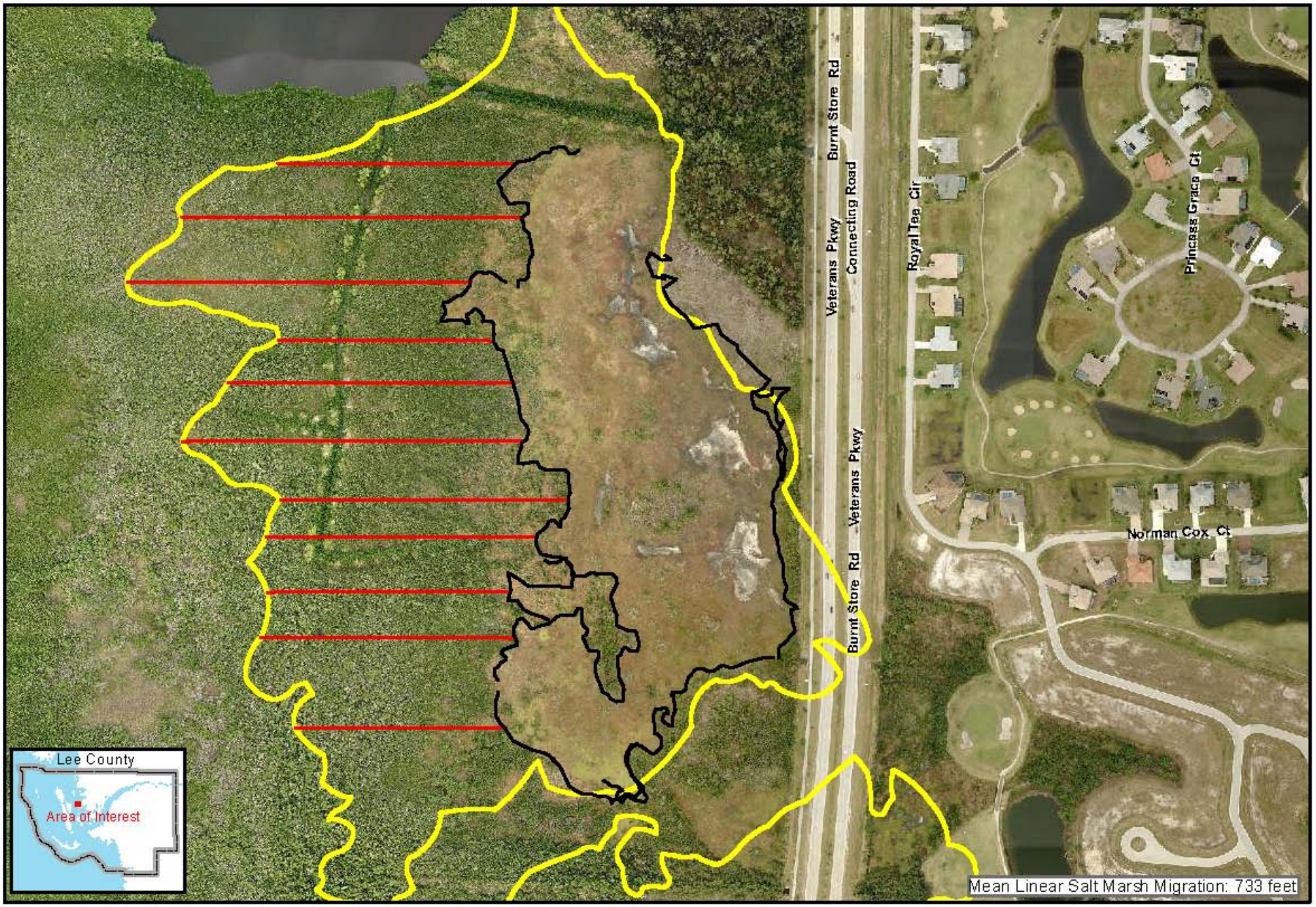
1953

2010

Migration – Matlacha Pass

- 1953
- 2010





Legend

- Salt Marsh 1953
- 2010 Observed
- Migration Segment

Salt Marsh Migration

1953 Aerial Imagery Derived Delineation
2010 Field Collected Data Points
2011 Migration Measurement

The field collected and historical salt marsh delineation data is an ongoing process. Please contact the program scientist for current information.

Feet
0 50 100 200 300

Conversion

- **Rising sea level**
  - **From marsh to open water**
  - **From high marsh to mid, low marsh, or mangroves**

Barriers to Landward Migration of Salt Marshes

- **Borrow Pits**
- **Spreader waterways**
- **Mosquito Control ditches**
- **Mosquito Control Impoundments** (J.N. Ding Darling NWR)
- **Bulkheads**
- **Rip-rap**
- **"Living shorelines" with rip-rap at landward side**
- **Berms**
- **Roadway Berms**
- **Drainage Canals**
- **Navigation Canals**

Drowning in Place

Freezing

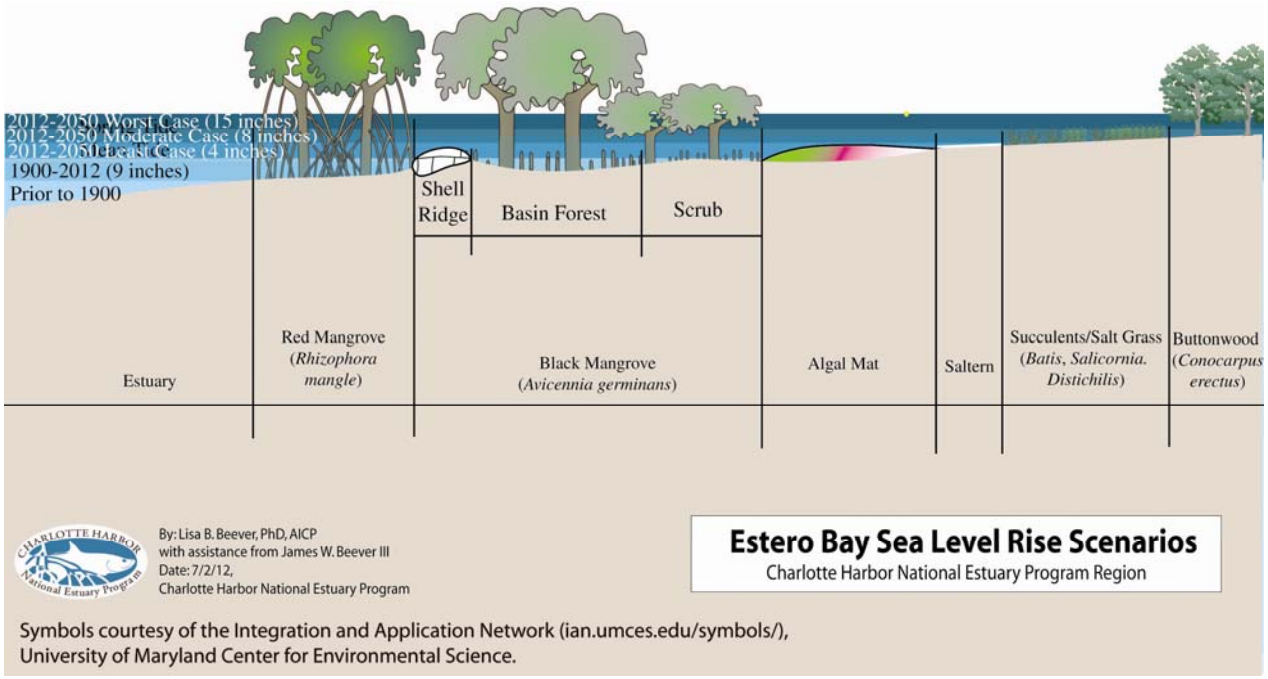
Invasive Species

Australian Pine

Vines

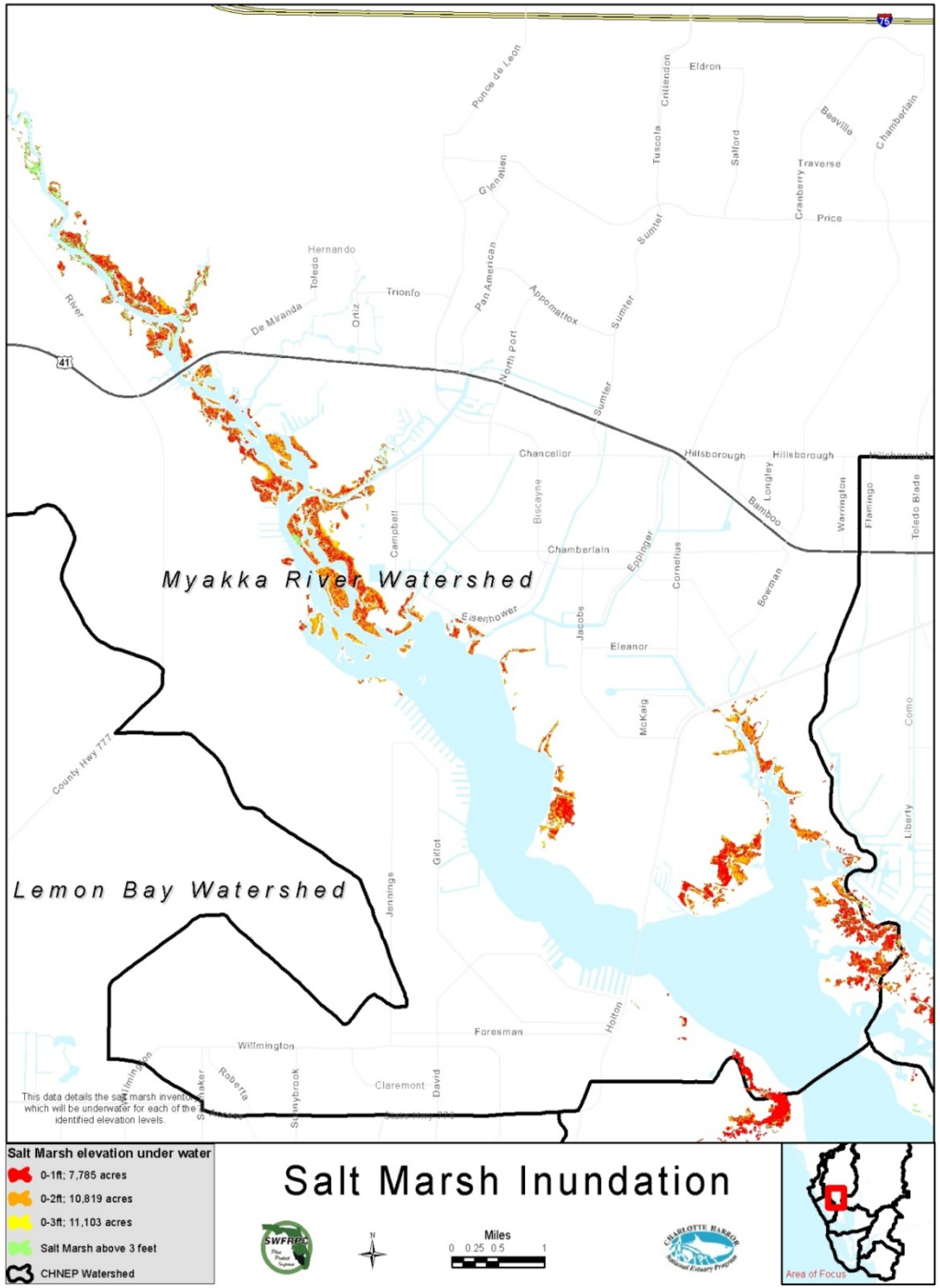
Brazilian Pepper

Three Potential Sea Level Rise Scenarios



Area of CHNEP Salt Marsh Inundated as Sea Level Rises

Amount of Inundation in Feet from 2012 Baseline	% Area of Salt Marsh Inundated	Area of Salt Marsh in Acres Inundated	Scenario Level Prediction
1 Foot	52%	7,785	Current Measure 2150 Best case 2114 Moderate case 2075 Worst Case 2021
2 Feet	73%	10,819	Current Measure 2150 Best Case 2228 Moderate Case 2108 Worst Case 2044
3 Feet	75%	11,103	Best Case 2342 Moderate Case 2162 Worst Case 2065


Myakka River Watershed
Lemon Bay Watershed
Ponce de Leon
Eldron
Tuscola
Crilendon
Salford
Beeville
Chamberlain
Traverse
Cranberry
Price
Glenallen
Sumter
Hernando
Toledo
Trionfo
Pan American
Appomattox
De Miranda
Ortiz
River
North Port
41
Chancellor
Hillsborough
Longley
Bamboo
Warrington
Flamingo
Toledo Blade
Campbell
Biscayne
Chamberlain
Eppinger
Cornelius
Bowman
Eisenhower
Jacobs
Eleanor
McKaig
Como
County Hwy 777
Grifot
Jennings
Liberty
Foresman
Hopton
Willmington
Roberts
Shinnybrook
Claremont
David
This data details the salt marsh inventory which will be underwater for each of the identified elevation levels.
Salt Marsh elevation under water
0-1ft; 7,785 acres
0-2ft; 10,819 acres
0-3ft; 11,103 acres
Salt Marsh above 3 feet
CHNEP Watershed
Salt Marsh Inundation
N
Miles
0 0.25 0.5 1
Area of Focus

Potential adaptations and recommended strategies to implement the AMMA options

- Maintain the existing marsh migration corridors that have been established on Cape Haze, Eastern Charlotte Harbor shoreline, and Estero Bay Buffer.
- Identify the highest priority marsh migration corridors so that they can protect these areas from future development. Followed by acquisition of inland buffer zones to provide an opportunity for habitats and wildlife to migrate inland.
- Support restoration of existing salt marshes by removal of exotic vegetation, removal of barriers to tidal connection, and degradation of exotic dominated adjacent uplands
- Discourage or stop shoreline hardening including seawalls, bulkheads, rip-rap, and "living shorelines" backed by rip-rap.
- Re-engineer existing vertical shoreline infrastructure to a sloped soil based shoreline with GeoWeb or other permeable stabilization.
- Restore impaired water flows to enhance sediment supply for marsh deposition
- Elevate roadway berms by bridging and culver ting or abandon coastal road corridors with associated beamed road beds..
- Back-fill mosquito control ditches to reduce depth and sediment loss
- Back fill borrow pits, agricultural pits, and spreader waterways to allow salt marsh establishment and establishment of marsh migration corridors
- Sediment-slurry addition to assist in marsh building processes

Southwest Florida Coastal Conservation Corridor Plan

Beever, James W.
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Punta Gorda, Florida. james.beever@MyFWC.com

Bryant, Mary
The Nature Conservancy, Sarasota, Florida. mbryant@tnc.org

Beever, Lisa B.
Charlotte Harbor National Estuary Program,
Fort Myers, Florida. lbeever@swfrpc.org

The Southwest Florida Coastal Conservation Corridor Plan (CCCP) is a detailed planning and protection initiative from Crystal River to Everglades National Park's Shark River Slough and east to the Lake Wales Ridge. The CCCP compiles, maps, and gathers biological, ecological, and hydrological data on natural lands critical for endangered species and habitat conservation. The CCCP has two phases: Scoping and Final Product. Work began in March 2000 and was completed October 2004. During Scoping, we compiled regional information from over 54 agencies and published reports. The Nature Conservancy's knowledge of private land natural resource values formed a component of the analysis. The Final Product is a detailed GIS-based map series with narrative descriptions of the natural resources, and other site attributes. The CCCP encompasses all existing conservation lands, proposed conservation lands, County platted ownerships, existing public access points, existing conservation easements, and metadata of ownership information.

Purpose

- Planning for landscape scale conservation.
- Enhancing cooperative planning between public and private land acquisition entities.
- Providing consistent and available information for decision-making

Partnership

- 3 National Estuary Programs
- 1 National Estuarine Research Reserve
- 21 Counties
- 3 Water Management Districts
- 3 Regional Planning Councils
- 2 State Agencies
- 3 Federal Agencies
- 7 Non-Profit Conservation Groups

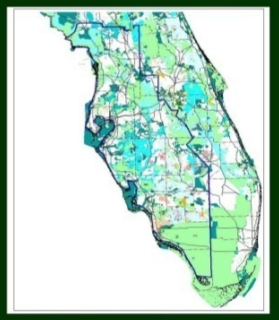
Plan Coordination

- Southwest Florida Regional Wildlife Habitat Plan
- Southwest Florida Feasibility Study (SWFFS)
- Comprehensive Everglades Restoration Plan (CERP)
- South Florida Ecosystem Restoration
- Multi-species Recovery Plan/ Multi-species Ecosystem Recovery Implementation Team
- National Estuary Programs' Comprehensive Conservation & Management Plans

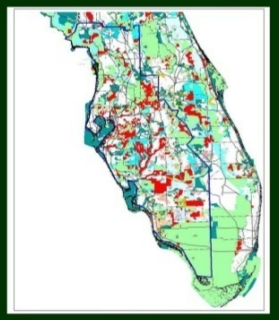
Sample GIS Map Series

Existing Conservation Lands with easements in orange

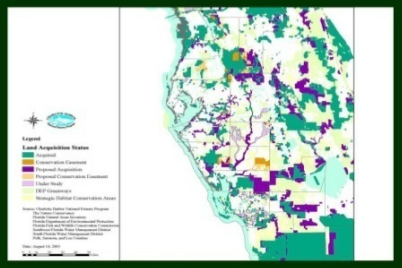
Add wildlife habitat data from FWC including Strategic habitat Conservation Areas



Add other partners conservation criteria form state, regional, local and private partners

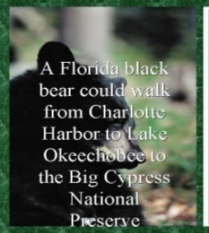


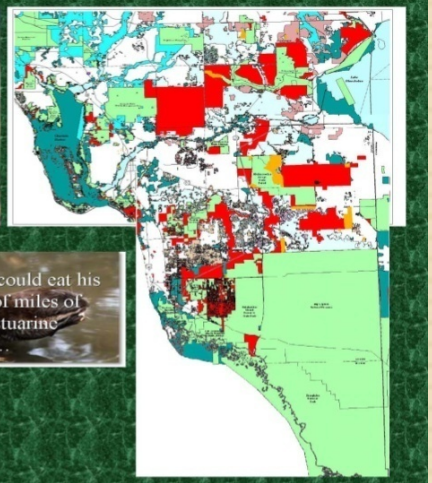
Current priority acquisitions within the CCCP (fee and less-than-fee are identified in red

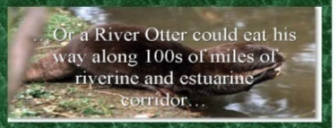


Plan goals are adopted into multi-jurisdictional conservation efforts that mutually support coastal conservation such as the Charlotte Harbor National Estuary Program Comprehensive Conservation and Management Plan (CCMP).

Vision





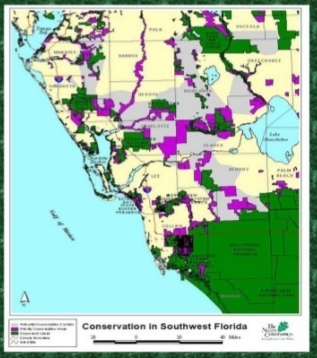


Example of Data Utilization

Panther Paths

Grey area illustrates potential panther corridor.

Plan to be placed on TNC internet site by 2005



Results

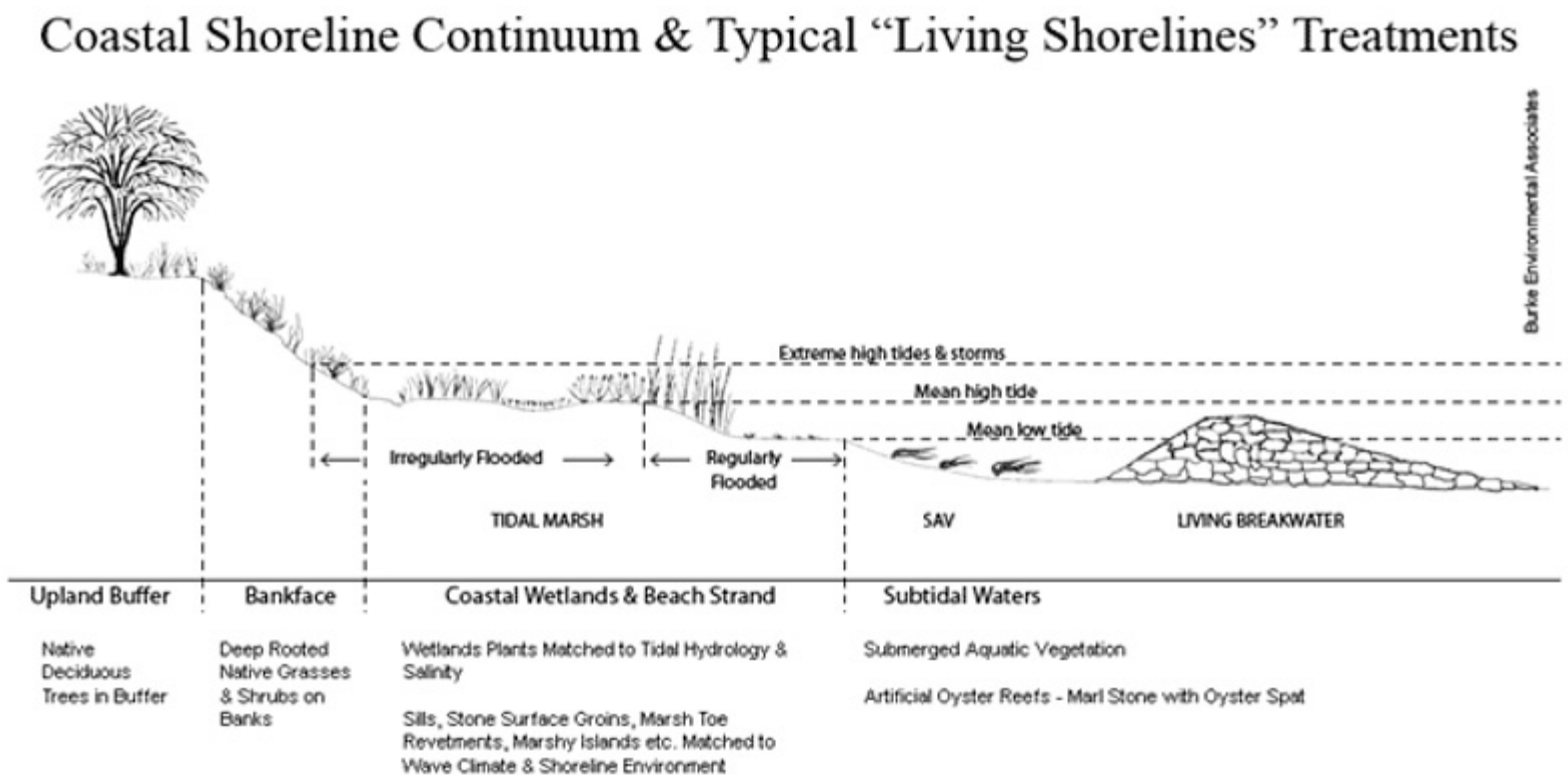
The CCCP analysis of the map series and concomitant data layers generates a conservation corridor system along Florida's west coast including estuarine bays, lagoons, and tributaries. The Plan, including the data layers and map series, will be placed on the internet by TNC in 2005. Using these data, CCCP partners will work to implement the corridor system through various fee simple and less-than-fee conservation methods to sustain Southwest Florida's biological diversity, estuarine hydrology, watershed quality, and estuarine fisheries.

County	Location	Level of Connection to adjacent Public Lands	Path of Connection	Potential extent of migration
Sarasota	Myakka River Riparian Corridor	High	North to Myakka River State park	High
Sarasota	Gottfried Creek	Low	North and East to Myakka River	Low
Sarasota	Rock Creek	Low	North and East to Myakka River	Low
Charlotte	Cape Haze State Preserve	High	North into Cape Haze	High Initially. Can be expanded with acquisitions to remain High
Charlotte	Tippecanoe Bay	High	North into Charlotte County Lands	High then Medium. Could be expanded north of SR 776
Charlotte-DeSoto	Peace River	Low	North up river	High but not extensive as River shoreline elevations become steeper
Charlotte	Shell Creek	Low	East toward headwaters	High then Low when blocked by water control structure
Charlotte	Charlotte Harbor State Buffer Preserve	High	East to extensive Public Lands include the Yucca Pens and Cecil Webb Wildlife Management Areas, Babcock Ranch, and Fisheating Creek	High. Perhaps the best in the CHNEP and southwest Florida if roadway barriers can be addressed.
Lee	Burnt Store Creek	Medium	East to extensive Public Lands include the Yucca Pens, Cecil Webb Wildlife Management Areas, Babcock Ranch, and Fisheating Creek	Medium. Connection is narrow and Burnt Store Road is a potential barrier.
Lee	Estero Bay Preserve- North	Medium	Further into preserve	Initially High but block by urban lands uses
Lee	Estero Bay Preserve	Medium	East on State lands and then along Estero River and halfway Creek	Initially High but narrow with several road barriers until connection to the

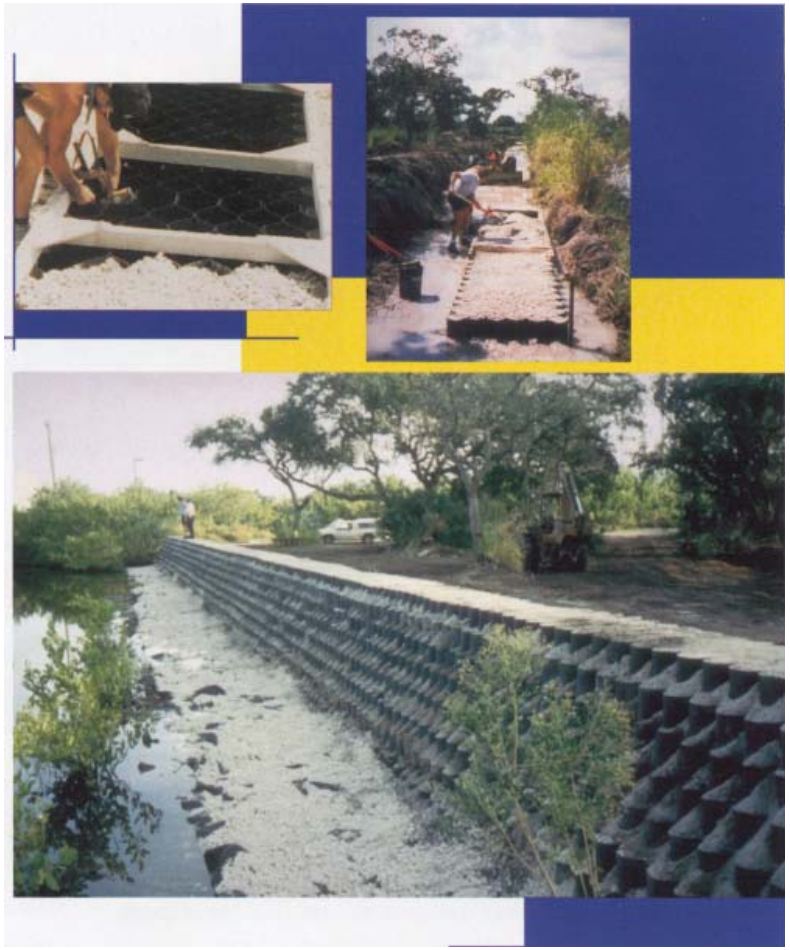
Island Park Area After Restoration.

Note return of saltern, mixed high marsh, grassy high marsh, and patches of succulent high marsh

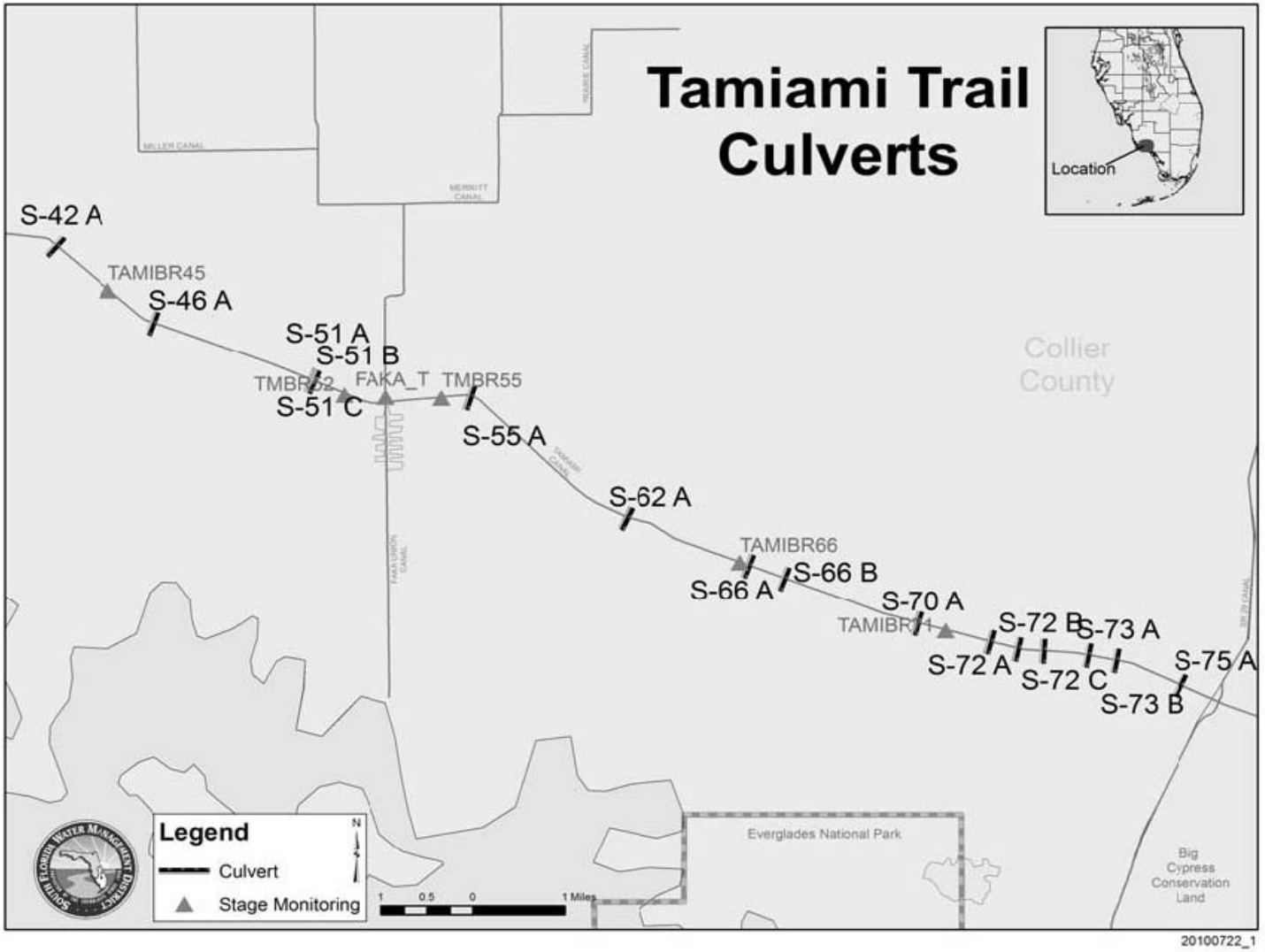
“Living Shoreline” designs without landward slope hardening



Stepped GeoWeb shoreline Vero Beach Florida 1994

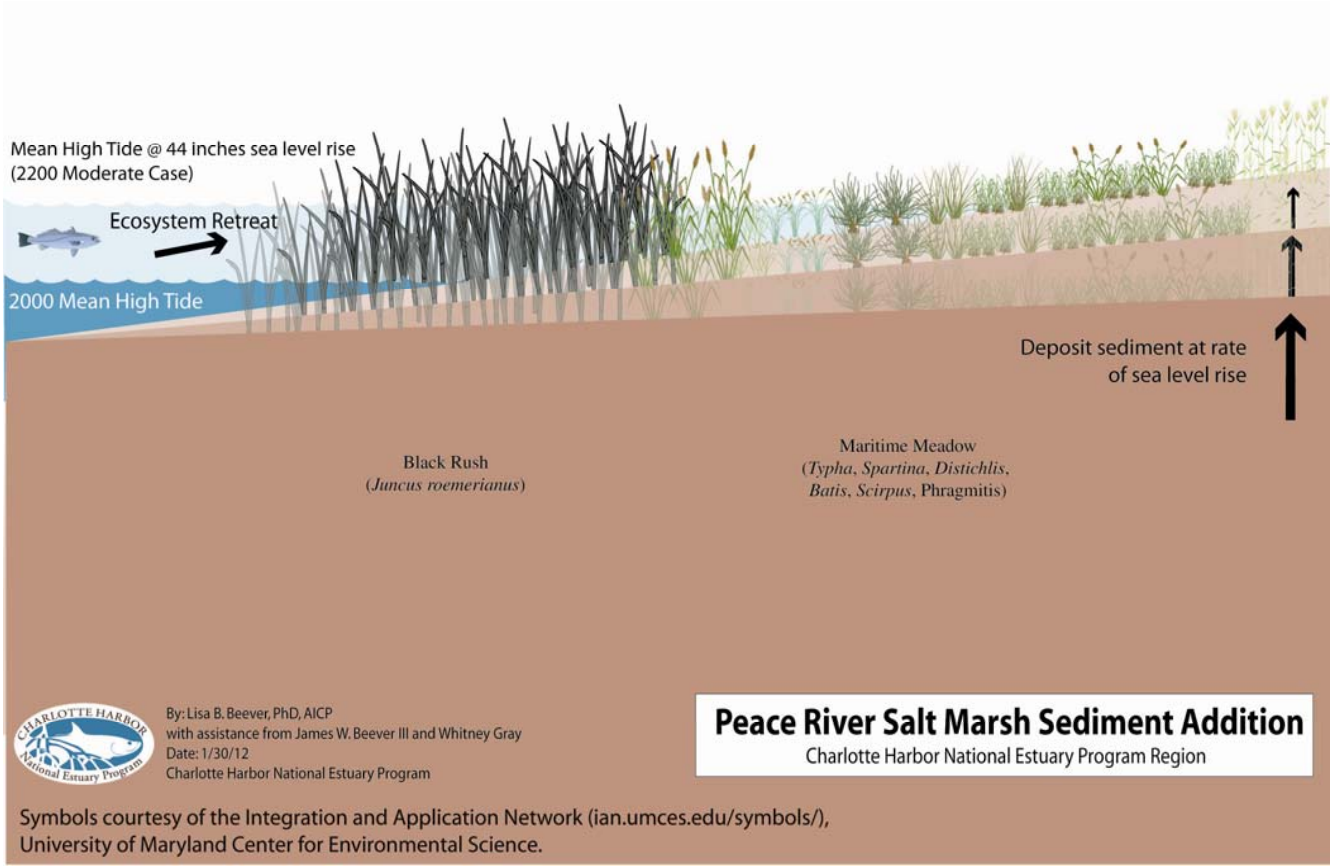


The Tamiami Trail culverts and the six stage monitoring sites.
Source: Abtew and Ciuca 2010



Restored backfilled mosquito control ditches on the Charlotte Harbor Preserve State Park

Sediment Slurry Addition



Web Site Access

QUESTIONS?

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Whitney Gray wgray@ufl.edu
Dan Cobb mapmaker13@hotmail.com
Tim Walker twalker@swfrpc.org
Lisa Beever lbeever@swfrpc.org

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CHNEP (239) 338-2556

Thanks!