Seagrass Conservation for Actionable Research: Management Areas for the Prevention of Scarring

Project Overview

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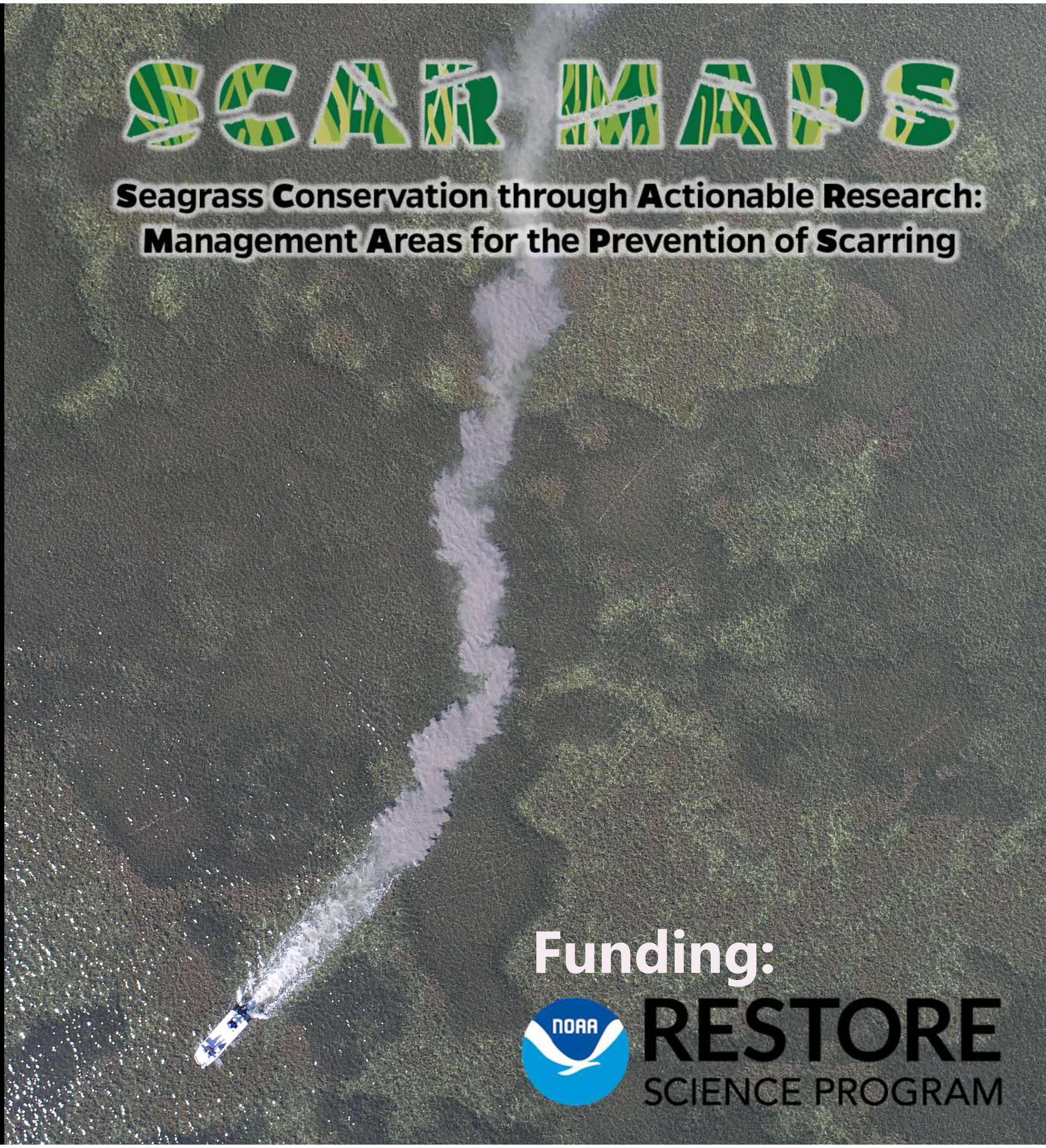
[4] Florida Department of Environmental Protection, Aquatic Preserve Program

UF|IFAS UNIVERSITY of FLORIDA   Sea Grant FLORIDA   FLORIDA DEPARTMENT OF ENVIRONMENTAL PROTECTION



Team & Location

Management (Florida Dept. of Environmental Protection)

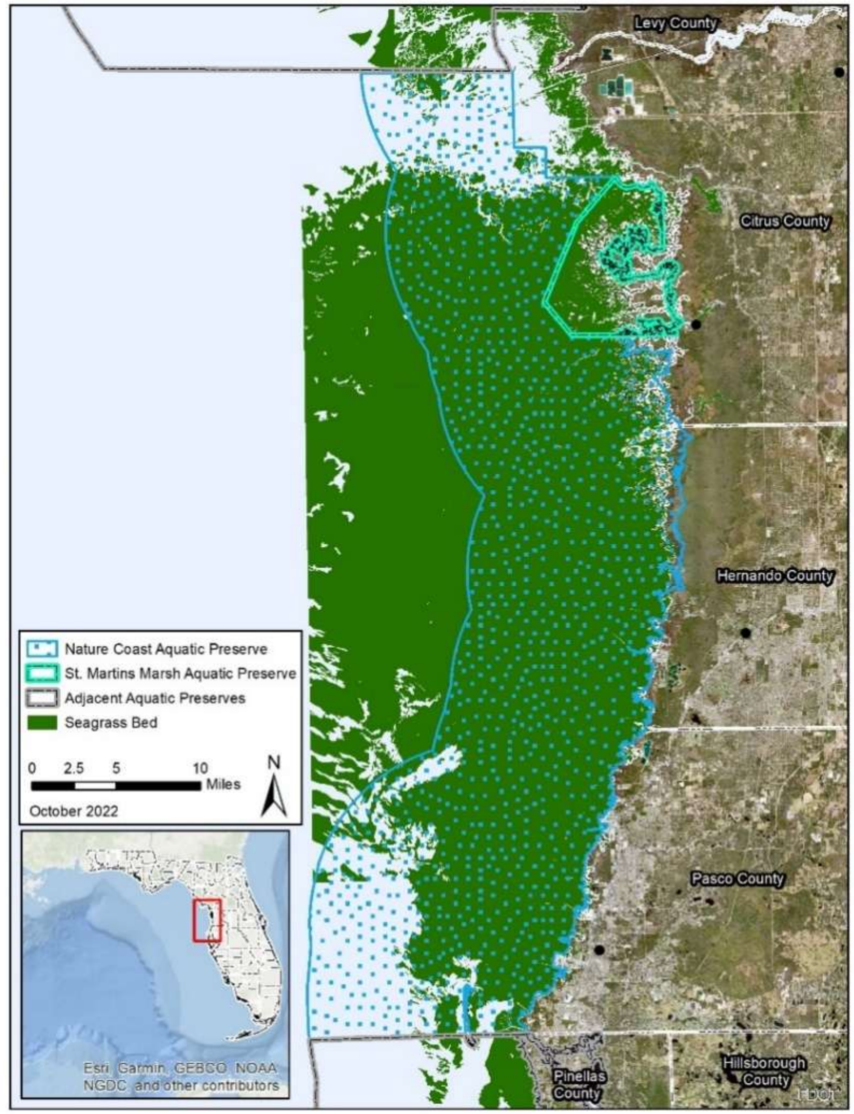
1. Timothy Jones, Regional Manager
2. Sandra Chupinsky, Manager
3. Tyler Ferguson, Manager

End Users (Homosassa Guides Association)

1. Capt. John Bazo, President
2. Capt. William Toney
3. Capt. Jonathan Hamilton

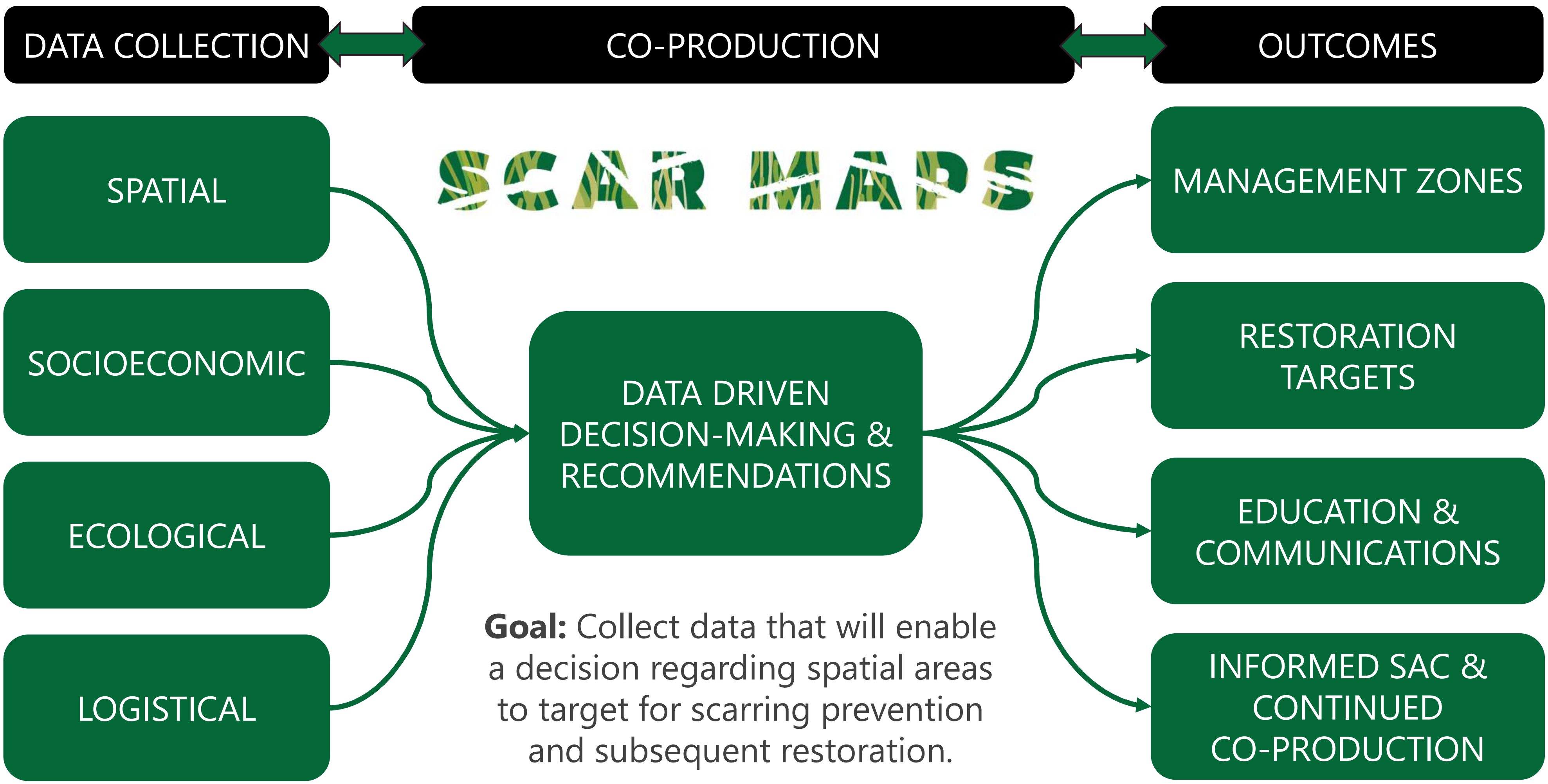
Research & Extension (University of Florida & Florida Sea Grant)

1. Savanna Barry, Regional Specialized Extension Agent
2. Laura Reynolds, Associate Professor
3. Mark Clark, Associate Professor
4. Edward Camp, Assistant Professor
5. Kelly Grogan, Associate Professor
6. Micheal Allen, Professor
7. Josh Patterson, Associate Professor
8. Holly Abeels, Brevard County Extension Agent
9. Tom Ankersen, Lecturer Emeritus
10. Enie Hensel, Postdoctoral Researcher
11. Adams Ceballos, Postdoctoral Researcher



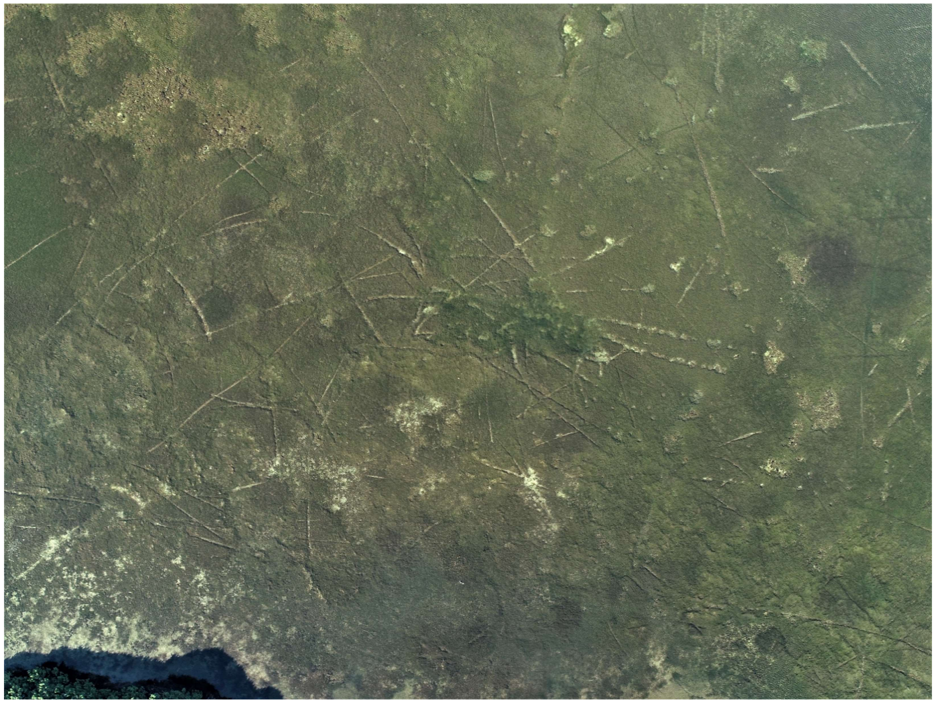
FDEP

Project Activities & Goals



Goal of SCAR MAPS

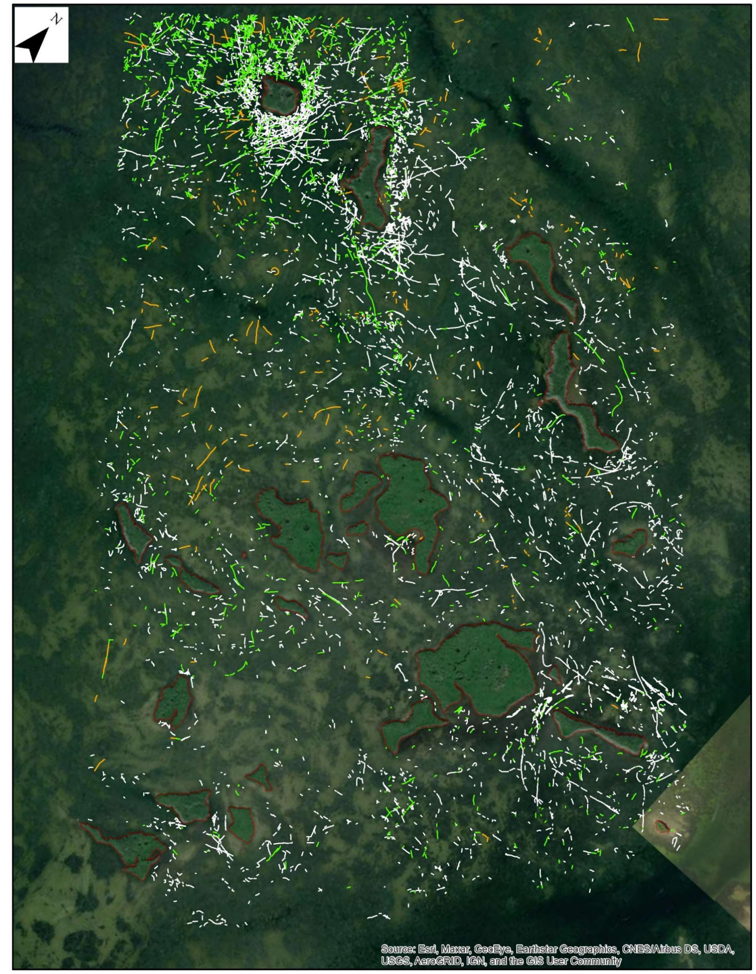
Address key uncertainties to enable a decision regarding spatial areas to target for scarring prevention and subsequent restoration based on spatial, ecological, and socioeconomic metrics.

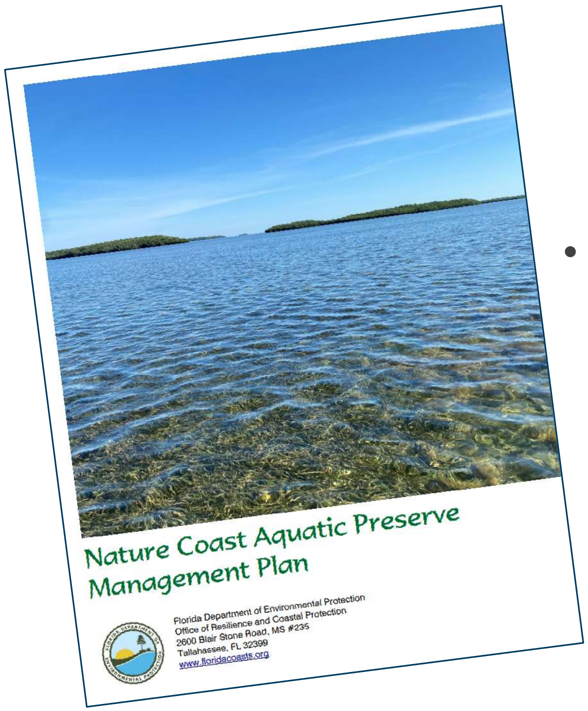


Mark Clark, University of Florida

Scoping Phase

- St. Martins Keys scar mapping (2020-2022)
  - Update propeller scar maps
  - Collaborative effort with Homosassa Guides Association





- Nature Coast Aquatic Preserve management plan (2021-2022)
  - FDEP-funded collaborative contract
  - Stakeholder-driven management planning process

Background

Nature Coast Aquatic Preserve Management Plan

- Issue 1: Water Resources
- Issue 2: Protection and Management of Submerged Resources
- Issue 3: Climate Change
- Issue 4: Human Dimensions
    - Goal Four: Identify impacted areas, assess impact severity, and begin to implement reduction and restoration efforts relating to propeller damage, vessel grounding, and anchoring-related activities occurring to submerged resources within the Nature Coast Aquatic Preserve.

10 actions related to propeller scarring

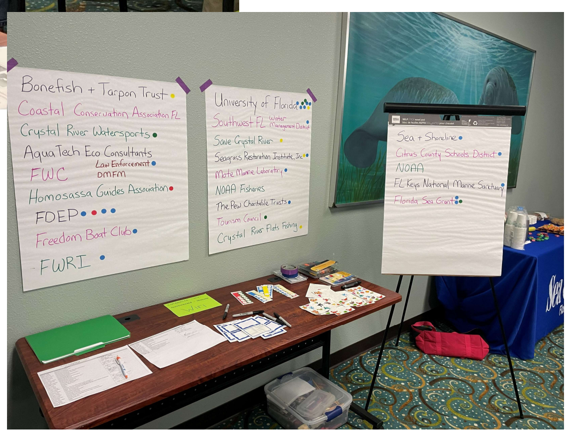
Nature Coast Aquatic Preserve Management Plan

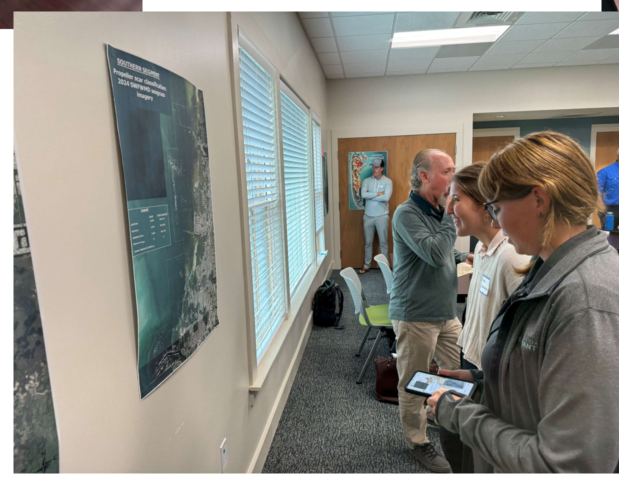
Co-production & Stakeholder Advisory Committee

1. Citrus County School District
2. The Pew Charitable Trusts
3. FDEP – Environmental Resource Permitting
4. FDEP – Regional Aquatic Preserves
5. Bonefish & Tarpon Trust
6. Mote Marine Laboratory
7. Coastal Conservation Association Florida
8. Seagrass Restoration Institute, Inc.
9. AquaTech Eco Consultants
10. Capt. James Kerr
11. FWC FWRI – Seagrass Research
12. FWC Law Enforcement
13. FWC Division of Marine Fisheries Management
14. FWC Habitat and Species Conservation
15. Sea & Shoreline LLC
16. Save Crystal River
17. Florida Sea Grant/University of Florida
18. Homosassa Guides Association
19. Freedom Boat Club
20. Southwest Florida Water Management District
21. NOAA Fisheries, Southeast Regional Office
22. Pasco County Extension
23. Hernando County Extension
24. Citrus County Aquatic Services
25. Hernando County Aquatic Services

Lead: Holly Abeels

SAC Meetings: Interactive Elements





1: Spatial

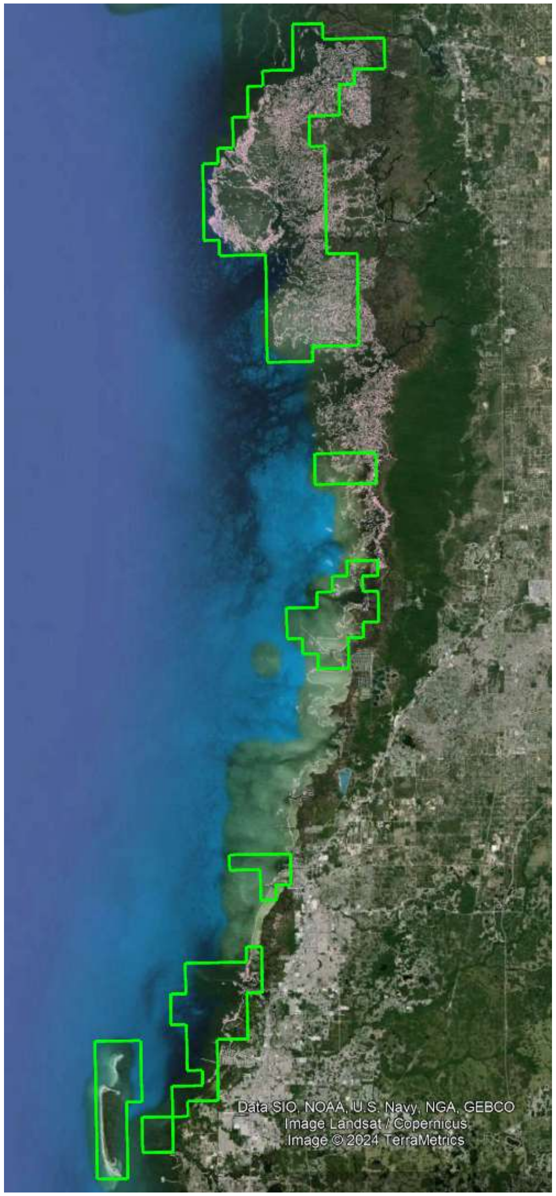
- Where are seagrass scarring hotspots within the Nature Coast?
- What is the annual rate of new scarring/natural recovery?

Approach: high resolution mapping of shallow seagrass using drone & SWFWMD imagery, spatial analysis, Computer vision/AI scar model development

SOUTHWEST FLORIDA WATER MANAGEMENT DISTRICT

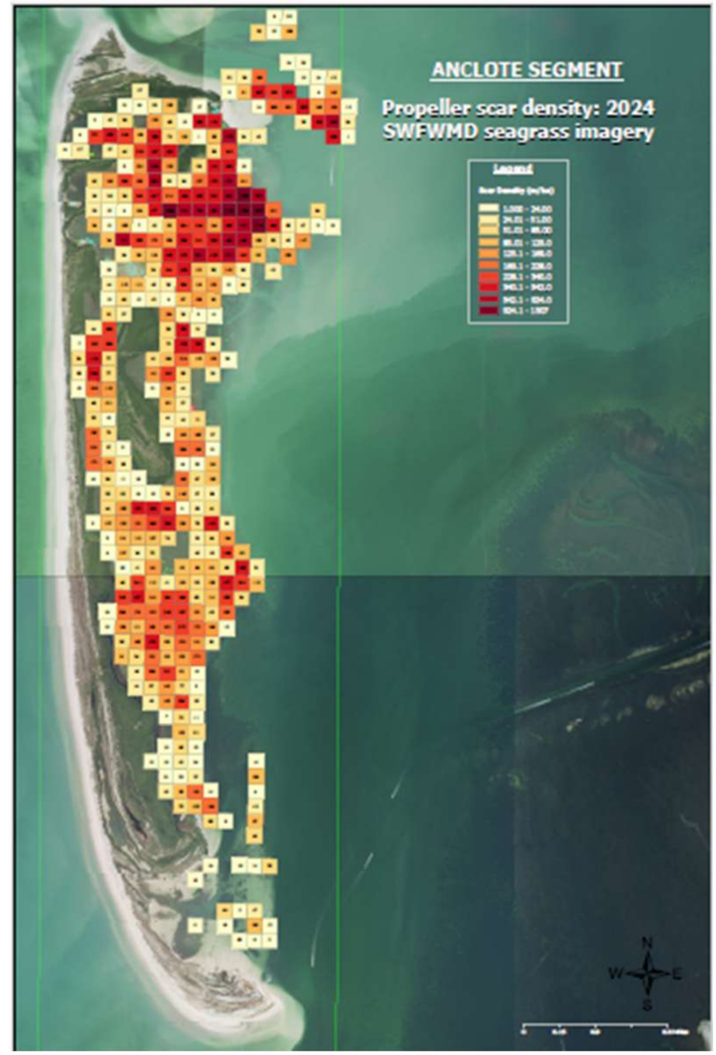
Plastic-i

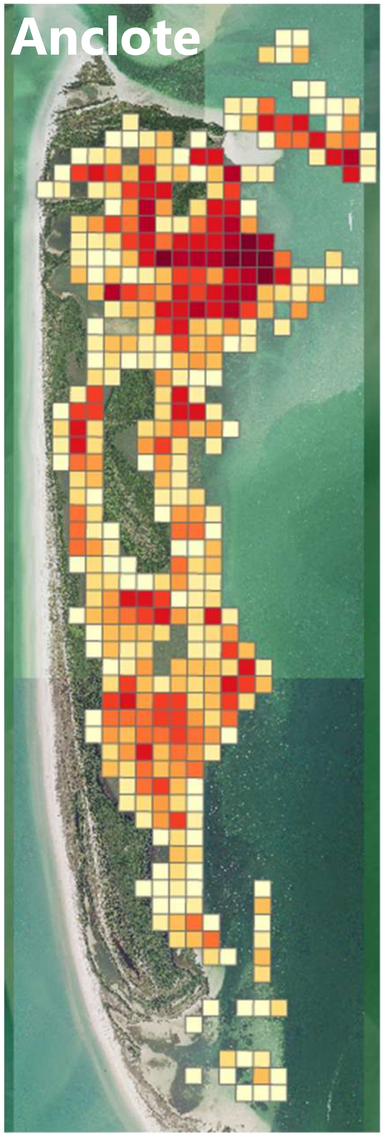
Lead: Mark Clark

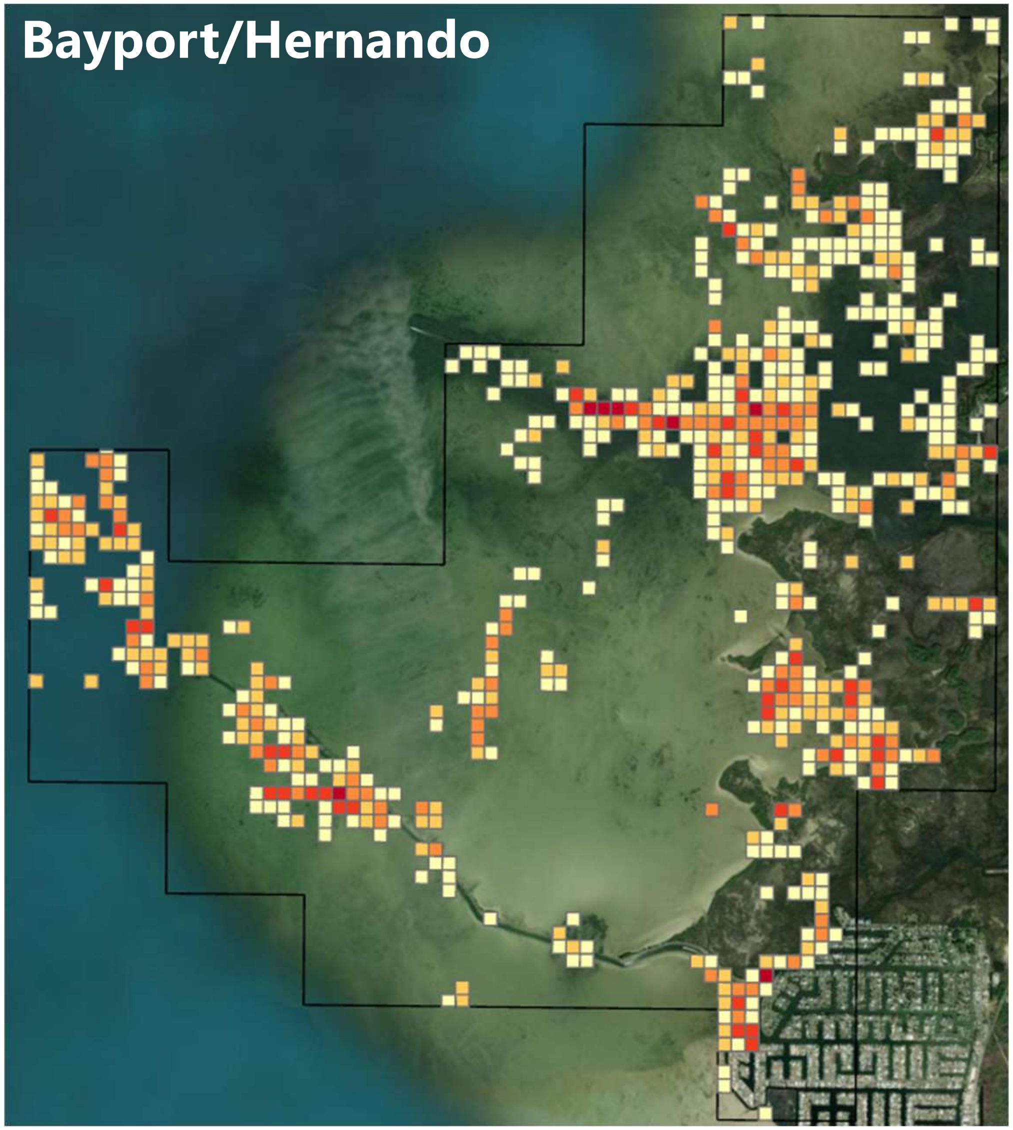


Scarring hotspot analysis

- Convert classified images into 1m scar segments
- Overlay segment with 1 hectare grid
- Count number of 1m scar segments in each grid
- Visualize scarring hot spots with heatmap
- Used to support ecological impacts site selection




Anclote


Bayport/Hernando

Early findings: Extent of scarring

- Total scarring among all segments.

Scar Type	Count	Total Length, feet	Total length, miles
Light Scar	31,863	2,005,846	380
Dark Scar	28,829	1,894,847	359
Softbottom Scar	7,046	808,385	153
Hardbottom Scar	375	27,197	5

- The Northern Segment, specifically the St. Martins Keys focus area, and the Anclote Key Segment had the highest concentration of light and dark scars.

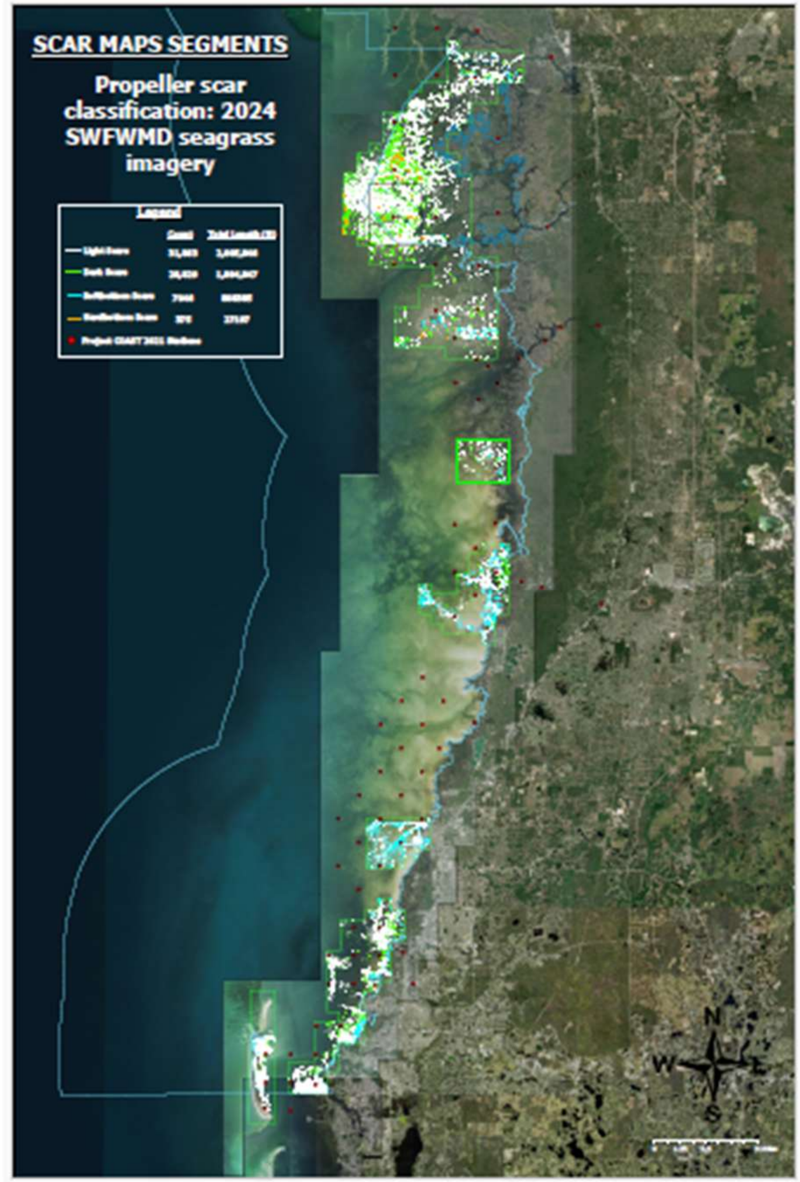
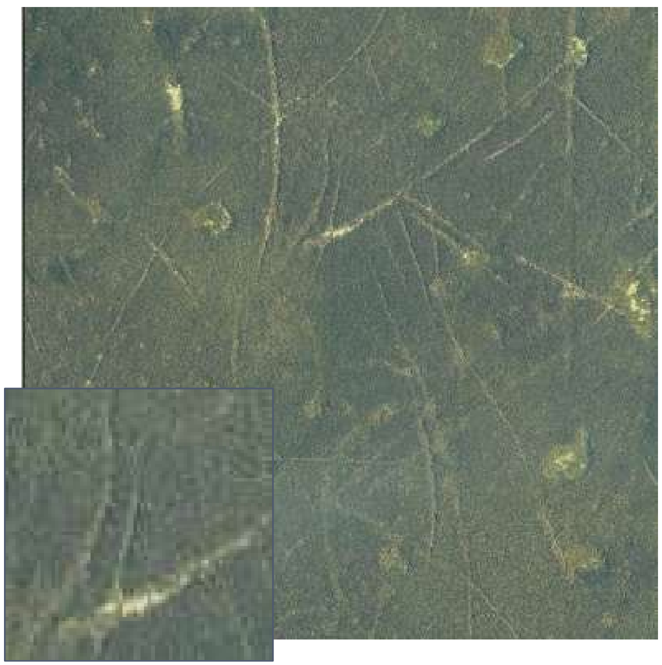


Image source investigation

Drone Imagery

- Excellent resolution (<5cm/pixel)
- Excellent spectral quality

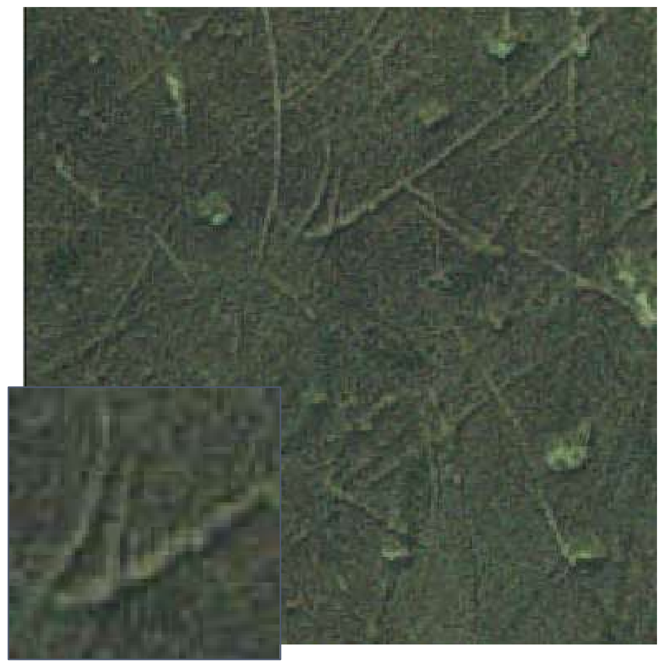
- Restrictive flight conditions (wind, sun glint, cloud cover)
- Limited spatial coverage
- High cost



Manned aircraft

- Good spectral quality
- Good spatial coverage
- Moderate resolution (15-30cm/pixel)

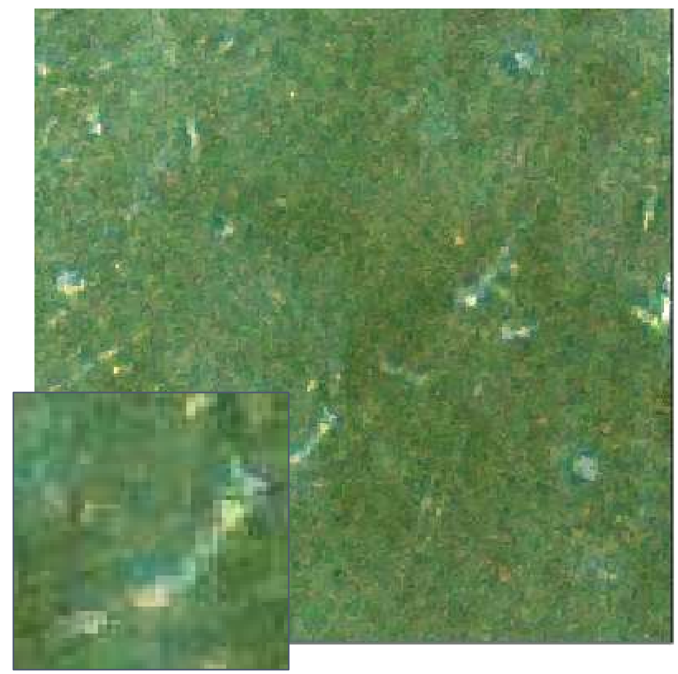
- Some flight restrictions (sun glint, cloud cover)
- High cost



Satellite imagery

- Excellent spatial coverage
- Low cost
- Often available, big range in quality – tasking possible

- Some spectral issues
- Moderate resolution (30-50cm/pixel)



Scar detection and classification methods

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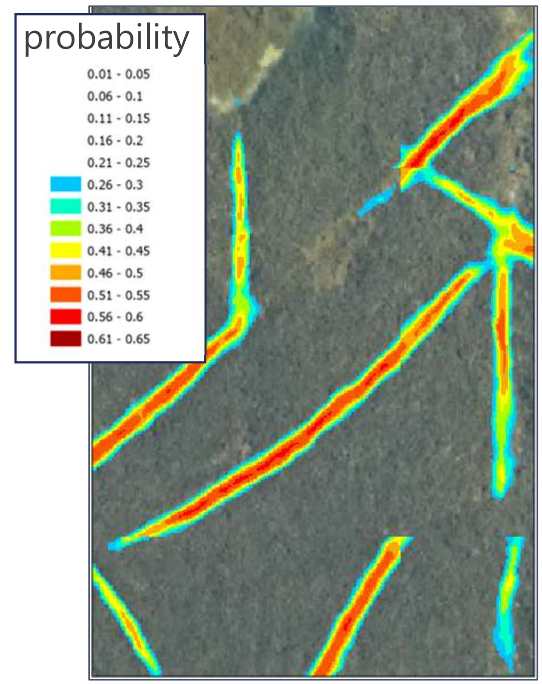
Base Image

Manual linear

Manual polygon

AI model pixel probability

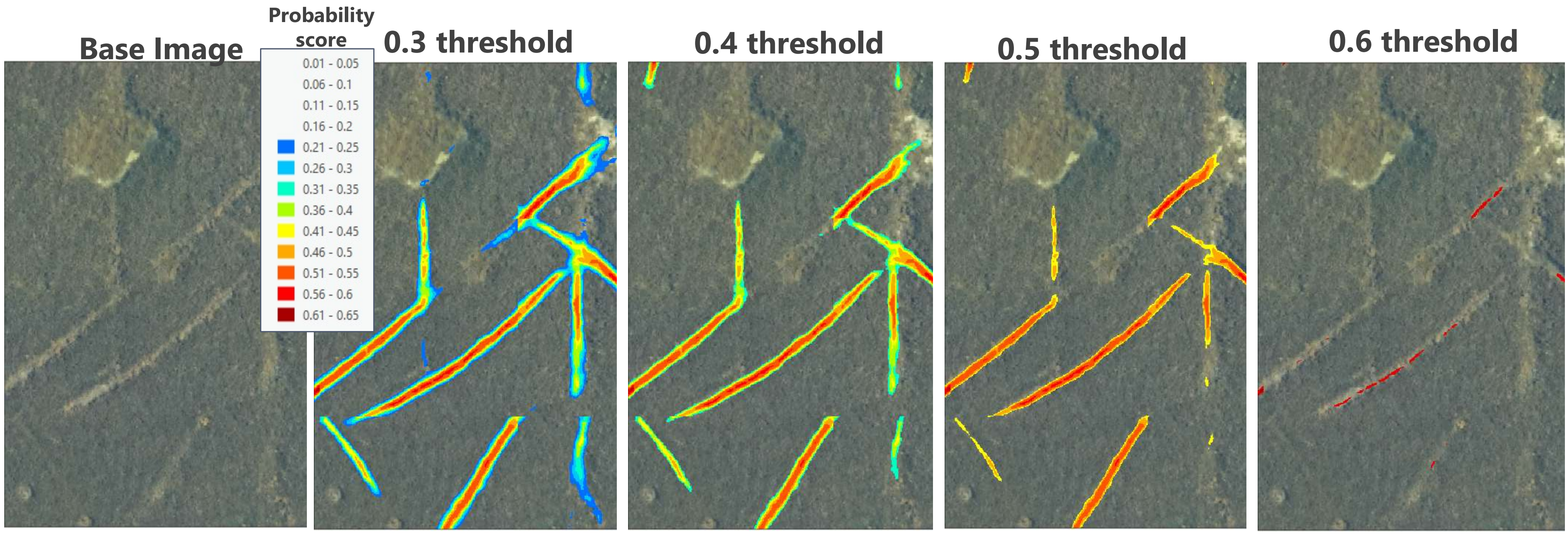


	Manual linear	Manual polygon	AI model pixel probability
Classification structure	binomial / linear	binomial / area	probabilistic pixel / area
Time to detect and classify	0.5 – 3.4 min ha^{-1}	1.2 – 7.1 min ha^{-1}	6-7 sec ha^{-1}
Subjective / objective	subjective	subjective	subjective in training objective in application

Computer vision / AI model

Plastic-i

- U-Net Architecture
- Assigns pixel level probability of scarring
- Changing the threshold of probability depending on management goal



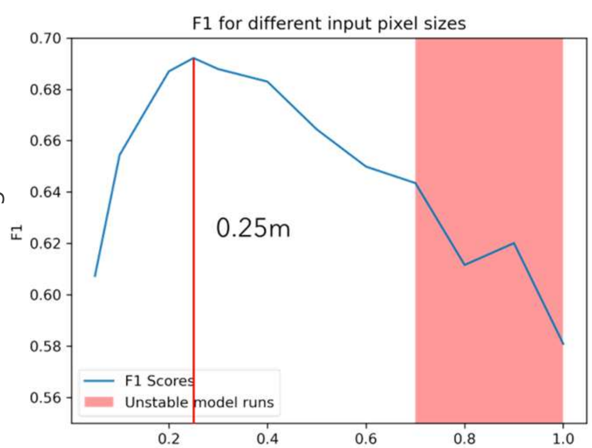
Less certain about individual pixel
Likely overestimate of total scarring

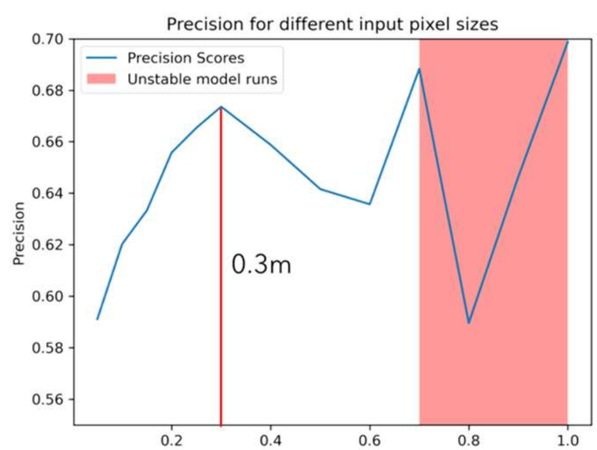
More certain about individual pixel
likely underestimate total scarring

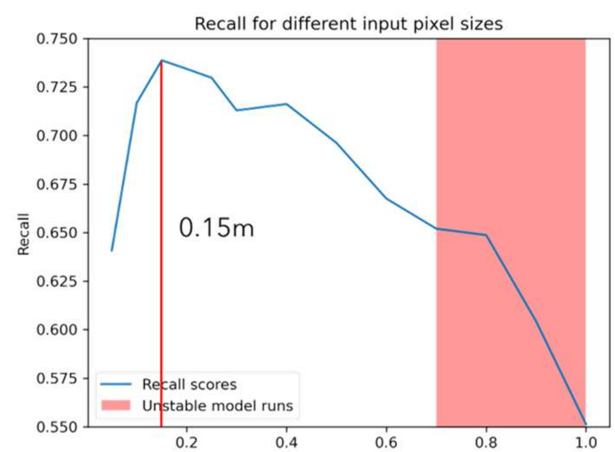
Pixel Size Comparisons

- Analysis of computer vision model sensitivity to pixel resolution
- Drone resolution = 5 cm/pixel vs. resampling with 5 cm decreasing resolution (increased pixel size) up to 1 m
- Results indicate resolution greater than 0.7m unacceptable, but 0.15-0.3m size optimal
- **Why does that matter?** It means imagery from manned aircraft (SWFWMD) and high-resolution satellite imagery is sufficient - not dependent on drone imagery!! Can help guide satellite imagery parameters.

Probability match between human tracing and model





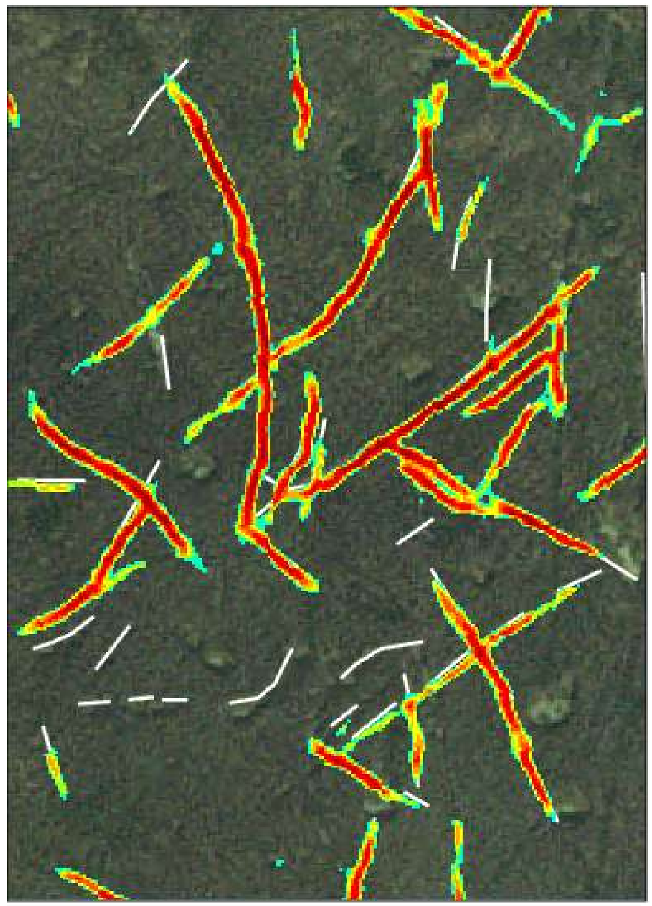


F1 = Weighted results between false positives and false negatives

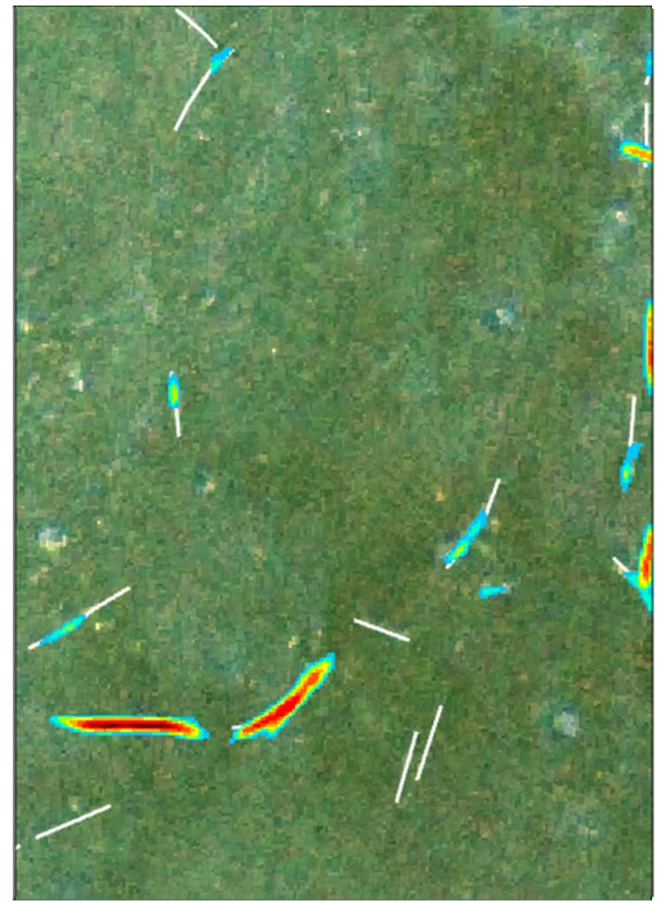
Comparison of model to manual detection

Drone Imagery

Manned aircraft Imagery



Satellite imagery



2: Socioeconomic

- How could resource users be expected to respond to pole-troll or other spatial management zones?
- What is the socio-economically optimal configuration of no-motor zones?

Approach: intercept & emailed survey, literature review, for-hire guide collaboration

Mark Clark, University of Florida

Lead: Kelly Grogan
Co-lead: Edward Camp

3: Ecological Effects

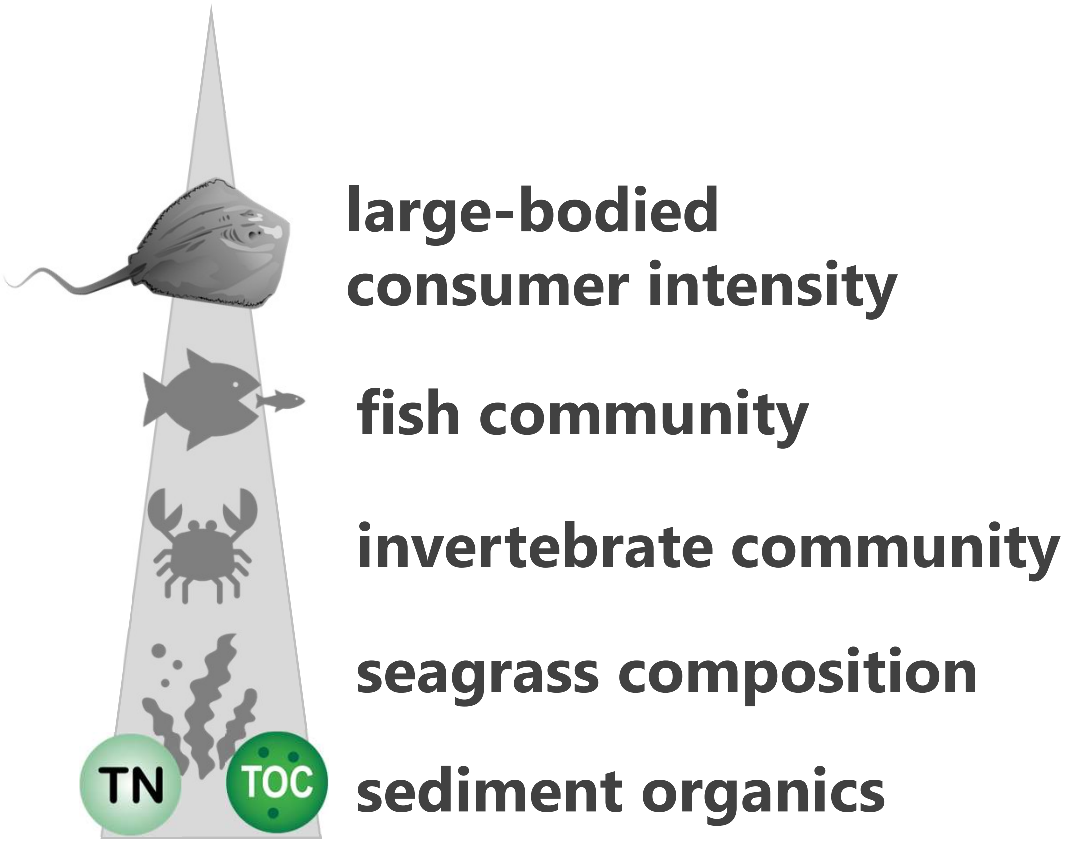
- How do propeller scars affect ecological and ecosystem components such as:
  - Water clarity
  - Invertebrate and fish communities
  - N and C storage

Approach: field surveys and observational studies

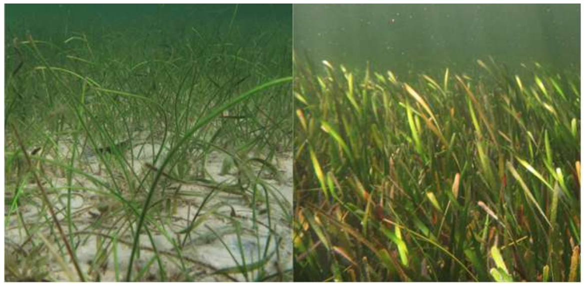
Conor MacDonnell, University of Florida

Lead: Laura Reynolds
Co-lead: Josh Patterson

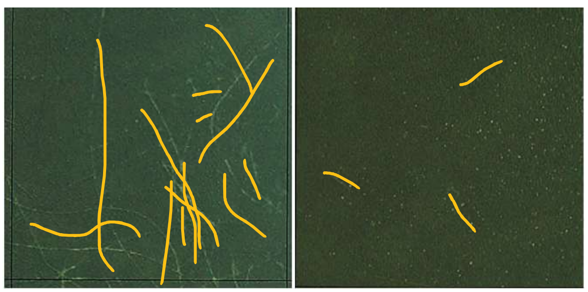
Multiple scales of investigation



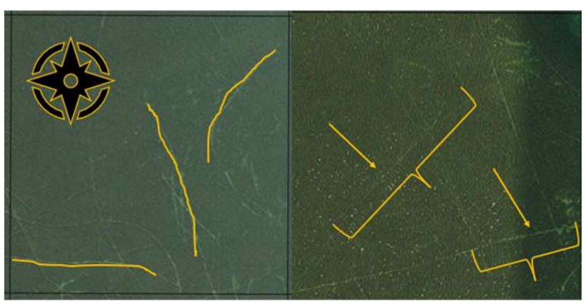
seagrass characteristics: location

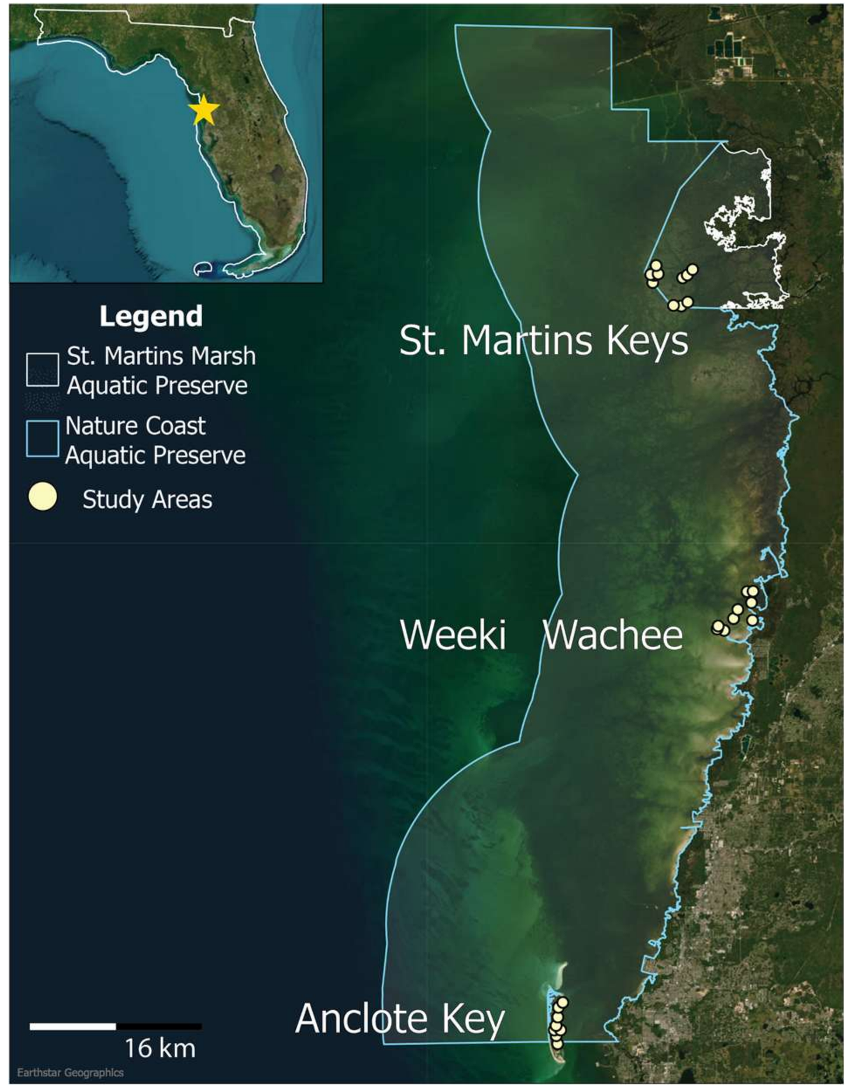


scar density: total length of scars per hectare



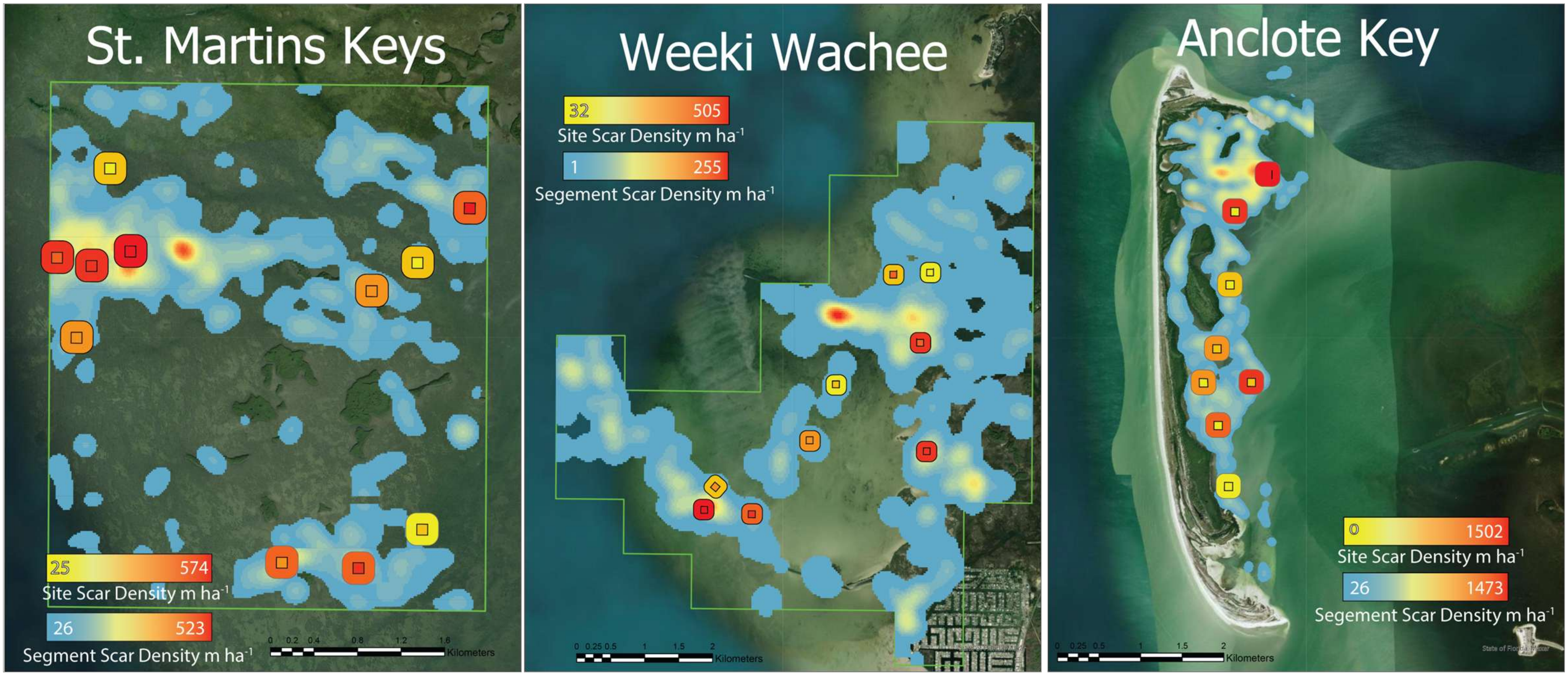
scar characteristics: dimensions, orientation





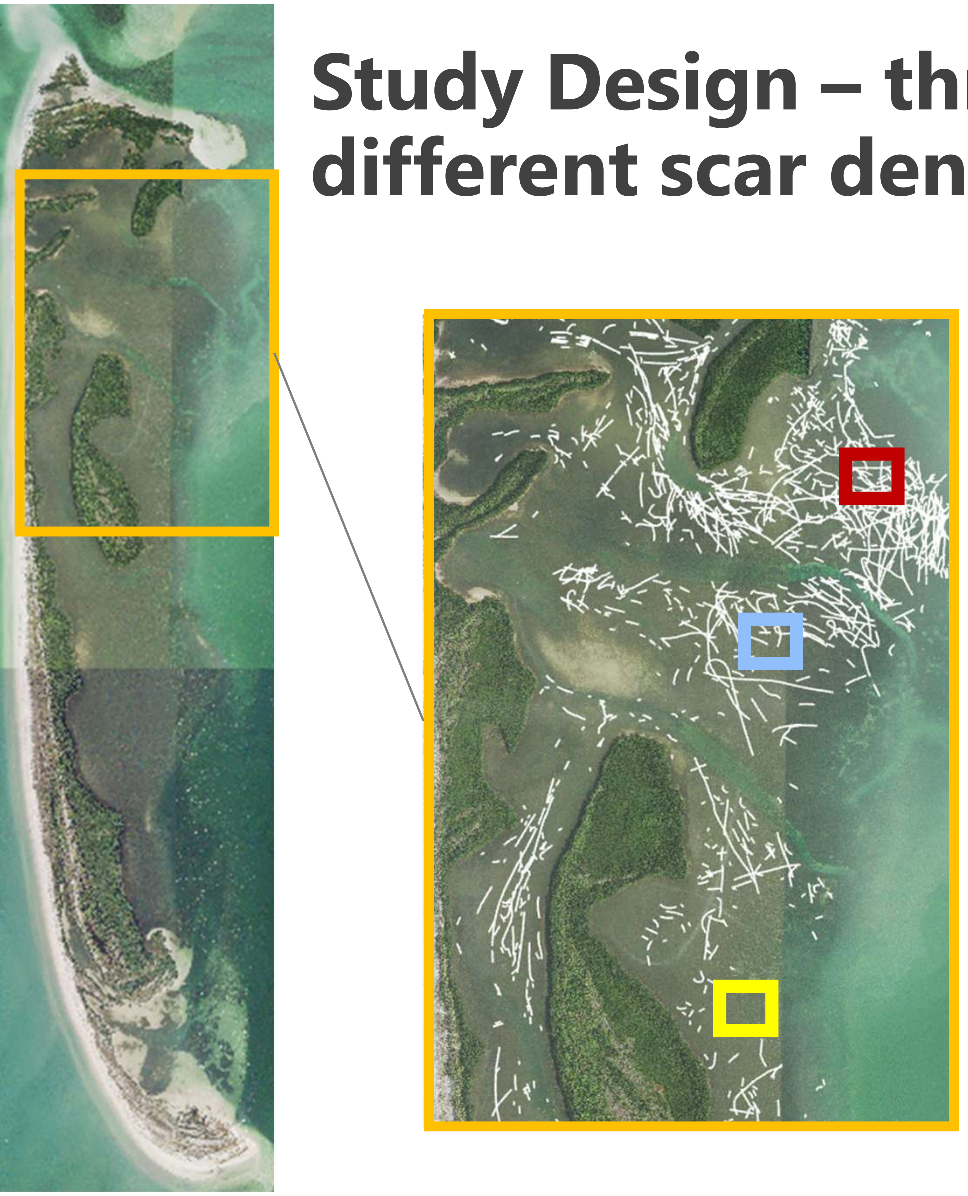
Nature Coast & St. Martins Marsh Aquatic Preserve

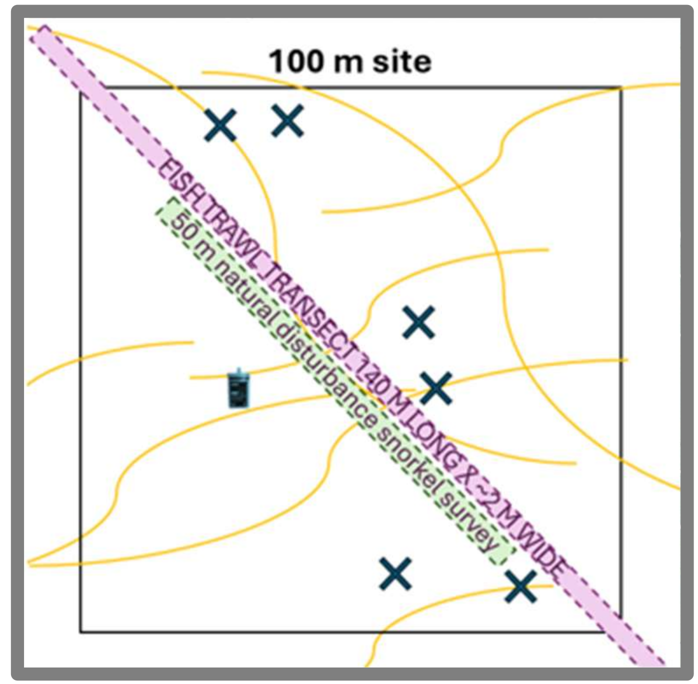
28 study sites across 3 locations



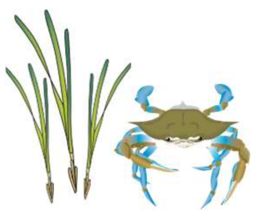
Figures created in ArcGIS by Dante Del Rosario & Mark W. Clark. Edited by Enie Hensel

Study Design – three example sites with different scar densities along Anclote Key

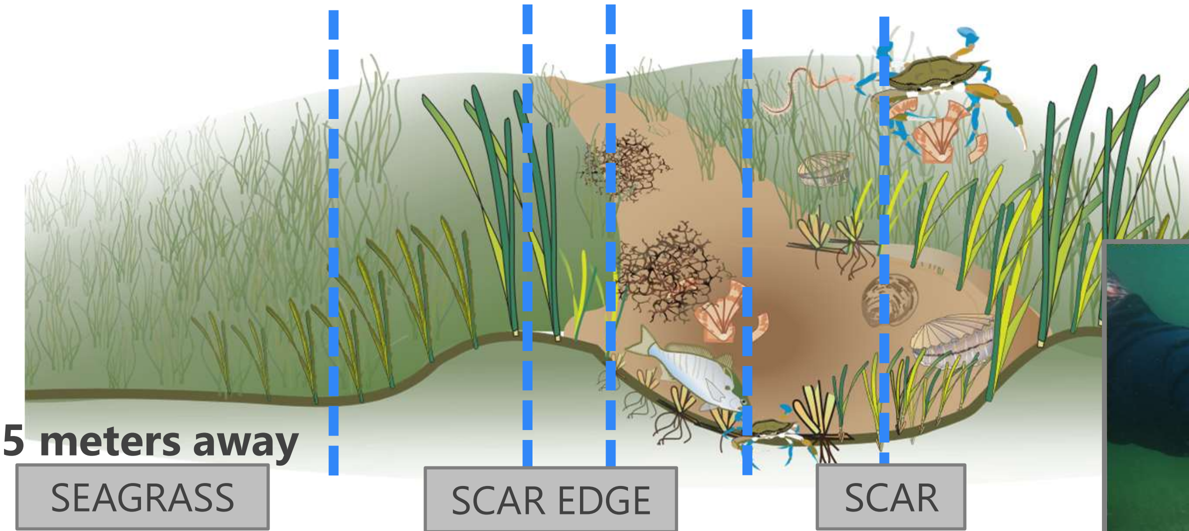




scar density per site (1 ha)
site buffer, scar density (9 ha)



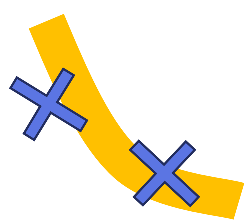
In each site, we surveyed for microhabitat alterations of three unique scars

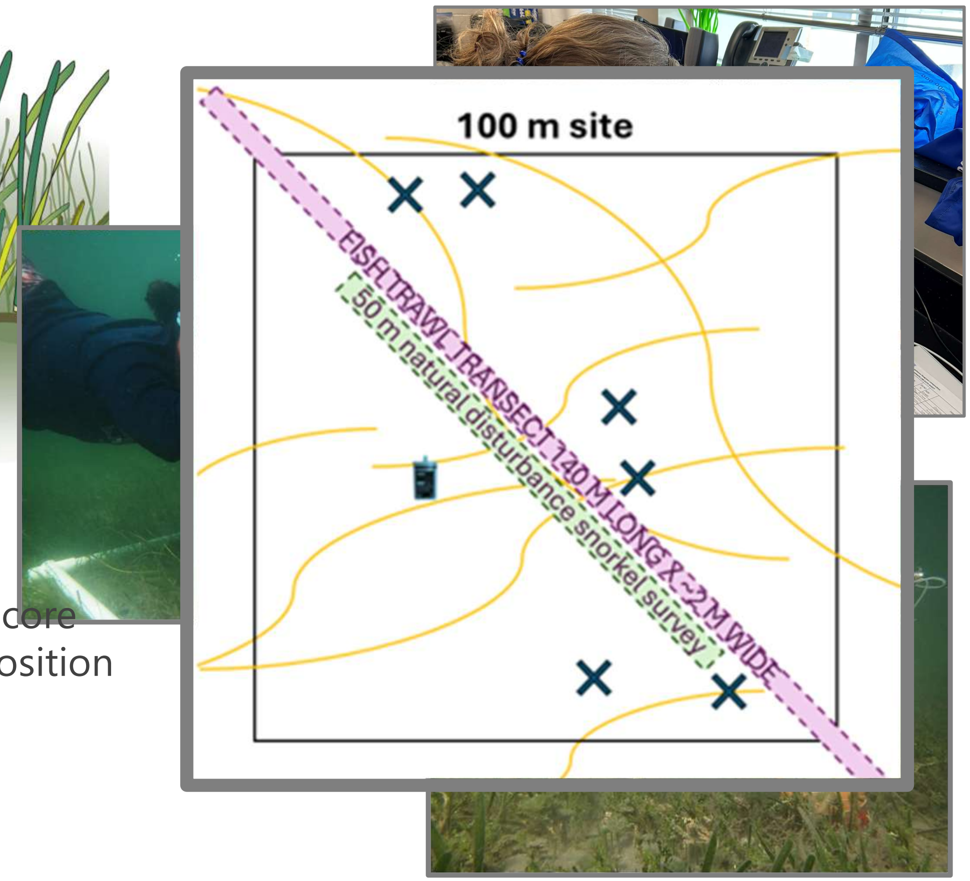


SEAGRASS
faunal-biomass core
SAV composition
canopy height
shoot density
sediment composition

SCAR EDGE
faunal-biomass core
SAV composition
canopy height
shoot density

SCAR
scar dimensions
faunal-biomass core
sediment composition





4: Restoration Planning

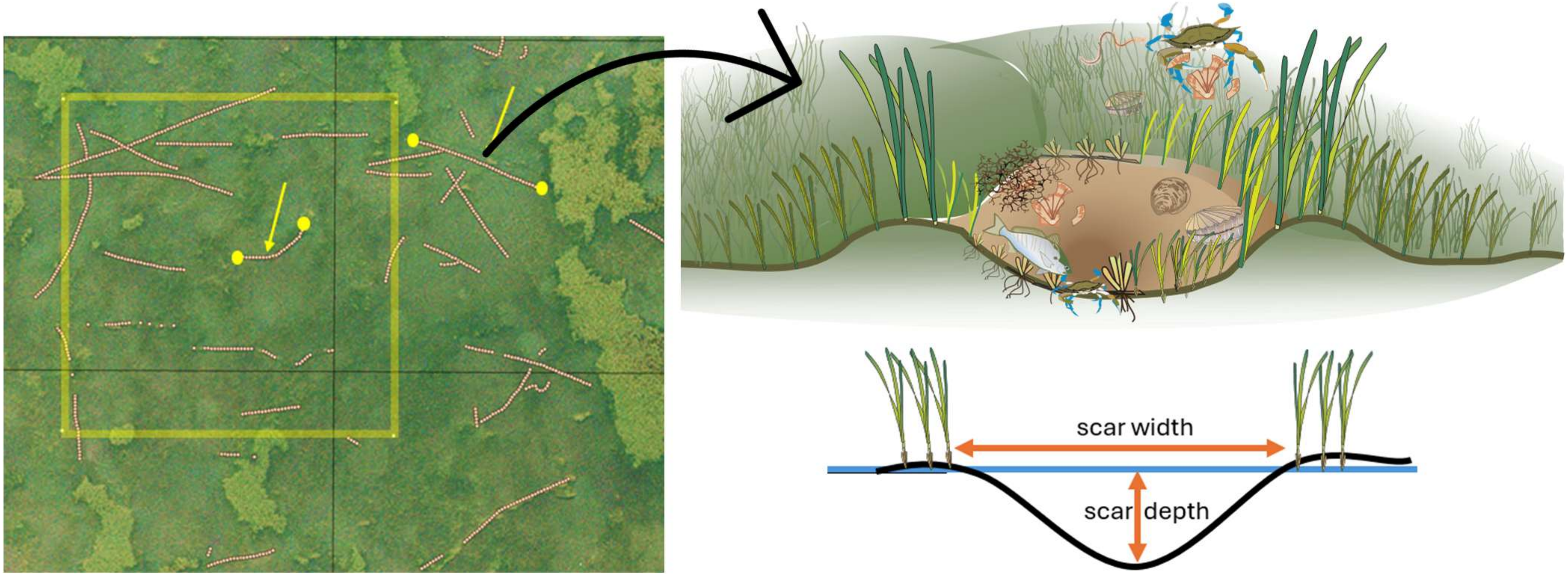
- Which scarred banks need restoration in addition to spatial zone interventions?
- Are there characteristics of scars that predict probability of natural recovery?
- How much restoration do managers need to plan for future funding?

Approach: field surveys and observational studies

Shelby Thomas, University of Florida

Lead: Josh Patterson
Co-lead: Laura Reynolds

Record recovery rate for 3 years

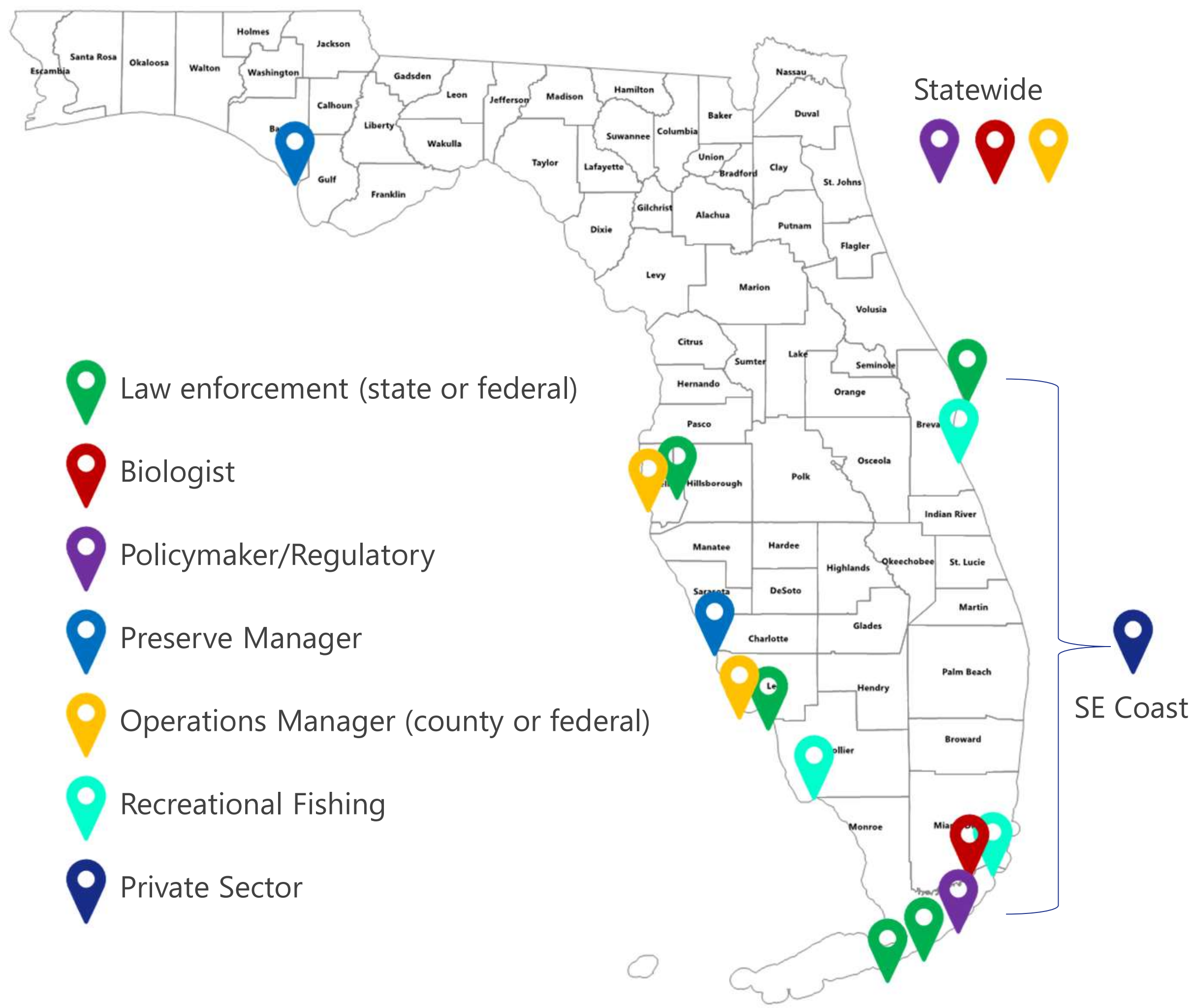


5: Logistical Guidance

- How will managers implement zones?
  - What kind of markers & how many?
  - What will it cost?
  - How will markers be maintained?
- How will actionable products be communicated effectively to user groups, law enforcement, and co-managing agencies?

Approach: literature review, studying existing spatial management zones, interviews & focus groups, SAC guidance

Lead: Savanna Barry

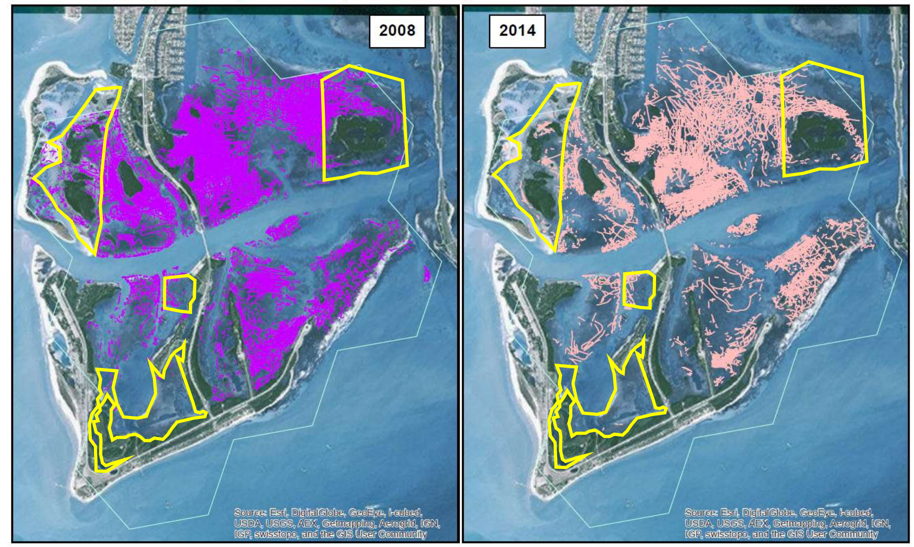


Results: Effectiveness

- **Data are sparse**
  - Pre-/post-data assessing the effectiveness of zones for seagrass protection rarely available
  - In a few cases, anecdotal (opportunistic aerial imagery) or direct pre/post-measurements of scarring intensity are available
    - Typically shows that zone reduced scarring

- **Expert opinion leans positive but acknowledge lack of data**
  - *""There are some areas that I have looked at just kind of browsing through- that- It's like, okay… seems like it's better in some locations that were really bad."* – Interview 8
  - *"The biggest challenge with seagrass scarring recovery monitoring is the ground truthing side of it."* – Interview 7
  - *"I don't think we have access, or, you know, have received any sort of data showing […] how effective these areas are."* - Interview 12

Seagrass Prop Scar Comparative Analysis 2008 vs. 2014, Fort De Soto, Florida



Pinellas County Watershed Management

Pinellas County

Date: 4/6/2017

Year	2008	2014
Total Study Area (ac)	8720	8720
Total Prop Scar Length (ft)	2,098,213	1,383,707

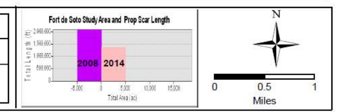


Figure E-2. Aerial imagery of Tavernier Key before and after establishment of a no-motor wildlife management area. Photo: Kruer

Looking ahead

- **Propeller scarring is a "wicked issue"**
  - Data gaps
  - Very little evidence-based guidance
  - Multiple scales and dimensions of impact
  - Diverse and diffuse stakeholders
  - Multiple jurisdictions/authorities

- **There is hope**
  - Place-based data, tools, and engagement supporting actionable recommendations
  - Tools and outcomes transferrable to other areas
  - Co-production model and large SAC sets team up for success

Mark Clark

SCAR MAPS

Acknowledgements

- **Key Partners:** Florida Department of Environmental Protection (regional Aquatic Preserves), Homosassa Guides Association
- **Collaborators/Team Members:** Tom Ankersen, Elix Hernandez, Morgan Edwards, Siyah Yongue, Jamie Loizzo, Shane White, Plastic-i, UF Gulf Scholars Program, & student interns
- **Primary Funding:** NOAA RESTORE Science Program
- **Logistical/field assistance:** Homosassa Guides Association, FDEP Nature Coast, Big Bend Seagrasses, & St. Martins Marsh Aquatic Preserves, Southwest Florida Water Management District, Florida Fish & Wildlife Conservation Commission

SCAR MAPS

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