CSA Ocean Sciences Inc.

FSBPA 2018

# Practical applications of drones (UAVs) for aerial mapping of beach and nearshore habitats & comparison to full-scale manned aircraft using GIS-based hardbottom classification

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Dustin Myers, UAV Coordinator
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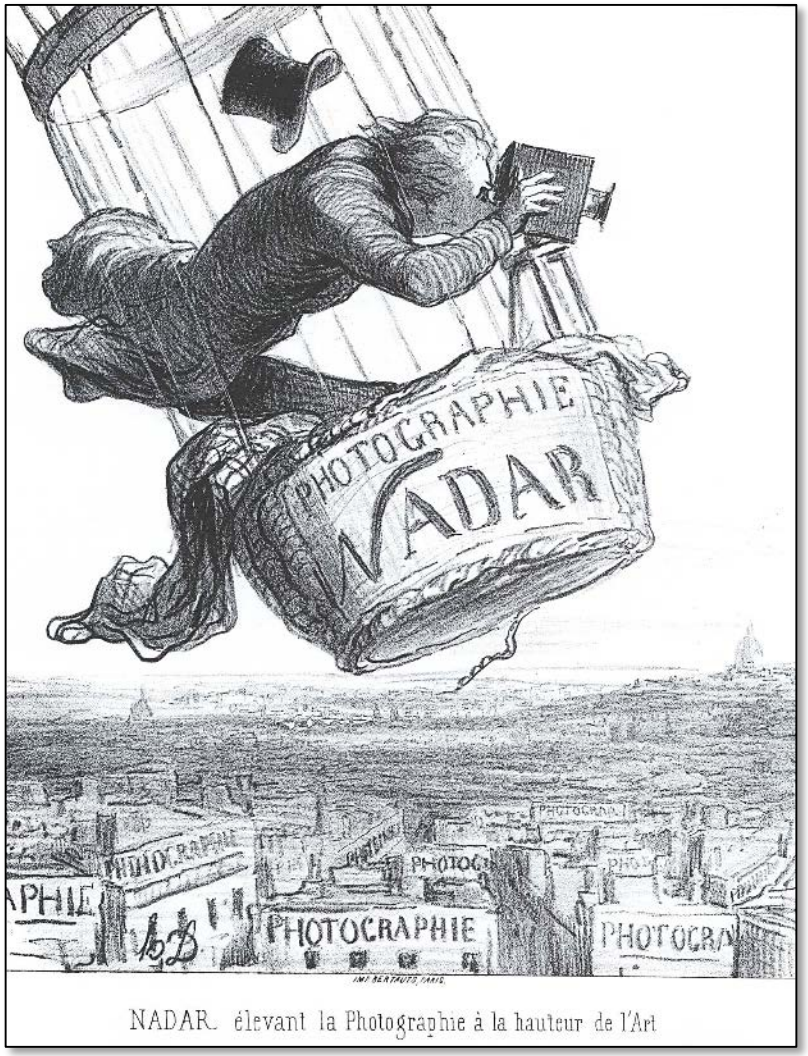
# Aerial Photography – observing change for 160 yrs




Honoré Daunier. Published in Le Boulevard 25th May, 1862

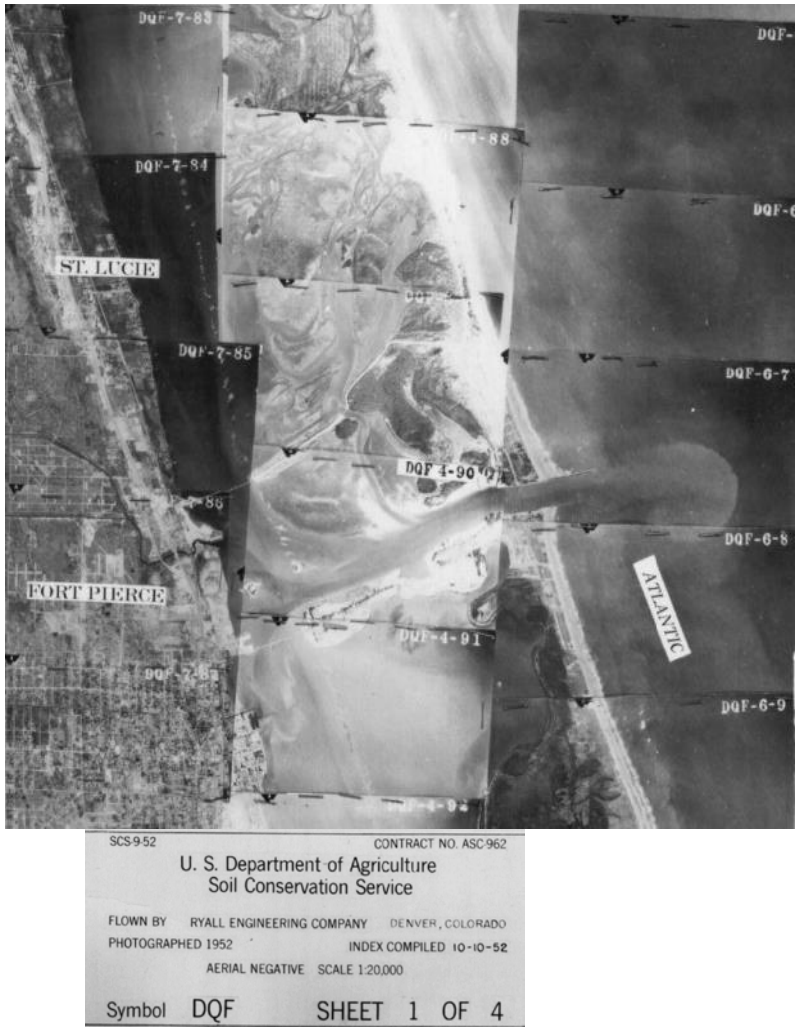
## Hot air balloons

- Earliest method
- Nadar, Paris 1858

## Manned aircraft

- 100+ years
- Photogrammetry revolutionized WWI

# Aerial Photography – observing change for 160 yrs




## Hot air balloons

- Earliest method
- Nadar, Paris 1858

## Manned aircraft

- 100+ years
- Photogrammetry revolutionized WWI

◀ **1952 Ft. Pierce Inlet**

- Still the preferred platform today

# MANNED AIRCRAFT


- Flown at ~10,000 ft
- Cover large area/short flight times
- Accuracy with ground controls
- 50 megapixel camera

Potential Cons:

- Resolution 15 cm (6 in) per pixel
- Speed of deployment
- High cost
- Logistically intensive

# AERIAL REQUIREMENTS

## Guidance: Nearshore Hardbottom Monitoring for Beach Erosion Control Projects, FDEP Joint Coastal Permits

- Hardbottom classification from aerials – 2014 Monitoring Standards
- Field team - report hardbottom conditions
  - Short windows of opportunity
  - Manned aircraft – costly, not always timely

**Identified Needs:**

- Faster response time
- High resolution images
- Accurate georeferencing
- Lower cost

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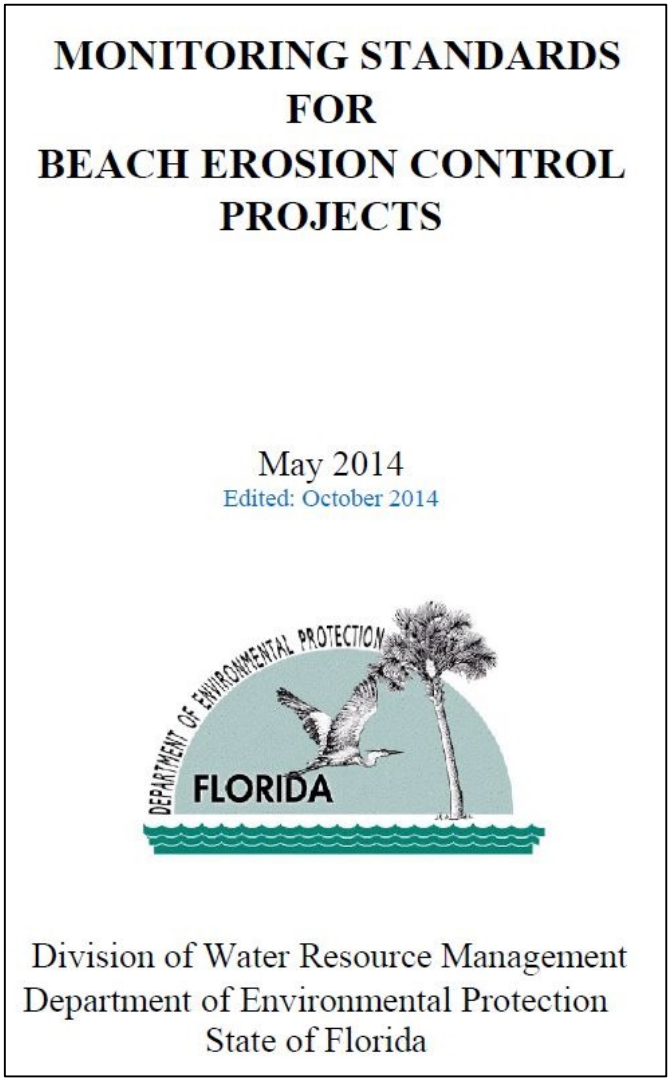

MONITORING STANDARDS
FOR
BEACH EROSION CONTROL
PROJECTS

May 2014
Edited: October 2014

DEPARTMENT OF ENVIRONMENTAL PROTECTION
FLORIDA

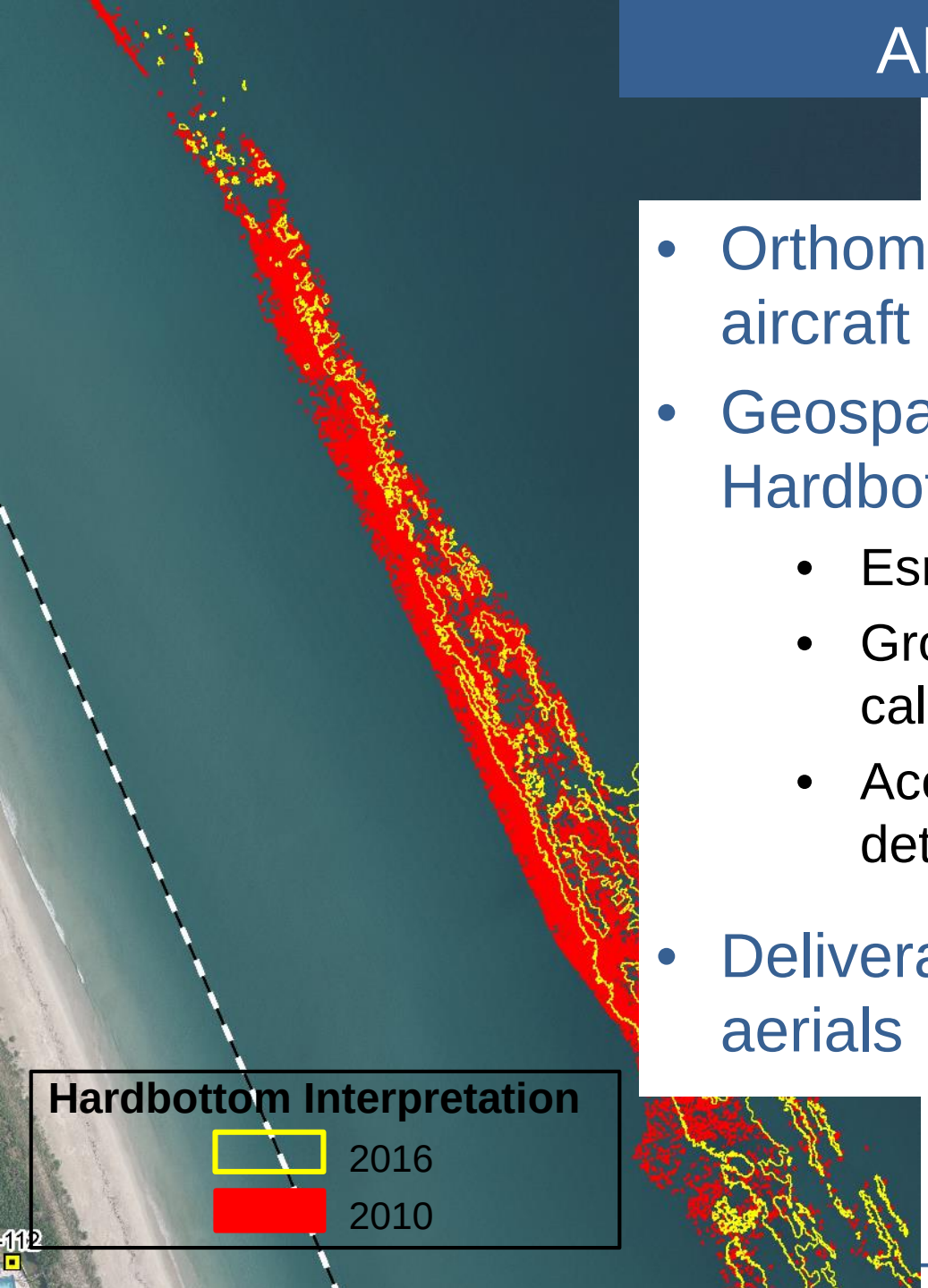
Division of Water Resource Management
Department of Environmental Protection
State of Florida

# FDEP Standards for Aerial Photography Acquisition include:

- Ground sampling distance (GSD) ≤15 cm (6 in)/pixel
- Horizontal accuracy 1 in = 500 ft
- Ground controls (2 cm accuracy) every 7-12 miles
- Sun angle ≤ 30°
- No cloud cover

# AERIAL INTERPRETATION

- Orthomosaics from manned aircraft
- Geospatial analysis: area of Hardbottom cover
  - Esri ArcGIS and ERDAS Imagine
  - Ground-truthing: software calibration, increase accuracy
  - Accuracy assessment –software determines error
- Deliverable - shapefile overlaid on aerials

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# UAV CAPABILITIES

## Pros:

- Low cost
- Portable, quickly deployed
- ≤ 4 cm/pixel resolution
- Accurate positioning

## Cons:

- Lower megapixel cameras
- Longer flight times
- Short battery life
- Small payload
- FAA regulations

# FAA UAV CONSIDERATIONS


- Part 107 certificate (FAA)
- Stipulations
  - Can't fly over 400 ft
  - Not beyond line of sight
  - Not at night
  - < 100 mph
- Airspace Classes

  Class G
  - No permission needed

  Classes B,C,D & E
  - Require approval

# Early R&D - drone vs. manned aircraft

## Martin County Artificial Reef

### UAV flight 1/26/2017

Elevation: 400 ft
GSD 2 in/pixel

### Manned flight 7/28/2017

Elevation: 10,000 ft
GSD 6 in/pixel

# Early R&D – drone vs. manned aircraft

Martin County Artificial Reef

Manned flight 7/28/2017

# Early R&D – drone vs. manned aircraft

## Martin County Artificial Reef

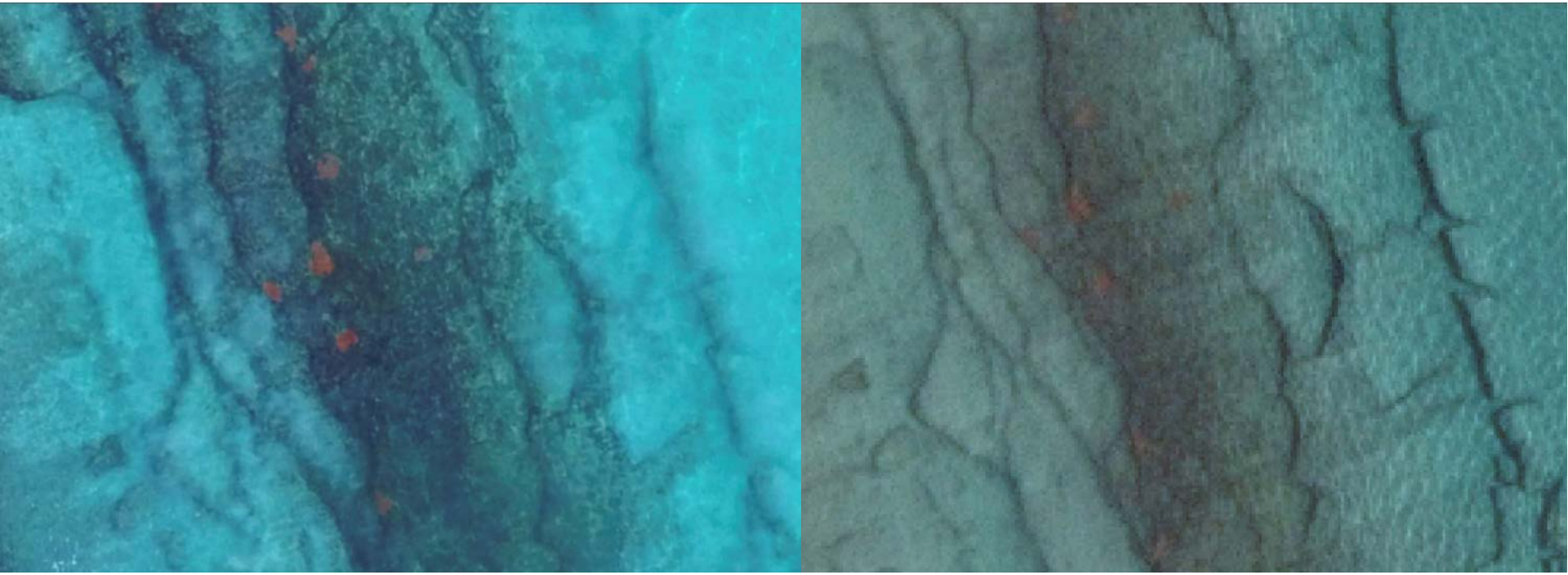
UAV flight 1/28/2017

# Early R&D - drone vs. manned aircraft

St. Lucie County

UAV Flight 07/11/2017
Elevation: 400 ft
GSD 2 in/pixel

Manned Flight 8/22/2016
Elevation: 10,000 ft
GSD 6 in/pixel



## High resolution and accuracy:

- Hypothesis : Suitable for hardbottom aerial extent
- Potential: habitat classification

# HABITAT CLASSIFICATION

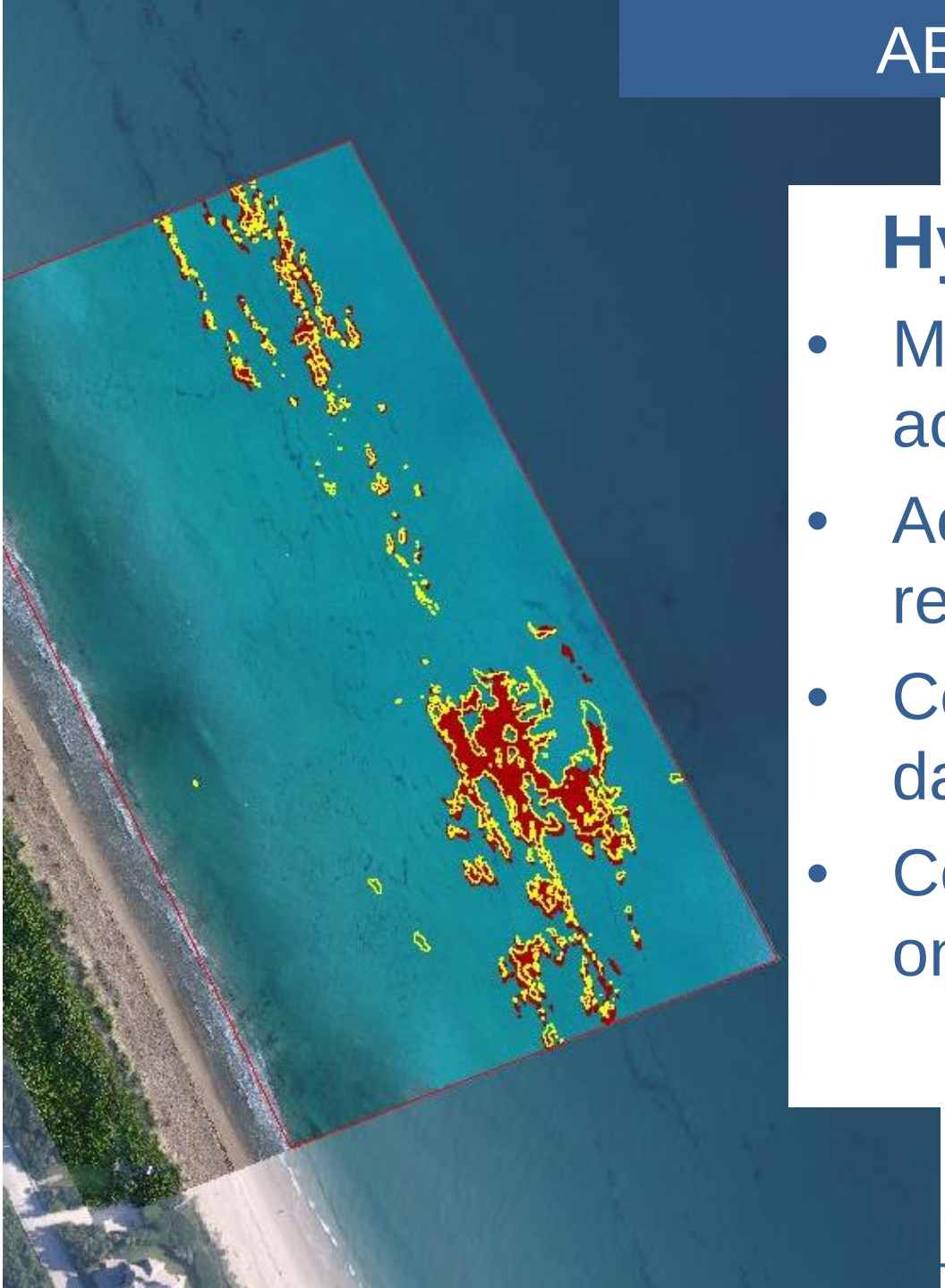

## FDEP Coral Reef Conservation Program Shallow Water Habitat Mapping [1]

- Habitat classified on aerial maps
- Extensive ground-truthing
- Expensive aerials and LADS

## UAV

- Lower labor & cost
- Better imagery
- Habitat depiction for HB community characterization

[1] Walker, B.K. and Klug, K. 2014. Southeast Florida shallow-water habitat mapping & coral reef community characterization. Florida DEP Coral Reef Conservation Program report. Miami Beach, FL. Pp. 83.



## Hypothesis testing

- Manned aircraft aerials acquired
- Aerial interpretation required for project
- Collected UAV aerials 33 days after manned flight
- Conducted interpretation on each dataset

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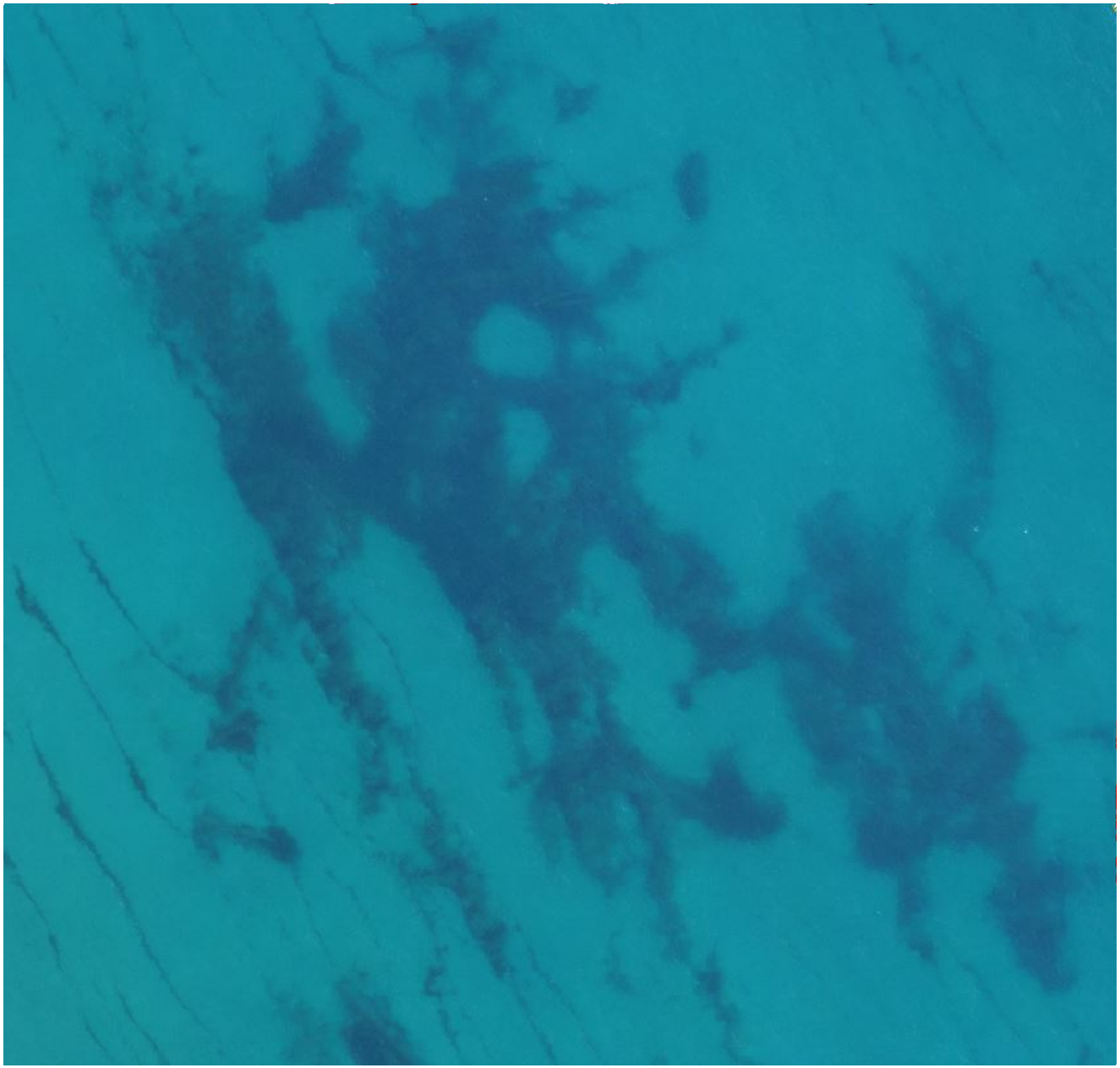
# RESULTS



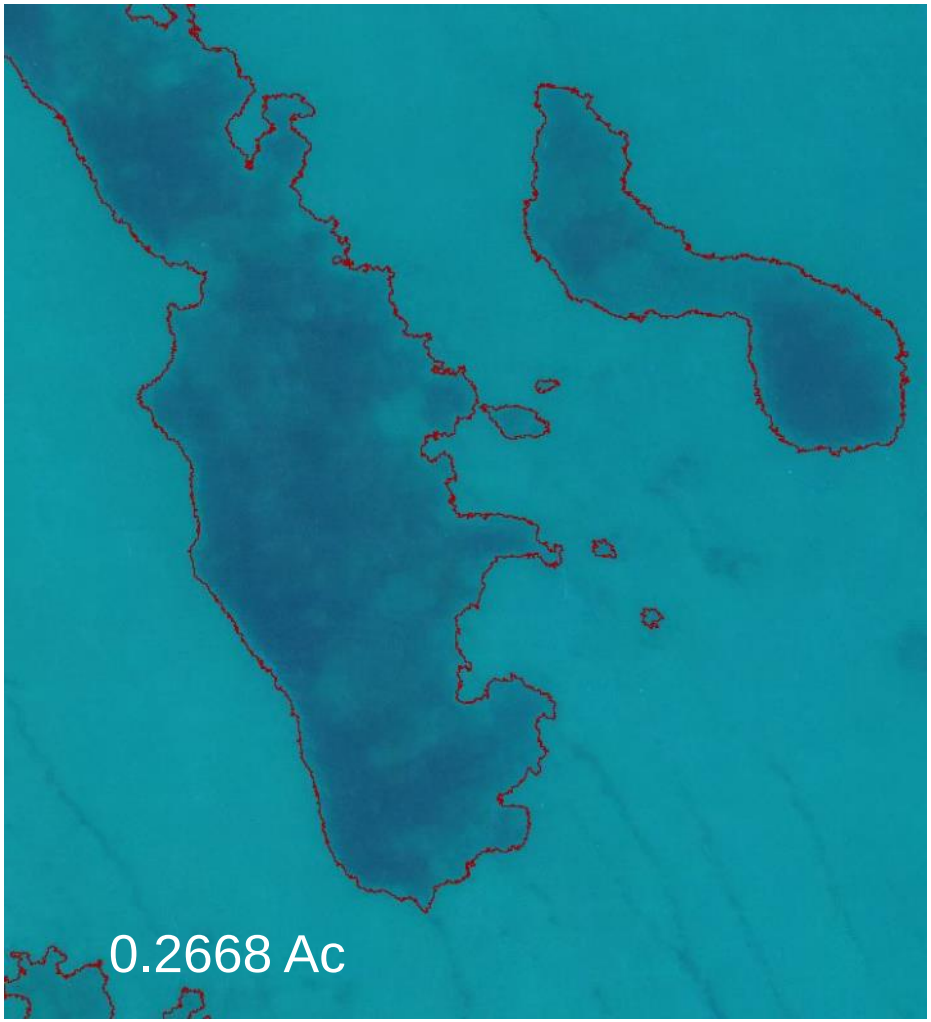
Total Area Analyzed: 77 Acres

Drone classification

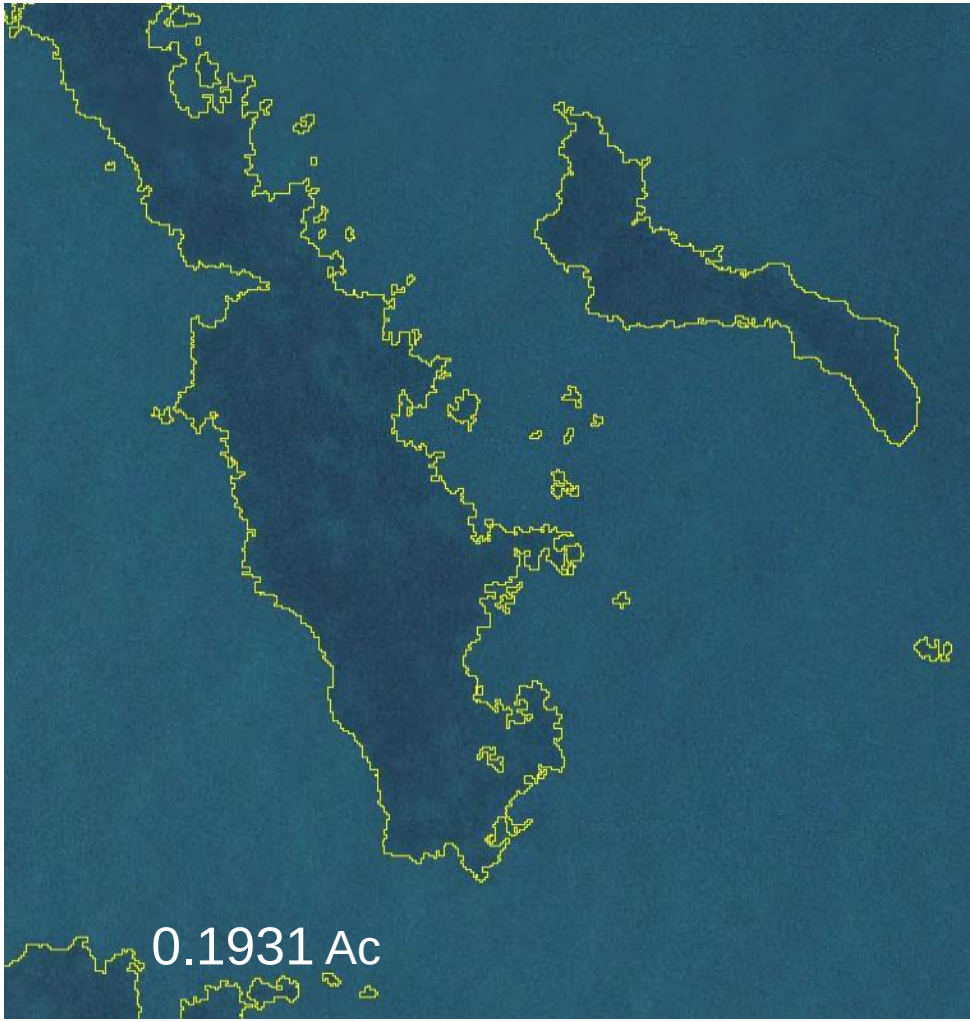
Manned aircraft classification

# RESULTS

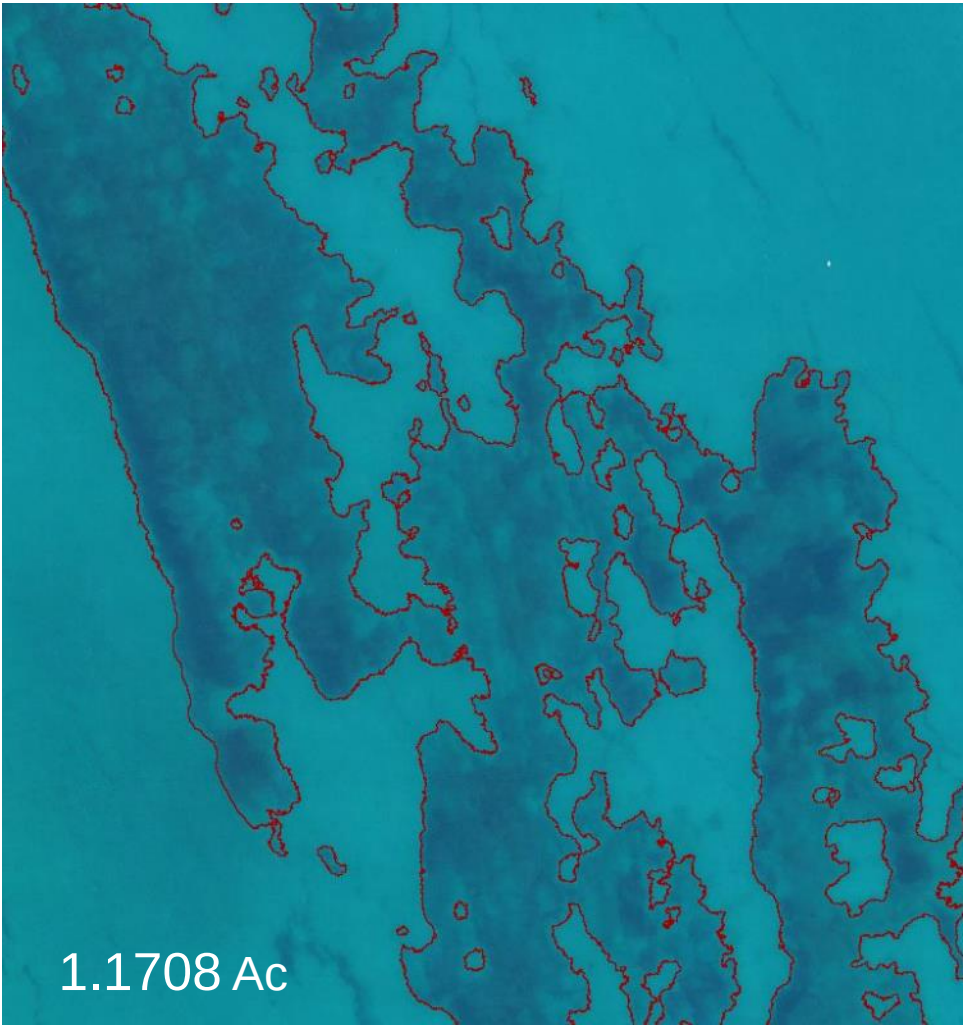
## Drone



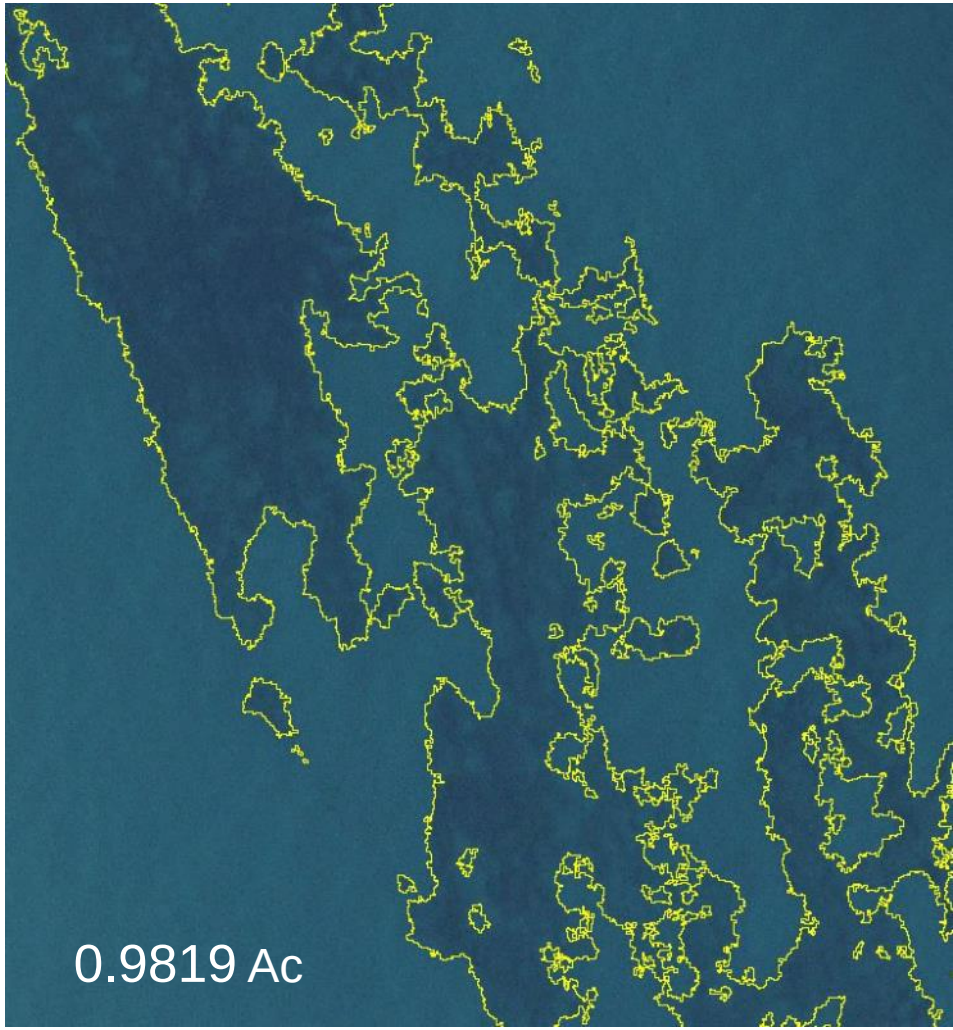

## Manned aircraft



## Drone




## Manned aircraft



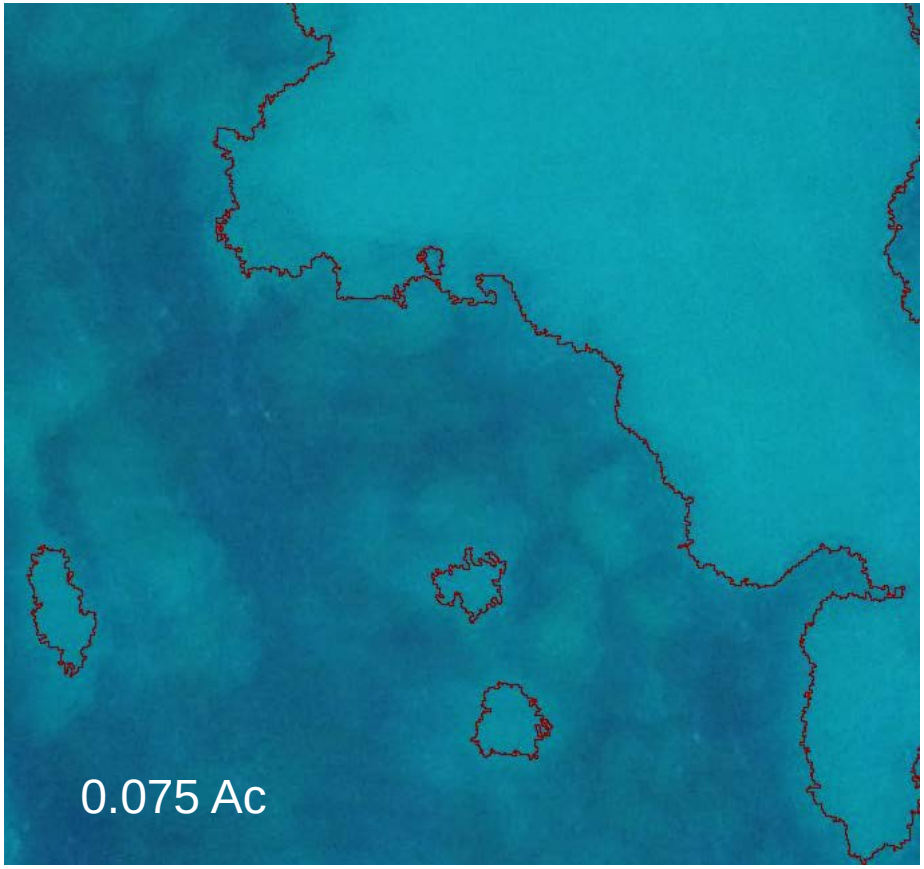
# ACCURACY ASSESSMENT

## Drone

Total Accuracy: 96.7%

Kappa Coefficient: 0.880

Total Acreage: 4.676

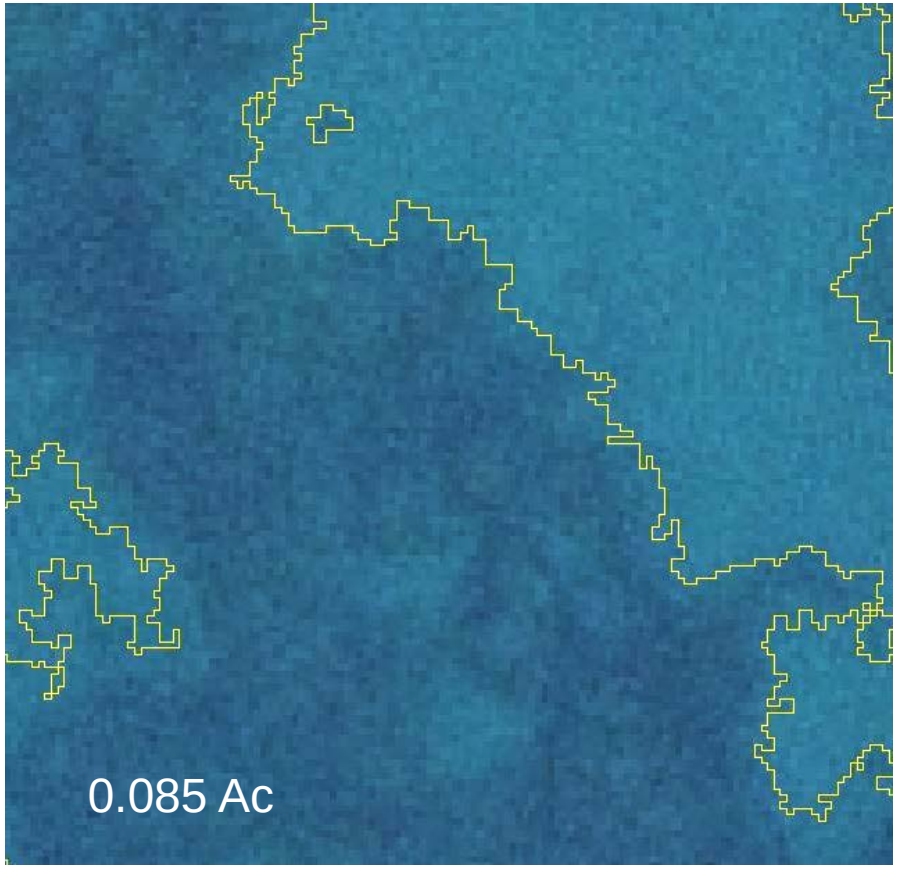



## Manned aircraft

Total Accuracy: 95.8%

Kappa Coefficient: 0.847

Total Acreage: 3.874



## Drone:

- Higher resolution
- Discern finer details
- 1% greater area & accuracy
- Higher contrast between bottom types

## Manned Aircraft:

- Collect entire area at once
- Collected under optimal conditions
- Ground controls provided better rectified orthomosaics

Manned aircraft are currently FDEP permit required

**However,**

## Drones ARE capable:

- Similar error rate in classification
- Better image resolution
- Considerable cost reduction

  ~ 25% the cost of manned aircraft

- Fast response time

  Take advantage of optimal field conditions

- Potential for increased precision

# FUTURE APPLICATIONS

## Goals:

1. Refine UAV imagery collection, accuracy & precision
   - ❖ White balance, exposure, ground controls
2. Develop UAV standards to meet Agency requirements
3. R&D UAV image collection for habitat classification
4. Further investigate UAV utility for other applications

# QUESTIONS?