Aerial photographic assessments of intertidal oyster reefs: A. Historical analyses, B. ArcView automated classification

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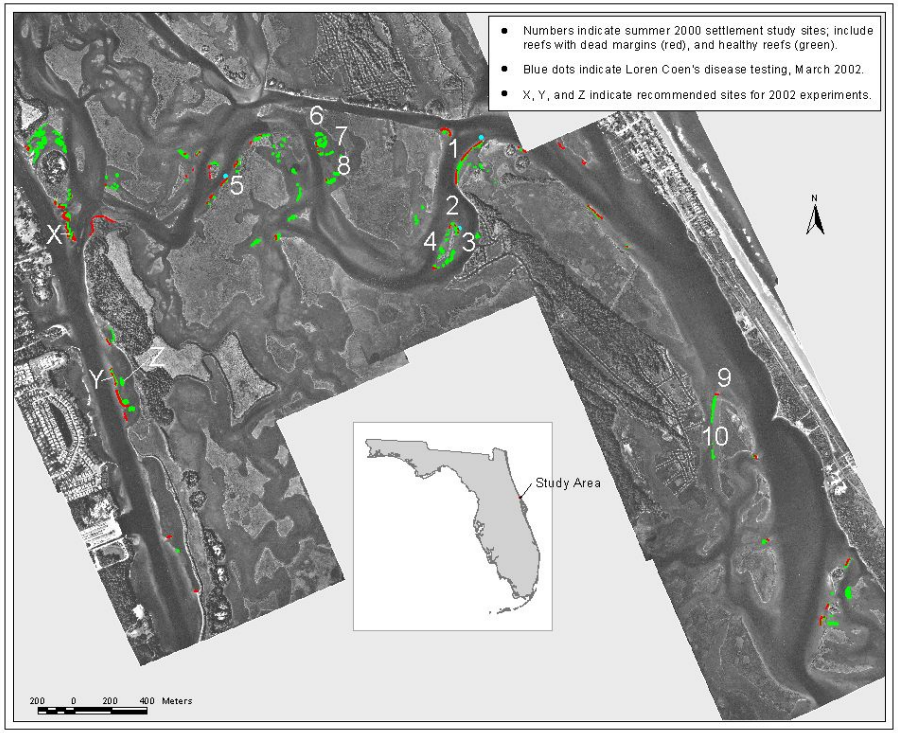
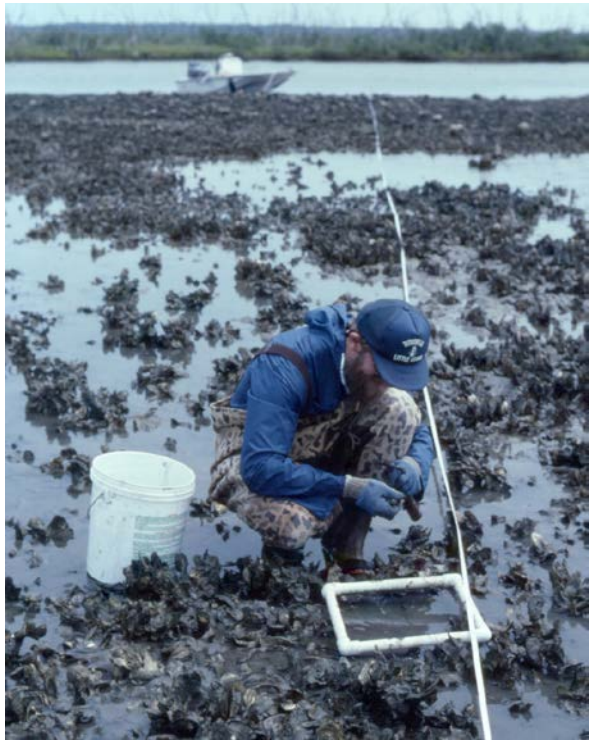
Study Area

Canaveral National Seashore, Florida

- Extensive intertidal oyster (*Crassostrea virginica*) reefs
- Reefs in open-water areas among mangrove islands
- Seagrass beds adjacent to oyster reefs in many areas





Introduction and Background

- Mapping and characterization of reefs conducted in 1988, 1994-95, 2000-01
- Reefs with dead margins *noticed* in 1998
- Studies of dead margins initiated in 2000

Historical Analyses: Objectives

- Distribution map of all reefs in 2000-01
- History (57-yr record) of occurrence of dead margins and adjacent reefs
- Experiments to test hypothetical causes of dieoffs (Walters, et al.)

Methods

- Sources for aerials: USGS, SJRWMD, Volusia Co.

- Processing of aerials: Scanning⇒digital files⇒ analysis with ArcView/ArcInfo GIS...

- Analysis of aerials
  - Reef “signatures” (live and dead)
  - Manual delineation of reefs (polygons)
  - GIS calculation of polygon area

- Ground-truthing: interpretation and location accuracy

Park-Wide Results

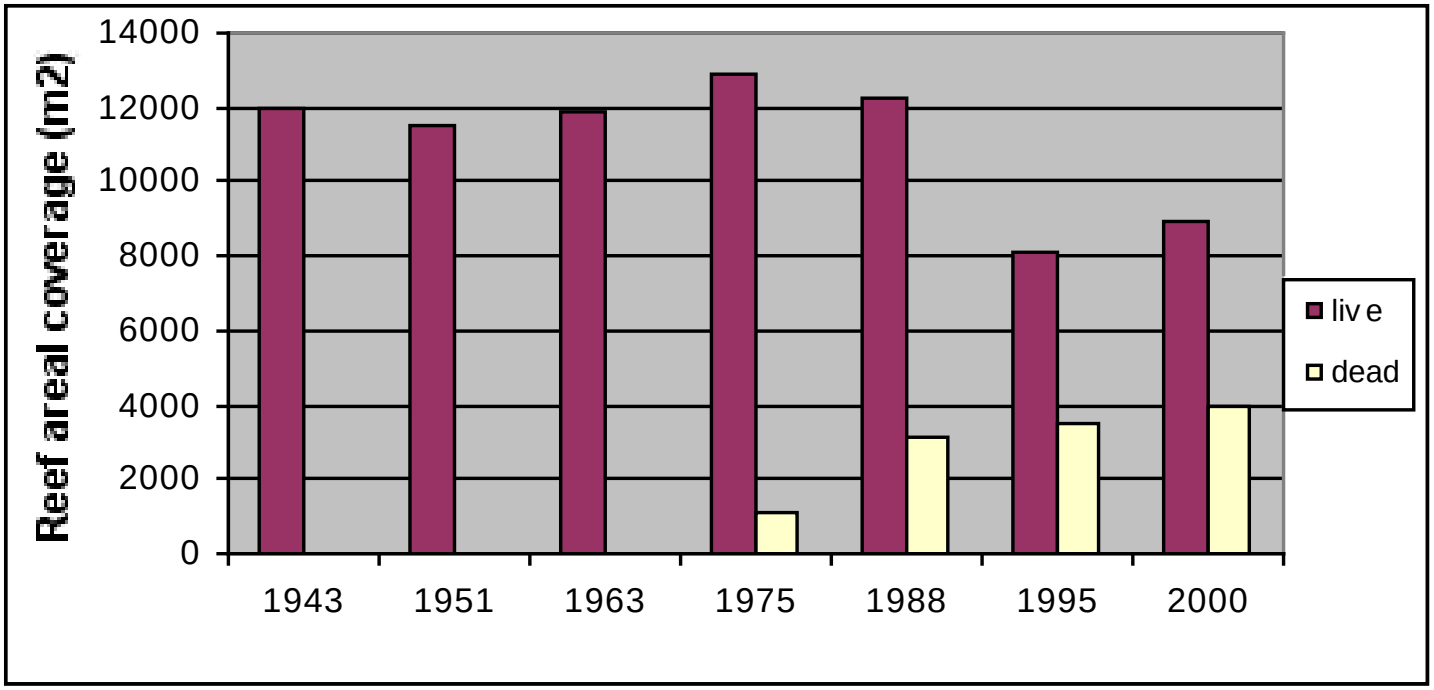
- ~400 reefs in Park, ~60 with dead margins in 2000
- 12.3 hectares covered by “live” reef
- 1.12 hectares of dead margin in 2000 (9.1% of total oyster reef areal coverage)

Long-Term Trends

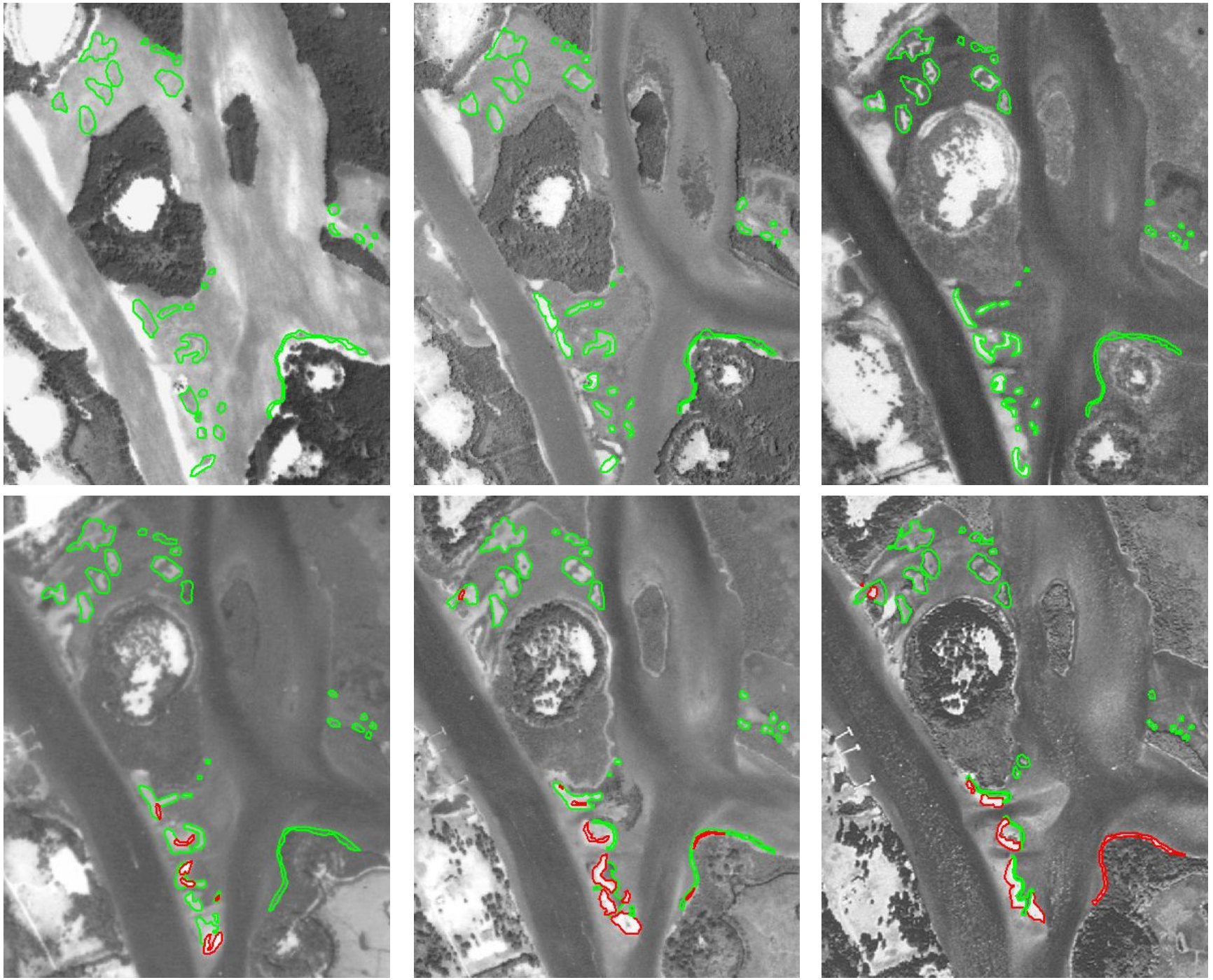
- Dead margins first appeared in 1943 aerials, on one reef adjacent to ICW
- ALL dead margins adjacent to boating channels
- Consistent increasing trend in dead margin occurrence from 1943 - 2000
- Individual reef variations in 57-year record ranged from “minimal change” to “total reef displacement/destruction”(⇒Group 1 as example)

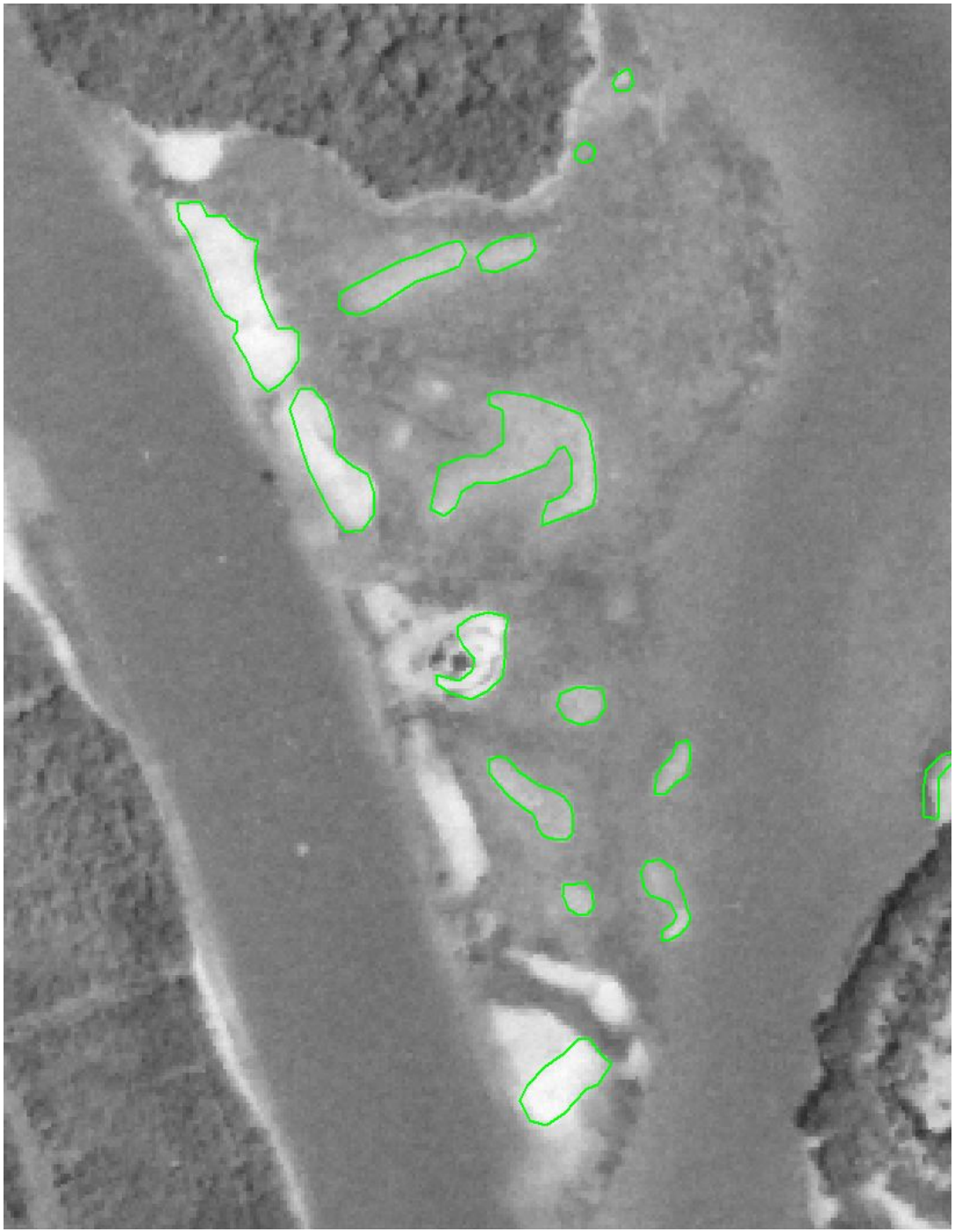

1 0 1 Kilometers

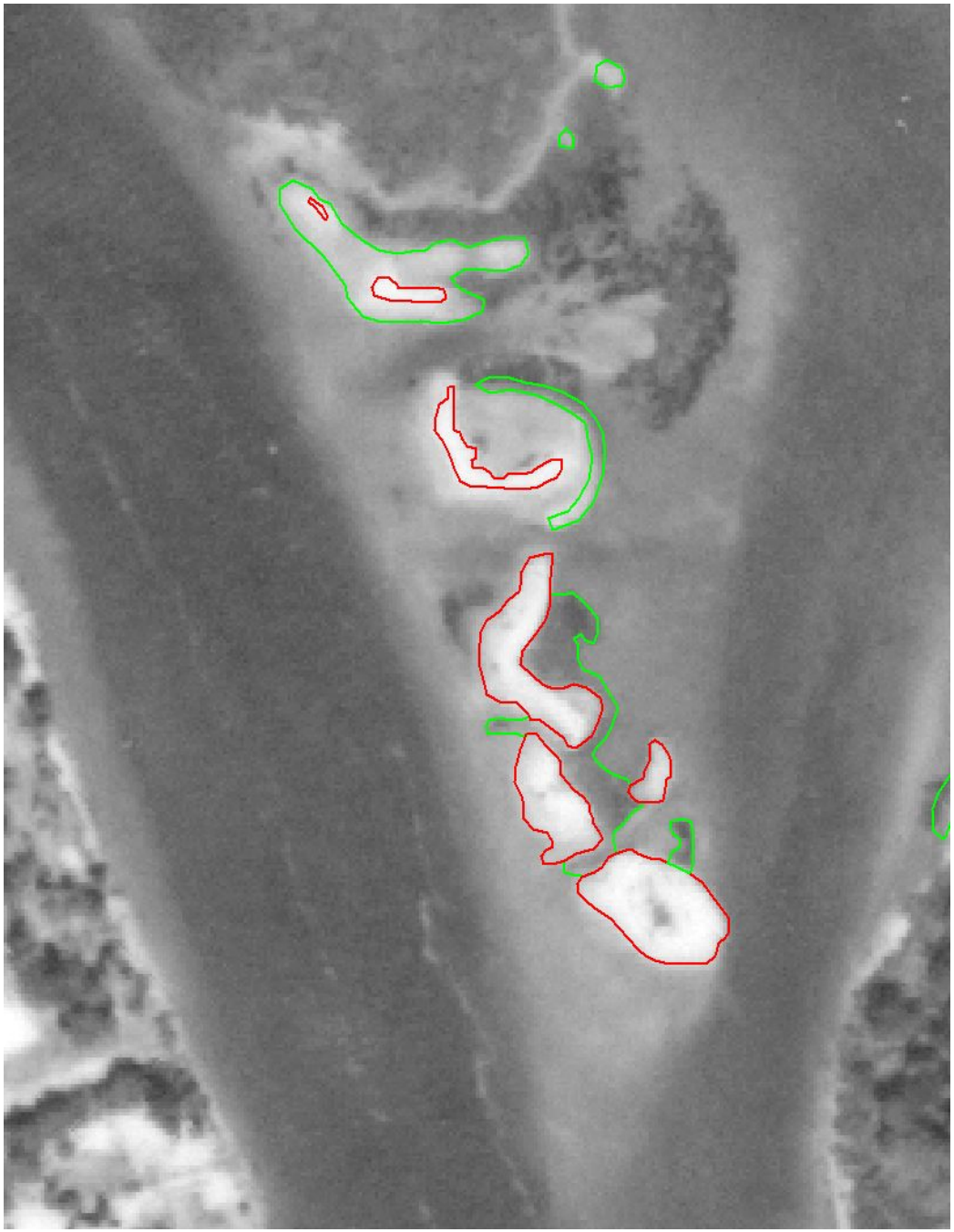
Reef areal coverage for Group 1 only

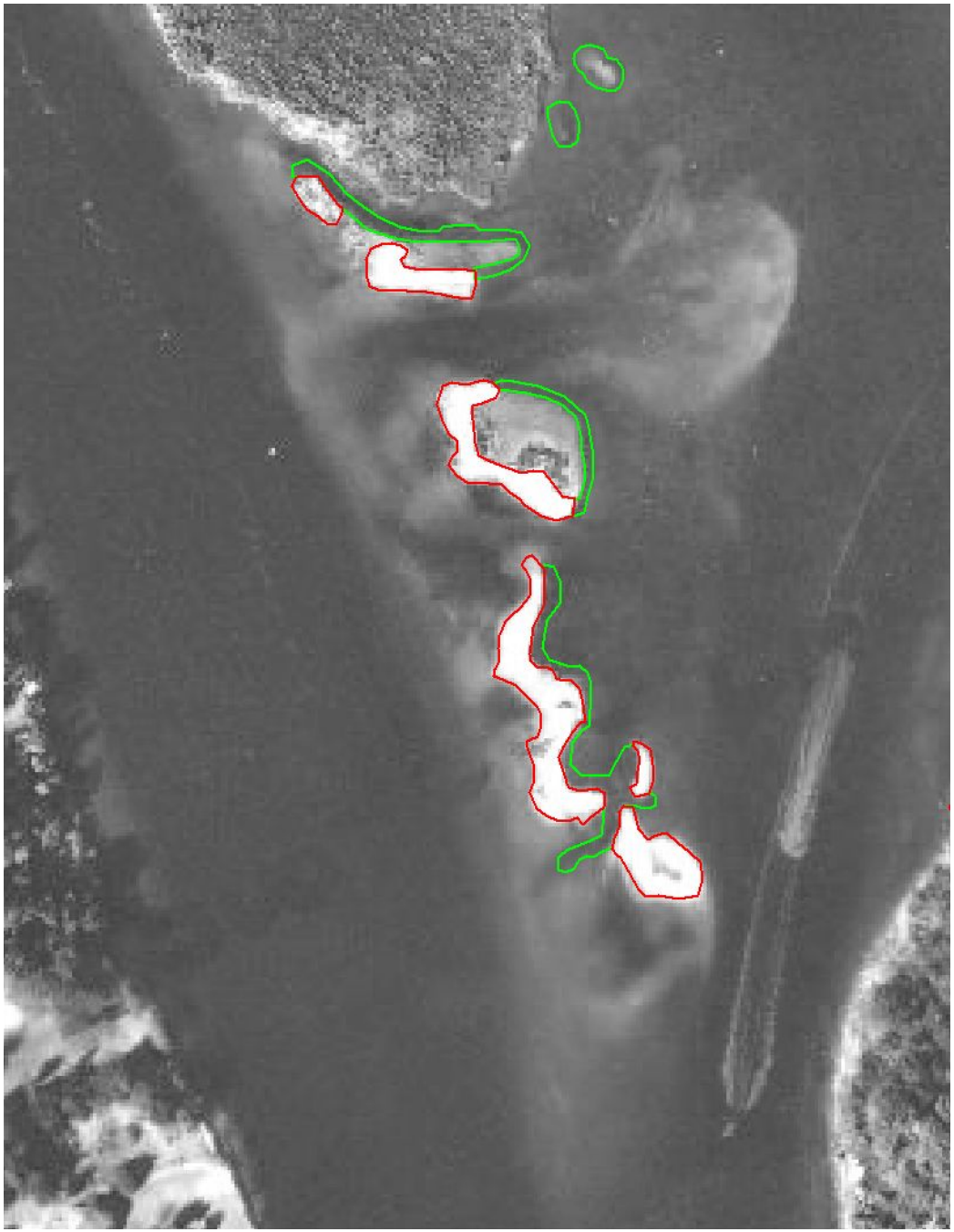


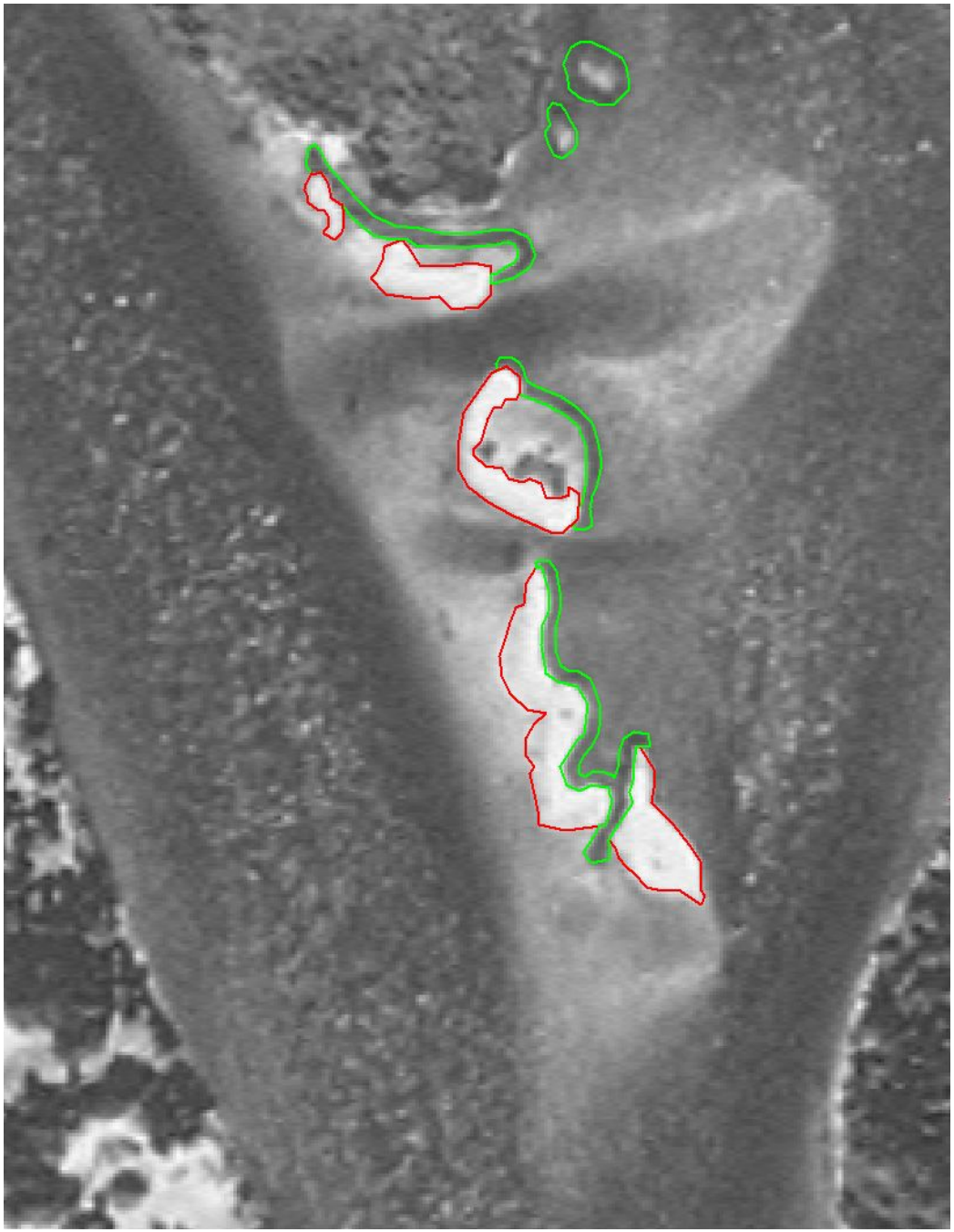
- nearly stable total areal coverage (live + dead) from 1943 - 2000
- increase in occurrence of dead margins from 1975-2000
- 2000: 0.9 ha live, 0.4 ha dead (=45% loss)











A. Historical Analysis - Conclusions

- 57-yr trend: increasing dead margins, decreasing (?) total reef areal coverage
- ***All*** reefs with dead margins adjacent to major boating channels, with most damage along ICW
- History of occurrences of dead margins correlated with potential boating activity in area
- Causal mechanisms part of ongoing studies

B. ArcView Automated Classification

- Objective: ***PRELIMINARY ASSESSMENT*** comparing quadrat density counts with low-altitude and high-altitude aerial imagery analyzed with ArcView's Image Analysis unsupervised categorization (classification) algorithm

Methods

- Low-altitude (1:6,000; 0.5-m resolution) color infrared aerials custom flown
- High-altitude (1:24,000; 1-m resolution) USGS digital orthophotos available on web
- Quadrat counts at measured intervals along marked, geo-referenced transects
- Visual inspection & ArcView Image Analysis, unsupervised classification

Rationale for Classification

Differences in reflectance (four shades of gray in classification) are caused by differences in oyster densities (estimated by quadrat counts).

CANA Reef 3

Low Altitude Aerial

Figure 3.A Area surrounding Reef 3. Flown 1/95.

Figure 3.B Unsupervised Classification performed in Arcview 3.1 with Image Analysis. Four classifications classes were made. Transect is 16 M long and runs N.

Figure 3.C Oyster densities collected along transect from 7/94-3/95.

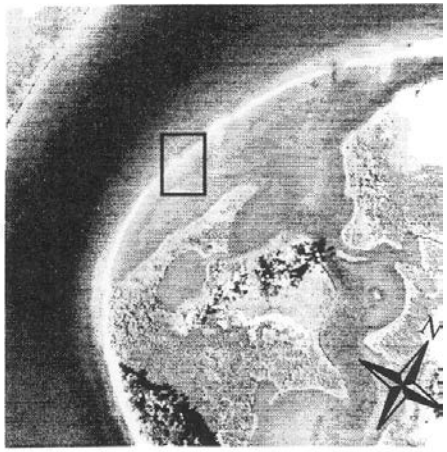


Figure 3.A

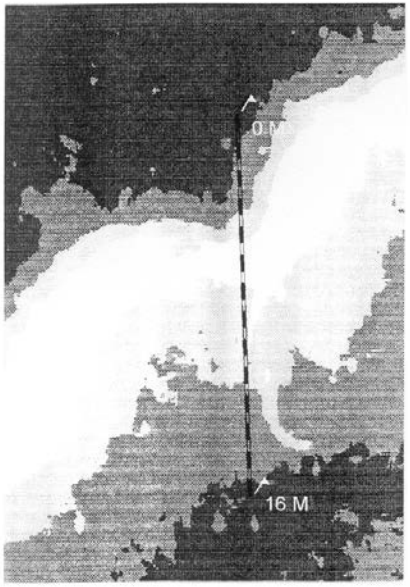


Figure 3.B

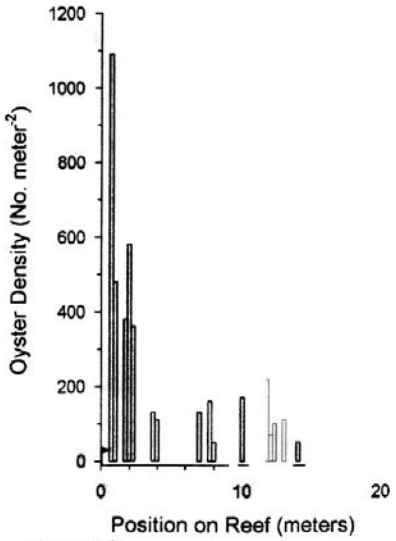


Figure 3.C

CANA Reef 3

USGS Digital Orthophoto

Figure 3.D Area surrounding Reef 3. Flown 1/95.

Figure 3.E Unsupervised Classification performed in Arcview 3.1 with Image Analysis. Four classifications classes were made. Transect is 16 M long and runs S.

Figure 3.F Oyster densities collected along transect from 7/94-3/95.

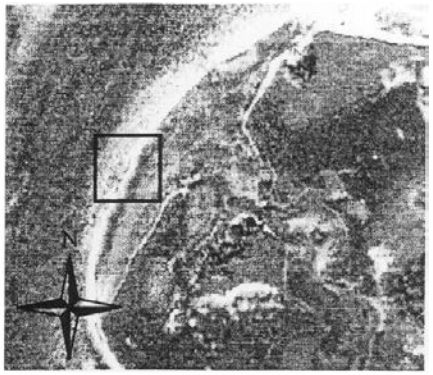


Figure 3.D

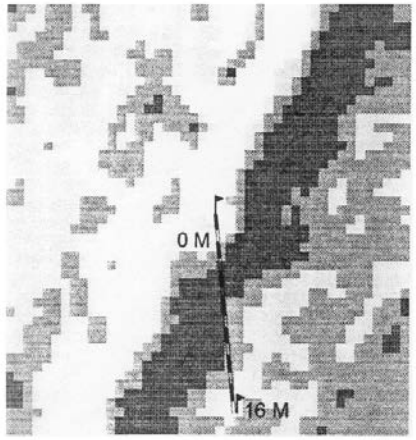


Figure 3.E

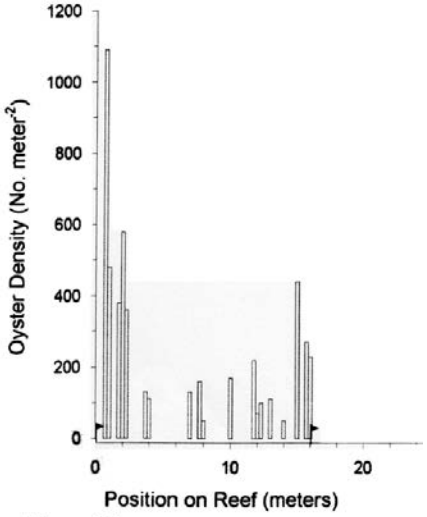


Figure 3.F

CANA Reef 4

Low Altitude Aerial

Figure 4.A Area surrounding Reef 4. Flown 1/95.

Figure 4.B Unsupervised Classification performed in Arcview 3.1 with Image Analysis. Four classifications classes were made. Transect is 10.4 M long and runs SE.

Figure 4.C Oyster densities collected along transect from 7/94-3/95.

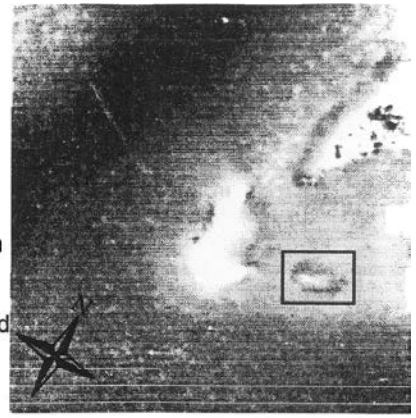


Figure 4.A

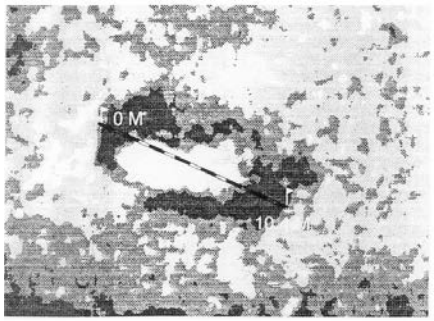


Figure 4.B

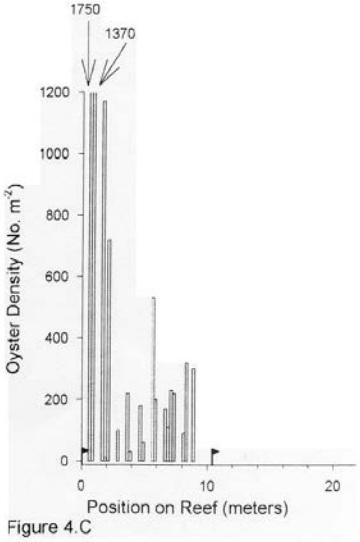


Figure 4.C

CANA Reef 4

USGS Digital Orthophoto

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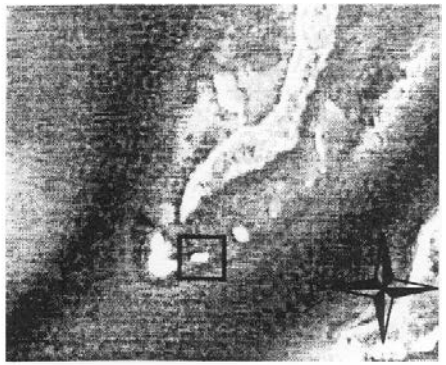

Figure 4.D

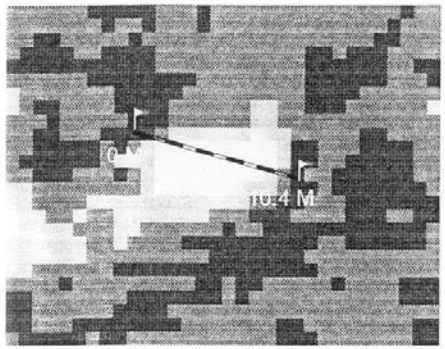

Figure 4.E

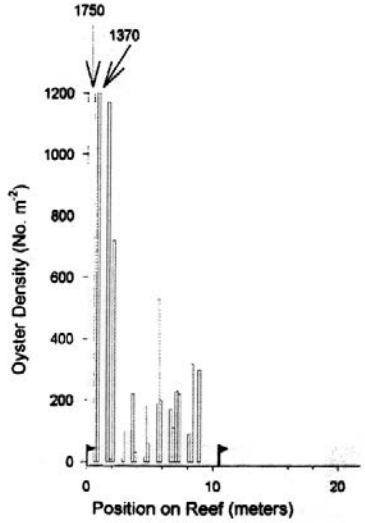

Figure 4.F

Results

- Visual inspection of low altitude (0.5-m resolution) and high altitude (1-m resolution) aerial imagery clearly shows reflectance differences on individual reefs.
- Reflectance differences are correlated with differences in oyster densities in some cases.
- ArcView automated analysis algorithms may be useful for monitoring changes in oyster densities.

B. Automated classification - Conclusions

- Automated analyses of digitized color and black & white aerial imagery shows promise as a routine monitoring tool.
- Similar results should be expected for digital hyperspectral imagery, assuming it is of sufficient spatial resolutioin.

Acknowledgments

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