# Mapping Oyster Beds Using WorldView Imagery: A Comparison of Object-Based and Pixel-Based Classification Approaches

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## Rational

- The eastern oyster, *Crassostrea virginica*, is a native bivalve species typically found along intertidal zones throughout northeast Florida (Fig. 1).
- Substantial loss of oyster reef habitat by human-induced and environmental stressors coupled with shellfish harvesting closures, has encouraged conservation, mapping, monitoring, and restoration efforts throughout Florida.
- Previous mapping conducted by SJRWMD involved manually delineating oyster beds on imagery, which was extremely time-consuming.
- The goal of this project was to evaluate whether computer-based segmentation could reliably identify oyster reefs.

## Methodology

- Orthorectified, pan-sharpened, 8 band, 0.5 m resolution WorldView imagery was collected along the intracoastal waterway in St. Augustine (Fig. 2). Texture metrics (Gray-Level Co-occurrence Matrix) and normalized difference water index (NDWI) were stacked with the imagery.
- Segmentation was calculated using four different methods with the software R, eCognition, and ArcGIS Pro: 1) Pixel-based segmentation 2) ESRI Segmentation, 3) Simple Non-Iterative Clustering (SNIC) object-based segmentation, and 4) eCognition object-based segmentation.
- The Pixel-based classification used a random forest model with 500 training points for differing plant communities (mangrove, salt marsh, oyster, mudflat, upland, water, and urban). The minimum filter of a plant community was 1.5 m. The scale on the SNIC and eCognition object-based segmentation was 50. Segmentation outputs for two areas (Fig. 2) are displayed in Figs. 3 and 4.


Figure 1. An eastern oyster, *Crassostrea virginica*, reef in NE Florida.


Figure 2. Areas with oyster reefs selected for segmentation examples near SR-206 in St. Augustine on color infrared imagery. Area A is presented in Fig. 3. Area B is presented in Fig. 4.

## Results & Summary

- Computer-based segmentation is significantly faster than manually drawing maps, and all four segmentation methodologies successfully identified oyster reefs (Figs. 3 & 4). However, imagery must be taken at low-tide, which is currently not a satellite tasking parameter.
- Pixel-based classification (Figs. 3-1 & 4-1) created a salt-and-pepper phenomenon that requires post-processing filters. It also requires training points to process in R.
- ESRI Segmentation (Figs. 3-2 & 4-2) requires a special imagery license and only allows the selection of 3 bands. It segments every reef, but it does not identify oyster reefs below the water.
- SNIC object-based segmentation (Figs. 3-3 & 4-3) did not segment every reef.
- The eCognition object-based segmentation approach (Figs. 3-4 & 4-4) performed the best at delineating oyster reefs. It segments every reef and it identifies reefs below the water. It does require a software license.
- The coloration of an oyster reef can help distinguish live oysters from dead ones, but determining density would still require ground-truth verification. Pixel-based classification, ESRI segmentation, and eCognition object-based segmentation show potential for distinguishing live from dead oyster reefs.

## Oyster Reef Segmentation Examples

| Oyster Area A | Pixel-Based Segmentation | ESRI Segmentation | SNIC Object-Based Segmentation | eCognition Object-Based Segmentation |
|---|---|---|---|---|

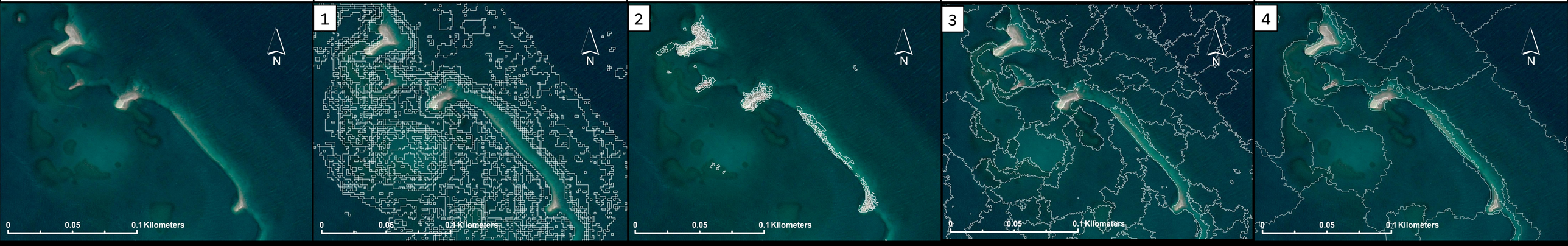


Figure 3. Oyster area A color infrared imagery with no segmentation. 1) Oyster area A color infrared imagery with pixel-based segmentation. 2) Oyster area A color infrared imagery with ESRI segmentation. 3) Oyster area A color infrared imagery with SNIC object-based segmentation. 4) Oyster area A color infrared imagery with eCognition object-based segmentation.

| Oyster Area B | Pixel-Based Segmentation | ESRI Segmentation | SNIC Object-Based Segmentation | eCognition Object-Based Segmentation |
|---|---|---|---|---|

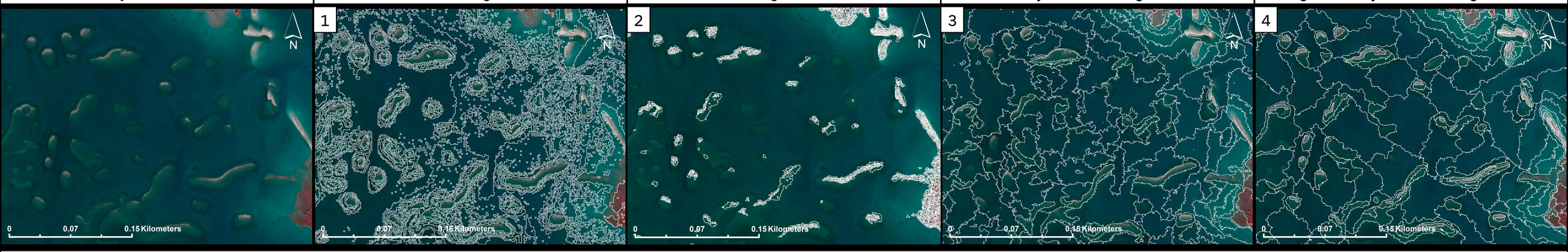


Figure 4. Oyster area B color infrared imagery with no segmentation. 1) Oyster area B color infrared imagery with pixel-based segmentation. 2) Oyster area B color infrared imagery with ESRI segmentation. 3) Oyster area B color infrared imagery with SNIC object-based segmentation. 4) Oyster area B color infrared imagery with eCognition object-based segmentation.

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