Long-term monitoring of seagrasses using a WV-2 satellite image, historical aerial photography and field data

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Whether I’m about to get eaten by a shark or a piece of seaweed touches my foot, I scream the same way.
Objective

• The main goal of this study is to determine long-term changes in seagrass habitat cover at Caja de Muertos Island Nature Reserve (CMINR).

  • Generate a more accurate and current seagrass benthic map of CMINR.
  • Reconstruct the historic distribution of seagrass around CMINR.
Study Area

Caja de Muertos Island
Nature Reserve
Field work

- Sampled area was determined based on 3 criteria:
  - Depth limit of *Thalassia testudinum*
  - Distance from shore
  - Seagrass detection limit of historic photos
- Sampling sites
  - 155 sites for calibration and validation
- Equipment
  - On-board submersible HD video camera
  - Boat depth sounder
  - Trimble Juno 3D Series
Pre-processing

DN to WorldView Radiance

Atmospheric correction

Water column correction

(Max Lyzenga 1978, 1981)

Maximum Likelihood Classification

Field Data

Accuracy Assessment

2014 Seagrass Benthic Map

Bathymetry Map

SPEAR Relative Water Depth

WorldView-2
## Benthic habitat map

### Benthic Categories
- **No Data**
- **Sand**
- **Hardbottom**
- **Coral**
- **Sparse seagrass**
- **Dense seagrass**
- **Very dense seagrass**

### Classifier results

<table>
<thead>
<tr>
<th>Benthic class</th>
<th>Sand</th>
<th>Hardbottom</th>
<th>Coral</th>
<th>Sparse seagrass</th>
<th>Dense seagrass</th>
<th>Very dense seagrass</th>
<th>Classification overall</th>
<th>Producer accuracy</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sand</td>
<td>8</td>
<td>1</td>
<td>1</td>
<td>9</td>
<td>88.89%</td>
<td>9</td>
<td>88.89%</td>
<td></td>
</tr>
<tr>
<td>Hardbottom</td>
<td>4</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>60.00%</td>
<td>1</td>
<td>60.00%</td>
<td>0.00%</td>
</tr>
<tr>
<td>Coral</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>2</td>
<td>50.00%</td>
<td>2</td>
<td>50.00%</td>
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<tr>
<td>Sparse seagrass</td>
<td>4</td>
<td>4</td>
<td>1</td>
<td>4</td>
<td>100.00%</td>
<td>4</td>
<td>100.00%</td>
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<tr>
<td>Dense seagrass</td>
<td>3</td>
<td>2</td>
<td>2</td>
<td>3</td>
<td>30.00%</td>
<td>10</td>
<td>30.00%</td>
<td></td>
</tr>
<tr>
<td>Very dense seagrass</td>
<td>3</td>
<td>2</td>
<td>2</td>
<td>4</td>
<td>33.33%</td>
<td>6</td>
<td>33.33%</td>
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<tr>
<td><strong>Truth overall</strong></td>
<td><strong>11</strong></td>
<td><strong>2</strong></td>
<td><strong>5</strong></td>
<td><strong>8</strong></td>
<td><strong>7</strong></td>
<td><strong>4</strong></td>
<td><strong>37</strong></td>
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</tr>
<tr>
<td><strong>User accuracy</strong></td>
<td><strong>72.73%</strong></td>
<td><strong>0.00%</strong></td>
<td><strong>20.00%</strong></td>
<td><strong>50.00%</strong></td>
<td><strong>42.86%</strong></td>
<td><strong>50.00%</strong></td>
<td><strong>Overall Accuracy: 48.65%</strong></td>
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</table>
Benthic categories

<table>
<thead>
<tr>
<th>Category</th>
<th>% Cover</th>
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<tbody>
<tr>
<td>Seagrass</td>
<td>10-40 %</td>
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<tr>
<td>Colonized hardbottom</td>
<td>40-70 %</td>
</tr>
<tr>
<td>Colonized hardbottom with some seagrass</td>
<td>70-100 %</td>
</tr>
<tr>
<td>Mix algae over unconsolidated sediments</td>
<td></td>
</tr>
<tr>
<td>Sand</td>
<td></td>
</tr>
</tbody>
</table>

Scale: 0-1 Km
Seagrass species

- Thalassia testudinum
- T. testudinum with macroalgae
- Syringodium filiforme
- S. filiforme with macroalgae
- T. testudinum and S. filiforme
- T. testudinum and S. filiforme with macroalgae
- Halodule wrightii
- H. wrightii and S. filiforme
Pre-Processing
- Noise and Sunglint Reduction
- DN to Radiance
- Atmospheric correction
- Water column correction (EOMAP’s algorithms)

Seafloor reflectance data

Field Data

Object-Based Image Analysis

Accuracy Assessment

2014 Seagrass Benthic Map

Detection of long-term changes in seagrass habitat cover

Historical Aerial Photography (1950-2014)

Object-Based Image Analysis

WorldView-2

Bathymetry data
1950-2014 Seagrass Cover Change

31% increase

<table>
<thead>
<tr>
<th>Year</th>
<th>Area (m²)</th>
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<tr>
<td>1950</td>
<td>598,173</td>
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<td>2014</td>
<td>867,731</td>
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<td>Change</td>
<td>269,558</td>
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Acknowledgments

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  - Milton Carlo
  - Orlando Espinosa

By: Hector Martinez