Estimating Net Gains and Losses of Coastal Wetlands in Galveston County and Cameron County, TX

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Urban Riparian Symposium 2017
Background: Coastal Wetlands

- Wetlands found in coastal watersheds: tidal and non-tidal wetlands are included
- Coastal Wetlands offer several important ecological services
Background: Historical Trends

41% of people worldwide live within 100 km of the coast (Martinez et al. 2014).

1996 – 2011 estimates the US lost 1,500 sq. mi. (960,000 acres) of coastal wetlands (Dahl and Stedman, 2013).

70+% were in watersheds surrounding the Gulf Coast (Diffenderfer, 2014).

25%-50% of the world’s coastal wetlands have been converted for anthropogenic uses (Bao, 2015).
Study Purpose

What is the current state of wetland acreage in Galveston and Cameron County?

Use aerial photography and online databases to map wetlands.

Both pictures from: Texaswetlands.org
Two Study Areas

- **Galveston County**
  - Northern Coast
  - Galveston Island
  - $4.2 billion generated to Texas economy through travel
  - 1/3 of Texas commercial fishing
  - Over half of recreational fishing

- **Cameron County**
  - Southern Coast
  - South Padre Island
  - SPI receives more than a million visitors annually
  - 33% Texas Shrimp Industry
  - Port of Brownsville
  - Eco-tourism
National Land Cover Database

- Provides Spatial reference and specific data for a variety of land covers
- 16 different land cover classes

Combined with:
- NOAA C-CAP
- USFWS NWI
Simplified Classification System

2001 Galveston County

2011 Cameron County
Quantifying Losses & Gains

- Raster Calculator was used for change detection: no change, conversion to upland, conversion to open water.
- Calculated percent change
Accuracy Assessments

Performed in ArcGIS 10.3 and Microsoft Excel
30 points for each classification – 90 total
Confusion Matrix was generated: Kappa coefficient, overall accuracy, errors of commission, errors of omission, producer accuracy, and user accuracy.
Accuracy Assessments
Issues with NAIP Imagery

2006 Galveston County

2006 Cameron County
Results
## Overall Gains and Losses: Galveston County

<table>
<thead>
<tr>
<th>Land Cover</th>
<th>% Change 2001-2006</th>
<th>% Change 2006-2011</th>
</tr>
</thead>
<tbody>
<tr>
<td>Upland</td>
<td>4.47%</td>
<td>2.84%</td>
</tr>
<tr>
<td>Wetland</td>
<td>-4.59%</td>
<td>-5.10%</td>
</tr>
<tr>
<td>Open Water</td>
<td>-1.15%</td>
<td>-0.29%</td>
</tr>
</tbody>
</table>
### Overall Gains and Losses: Galveston County

<table>
<thead>
<tr>
<th>Conversion Type</th>
<th>2001-2006 acreage</th>
<th>2006-2011 acreage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wetland to Upland</td>
<td>10562.82</td>
<td>11213.32</td>
</tr>
<tr>
<td>Wetland to Open Water</td>
<td>1441.34</td>
<td>2054.70</td>
</tr>
<tr>
<td>Upland to Wetland</td>
<td>5644.58</td>
<td>7711.51</td>
</tr>
<tr>
<td>Open Water to Wetland</td>
<td>2445.89</td>
<td>1541.19</td>
</tr>
</tbody>
</table>
Overall Gains & Losses: Galveston County

2001-2006 Galveston County Land Change

2006-2011 Galveston County Land Change
Wetland Gains: Galveston County (2001-2006)
Galveston County Gains 2001-2006 - Close Up
Wetland Loss: Galveston County (2001-2006)
Galveston County Losses 2001-2006 – Close Up
Wetland Gain: Galveston County (2006-2011)
Wetland Loss: Galveston County (2006-2011)
Galveston County Losses 2006-2011 – Close Up
# Overall Gains & Losses: Cameron County

<table>
<thead>
<tr>
<th>Land Cover</th>
<th>% Change 2001-2006</th>
<th>% Change 2006-2011</th>
</tr>
</thead>
<tbody>
<tr>
<td>Upland</td>
<td>-1.1%</td>
<td>0.1%</td>
</tr>
<tr>
<td>Wetland</td>
<td>-1.4%</td>
<td>-0.47%</td>
</tr>
<tr>
<td>Open Water</td>
<td>4.19%</td>
<td>-.002%</td>
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</table>
### Overall Gains & Losses: Cameron County

<table>
<thead>
<tr>
<th>Conversion Type</th>
<th>2001-2006 acreage</th>
<th>2006-2011 acreage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wetland to Upland</td>
<td>1,040.58</td>
<td>2,292.00</td>
</tr>
<tr>
<td>Wetland to Open Water</td>
<td>603.13</td>
<td>165.91</td>
</tr>
<tr>
<td>Upland to Wetland</td>
<td>56.27</td>
<td>1,345.71</td>
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<tr>
<td>Open Water to Wetland</td>
<td>10.45</td>
<td>592.46</td>
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Overall Gains & Losses: Cameron County

2001-2006 Cameron County Land Change

2006-2011 Cameron County Land Change
Cameron County Wetland Loss 2001-2006: Close Up
Wetland Loss: Cameron County (2006-2011)
## Accuracy Assessments

<table>
<thead>
<tr>
<th>Year</th>
<th>Galveston County</th>
<th>Cameron County</th>
</tr>
</thead>
<tbody>
<tr>
<td>2001</td>
<td>89.89%</td>
<td>87.78%</td>
</tr>
<tr>
<td>2006</td>
<td>98.89%</td>
<td>82.22%</td>
</tr>
<tr>
<td>2011</td>
<td>95.56%</td>
<td>96.67%</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Year</th>
<th>Kappa</th>
<th></th>
<th></th>
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</thead>
<tbody>
<tr>
<td>2001</td>
<td>0.897</td>
<td>0.875</td>
<td></td>
</tr>
<tr>
<td>2006</td>
<td>0.989</td>
<td>0.818</td>
<td></td>
</tr>
<tr>
<td>2011</td>
<td>0.955</td>
<td>0.960</td>
<td></td>
</tr>
</tbody>
</table>
Summary of Results

- Wetland loss is greater than wetland gains.
- Majority of losses were from conversion to upland areas (>80%)
  - In urban areas
- Galveston County experienced an overall 10% loss between 2001 and 2011 (~5% each study period)
- Cameron County experienced an overall 2% loss between 2001 and 2011 (1.5% loss 2001-2006 and 0.5% loss 2006-2011)
- Our maps had above 80% accuracy in identifying between wetland, upland, and open water
- 20% increase in population for both counties between 2001-2011
Important to see the overall trends in these rapidly changing areas.
Can easily compare areas and see priority areas for wetland conservation.
Further look at policy and management practices between Galveston and Cameron County.
  Both had 20% increase in population but had different amount of wetland loss (10% - Galveston County and 2% - Cameron County)
Fairly accurate results can be obtained by using a simplified classification system and aerial photography. Cursory knowledge of the area.
References


Questions & Comments

Thank you