Primary Bay Habitats

- **Seagrass**
- **Emergent Tidal Wetlands (ETW)**
  - Mangrove = mangrove + *Spartina* marshes = polyhaline habitat
  - Salt Marsh = *Juncus* marsh = oligohaline habitat
  - Salt Barren = hypersaline habitat

- Habitat/salinity continuum is needed to support life histories of estuarine dependent species
Habitat Change Analysis History

- 1996 “Restoring the Balance” document
  - 1950 FDNR marine resource coverage
  - 1990 SWFWMD land use coverage
  - Modification of cover classes for consistency
    - Mangroves + *S. alterniflora* = mangrove/marsh
    - *Juncus roemerianus* = salt marsh
  - PI/Digitizing of 1990 salt barren coverage
  - Conduct change analysis using GIS overlay techniques
Habitat Change Analysis History

• 2009 Habitat Master Plan
  – Extends change analysis for 4 time periods
    • 1990-1995
    • 1995-1999
    • 1999-2004
    • 2004-2007
  – Source data
    • 1995 salt barren coverage from TBEP (Janicki Env.)
    • PBS&J created 1999 salt barren coverage from high resolution aerial imagery
    • PBS&J conducted review of 2004 SWFWMD GIS data and developed data layer for ETW in transition
# Time Period Comparison

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Mangrove</td>
<td>-2,048</td>
<td>379</td>
</tr>
<tr>
<td></td>
<td>-12.9%</td>
<td>2.6%</td>
</tr>
<tr>
<td>Salt Marsh</td>
<td>-2,452</td>
<td>52</td>
</tr>
<tr>
<td></td>
<td>-37.0%</td>
<td>1.2%</td>
</tr>
<tr>
<td>Salt Barren</td>
<td>-484</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>-35.3%</td>
<td>0.4%</td>
</tr>
<tr>
<td>Totals</td>
<td>-4,984</td>
<td>433</td>
</tr>
<tr>
<td></td>
<td>-20.9%</td>
<td>2.2%</td>
</tr>
</tbody>
</table>
Can We Believe the Numbers?

• Yes, for macro-level changes
  – 1950-1990 analysis is valid

• Probably not for small-scale changes over short time periods
  – Different GIS standards (1990 dataset)
  – Photo-interpretation inconsistencies
  – Classification errors
  – Transitional areas difficult to classify
How Can We Assess Small Changes?

Review previous studies for accuracy

Use new minimum mapping units appropriate to changes occurring (0.25 ac vs. 2 to 5 ac?)

Use imagery with appropriate resolution to map to minimum units

Automate processes: implement standardized, non-biased, repeatable mapping methods

Utilize field plots and signature sites to augment automated processes
The Past: 1940 -1950 habitats

Mapping from aerial black/white photographs
The Past: 1972

Landsat imagery -- 15 to 60m - 8 bands
The Past: 1994 - 2004

Digital Orthoquads – 1m DOQs
# The Present:
## Commercial Imagery Sources

<table>
<thead>
<tr>
<th>Aerial Platforms</th>
<th>Space Platforms</th>
</tr>
</thead>
<tbody>
<tr>
<td>4-band digital sensors</td>
<td>4-band digital sensors</td>
</tr>
<tr>
<td>Resolution: 3”+ pixels</td>
<td>Resolution: 16”-18” pixels</td>
</tr>
<tr>
<td>Format: frames with overlap for stereo</td>
<td>Format: line scanner, extra cost for stereo</td>
</tr>
<tr>
<td><strong>Pros:</strong> high resolution, mission timing for optimal image conditions</td>
<td><strong>Pros:</strong> large footprint, global coverage, rapid revisit of sites</td>
</tr>
<tr>
<td><strong>Cons:</strong> small footprint, “local” coverage</td>
<td><strong>Cons:</strong> no control over ground conditions, atmospheric correction required</td>
</tr>
</tbody>
</table>
The Present:
4-Band High Resolution Imagery – 6” to 1’

2008 Natural Color

2008 Color Infrared
The Present:

1’ Resolution vs. 1m resolution
The Present: 3-D 4-Band High Resolution Imagery
The Present: 3-D 4-Band High Resolution Imagery
The Present: 3-D 4-Band High Resolution Imagery
The Present: 3-D 4-Band High Resolution Imagery
The Present: 3-D 4-Band High Resolution Imagery
The Present:
CPU Development

CPU Transistor Counts 1971-2008 & Moore’s Law

Curve shows ‘Moore’s Law’: transistor count doubling every two years.
The Present:
Maps based on LiDAR

ALS-60 LiDAR unit
The Present:
Maps based on LiDAR

USGS DEM

LiDAR DEM
Contour Generation
Intensity & Texture Images
The Present:
Elementary Data Fusion

Field Observations

GIS
ArcGIS

Remote Sensing
ERDAS Imagine
ENVI

Photo Interpretation or
Semi-Automated
Feature Generation

Feature Analyst
ERDAS Objective
Definiens
Socet GXP
Semi-Automated Feature Generation
Semi-Automated Feature Generation
The Future: BASIS 6?

Automated Mapping will require

Spectral Signature Library for Vegetation/Phases
High Resolution 16 to 256 band Hyperspectral Imagery
Concurrent LiDAR acquisition or improved auto-correlation
Desktop Supercomputers with 3-D monitors & petabyte hard drives
Robust Rulesets for Image Classification
Field and Visual Accuracy Assessment

Image Classification

Data Cube: Hydrology, NDVI, Greenness, etc, spp signatures, slope, aspect, elevation, etc

LIDAR or DEM GRID to Elevation Polygons
LIDAR or DEM GRID to TIN for derivation of Slope & Aspect

Field Work: spp signatures & Baselines Data

Minimum Mapping Unit Polygons with Preliminary Dominance-type

QC: 3D Manual Interpretation of Dominance-Type

NO

PASS?

Final Accuracy Assessment: Field Verification & Image Interpretation

Polygon Feature Class with Dominance Type & Canopy Cover %

Polygon Feature Class with Dominance Type

Build Height vs. DBH tables/regressions for each dominance-type tree spp

Build Height vs. DBH table to determine polygon height statistics

Calculate percentage of polygon above surface height based on Dominance Type

Correlate polygon distribution table with DBH table to determine polygon tree size class

Vegetation Polygons with Dominance Type, Canopy Cover, & Tree Size Class

Build Frequency Distribution Table of height vs pixel count for each polygon to determine polygon height statistics

Pixel Height Above Surface (PHASE) GRID

Trees

LIDAR or DEM GRID To Elevation Polygons
LIDAR or DEM GRID To TIN for derivation of Slope & Aspect

Field Work: spp signatures & Baselines Data

Minimum Mapping Unit Polygons with Preliminary Dominance-type

QC: 3D Manual Interpretation of Dominance-Type

NO

PASS?
Monitoring Recommendations

More accurate and precise change analysis methods should be implemented to track small-scale changes in habitat cover over short time scales (years vs. decades)

- Multi-spectral automated analysis of high resolution aerial imagery
- Combined with LiDAR to assess critical coastal uplands for acquisition
- Pilot project completed by 2010
Monitoring Recommendations

Ground-level monitoring should be implemented to document community-level changes in response to climate change and other stressors

- Minimum of 5 permanent transects – one per primary bay segment
- Fixed stations with established quadrats
  - Plant composition and % cover
  - Interstitial salinity
In Conclusion

“The Future is fun
The Future is fair
You may already have one
You may already be there!”

Firesign Theatre – We’re All Bozos on this Bus

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