CREATING A HABITAT SUITABILITY INDEX TO PLAN FOR FUTURE SEAGRASS RESTORATION

Bob Swett[1], **Althea S. Hotlaing[2]**, Tom Frazer[2], Rex Ellis[3], Chuck Listowski[4]

[1]University of Florida School of Forest Resources and Conservation, Gainesville, FL, USA
[2]University of Florida School of Natural Resources and Environment, Gainesville, FL, USA
[3]University of Florida Department of Soil and Water Science, Gainesville, FL, USA
[4]West Coast Inland Navigation District, Venice, FL USA

Seagrass Ecosystem Services

- Sediment stabilization
- Water filtration
- Protection from storms
- Habitat and nursery for commercial and recreational fish species

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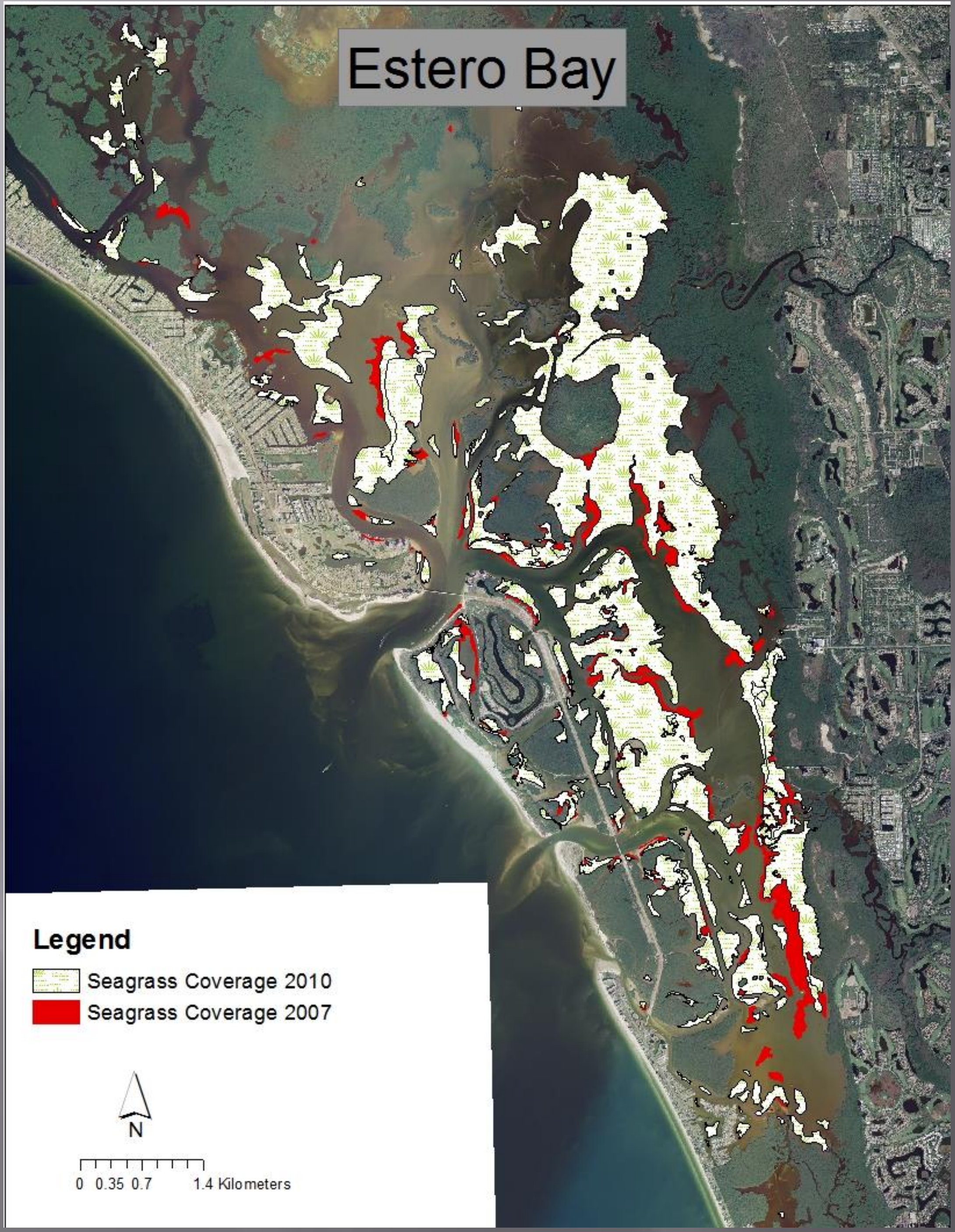
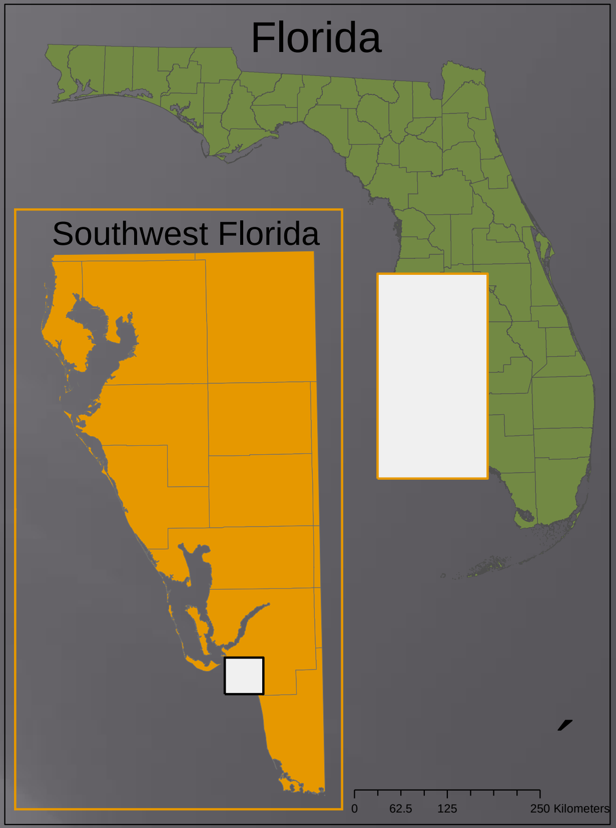
Loss

- In the last two decades the documented loss of seagrass has been 3.3 million hectares or 20% of total documented coverage in the world
- Estimated 1,600 hectares needs to be restored SW Florida



Estero Bay
Legend
Seagrass Coverage 2010
Seagrass Coverage 2007
N
0 0.35 0.7 1.4 Kilometers



Florida
Southwest Florida
0 62.5 125 250 Kilometers

Causes

- Direct loss of seagrass
  - Docks
  - Marinas
  - Navigation channels
  - Increase in boating (particularly by inexperienced boaters)
- Indirect causes of loss
  - Eutrophication
  - Sedimentation
  - Changing salt/freshwater flow patterns
  - Climate change
  - Sea level rise

Habitat Suitability Index

- Identify areas of the bay that have a suitable light environment for seagrass restoration
  - Throughout Bay (Space)
  - Seasonality (Time)
- Improve science behind restoration site selection

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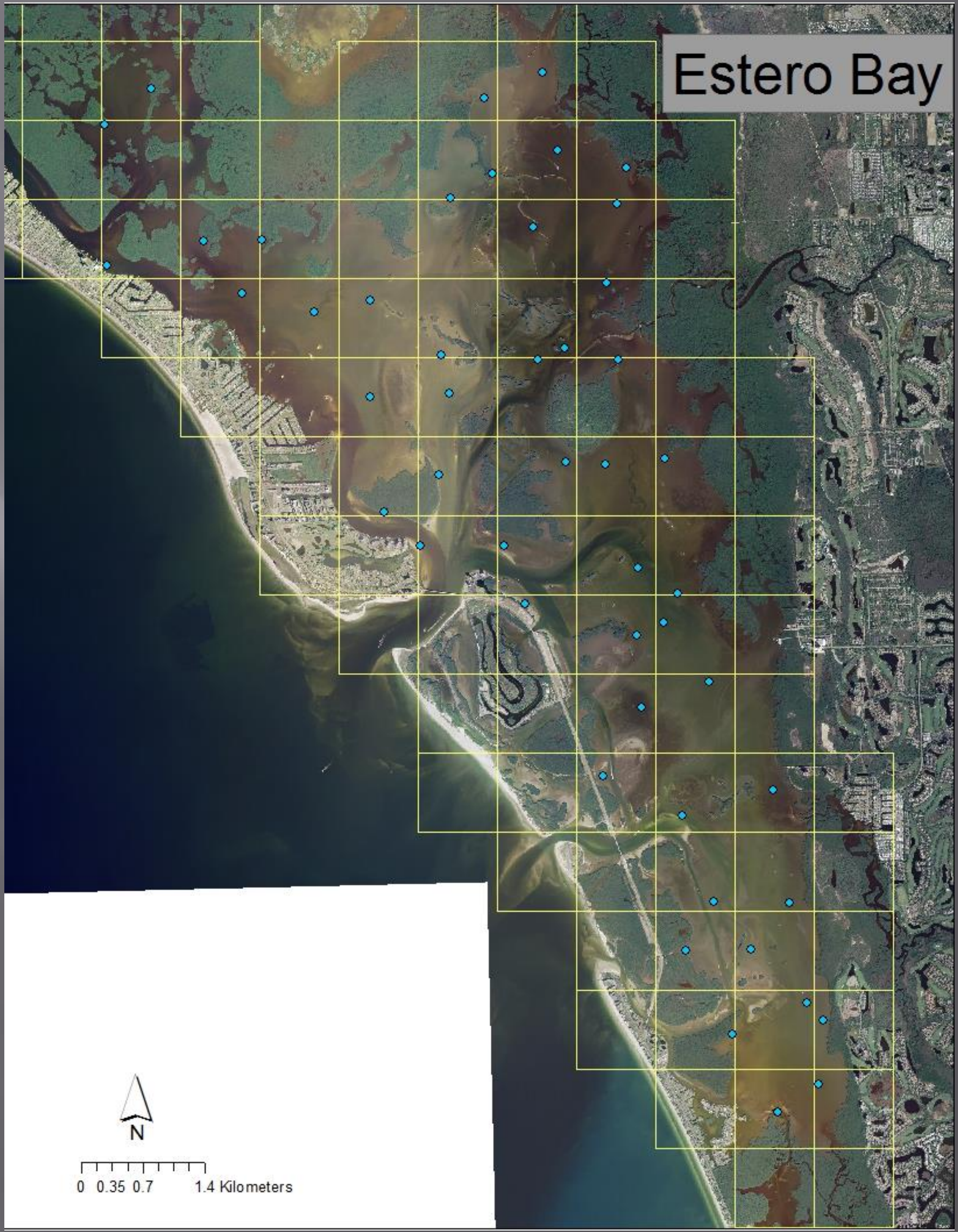
Methods

- Stratified random sampling was used to identify 50 points in the bay
- Data collection occurred over 2 days every 3 weeks for a year
- Data recorded at each site
  - PAR (photosynthetically active radiation)
  - Water Depth
  - Salinity
  - Water Temperature
  - Dissolved Oxygen
  - Sampling Time



- PAR readings are paired, one on the surface and one 25 cm from the bottom
  - Between 10 am and 2 pm
  - 3 replicate measurements are made more than 30 sec apart at each site
- The percent of light available at the bottom is calculated for each reading and then the 3 percentages obtained for that sampling event are averaged
- LI-COR LI-1400 Data Logger
- Paired LI-COR LI-193SA Underwater Spherical Quantum Sensors

Light attenuation coefficients (K_d)

- Calculated from paired light readings using the Lambert-Beer Law:

$$I_Z = I_O e^{-(K_d)z}$$

- Where I_Z is light measured at depth z, I_O is light measured at the surface and K_d is the light attenuation coefficient in units of m^{-1}
- For each of the 50 sites the average K_d, minimum K_d, max K_d, lower quartile, upper quartile, and 90th percentile was calculated.

Kriging

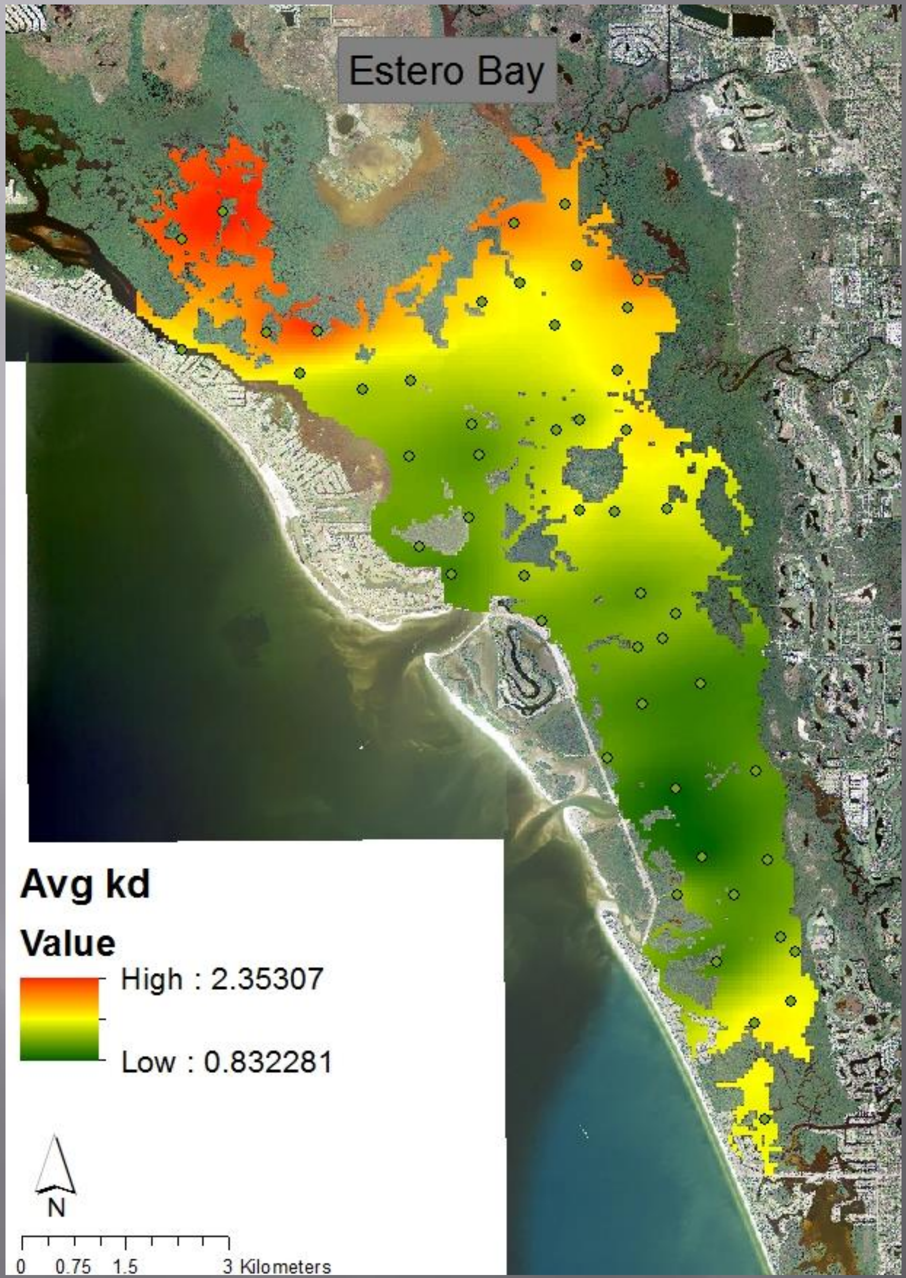
- Geostatistics- uses statistical theory and software to analyze data with location coordinates
- Kriging allows you to predict values where no measurements have been taken
  - Measure the error of your prediction
- ArcGIS 10.1, Geostatistical Analyst
- Ordinary, simple, and universal kriging models were fit to the data
- Transformations, trend removals, anisotropy, and an iterative cross validation techniques was used to optimize model parameters
- Model with the smallest root mean square error was selected in each case

A
Value 10

B
Value ?

C
Value 20

Water Clarity

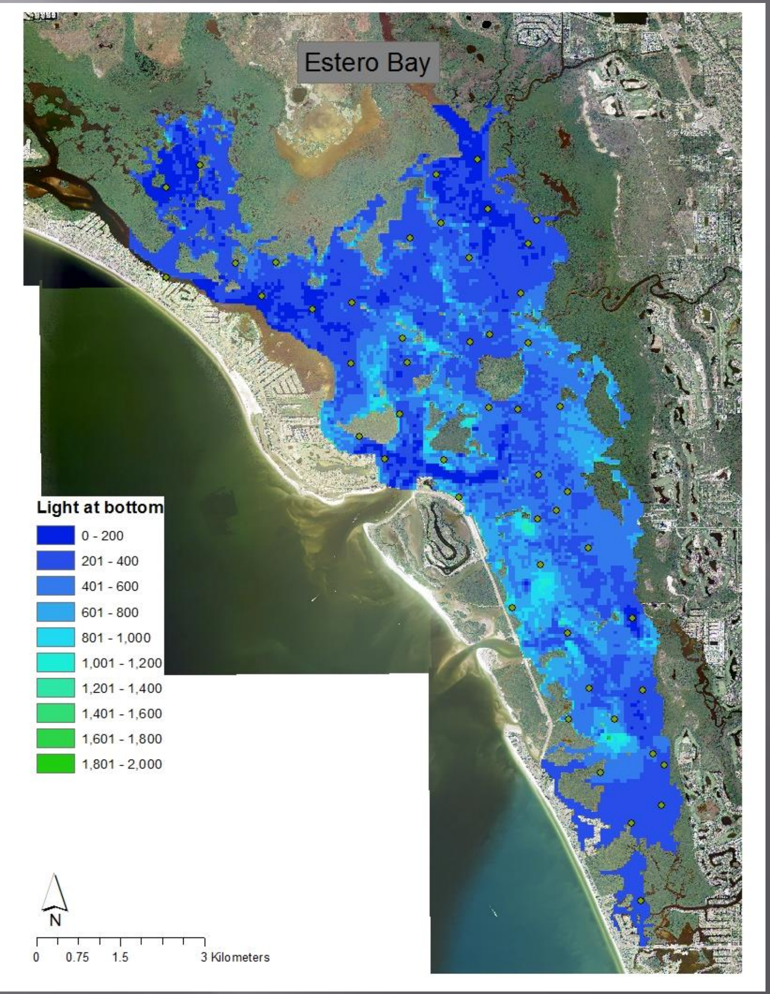


- Convert to raster
- Spatial Analyst Tools
  - Map Algebra
  - Raster Calculator
- Use depths from dense Lidar bathymetry layer
- Using Lambert Beers Law with known depths and predicted kd can predict light available at the bottom under average surface light conditions

Bathymetry

- 816,218 depths
- Lidar
- Collected by USGS for South Florida Water Management District
- 2003
- NASA EAARL lidar

Average Amount of Light (µmol photons) Available at the Bottom of Estero Bay



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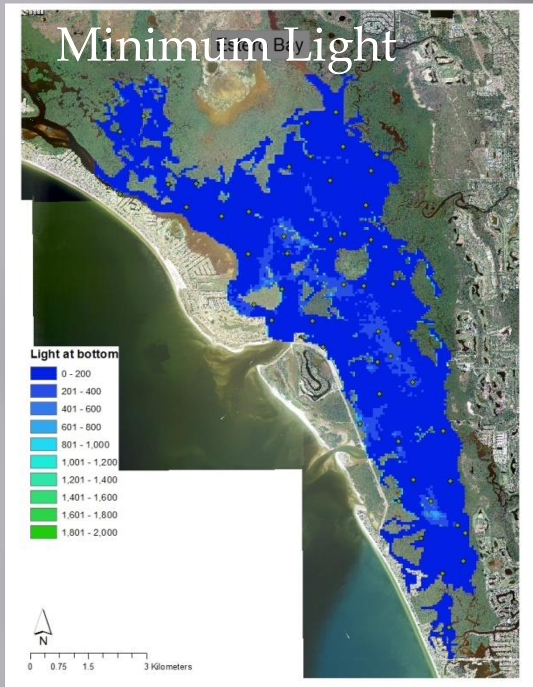
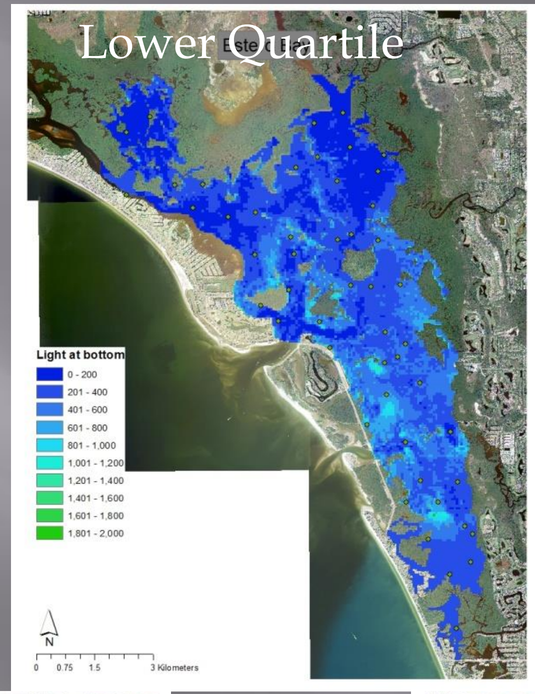
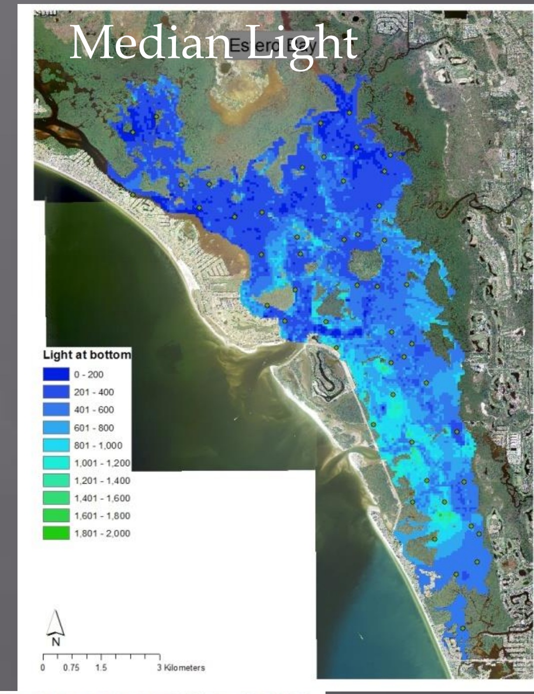
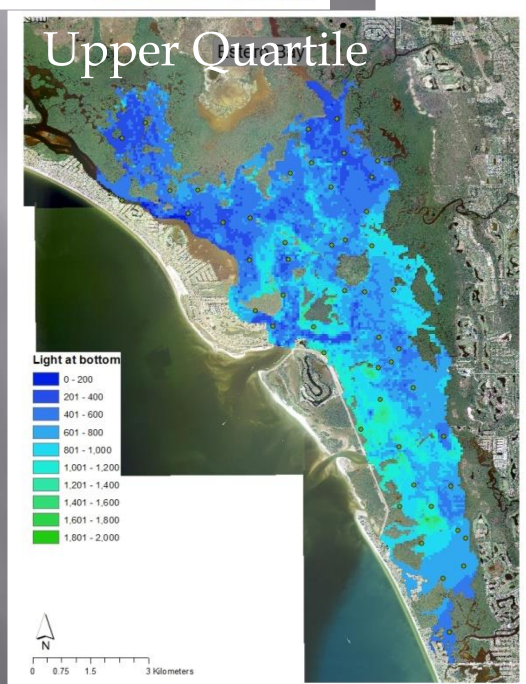
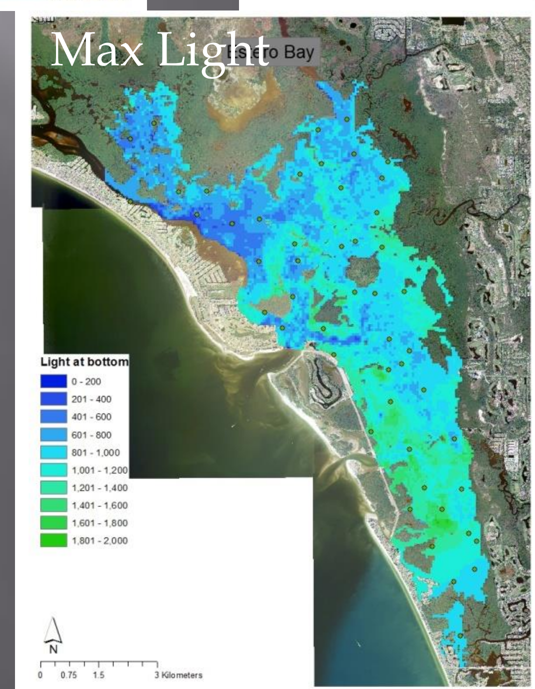

Minimum Light
Light at bottom
0 - 200
201 - 400
401 - 600
601 - 800
801 - 1,000
1,001 - 1,200
1,201 - 1,400
1,401 - 1,600
1,601 - 1,800
1,801 - 2,000
N
0 0.75 1.5 3 Kilometers


Lower Quartile
Light at bottom
0 - 200
201 - 400
401 - 600
601 - 800
801 - 1,000
1,001 - 1,200
1,201 - 1,400
1,401 - 1,600
1,601 - 1,800
1,801 - 2,000
N
0 0.75 1.5 3 Kilometers


Median Light
Light at bottom
0 - 200
201 - 400
401 - 600
601 - 800
801 - 1,000
1,001 - 1,200
1,201 - 1,400
1,401 - 1,600
1,601 - 1,800
1,801 - 2,000
N
0 0.75 1.5 3 Kilometers


Upper Quartile
Light at bottom
0 - 200
201 - 400
401 - 600
601 - 800
801 - 1,000
1,001 - 1,200
1,201 - 1,400
1,401 - 1,600
1,601 - 1,800
1,801 - 2,000
N
0 0.75 1.5 3 Kilometers


Max Light
Light at bottom
0 - 200
201 - 400
401 - 600
601 - 800
801 - 1,000
1,001 - 1,200
1,201 - 1,400
1,401 - 1,600
1,601 - 1,800
1,801 - 2,000
N
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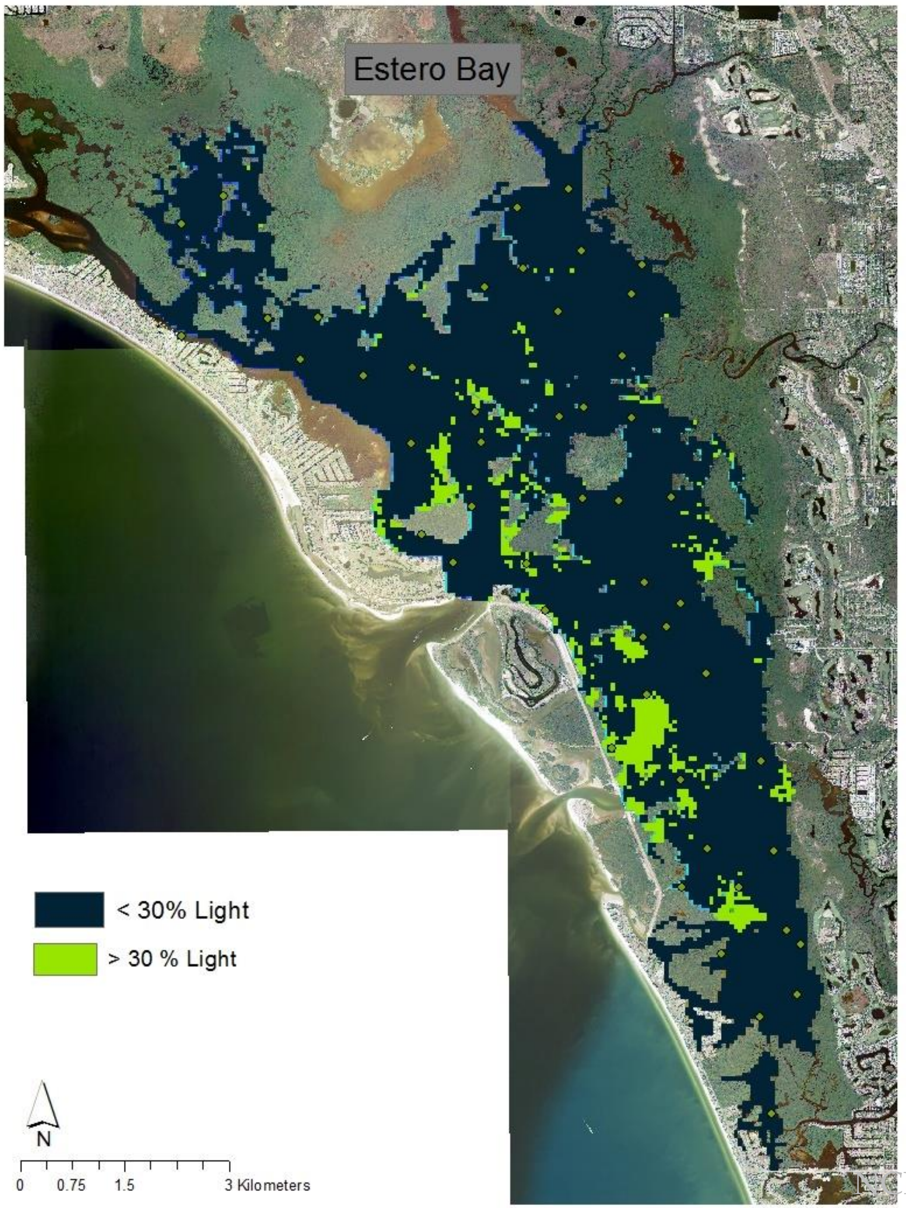
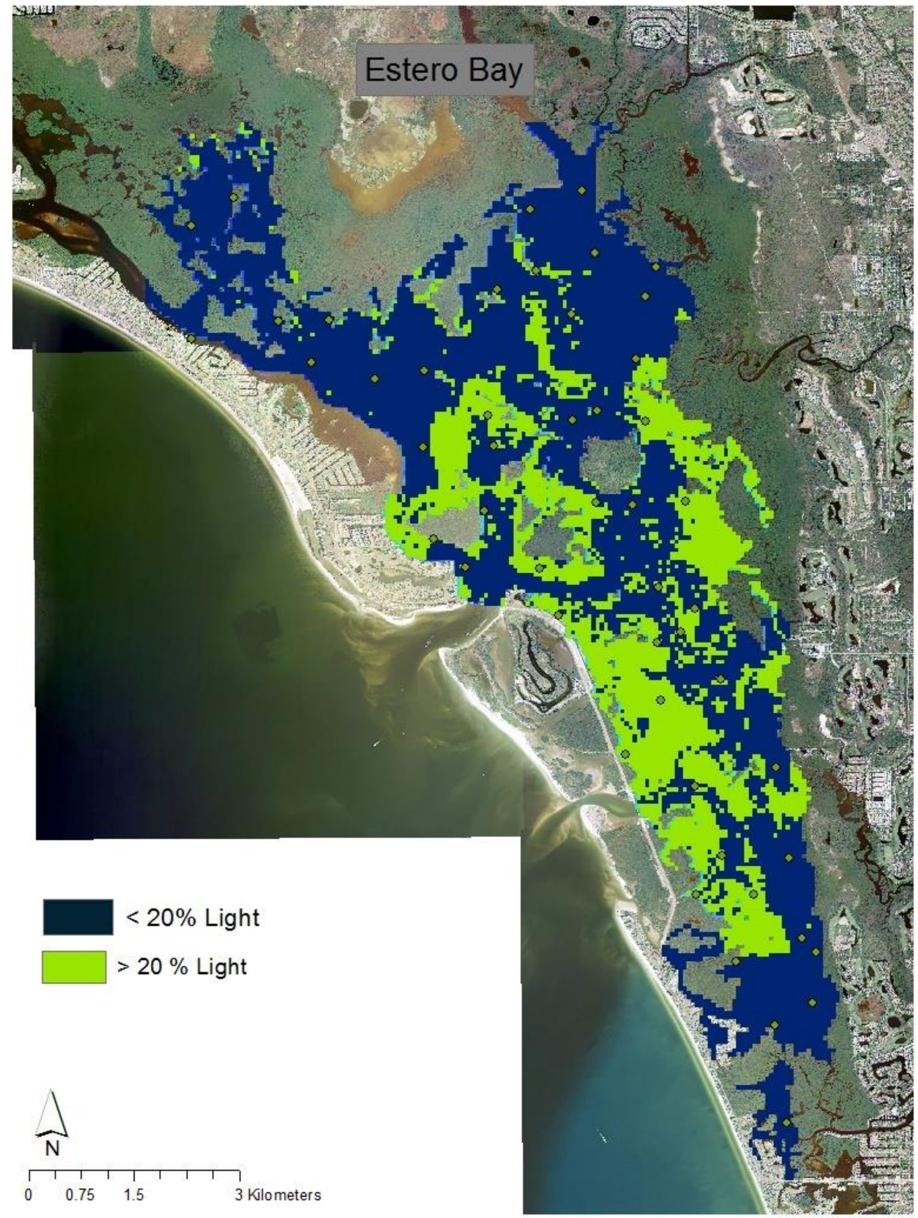

Estero Bay
< 30% Light
> 30 % Light
N
0 0.75 1.5 3 Kilometers


Estero Bay
< 20% Light
> 20 % Light
N
0 0.75 1.5 3 Kilometers

Acknowledgements

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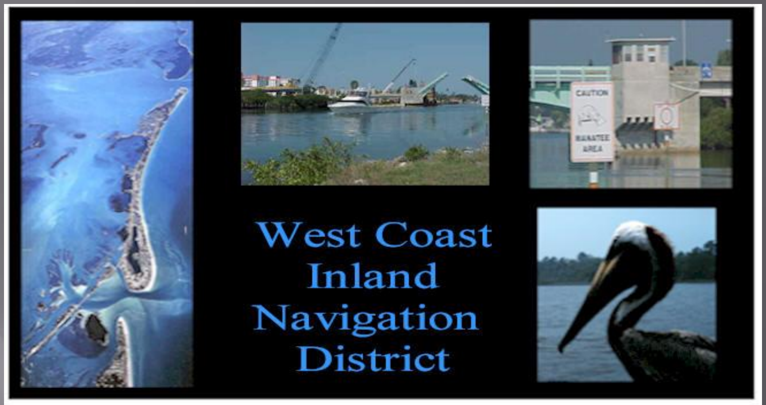
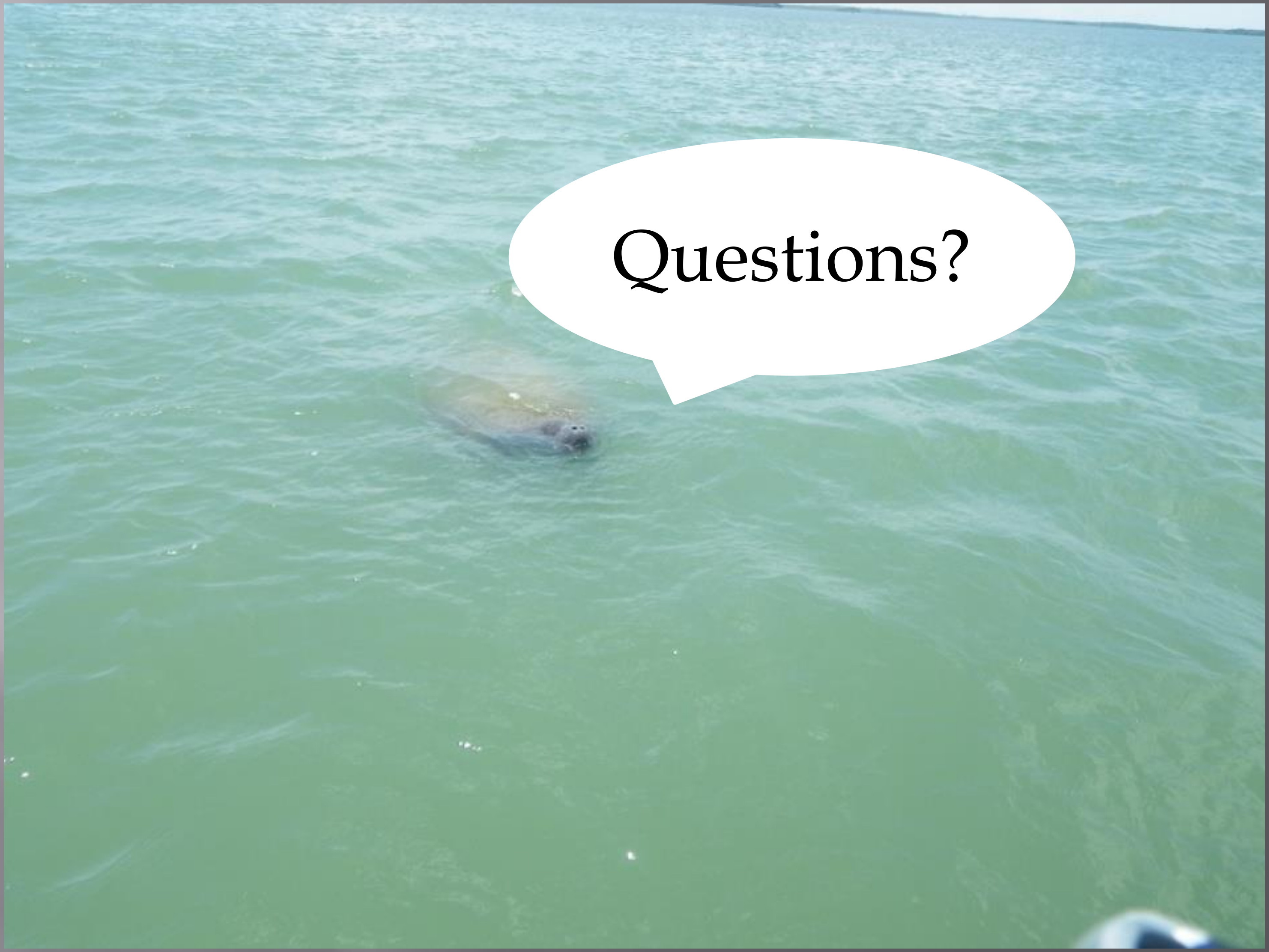


UF Boating and Waterway Management Program
IFAS Extension
UNIVERSITY of FLORIDA

Sea Grant
Florida


Questions?