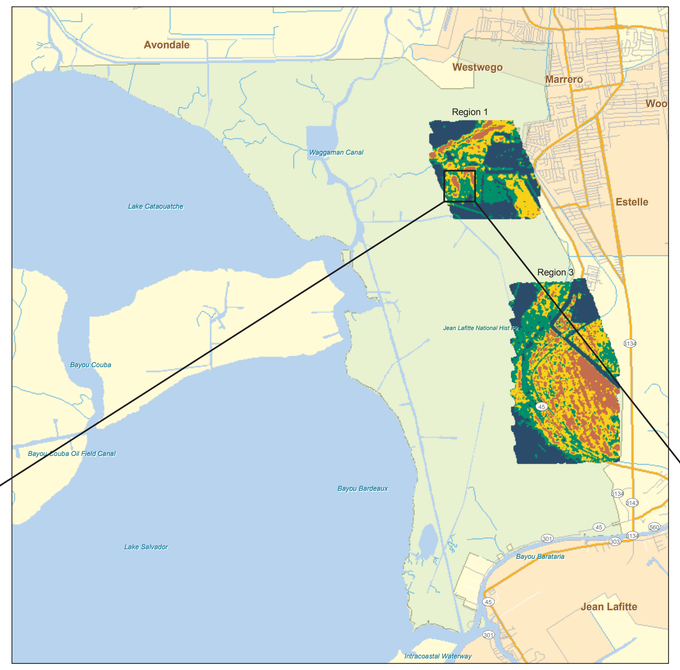
GULN LiDAR Ground-truthing: A GIS aided sample design to collect vegetation composition data for assessing correspondence

Jeff Bracewell, GULN; Robert Woodman, GULN; Kyle Harms, LSU

Abstract: At Jean Laffite National Historical Park and Preserve (Barataria Preserve) Principal Components Analysis has been used by the GULN, in cooperation with USGS, to classify vegetation structure based on EAARL LiDAR. Using this LiDAR-based approach, vegetation structure will be monitored over time to indicate changes that may warrant further investigation. Four LiDAR-based measures were combined to represent vegetation structure for the entire Barataria Unit which can be aggregated into as many as 16 statistically distinct classes and collapsed down to as few as 4 classes. To make this classification product useful in terms of park management, the GULN needed to establish a set of methods to find biological correspondence to discrete "patches" in the classed product. The GULN termed this process "ground-truthing". The methodology for ground-truthing was developed, in cooperation with Louisiana State Univ, resulting in a two phase approach. Phase 1, a "first-look", was based on a four-class product using transects to traverse across class boundaries and take a suite of vegetation-related measurements within classes. Phase 2 took a more detailed approach employing a grid-based sample method using an 8-class product. Details of sample design using GIS as well as sample outcomes (field measures) from the ground-truthing project at Barataria are presented here to highlight the ground-truth sampling portion of the vegetation structure monitoring protocol currently under development.



Four Class Model

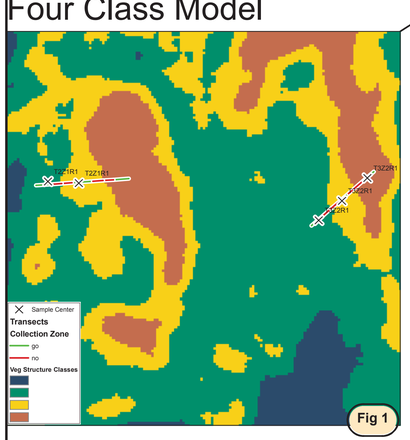


Fig 1

Fig 1. Sample transects with "go" zones where samples could be collected and "no go" zones which were zones of transition and samples were not permitted.

The Plan (Ph 1):
A four class model was chosen for a "first look" at correspondence between LiDAR classified structure and on-the-ground structure. The four class model was ideal starting point in that it allowed for a relatively low grade of precision in locating one's self well within a class and avoiding transition zones. Transects were chosen as sample features to reflect gradients of veg structure by crossing class boundaries, avoiding transition zones. Transects were assumed to be an efficient means to navigate several sample points in multiple classes in a single sample route. In constructing transects we tried to be flexible by creating "go" and "no go" zones (fig 1). A "go" zone was a collection area defined as anything along a transect that was 20 meters or more away from a class boundary. Conversely a "no go" zone was not a collection area and was defined as anything along a transect within 20m of either side of a class boundary. Sample areas were designed as 20m dia circular plots with the plot center located anywhere along a "go" zone. Transects averaged about 200m in length and were positioned to cover multiple classes. A total of 45 possible sample sites ("go"zones) were chosen for a team to sample from.

The Reality (Ph 1):
When boots hit the ground several challenges quickly arose (as outlined below). Despite the difficulties, our field crew was able to take a suite of veg structure measurements at 45 sites and offer good suggestions for ph 2 of GT.
Key lessons from Ph 1:
• Straight lines are next to impossible to traverse at JELA due to dense vegetation and the lack of solid ground (fig 2)
• Cooperators seemed to struggle with the concept of locating a site along a transect instead of having a single "go to" point
• Some places are just impossible to safely get to.
• An insufficient number of possible sample sites were given to allow flexibility and adaptability in logistics
• Results were unbalanced across classes (fig 3)

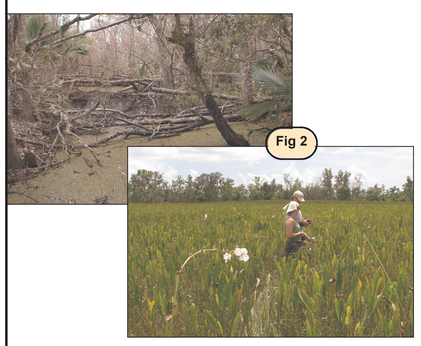
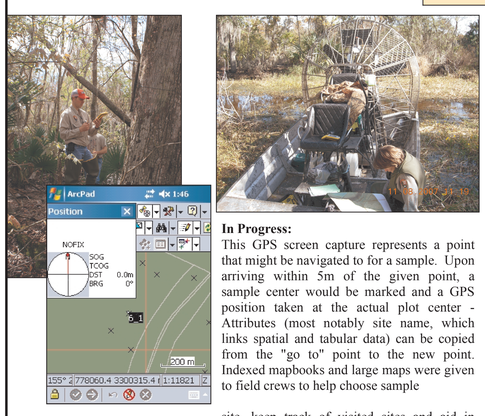
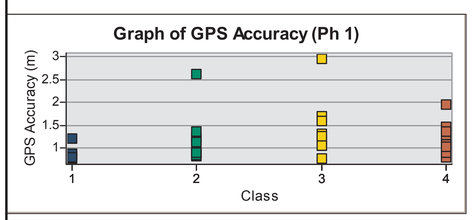


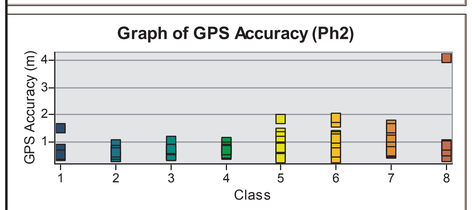
Fig 2



In Progress:
This GPS screen capture represents a point that might be navigated to for a sample. Upon arriving within 5m of the given point, a sample center would be marked and a GPS position taken at the actual plot center - Attributes (most notably site name, which links spatial and tabular data) can be copied from the "go to" point to the new point. Indexed mapbooks and large maps were given to field crews to help choose sample

site, keep track of visited sites and aid in navigation.





We were aware that GPS accuracy may be degraded in some environments. Accuracy reports were processed to allow for exploration of possible relationships between habitat composition and position accuracy. These graphs suggest that GPS accuracy and precision differs between classes of habitat composition.

The Plan (Ph 2):
Phase 2 of LiDAR GT was based on an eight class model. This fact meant that sample sites would have to be fit into smaller areas and requiring greater precision in planning and navigation to sites. Taking the need for greater precision and lessons from ph 1 into account, we developed a new plan for ph 2 based on sample points. A margin of flexibility was built into "go to" point by allowing a buffer of 5m, creating a 10m dia sample center circle to navigate within. A 10m buffer was then applied to the sample center circle creating a 30m dia possible sample area. A sample area, again using a 20m dia plot, could rove anywhere within this outer dimension (fig 5). These 30m dia circles were used as placeholders to shuffle around the 8-class map to define sample sites. A minimum of ten potential sample sites per class were chosen in each region. Additionally, a grid system of 0.5 km^2 was employed to help increase spatial distribution. We also stressed that if a sample from one class is taken, samples from the remaining seven classed should also be taken. Therefore, a fully balanced, complete effort would result in 8 classes x 2 regions x 10 samples/class = 160 total samples. A total of 198 potential sample sites were identified with the highest degree of flexibility built into class 8, which we knew generally required airboat support.

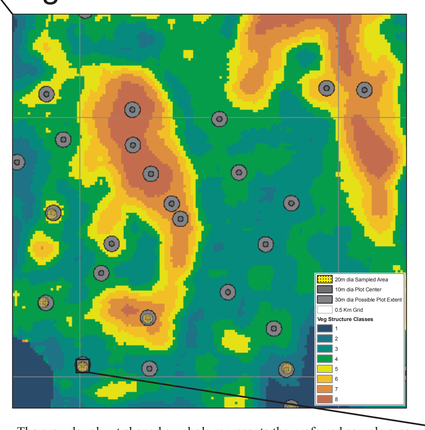
Key Sampling Points (Ph 2):
•Ideally, plots distributed equally among classes and regions.
•No more than two samples per class were allowed per grid.
•Avoid sampling in adjacent squares to force spatial distribution.

Possible Plots	
Class	Class Count
1	23
2	21
3	23
4	27
5	24
6	27
7	23
8	30

Plots Visited	
Class	Class Count
1	12
2	12
3	12
4	13
5	13
6	15
7	14
8	12

Outcome (Ph 2 Samples):
Of a total 196 possible plots, 103 were were actually visited. If considering equal class distribution, a least common denominator of 12 samples per class yields 96 plots for Region 1 and Region 3 combined.

Eight Class Model



The gray doughnut shaped symbols represents the preferred sample area for a given site. A Field Crew was directed to navigate within the center, "hole" (10m dia.) part of the doughnut. This area of "slop" allowed for any obstacles that might restrict access to a given point. The outer perimeter of the doughnut is a 10m buffer of the "hole" and represents the entire zone (30m dia.) that a sample site should fall within. The yellow, stippled circles show an actual sampled area.

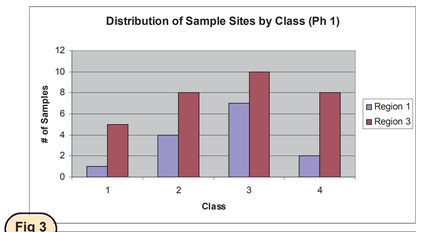
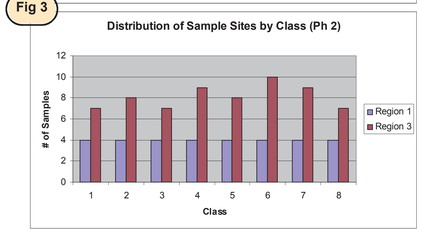
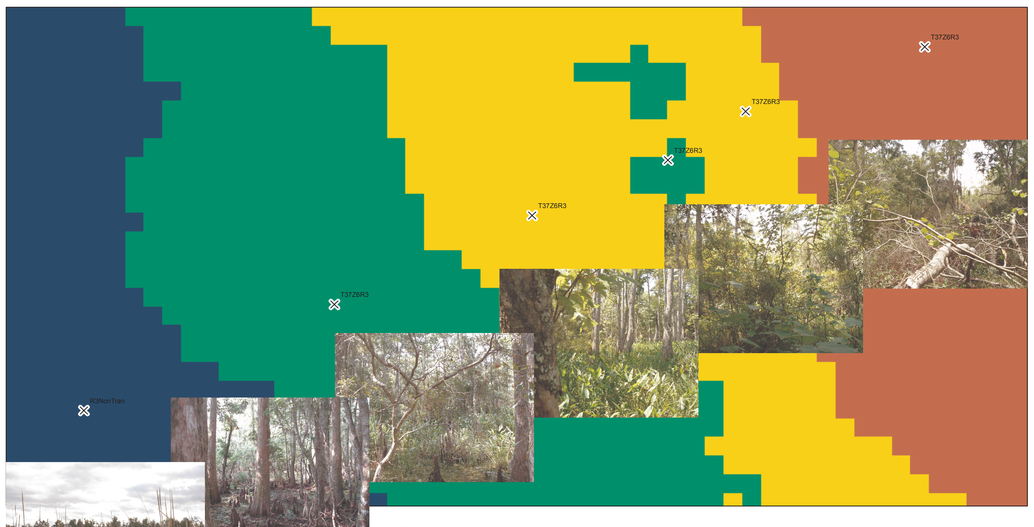


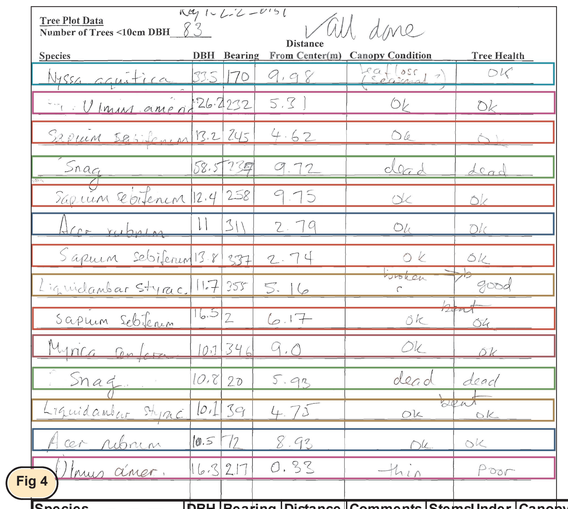
Fig 3



Outcome (Distribution of Samples by Class):
Adjustments to sample design, increased boat support and better communication with cooperators in Ph 2 resulted in more samples and better between class distribution. However, ultimately 'logistics rule' and access to sample sites in region 1, in both phases, proved difficult and was limited.



Photos from each of the sample sites along a transect. All of these photos are facing south from the plot center.



Tree Plot Data
Number of Trees <10cm DBH 83
Distance
All done

Species	DBH	Bearing	From Center(m)	Canopy Condition	Tree Health
Nyssa aquatica	33.5	170	9.98	leaf loss (seasonal)	OK
Ulmus americana	26.2	232	5.31	Ok	Ok
Sapium sebiferum	13.2	245	4.62	Ok	Ok
Snag	58.5	237	9.72	dead	dead
Sapium sebiferum	12.4	258	9.75	Ok	Ok
Acer rubrum	11	311	2.79	Ok	Ok
Sapium sebiferum	13.8	337	2.74	Ok	Ok
Liquidambar styraci.	11.7	358	5.16	broken	broken → good
Sapium sebiferum	16.5	2	6.17	Ok	bent Ok
Myrica cerifera	10.1	346	9.0	Ok	ok
Snag	10.8	20	5.92	dead	dead
Liquidambar styac	10.1	39	4.75	Ok	bent ok
Acer rubrum	10.5	72	8.92	Ok	Ok
Ulmus amer.	16.3	217	0.33	thin	Poor

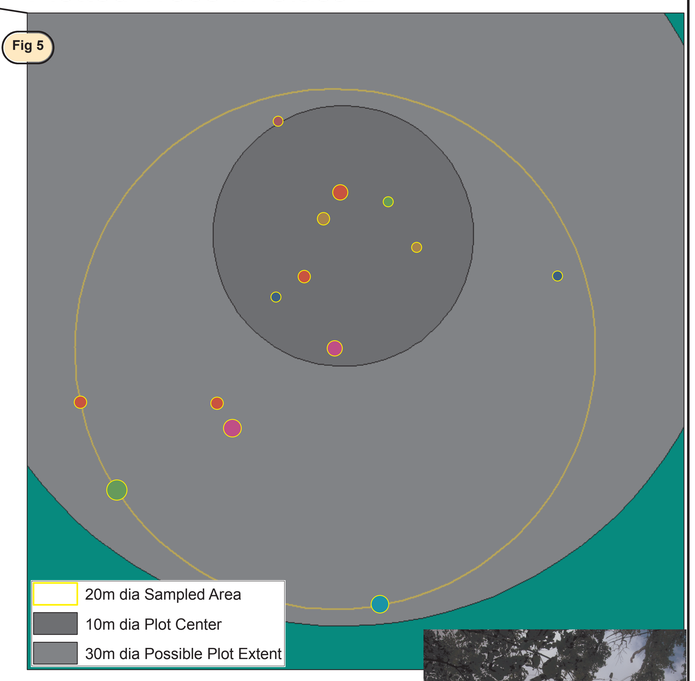
Fig 4

Species	DBH	Bearing	Distance	Comments	StemsUnder	CanopyCond	TreeHealth
Acer rubrum	11	311	3		0	OK	OK
Acer rubrum	11	72	9		0	OK	OK
Liquidambar styraciflua	12	355	5		0	OK	broken
Liquidambar styraciflua	10	39	5		0	OK	bent
Myrica cerifera	10	346	9		0	ok	ok
Nyssa aquatica	34	170	10		0	poor	OK
Sapium sebiferum	13	245	5		0	OK	OK
Sapium sebiferum	12	258	10		0	ok	ok
Sapium sebiferum	14	337	3		0	ok	ok
Sapium sebiferum	17	2	6		0	OK	bent
snag	59	237	10		0	dead	dead
snag	11	20	6		0	dead	dead
Ulmus americana	26	232	5		0	OK	OK
Ulmus americana	16	217	0		0	thin	poor

Outcome (Tree Data): Among other metrics, distances and bearings from plot center to all trees (measuring >10cm dbh) were captured with individual tree data (Species, DBH, Canopy Condition, and Tree Health). Figure (4) shows the translation of a field sheet to a digital table. Figure (5) shows these data points (trees) plotted by distance and bearing radiating from the sample center. Colors are matched by species to the data table and fit into five size classes proportional to DBH.

Plotted Trees In Class 2

Fig 5





Zenith Photo from Center of Sample Plot

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For More Information on EAARL LiDAR

- http://lidar.cr.usgs.gov/eaarl/
- http://inst.wff.nasa.gov/eaarl/
- http://coastal.er.usgs.gov/remote-sensing/advancedmethods/eaarl.html

EAARL Open File Reports

- 2007 OFR 2007-1432, *Submarine Topography (ST) – Northern Florida Keys Reef Tract*
- 2007 OFR 2007-1422, *EAARL Topography - Gulf Islands National Seashore-Florida*
- 2007 OFR 2007-1395, *EAARL Submarine Topography - Florida Keys National Marine Sanctuary*
- 2007 OFR 2007-1394, *Bare Earth (BE) Topography – Sagamore Hill National Historical Site*
- 2007 OFR 2007-1388, *Geomorphology and Depositional Sub-environments of Assateague Island MD/VA*
- 2007 OFR 2007-1377, *EAARL Topography-Gulf Islands National Seashore-Mississippi*
- 2007 OFR 2007-1375, *EAARL Topography - Cape Cod National Seashore*
- 2007 OFR 2007-1179, *EAARL Topography - George Washington Birthplace National Monument*
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- 2007 OFR 2007-1176, *EAARL Topography - Assateague Island National Seashore*
- 2007 OFR 2007-1007, *EAARL Topography - Fire Island National Seashore*
- 2006 OFR 2006-1384, *Bare Earth (BE) Lidar Topography – Fire Island National Seashore*
- 2008 OFR 2006-1244, *EAARL Topography - Dry Tortugas National Park*
- 2006 OFR 2006-1118, *EAARL Submarine Topography - Biscayne National Park*