



Tampa Bay Estuary Program  
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## Tampa Bay Oyster Mapping and Assessment

FINAL REPORT

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# **Tampa Bay Oyster Bar Mapping and Assessment**

## **Final Report to Tampa Bay Estuary Program**

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**Florida Fish and Wildlife Conservation Commission  
Fish & Wildlife Research Institute  
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## **Project Summary**

The objectives of this mapping exercise were to establish a baseline map layer for the current extent of oysters within Tampa Bay, to assess the accuracy of the mapping effort, and to develop an historic map layer derived from scanned USGS post-1927 T-sheets. These efforts will provide the base data for future mapping projects and enable trend analyses to be performed that will aid scientists in monitoring changes to oyster resources in Tampa Bay.

In addition to identifying oysters within the Bay, there was a desire to ascertain if the mapping of this resource is something that can be automated. Currently, maps are most often produced using ground surveys and manual interpretation of aerial photographs. These techniques are time-consuming and labor intensive. An integrated automated mapping method that incorporates high resolution sources (spectral and spatial) at a lower cost would be a useful tool for resource managers in Tampa Bay as well as many other areas. If a remote sensing method can be proven to secure reliable results, it will enable mapping of oysters on a large geographic scale. This would be efficient as well as economical. To this end, two separate semi-automated feature extraction approaches were employed as well as traditional photointerpretation methods.

Staff at the Fish & Wildlife Research Institute (FWRI) performed mapping, field verification and quality assurance on all products. For this effort, hyperspectral imagery collected by the Galileo-Group, Inc. (Galileo) and 2004 digital orthophoto quarter quadrangles (DOQQs) were used. Extensive field reconnaissance was performed to provide training sets as well as to identify errors of commission and omission.

## **Project Details**

### **Historic Charts**

FWRI staff processed two types of digital charts. The first consisted of the scanned 1927 USGS T-Sheets, acquired from the University of Florida's Publication of Archival, Library & Museum Materials. Fourteen T-Sheets were geo-referenced and combined to create one mosaic. The second type of chart is the 1:40,000 scale NOAA nautical charts, acquired from the US Geological Survey. For each year, two nautical charts were combined to make one mosaic. The nautical charts included the following years: 1928, 1930, 1935, 1943, 1959, 1969, 1978, and 1988.

These scanned and geo-referenced images as well as the associated metadata are available via the image server site that FWRI created for the Tampa Bay Estuary Program (TBEP). This site offers the ability to blend and swipe layered images in order to view changes through time. The url for that site is

<http://ocean.floridamarine.org/tbep/>

Originally, it was planned to use the historic U.S. Coast and Geodetic Survey T-Sheets and nautical charts to plot a vector layer depicting the location of historic oyster beds and reefs. Unfortunately, a legend corresponding to the charts could not be located. Without a clear legend describing the symbology depicted on the charts, creating a vector layer would have been guesswork. It was determined that the best solution possible was to offer geo-referenced mosaics viewable through the TBEP site. This solution permits overlay by vector datasets and viewing of multiple years simultaneously. Changes over time can be easily evaluated this way.

### **Mapping Effort**

#### *Hyperspectral Approach*

Hyperspectral imagery, comprising 128 spectral bands, was collected at low tide for the nearshore of Tampa Bay, and of Boca Ciega Bay from its southern terminus north to the "Narrows" at 1.5 and 2 meter ground resolution.

The Flight Plan is shown as Figure 1 below, while the Flight Log is attached as Attachment 1. The flight was planned to correspond with the low tide cycle so that the intertidal areas of the Bay would be exposed. The Galileo Group flew the area on May 21, 2005 and performed the hyperspectral analyses. In addition, 2004 high resolution ADS40 digital orthophoto quarter quadrangles (DOQQs) were used as an ancillary source of imagery.

**Figure 1: Flight Plan**



Field reconnaissance was conducted by helicopter on February 9<sup>th</sup> and July 18<sup>th</sup> during periods of low tide with clear water conditions. Digital imagery was collected to aid in the identification effort. Ground surveys were accomplished on foot as well as through the use of kayaks and FWRI boats. GPS units were used to acquire location information on points representing homogenous oyster beds as well as locations that were heterogeneous, like oyster/shell mixtures. These field collection points were used to “train” the analyses, to separate clear from confused signatures, and to obtain data points to be used in the accuracy assessment. Figures 2 and 3 provide a visual example of the differences realized by viewing the imagery obliquely and from aerial photography. Field Reconnaissance Notes are attached as Attachment 4.

Figure 2: Tarpon Key Oblique Image



Figure 3: Tarpon Key Aerial Photo



Galileo applied proprietary algorithms to extract the oyster signatures from the hyperspectral imagery. Three iterations of the image processing were performed by Galileo. Through this iterative process, Galileo separated out the digital signatures that corresponded to the oysters anticipated in the field. To generate maps, Galileo used geo-referenced false color highlights against natural color representation from the hyperspectral data. The predicted automated airborne measured ground accuracy for this effort was five meters.

During one field trip, disagreement was noted in two components of the image processing: 1) there was a minor offset in the geographic location information used in the hyperspectral effort; 2) in several instances, sand flats were identified as oyster reefs by the hyperspectral algorithm. The offset was corrected and Galileo attempted to correct the misidentification of sand flats.

Galileo provided a finished map of oyster bed presence and corresponding shape files of mapping results as well as the raw and finished radiance corrected post-processed hyperspectral data. To test the Galileo product, additional field work was conducted. An error matrix was developed using 1229 points that were identified through the field verification phases as being oyster beds or fringing reefs.

#### *Feature Analyst Semi-Automated Approach*

Feature Analyst, a software developed by Visual Learning Systems, was used as a secondary method to test the feasibility of automating oyster mapping efforts. This software operates by using a suite of machine learning algorithms that “learn” how to classify the object-specific geographic features. Some of these learning algorithms, like Nearest Neighbor and Neural Networks, are used to extract features that have been specified by the user.

A Nearest Neighbor algorithm was selected and customized with a *Bulls-eye 3* input representation pattern after masking the land and water deeper than 6 feet. FWRI staff used field data points to “train” the software. A minimum of 4 iterations were performed on each output from Feature Analyst at each stage of the process for a total of approximately 30 iterations to test this approach. Feature Analyst used the results of each progressive iteration along with the initial settings for the first training set of a new iteration to “learn” about the feature being extracted from the imagery and to further refine the extraction parameters.

#### *Traditional Photointerpretation Approach*

For this effort, Galileo’s low tide imagery was used to perform the photointerpretation. The 2004 DOQQs were used as ancillary data and to fill in areas that were obscured in the Galileo imagery. Galileo’s imagery provided a much clearer picture at low tide when compared with the DOQQs. 90% of the full field collection data set was used to refine both the signatures and locational characteristics of the oyster habitat around the Bay.

#### *Review*

Early on it was decided that only free-standing or fringing reefs would be mapped. No oysters on rubble and seawall were targeted. Attempts were made to map oysters growing with mangroves. These were particularly problematic since the vertical relief of the tree canopy and consequent shadow obscured the oysters.

Vertical relief such as that found with the free-standing pristine reefs in South Carolina is not typical of oyster reefs in Tampa Bay. Additionally, oyster beds in Tampa Bay are often covered with macroalgae and/or mud and sand. This combination caused great confusion in the digital signatures.

After several iterations with the Feature Analyst software it was determined that we had reached a point of diminishing returns. Feature Analyst had a difficult time separating the different pixel values for oyster reefs. Fringing reefs seemed to be the most difficult for Feature Analyst to extract due to the shadows cast by the mangroves. Virtually all shadows were classified as oysters when using the DOQQs. The software also classified too many areas as oysters that were actually mud, sand, or algae. Several different ground truth data sets were used to try to “train” the software to distinguish oyster reefs from sand, mud, algae and mixtures. This problem was experienced with both sources of imagery and all three feature extraction approaches. The low tide imagery supplied by Galileo fared much better overall with fewer mis-classified oyster reefs that were much smaller in area.

There is too little consistency in the digital signature of oysters in Tampa Bay for this automated approach to produce high accuracy. The decision was made to finish the feature extraction by traditional photointerpretation means. The following section describes the methods used to ascertain accuracy and also summarizes the results of the overall mapping effort

### **Assessment**

At each site, we used an xGPS (Xplore Technologies) unit mounted on a Garmin ArcPad digital tablet to provide latitude/longitude location information for each sample point. Positional accuracy of this unit is stated to be 5 m or better. We first defined the perimeter of each selected reef by walking the perimeter and sampling at approximately 5 m intervals. We then randomly sampled a variable number of points within the reef. We also sampled a variable number of points in the surrounding area to test the signature emanating from structures such as seagrass, sand, and rock. Finally, we visited several sites that had been identified from the Galileo algorithm as being oyster reef, but that we knew from previous experience were not reefs, in an effort to determine what habitat features were being mischaracterized by Galileo. At each point within a site, we determined the actual habitat structure at that point. Stochastic tests of the accuracy and precision of our GPS unit indicated that we were able to 1) return during a single sampling event to a selected point within an error of approximately 1 m and 2) return on a subsequent date to that same location with an error of approximately 5m. Thus, some of the inconsistency between the Galileo mapping results and our field tests can be attributed to measurement error.

An error matrix (Table 1) was developed from a comparison of Galileo oyster reef locations versus actual reef locations determined from on-site sampling. This 2x2 matrix included a box containing the count of all points where Galileo predicted that oysters would be located and where we actually found oysters (yes-yes), a box where Galileo predicted that oysters would be located but where we did not find oysters (yes-no), and a box where Galileo did not find oysters but we determined oysters actually did exist (no-yes). The fourth box, describing locations where Galileo predicted that no oysters were located and where we did not find oysters, is not included because this would strongly bias the outcome towards success (an almost infinite number of no-no points could be located within Tampa Bay, thereby greatly increasing the percent agreement between the two methods). The success of the hyperspectral approach for mapping oyster reefs in Tampa Bay was determined from the percent of total points that were predicted to be oyster reef and actually were oyster reef. Since location error is inherent in both the Galileo and GPS approaches, points within 5 m of one another that were consistent in their substrate composition were considered to be in agreement.

**Table 1**

**Hyperspectral Error Matrix**

		<b>FWRI</b>	
		<b>Y</b>	<b>N</b>
<b>Galileo</b>	<b>Y</b>	460 / 1424 32.3%	195 / 1424 13.7%
	<b>N</b>	769 / 1424 54.0%	Not Assessed

Note: All points buffered by 5 meters.  
In situ information was collected for overall assessment of oysters in Tampa Bay

*Hyperspectral Approach*

To assess the accuracy of the final hyperspectral product, we selected fourteen sites (Table 2) dispersed throughout the general area of Tampa Bay (including Boca Ciega Bay) to identify habitat features of oyster reefs and surrounding areas. Data acquired from these sites were used for 3 purposes: to ground-truth the oyster extraction algorithm developed from the Galileo overflight and data processing efforts; to acquire data from habitats surrounding each reef; and to identify sites that were designated by the Galileo flight team as oyster reefs but that we knew *a priori* were not oyster reefs. The location of each ground-truth sample site is depicted in Figure 4. The complete summary table is included on the CD. An example of the Filed Data Collection sheets and excerpt of the summary table are provided in Figures 5 and 6 respectively.

**Table 2: Sampling Locations**

SITE TABLE											
Site	Site Key	Points	Coordinate Center Points		Date	Approx. Field Time		Tide			
			Longitude (DMS)	Latitude (DMS)		Start	End				
Madeline Key	MAD	12	-82 42 45	27 38 49	09/01/05	10:05	11:30	6:43 L 1.4ft	13:08 H 2.6ft		
Pinellas Point Reef	PPR	20	-82 39 34	27 42 03	09/01/05	11:40	12:15	6:43 L 1.4ft	13:08 H 2.6ft		
Blackthorn Memorial Park	BTM	51	-82 40 49	27 39 07	09/07/05	8:20	10:15	2:10 H 2.1ft	8:56 L 0.5ft	15:16 H 1.8ft	
Pinellas Point Reef	PPR	185	-82 39 34	27 42 03	10/05/05	8:45	11:40	2:47 H 2.4ft	9:59 L 0.2ft	16:36 H 2.0ft	
Cockroach Bay	CRB	231	-82 30 12	27 42 29	10/06/05	8:50	14:45	2:09 H 2.5ft	9:55 L 0.1ft	16:34 H 1.7ft	
Tarpon Key	TAK	144	-82 41 28	27 39 55	10/27/05	12:06	15:15	8:32 H 1.8ft	15:50 L 0.4ft		
Indian Key	IND	90	-82 41 27	27 42 08	10/27/05	15:25	17:15	8:32 H 1.8ft	15:50 L 0.4ft	22:30 H 1.7ft	
The Narrows	NAR	95	-82 50 29	27 51 20	10/28/05	13:00	14:47	9:35 H 2.0ft	16:20 L 0.6ft		
Terra Ceia	TEC	164	-82 35 57	27 35 13	11/01/05	8:45	12:20	6:42 L 0.0ft	13:14 H 1.8ft		
Cross Bayou	CBA	180	-82 45 48	27 49 23	11/02/05	8:15	12:30	6:05 L - 0.2ft	12:52 H 1.7ft		
Upper Tampa Bay Park	UTB	176	-82 37 32	28 00 11	11/03/05	9:55	14:00	1:56 H 3.3ft	10:23 L - 0.4ft	17:10 H 2.1ft	
Boca Ciega Bay	BCB	25	-82 47 07	27 48 27	01/31/06	12:00	14:30	7:46 L - 0.7ft	14:03 H 1.2ft		
Upper Tampa Bay Park	UTB	154	-82 37 32	28 00 11	02/01/06	12:00	16:30	11:56 L - 0.6ft	18:06 H 1.6ft		
North Gandy Bridge	NGB	125	-82 36 50	27 52 44	02/07/06	10:30	13:30	5:25 L - 0.6ft	21:03 H 2.2ft		

Figure 4: Hyperspectral Accuracy Sampling Sites

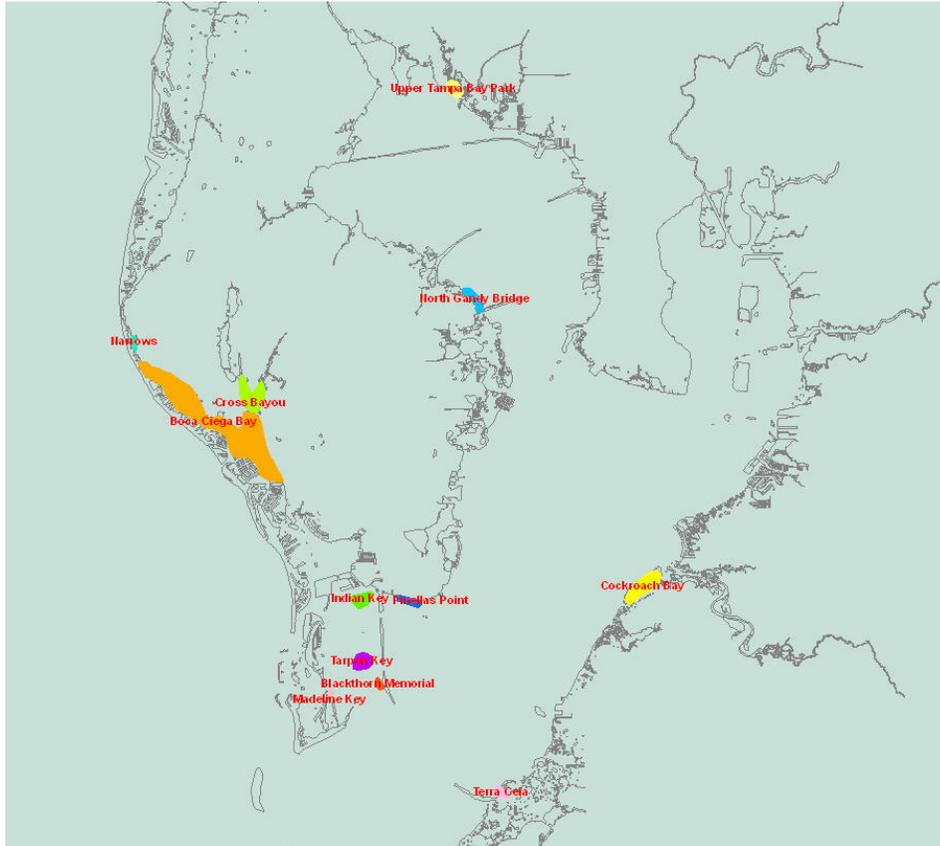
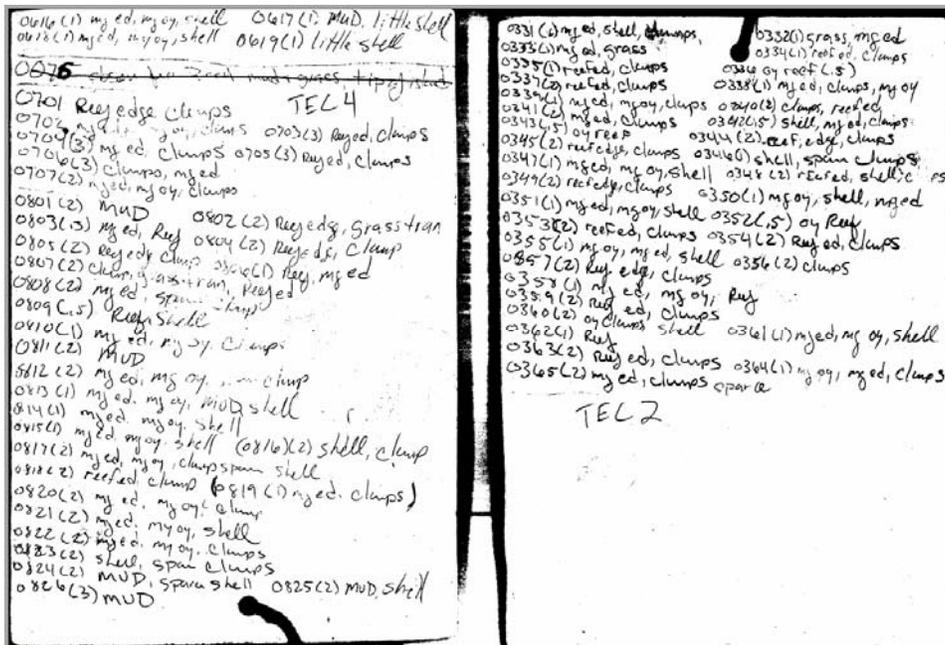


Figure 5: Field Data Collection Sheet



## Figure 6: Field Summary Sheet

fieldwork 11-03-05mergek.xls (Excerpt. Entire Document included on CD)

ID	SITE	STATION	REPLICANT	LIVE	DATE	TIME	APPROXDEPTH	HABITAT	COMMENTS	DEAD	SHELL	DRIFTALGAE	OTHERFAUNA	SOURCE	ETHM	TRANSITION
0	MAD	01	01	yes	9/1/05	10:05am	3.5ft	oyster clumps/reef						fieldwork	11-2-05merge.dbf	
0	MAD	01	02	yes	9/1/05		3.5ft	oyster clumps/reef						fieldwork	11-2-05merge.dbf	
0	MAD	02	01	yes	9/1/05		3.5ft	sparse oyster clumps						fieldwork	11-2-05merge.dbf	oyster to mangrove
0	MAD	02	02	yes	9/1/05		3.5ft	oyster clumps/reef						fieldwork	11-2-05merge.dbf	
0	MAD	02	03	yes	9/1/05		3.5ft	oyster clumps/reef						fieldwork	11-2-05merge.dbf	
0	MAD	02	04	yes	9/1/05		3.5ft	oyster clumps/reef						fieldwork	11-2-05merge.dbf	
0	MAD	02	05	yes	9/1/05		3.5ft	oyster clumps/reef						fieldwork	11-2-05merge.dbf	oyster to mangrove
0	MAD	02	06	yes	9/1/05		3.5ft	oyster clumps/reef						fieldwork	11-2-05merge.dbf	oyster to mangrove
0	MAD	00	01		9/1/05		3.5ft	mud/sand						fieldwork	11-2-05merge.dbf	mangrove to mud
0	MAD	01	03	yes	9/1/05		3.5ft	oyster clumps/reef						fieldwork	11-2-05merge.dbf	
0	MAD	00	02		9/1/05		3.5ft	mud/sand						fieldwork	11-2-05merge.dbf	
0	MAD	00	03		9/1/05		3-4ft	seagrass	observed from boat					fieldwork	11-2-05merge.dbf	
0	PPR	01	01	yes	9/1/05	11:40a	3ft	sparse oyster clumps						fieldwork	11-2-05merge.dbf	oyster to seagrass
0	PPR	01	02	yes	9/1/05		2.5ft	oyster reef						fieldwork	11-2-05merge.dbf	
0	PPR	01	03	yes	9/1/05		3ft	sparse oyster clumps						fieldwork	11-2-05merge.dbf	oyster to sea grass
0	PPR	01	04	yes	9/1/05		2.5ft	oyster clumps/reef						fieldwork	11-2-05merge.dbf	oyster to sea grass
0	PPR	00	01		9/1/05		2ft	seagrass						fieldwork	11-2-05merge.dbf	
0	PPR	00	02		9/1/05		2ft	mud/sand						fieldwork	11-2-05merge.dbf	
0	PPR	01	05	yes	9/1/05		2ft	oyster reef						fieldwork	11-2-05merge.dbf	oyster to mud
0	PPR	01	06	yes	9/1/05		2ft	oyster reef						fieldwork	11-2-05merge.dbf	
0	PPR	01	07	yes	9/1/05		2ft	oyster reef						fieldwork	11-2-05merge.dbf	
0	PPR	00	03		9/1/05		3ft	seagrass						fieldwork	11-2-05merge.dbf	
0	PPR	02	01		9/1/05		2.5ft	seagrass						fieldwork	11-2-05merge.dbf	
0	PPR	02	02	yes	9/1/05		2ft	oyster reef						fieldwork	11-2-05merge.dbf	
0	PPR	02	03	yes	9/1/05		2ft	oyster reef						fieldwork	11-2-05merge.dbf	
0	PPR	00	04		9/1/05		2ft	seagrass						fieldwork	11-2-05merge.dbf	
0	PPR	00	05		9/1/05		2ft	seagrass						fieldwork	11-2-05merge.dbf	
0	PPR	00	06		9/1/05		2ft	seagrass						fieldwork	11-2-05merge.dbf	
0	PPR	02	04	yes	9/1/05		2ft	oyster reef						fieldwork	11-2-05merge.dbf	oyster to mud
0	PPR	02	05	yes	9/1/05		2ft	oyster reef						fieldwork	11-2-05merge.dbf	
0	PPR	02	06	yes	9/1/05		2ft	oyster reef						fieldwork	11-2-05merge.dbf	oyster to mud
0	PPR	00	07		9/1/05		2ft	seagrass						fieldwork	11-2-05merge.dbf	
0	BTM	01	01	yes	9/7/05	8:20am	>1ft	oyster reef	length 202ft btm0					fieldwork	11-2-05merge.dbf	oyster to mud
0	BTM	01	02	yes	9/7/05		exposed	oyster reef						fieldwork	11-2-05merge.dbf	
0	BTM	01	03	yes	9/7/05		exposed	oyster reef						fieldwork	11-2-05merge.dbf	
0	BTM	01	04	yes	9/7/05		exposed	oyster reef						fieldwork	11-2-05merge.dbf	oyster to mangrove
0	BTM	00	01		9/7/05		>1ft	mud/sand						fieldwork	11-2-05merge.dbf	
0	BTM	01	05	yes	9/7/05		exposed	oyster clumps						fieldwork	11-2-05merge.dbf	oyster to mangrove
0	BTM	01	06	yes	9/7/05		exposed	oyster clumps						fieldwork	11-2-05merge.dbf	oyster to mangrove
0	BTM	01	07	yes	9/7/05		exposed	oyster reef						fieldwork	11-2-05merge.dbf	
0	BTM	01	08	yes	9/7/05		exposed	oyster reef						fieldwork	11-2-05merge.dbf	
0	BTM	01	09	yes	9/7/05		exposed	oyster reef						fieldwork	11-2-05merge.dbf	
0	BTM	01	10	yes	9/7/05		exposed	oyster reef						fieldwork	11-2-05merge.dbf	oyster to mud
0	BTM	01	11	yes	9/7/05		exposed	oyster reef	width 83ft btm01-					fieldwork	11-2-05merge.dbf	oyster to mud
0	BTM	01	12	yes	9/7/05		exposed	oyster reef						fieldwork	11-2-05merge.dbf	oyster to mud
0	BTM	00	02		9/7/05		exposed	mud/sand						fieldwork	11-2-05merge.dbf	
0	BTM	00	03		9/7/05		exposed	mud/sand						fieldwork	11-2-05merge.dbf	
0	BTM	00	04		9/7/05		>1ft	seagrass						fieldwork	11-2-05merge.dbf	

### Feature Analyst Approach

Accuracy of the final dataset was conducted by buffering 1229 known oyster locations by 5 meters (the predicted horizontal accuracy) and intersecting the GIS dataset. Of the 1568 total polygons created by Feature Analyst, 119 of them fell within 5 meters of the known oyster points producing about a 10% correct ratio for this semi-automated approach. At this point, Feature Analyst was abandoned in favor of the traditional photo interpretation approach. The final output from Feature Analyst was used as a starting point for this effort; polygons were removed that were incorrect and polygons added that Feature Analyst missed.

### Traditional Approach

Of the 1229 verified oyster location points, 10% (123) were set aside to use as a control set in the quality assessment of the final product. The remainder of the known points was used as a guide to ensure that the proper photographic signature was identified and fell within the parameters of habitats observed in the field. Overall, 1720 polygons representing oysters in Tampa Bay were identified through this traditional method. Of the 123 points in the control set, 58 of these were identified as free-standing reefs, while 65 were identified as fringing. For the free-standing reefs, 84.8% accuracy was attained. As expected, for the fringing reefs, a lower accuracy

was realized and only 72.3% of fringing reefs were identified. Overall accuracy for this method is 78%. The points that were mis-classified or missed have been rectified in the final product and are not part of the overall accuracy percentage.

## **Conclusions**

Due to the generally low relief of the oysters found in Tampa Bay and the prevalence of mangrove islands with their canopy cover and abundant shadow, we experienced less than favorable results using semi-automated mapping techniques. While it is believed that semi-automated feature extraction is of great value in the mapping of natural resources, in this particular case, the resource and geographic locations did not lend themselves to effective use of these methodologies.

Using traditional methods, we have achieved an 85% accuracy for the free-standing reefs and 78% accuracy overall. The error matrix created for the hyperspectral effort indicates errors that are primarily of omission. We believe this is caused by the confusion of the spectral signature with sand, mud and algae due to the low relief observed with these habitats in the Bay. Additionally, as shown by the traditional method, errors of omission may be largely in the area of the fringing reefs.

Extensive field reconnaissance was crucial to this effort in Tampa Bay. Due to the problematic nature of the oysters within the mangrove islands and the prevalence of that form, estimated to be ~30% of total of all oysters observed, we believe that mapping these resources in the oblique may hold some promise. Mapping on the oblique may negate the feature extraction problems experienced due to canopy cover and shadow.

## **Deliverables**

- ARC Shapefile representing the oyster coverage. The data are provided in Albers Equal Area Projection, NAD83, Meters.
- Digital geo-referenced images representing the historic oyster coverage
- Field Summary Sheet: fieldwork 11-03-05mergek.xls
- FWRI has posted these data on the TBEP internet map server <http://ocean.floridamarine.org/tbep/>
- Final Report
- Due to size constraints, FWRI will store a drive containing the following
  - Hyperspectral imagery of Tampa Bay in Geotiff format
  - Radiance Data in RAW format

*Note:* Since hyperspectral imagery was collected in 128 bands, a number of analyses can be performed on the imagery by determining appropriate bands for the targeted study. For example, this same imagery can be used to map presence/absence of seagrass. It is possible that some species identification may be determined.

Examples of band combinations are included for review and labeled Attachment 2.

True\_color.jpg utilizes these values: Red: 641.37nm Green: 551.94nm Blue: 460.95nm

CIR.jpg utilizes these values: R: 861.49nm G: 650.82nm B: 551.94nm

Hyperspectral.jpg is a false color image depicting the probability of oyster bed mapping using rainbow color map. The rainbow color map changes from black->blue->green->yellow->red when the probability increases from 0 to 1.

**Attachment 1: Galileo Flight Log**

<b>1.5 meter, 128 bands</b>		<b>2.0 meter, 128 bands</b>
<b>17 mm</b>		<b>17 mm</b>
E:\Oyster\Vectors\T1.evf		E:\Oyster\Vectors\T1.evf
Total flight lines: 22		Total flight lines: 17
Total imaging distance: 39mile / 62km		Total imaging distance: 30mile / 49km
Average flight line length: 1.8mile / 2.9km		Average flight line length: 1.8mile / 2.9km
Median flight line length: 1.8mile / 2.9km		Median flight line length: 1.8mile / 2.9km
Maximum flight line length: 2.1mile / 3.4km		Maximum flight line length: 2.2mile / 3.5km
Minimum flight line length: 1.5mile / 2.4km		Minimum flight line length: 1.5mile / 2.4km
Estimated data size (128 bands, 1.5m): 10GB		Estimated data size (128 bands, 2.0m): 6GB
Individual flight line length:		Individual flight line length:
E:\Oyster\Vectors\T2.evf		E:\Oyster\Vectors\T2.evf
Total flight lines: 9		Total flight lines: 7
Total imaging distance: 19mile / 30km		Total imaging distance: 15mile / 24km
Average flight line length: 2.1mile / 3.4km		Average flight line length: 2.2mile / 3.5km
Median flight line length: 2.1mile / 3.4km		Median flight line length: 2.2mile / 3.5km
Maximum flight line length: 2.2mile / 3.6km		Maximum flight line length: 2.2mile / 3.6km
Minimum flight line length: 2.0mile / 3.3km		Minimum flight line length: 2.1mile / 3.3km
Estimated data size (128 bands, 1.5m): 5GB		Estimated data size (128 bands, 2.0m): 2GB
Individual flight line length:		Individual flight line length:
E:\Oyster\Vectors\T3.evf		E:\Oyster\Vectors\T3.evf
Total flight lines: 16		Total flight lines: 13
Total imaging distance: 42mile / 68km		Total imaging distance: 35mile / 56km
Average flight line length: 2.7mile / 4.3km		Average flight line length: 2.7mile / 4.3km
Median flight line length: 2.9mile / 4.6km		Median flight line length: 3.0mile / 4.8km
Maximum flight line length: 3.6mile / 5.7km		Maximum flight line length: 3.9mile / 6.2km
Minimum flight line length: 0.9mile / 1.4km		Minimum flight line length: 1.1mile / 1.8km
Estimated data size (128 bands, 1.5m): 11GB		Estimated data size (128 bands, 2.0m): 6GB

Individual flight line length:		Individual flight line length:
E:\Oyster\Vectors\T4.evf		E:\Oyster\Vectors\T4.evf
Total flight lines: 13		Total flight lines: 2
Total imaging distance: 22mile / 35km		Total imaging distance: 16mile / 27km
Average flight line length: 1.7mile / 2.7km		Average flight line length: 8.4mile / 13.6km
Median flight line length: 1.7mile / 2.8km		Median flight line length: 8.7mile / 14.0km
Maximum flight line length: 1.8mile / 2.9km		Maximum flight line length: 8.7mile / 14.0km
Minimum flight line length: 1.2mile / 2.0km		Minimum flight line length: 8.2mile / 13.1km
Estimated data size (128 bands, 1.5m): 5GB		Estimated data size (128 bands, 2.0m): 3GB
Individual flight line length:		Individual flight line length:
E:\Oyster\Vectors\T5.evf		E:\Oyster\Vectors\T5.evf
Total flight lines: 3		Total flight lines: 4
Total imaging distance: 8mile / 13km		Total imaging distance: 7mile / 12km
Average flight line length: 2.8mile / 4.5km		Average flight line length: 2.0mile / 3.2km
Median flight line length: 2.8mile / 4.5km		Median flight line length: 2.2mile / 3.5km
Maximum flight line length: 3.0mile / 4.8km		Maximum flight line length: 2.5mile / 4.0km
Minimum flight line length: 2.6mile / 4.2km		Minimum flight line length: 1.5mile / 2.5km
Estimated data size (128 bands, 1.5m): 2GB		Estimated data size (128 bands, 2.0m): 1GB
Individual flight line length:		Individual flight line length:
E:\Oyster\Vectors\T6.evf		E:\Oyster\Vectors\T6.evf
Total flight lines: 27		Total flight lines: 21
Total imaging distance: 68mile / 110km		Total imaging distance: 54mile / 87km
Average flight line length: 2.5mile / 4.1km		Average flight line length: 2.6mile / 4.2km
Median flight line length: 2.7mile / 4.4km		Median flight line length: 2.8mile / 4.5km
Maximum flight line length: 3.7mile / 6.0km		Maximum flight line length: 3.4mile / 5.4km
Minimum flight line length: 1.3mile / 2.1km		Minimum flight line length: 1.1mile / 1.7km
Estimated data size (128 bands, 1.5m): 17GB		Estimated data size (128 bands, 2.0m): 10GB
Individual flight line length:		Individual flight line length:

E:\Oyster\Vectors\T7.evf		E:\Oyster\Vectors\T7.evf
Total flight lines: 10		Total flight lines: 2
Total imaging distance: 18mile / 29km		Total imaging distance: 12mile / 20km
Average flight line length: 1.8mile / 2.9km		Average flight line length: 6.4mile / 10.3km
Median flight line length: 1.8mile / 3.0km		Median flight line length: 6.6mile / 10.6km
Maximum flight line length: 2.2mile / 3.5km		Maximum flight line length: 6.6mile / 10.6km
Minimum flight line length: 1.5mile / 2.5km		Minimum flight line length: 6.2mile / 9.9km
Estimated data size (128 bands, 1.5m): 4GB		Estimated data size (128 bands, 2.0m): 2GB
Individual flight line length:		Individual flight line length:
E:\Oyster\Vectors\T8.evf		E:\Oyster\Vectors\T8.evf
Total flight lines: 17		Total flight lines: 13
Total imaging distance: 44mile / 71km		Total imaging distance: 35mile / 56km
Average flight line length: 2.6mile / 4.2km		Average flight line length: 2.7mile / 4.3km
Median flight line length: 2.6mile / 4.3km		Median flight line length: 2.7mile / 4.4km
Maximum flight line length: 3.1mile / 5.0km		Maximum flight line length: 3.1mile / 5.1km
Minimum flight line length: 1.8mile / 3.0km		Minimum flight line length: 2.1mile / 3.4km
Estimated data size (128 bands, 1.5m): 11GB		Estimated data size (128 bands, 2.0m): 6GB
Individual flight line length:		Individual flight line length:
E:\Oyster\Vectors\T9.evf		E:\Oyster\Vectors\T9.evf
Total flight lines: 5		Total flight lines: 4
Total imaging distance: 9mile / 15km		Total imaging distance: 7mile / 12km
Average flight line length: 1.9mile / 3.1km		Average flight line length: 1.9mile / 3.1km
Median flight line length: 2.0mile / 3.2km		Median flight line length: 2.1mile / 3.4km
Maximum flight line length: 2.2mile / 3.6km		Maximum flight line length: 2.2mile / 3.5km
Minimum flight line length: 1.4mile / 2.3km		Minimum flight line length: 1.5mile / 2.4km
Estimated data size (128 bands, 1.5m): 2GB		Estimated data size (128 bands, 2.0m): 1GB
Individual flight line length:		Individual flight line length:
E:\Oyster\Vectors\T10.evf		E:\Oyster\Vectors\T10.evf
Total flight lines: 21		Total flight lines: 14

Total imaging distance: 54mile / 87km		Total imaging distance: 42mile / 67km
Average flight line length: 2.6mile / 4.1km		Average flight line length: 3.0mile / 4.9km
Median flight line length: 2.6mile / 4.2km		Median flight line length: 2.8mile / 4.5km
Maximum flight line length: 3.9mile / 6.3km		Maximum flight line length: 4.9mile / 8.0km
Minimum flight line length: 1.0mile / 1.6km		Minimum flight line length: 1.4mile / 2.2km
Estimated data size (128 bands, 1.5m): 14GB		Estimated data size (128 bands, 2.0m): 8GB
Individual flight line length:		Individual flight line length:
E:\Oyster\Vectors\T11.evf		E:\Oyster\Vectors\T11.evf
Total flight lines: 26		Total flight lines: 20
Total imaging distance: 109mile / 175km		Total imaging distance: 84mile / 135km
Average flight line length: 4.2mile / 6.8km		Average flight line length: 4.2mile / 6.8km
Median flight line length: 3.3mile / 5.3km		Median flight line length: 3.3mile / 5.3km
Maximum flight line length: 7.6mile / 12.2km		Maximum flight line length: 6.9mile / 11.1km
Minimum flight line length: 0.9mile / 1.4km		Minimum flight line length: 1.4mile / 2.3km
Estimated data size (128 bands, 1.5m): 28GB		Estimated data size (128 bands, 2.0m): 16GB
Individual flight line length:		Individual flight line length:
E:\Oyster\Vectors\T12.evf		E:\Oyster\Vectors\T12.evf
Total flight lines: 9		Total flight lines: 8
Total imaging distance: 28mile / 46km		Total imaging distance: 22mile / 36km
Average flight line length: 3.2mile / 5.2km		Average flight line length: 2.8mile / 4.6km
Median flight line length: 3.2mile / 5.2km		Median flight line length: 2.9mile / 4.6km
Maximum flight line length: 3.6mile / 5.7km		Maximum flight line length: 3.6mile / 5.8km
Minimum flight line length: 2.8mile / 4.6km		Minimum flight line length: 1.9mile / 3.1km
Estimated data size (128 bands, 1.5m): 7GB		Estimated data size (128 bands, 2.0m): 4GB
Individual flight line length:		Individual flight line length:
E:\Oyster\Vectors\T13.evf		E:\Oyster\Vectors\T13.evf
Total flight lines: 29		Total flight lines: 22
Total imaging distance: 137mile /		Total imaging distance: 106mile /

221km		171km
Average flight line length: 4.7mile / 7.6km		Average flight line length: 4.8mile / 7.8km
Median flight line length: 5.2mile / 8.4km		Median flight line length: 5.4mile / 8.7km
Maximum flight line length: 7.1mile / 11.4km		Maximum flight line length: 7.2mile / 11.7km
Minimum flight line length: 1.3mile / 2.1km		Minimum flight line length: 1.4mile / 2.3km
Estimated data size (128 bands, 1.5m): 36GB		Estimated data size (128 bands, 2.0m): 20GB
Individual flight line length:		Individual flight line length:
<b>597 miles</b>		<b>465 miles</b>
<b>152 GB</b>		<b>85 GB</b>

**Attachment 2**

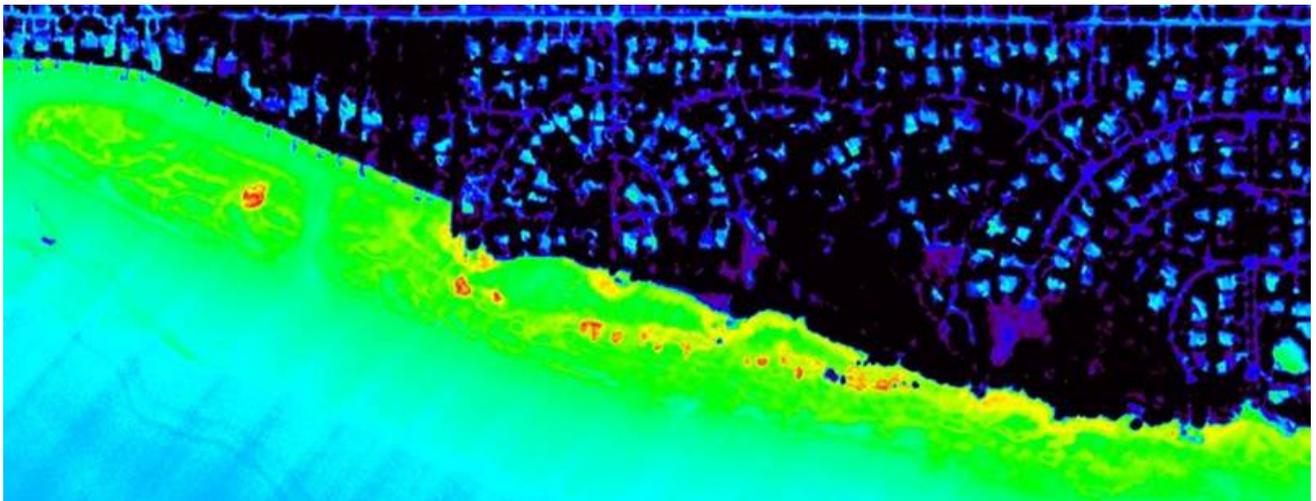
**Example 1  
Hyperspectral Imagery  
(True Color )**



**Example 2**  
**Hyperspectral Imagery**  
**(Color InfraRed)**



**Example 3**  
**Hyperspectral Imagery**  
**(False Color)**



## Attachment 3: Metadata



*Applied Hyperspectral Imaging Services*

### Hyperspectral Oyster Bed Mapping of Tampa Bay DATA MANUAL

#### 1. GIS Layer

**Projection:** Albers DOQQ, meter, NAD83

**NEPTUNE II\_Oyster Bed\_Sites.shp:**

- Each mapped oyster bed site is represented by a point
- SITE: oyster bed site number
- FLIGHT: flight number where the oyster bed is located
- SITE1: local site number within one flight

**NEPTUNE II\_Oyster Bed\_Polygons.shp:**

- The shape of each oyster bed is represented by one or more polygons
- POLYGON: ordered overall polygon number
- SITE: oyster bed site number
- POLYGON1: ordered polygon number within one site
- FLIGHT: flight number where the oyster bed is located

#### 2. Radiance Data

**Directory:** Data\20050521\RAD; Data\20050523\RAD; ...

**File:** 0521-0836\_rad.dat & 0521-0836\_rad\_rgb.dat

- 0521: flight date (May 21, 2005)
- 0836: flight time (08:36 ET)
- \_rgb: selected 3 bands data for natural color image

**Flight Altitude:** 6,600 Feet

**Specification:** check header file like 0521-0836\_rad.hdr

**Software:** ENVI or ArcGIS with ENVI plug-in for simple processing. For spectral analysis, ENVI is highly recommended.

#### 3. Mosaic Image

**Directory:** Mosaic

**File:** Neptune II\_Mosaic.tif

**Projection:** UTM, N17, meter, NAD83 (same as the DOQQ ortho-photo used as reference)

#### 4. Geographic Lookup Table (GLT) File

**Directory:** Data\20050521\GLT; Data\20050523\GLT; ...

**File:** 0521-0836\_glt\_map.dat

- 0521: flight date (May 21, 2005)
- 0836: flight time (08:36 ET)

**Function:** Each radiance file has a GLT file. It is used to geo-rectify radiance data or any analysis results based on radiance data to the following projection. Geo-reference using GLT file is supported by ENVI, or other software (may or may not).

**Projection:** Albers DOQQ, meter, NAD83

**Note:** The GLT file is generated by Galileo Group for your convenience while the delivered shape and mosaic file are processed by proprietary software from the sensor manufacturer. The difference of these two is 1-2 pixels RMSE. There are also some artifacts in GLT results due to different resampling methods in processing.

## GIS Metadata:

### 0811\_NEPTUNE II\_Oyster Bed\_Polygons

#### Metadata:

- [Identification Information](#)
- [Data Quality Information](#)
- [Spatial Data Organization Information](#)
- [Spatial Reference Information](#)
- [Entity and Attribute Information](#)
- [Distribution Information](#)
- [Metadata Reference Information](#)

---

#### *Identification\_Information:*

*Citation:*

*Citation\_Information:*

*Publication\_Date:* Unpublished Material

*Title:* 0811\_NEPTUNE II\_Oyster Bed\_Polygons

*Geospatial\_Data\_Presentation\_Form:* vector digital data

*Description:*

*Abstract:*

This data set represents Hyperspectral Oyster Bed Mapping of Tampa Bay. The Galileo Group, Inc. flew the Tampa Bay coastline at low tide to collect the hyperspectral data as well as RGB photo imagery.

*Purpose:*

The objective of this mapping exercise was to establish a baseline map layer for the current extent of oysters within Tampa Bay. This effort provides the base data source for future mapping projects and enables trend analyses to be performed to aid scientists in their monitoring efforts. Hyperspectral imagery, comprising 128 spectral bands, was collected at low tide for the near shore of Tampa Bay, Boca Ciega and the Narrows. The flight was planned to correspond with the low tide cycle so that the intertidal areas of the Bay would be exposed. The Galileo Group flew the area and performed the hyperspectral analysis.

*Time\_Period\_of\_Content:*

*Time\_Period\_Information:*

*Single\_Date/Time:*

*Calendar\_Date:* 9/15/2005

*Currentness\_Reference:* ground condition

*Status:*

*Progress:* Complete

*Maintenance\_and\_Update\_Frequency:* As needed

*Spatial\_Domain:*

*Bounding\_Coordinates:*

*West\_Bounding\_Coordinate:* -82.764659

*East\_Bounding\_Coordinate:* -82.383251

*North\_Bounding\_Coordinate:* 28.020282

*South\_Bounding\_Coordinate:* 27.569306

*Keywords:*

*Theme:*

*Theme\_Keyword:* Hyperspectral

*Theme\_Keyword:* Tampa Bay

*Theme\_Keyword:* oyster

*Theme\_Keyword:* oyster reefs

*Theme\_Keyword:* oyster beds

*Theme\_Keyword:* oyster clumps

*Place:*

*Place\_Keyword:* Tampa Bay

*Access\_Constraints:*

All data must be verified by Principal Investigator or Group Database Analyst prior to release. It is strongly recommended that this data is directly acquired from FWC and not indirectly through other sources which may have changed the data in some way. FWC makes no claims as to the data's suitability for other purposes.

*Use\_Constraints:*

FWC-FWRI must be credited. This is not a survey data set and should not be utilized as such. These data are not to be used for navigation. Acknowledgement of the FWC-FWRI (Florida Fish and Wildlife Conservation Commission-Fish and Wildlife Research Institute) as the data source would be appreciated in any products developed from these data, and such acknowledgment as is standard for citation and legal practices for data source is expected by users of this data. Please cite the original metadata when using portions of the record to create a similar record of slightly altered data, such as reprojection. If any data are modified or adjusted, please share the edited information with FWC. Users should be aware that comparison with other data sets for the same area from other time periods may be inaccurate due to inconsistencies resulting from changes in mapping conventions, data collection, and computer processes over time. FWC shall not be liable for improper or incorrect use of this data. These data are not legal documents and are not to be used as such. This is not a survey data set and should not be utilized as such. These data are not to be used for navigation.

*Point\_of\_Contact:*

*Contact\_Information:*

*Contact\_Person\_Primary:*

*Contact\_Person:* GIS Data Librarian

*Contact\_Organization:*

FWC-FWRI (Florida Fish and Wildlife Conservation Commission-Fish and Wildlife Research Institute)

*Contact\_Position:* GIS Data Librarian

*Contact\_Address:*

*Address\_Type:* mailing and physical address

*Address:*

Fish and Wildlife Research Institute 100 Eighth Avenue Southeast

*City:* St. Petersburg

*State\_or\_Province:* Florida

*Postal\_Code:* 33701-5020

*Country:* USA

*Contact\_Voice\_Telephone:* 727-896-8626

*Contact\_Facsimile\_Telephone:* 727-893-1679

*Contact\_Electronic\_Mail\_Address:* GISLibrarian@MyFWC.com  
*Hours\_of\_Service:* Monday – Friday 8:00 a.m.-5:00 p.m. Eastern time  
*Security\_Information:*  
*Security\_Classification\_System:* FWRI-DC  
*Security\_Classification:* Available without restriction  
*Security\_Handling\_Description:* Available without restriction  
*Native\_Data\_Set\_Environment:*  
Microsoft Windows XP Version 5.1 (Build 2600) Service Pack 2; ESRI ArcCatalog 9.1.0.722

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*Data\_Quality\_Information:*  
*Attribute\_Accuracy:*  
*Attribute\_Accuracy\_Report:* All entities and attributes have been identified.  
*Lineage:*  
*Process\_Step:*  
*Process\_Date:* Unknown

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*Spatial\_Data\_Organization\_Information:*  
*Direct\_Spatial\_Reference\_Method:* Vector  
*Point\_and\_Vector\_Object\_Information:*  
*SDTS\_Terms\_Description:*  
*SDTS\_Point\_and\_Vector\_Object\_Type:* G-polygon  
*Point\_and\_Vector\_Object\_Count:* 1009

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*Spatial\_Reference\_Information:*  
*Horizontal\_Coordinate\_System\_Definition:*  
*Planar:*  
*Map\_Projection:*  
*Map\_Projection\_Name:* Albers Conical Equal Area  
*Albers\_Conical\_Equal\_Area:*  
*Standard\_Parallel:* 24.000000  
*Standard\_Parallel:* 31.500000  
*Longitude\_of\_Central\_Meridian:* -84.000000  
*Latitude\_of\_Projection\_Origin:* 24.000000  
*False\_Easting:* 400000.000000  
*False\_Northing:* 0.000000  
*Planar\_Coordinate\_Information:*  
*Planar\_Coordinate\_Encoding\_Method:* coordinate pair  
*Coordinate\_Representation:*  
*Abscissa\_Resolution:* 0.000128  
*Ordinate\_Resolution:* 0.000128  
*Planar\_Distance\_Units:* meters  
*Geodetic\_Model:*  
*Horizontal\_Datum\_Name:* North American Datum of 1983  
*Ellipsoid\_Name:* Geodetic Reference System 80  
*Semi-major\_Axis:* 6378137.000000  
*Denominator\_of\_Flattening\_Ratio:* 298.257222

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*Entity\_and\_Attribute\_Information:*

*Detailed\_Description:*

*Entity\_Type:*

*Entity\_Type\_Label:* 0811\_NEPTUNE II\_Oyster Bed\_Polygons

*Attribute:*

*Attribute\_Label:* FID

*Attribute\_Definition:* Internal feature number.

*Attribute\_Definition\_Source:* ESRI

*Attribute\_Domain\_Values:*

*Unrepresentable\_Domain:*

Sequential unique whole numbers that are automatically generated.

*Attribute:*

*Attribute\_Label:* Shape

*Attribute\_Definition:* Feature geometry.

*Attribute\_Definition\_Source:* ESRI

*Attribute\_Domain\_Values:*

*Unrepresentable\_Domain:* Coordinates defining the features.

*Attribute:*

*Attribute\_Label:* POLYGON

*Attribute\_Definition:* ordered overall polygon number

*Attribute\_Definition\_Source:* Derived from information provided by the Galileo Group

*Attribute:*

*Attribute\_Label:* SITE

*Attribute\_Definition:* oyster bed site number

*Attribute\_Definition\_Source:* Derived from information provided by the Galileo Group

*Attribute:*

*Attribute\_Label:* POLYGON1

*Attribute\_Definition:* ordered polygon number within one site

*Attribute\_Definition\_Source:* Derived from information provided by the Galileo Group

*Attribute:*

*Attribute\_Label:* FLIGHT

*Attribute\_Definition:* flight number where the oyster bed is located

*Attribute\_Definition\_Source:* Derived from information provided by the Galileo Group

*Overview\_Description:*

*Entity\_and\_Attribute\_Overview:*

This is a detailed description of the attributes for the 0811\_NEPTUNE II\_Oyster Bed\_Polygons. These attributes were obtained from the Galileo Group, Inc. The shape of each oyster bed is represented by one or more polygons.

---

*Distribution\_Information:*

*Distributor:*

*Contact\_Information:*

*Contact\_Person\_Primary:*

*Contact\_Person:* GIS Data Librarian

*Contact\_Organization:*

FWC-FWRI (Florida Fish and Wildlife Conservation Commission-Fish and Wildlife Research Institute)

*Contact\_Position:* GIS Data Librarian

*Contact\_Address:*

*Address\_Type:* mailing and physical address

*Address:*

Fish and Wildlife Research Institute 100 Eighth Avenue Southeast

*City:* St. Petersburg

*State\_or\_Province:* Florida

*Postal\_Code:* 33701-5020

*Country:* USA

*Contact\_Voice\_Telephone:* 727-896-8626

*Contact\_Facsimile\_Telephone:* 727-893-1679

*Contact\_Electronic\_Mail\_Address:* GISLibrarian@MyFWC.com

*Hours\_of\_Service:* 8:00 a.m.-5:00 p.m. Eastern time

*Resource\_Description:* Downloadable Data

*Distribution\_Liability:*

This data set is in the public domain, and the recipient may not assert any proprietary rights thereto nor represent it to anyone as other than a FWC-FWRI produced data set; it is provided "as-is" without warranty of any kind, including, but not limited to, the implied warranties of merchantability and fitness for a particular purpose. The user assumes all responsibility for the accuracy and suitability of this data set for a specific application. In no event will the staff of the Fish and Wildlife Research Institute be liable for any damages, including lost profits, lost savings, or other incidental or consequential damages arising from the use of or the inability to use this data set.

*Standard\_Order\_Process:*

*Non-digital\_Form:*

Contact GIS Librarian by e-mail, telephone, or letter explaining which products are needed and providing a brief description of how the products will be used. Also, provide name and address of the person or organization requesting the products

*Fees:*

None. However, persons or organizations requesting information must provide transfer media (CD-ROM only) if FTP is not available and must pay express shipping costs if express shipping is required.

*Ordering\_Instructions:*

Contact GIS Librarian by e-mail, telephone, or letter explaining which products are needed and providing a brief description of how the products will be used. Also, provide name and address of the person or organization requesting the products.

*Turnaround:*

Usually within 10 business days, although, complex requests may take longer

*Custom\_Order\_Process:* Contact GIS Librarian

*Available\_Time\_Period:*

*Time\_Period\_Information:*

*Single\_Date/Time:*

*Calendar\_Date:* 2/14/2006

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*Metadata\_Reference\_Information:*

*Metadata\_Date:* 20060213

*Metadata\_Contact:*

*Contact\_Information:*

*Contact\_Person\_Primary:*

*Contact\_Person:* GIS Data Librarian

*Contact\_Organization:*

FWC-FWRI (Florida Fish and Wildlife Conservation Commission-Fish and Wildlife Research Institute)

*Contact\_Position:* GIS Data Librarian

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*Contact\_Facsimile\_Telephone:* 727-893-1679

*Contact\_Electronic\_Mail\_Address:* GISLibrarian@MyFWC.com

*Hours\_of\_Service:* 8:00 a.m.-5:00 p.m. Eastern time

*Metadata\_Standard\_Name:* FGDC Content Standards for Digital Geospatial Metadata

*Metadata\_Standard\_Version:* FGDC-STD-001-1998

*Metadata\_Time\_Convention:* local time

*Metadata\_Access\_Constraints:* No restrictions on metadata.

*Metadata\_Use\_Constraints:* Metadata must be distributed with the data set

*Metadata\_Security\_Information:*

*Metadata\_Security\_Classification\_System:* FWRI-MC

*Metadata\_Security\_Classification:* Available

*Metadata\_Extensions:*

*Online\_Linkage:* <<http://www.esri.com/metadata/esriprof80.html>>

*Profile\_Name:* ESRI Metadata Profile

## **FWRI\_TB\_oysters**

### **Metadata:**

- [Identification Information](#)
- [Data Quality Information](#)
- [Spatial Data Organization Information](#)
- [Spatial Reference Information](#)
- [Entity and Attribute Information](#)
- [Distribution Information](#)
- [Metadata Reference Information](#)

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*Identification\_Information:*

*Citation:*

*Citation\_Information:*

*Originator:* FWC-FWRI

*Publication\_Date:* Unpublished Material

*Publication\_Time:* 2/14/2006

*Title:* FA\_4\_PI

*Geospatial\_Data\_Presentation\_Form:* vector digital data

*Description:*

*Abstract:*

This data set represents oyster reef coverage around Tampa Bay. A combination of methodologies was employed on 2005 low tide true color imagery provided by the Galileo Group, Inc. Visual Learning Systems software, Feature Analyst and photo interpretation was used to ascertain oyster reef coverage in the Bay area.

*Purpose:*

The objective of this mapping exercise was to establish a baseline map layer for the current extent of oysters within Tampa Bay. This effort provides the base data source for future mapping projects and enables trend analyses to be performed to aid scientists in their monitoring efforts.

*Supplemental\_Information:*

Prior to July 1, 2004, the Fish and Wildlife Research Institute (FWRI) was known as the Florida Marine Research Institute (FMRI). The institute name has not been changed in historical data sets or references to work completed by the Florida Marine Research Institute. The institute name has been changed in references to ongoing research, new research, and contact information.

*Time\_Period\_of\_Content:*

*Time\_Period\_Information:*

*Single\_Date/Time:*

*Calendar\_Date:* 2/14/2006

*Currentness\_Reference:* ground condition

*Status:*

*Progress:* Complete

*Maintenance\_and\_Update\_Frequency:* As needed

*Spatial\_Domain:*

*Bounding\_Coordinates:*

*West\_Bounding\_Coordinate:* -82.846493

*East\_Bounding\_Coordinate:* -82.385410

*North\_Bounding\_Coordinate:* 28.023691

*South\_Bounding\_Coordinate:* 27.581787

*Keywords:*

*Theme:*

*Theme\_Keyword:* oysters

*Theme\_Keyword:* Tampa Bay

*Theme\_Keyword:* oyster reef mapping

*Theme\_Keyword:* oyster reef

*Theme\_Keyword:* oyster clumps

*Theme\_Keyword:* mangrove root oyster

*Theme\_Keyword:* low tide imagery

*Place:*

*Place\_Keyword:* Tampa Bay

*Access\_Constraints:*

All data must be verified by Principal Investigator or Group Database Analyst prior to release. It is strongly recommended that this data is directly acquired from FWC and not indirectly through

other sources which may have changed the data in some way. FWC makes no claims as to the data's suitability for other purposes.

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*Contact\_Person:* GIS Data Librarian

*Contact\_Organization:*

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*Contact\_Position:* GIS Data Librarian

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*Address\_Type:* mailing and physical address

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*Postal\_Code:* 33701-5020

*Country:* USA

*Contact\_Voice\_Telephone:* 727-896-8626

*Contact\_Facsimile\_Telephone:* 727-893-1679

*Contact\_Electronic\_Mail\_Address:* GISLibrarian@MyFWC.com

*Security\_Information:*

*Security\_Classification\_System:* FWRI-DC

*Security\_Classification:* Available without restriction

*Security\_Handling\_Description:* Available without restriction

*Native\_Data\_Set\_Environment:*

Microsoft Windows XP Version 5.1 (Build 2600) Service Pack 2; ESRI ArcCatalog 9.1.0.722

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*Data\_Quality\_Information:*

*Attribute\_Accuracy:*

*Attribute\_Accuracy\_Report:* Attributes are accurate as the source data.

*Logical\_Consistency\_Report:* These data are logically consistent.

*Completeness\_Report:* These data are complete for the state of Florida

*Positional\_Accuracy:*

*Horizontal\_Positional\_Accuracy:*

*Horizontal\_Positional\_Accuracy\_Report:*

Positional accuracy has not been determined and varies according to linework source.

*Lineage:*

*Source\_Information:*

*Source\_Citation:*

*Citation\_Information:*

*Originator:* Galileo Group, Inc.

*Publication\_Date:* Unpublished Material

*Title:* NeptuneII\_mosaic

*Geospatial\_Data\_Presentation\_Form:* raster digital data

*Source\_Scale\_Denominator:* 6600

*Type\_of\_Source\_Media:* Digital imagery

*Source\_Time\_Period\_of\_Content:*

*Time\_Period\_Information:*

*Single\_Date/Time:*

*Calendar\_Date:* 29/2005

*Source\_Currentness\_Reference:* ground condition

*Source\_Contribution:*

Low tide imagery was use for photo interperation of oyster reefs in Tampa Bay

*Process\_Step:*

*Process\_Description:*

Oyster reefs were produced by “heads up” digitizing using the 2005 imagery provided by the Galileo Group, Inc. of Tampa Bay. In specific cases, 2004 digital ortho-photography were used.

*Process\_Date:* 2005

*Process\_Contact:*

*Contact\_Information:*

*Contact\_Person\_Primary:*

*Contact\_Person:* GIS Data Librarian

*Contact\_Organization:*

FWC-FWRI (Florida Fish and Wildlife Conservation Commission-Fish and Wildlife Research Institute)

*Contact\_Position:* GIS Data Librarian

*Contact\_Address:*

*Address\_Type:* mailing and physical address

*Address:*

Fish and Wildlife Research Institute 100 Eighth Avenue Southeast

*City:* St. Petersburg

*State\_or\_Province:* Florida

*Postal\_Code:* 33701-2050

*Country:* USA

*Contact\_Voice\_Telephone:* 727-896-8626

*Contact\_Facsimile\_Telephone:* 727-893-1679

*Contact\_Electronic\_Mail\_Address:* GISLibrarian@MyFWC.com

*Hours\_of\_Service:* 8:00 a.m.-5:00 p.m. Eastern time

---

*Spatial\_Data\_Organization\_Information:*

*Direct\_Spatial\_Reference\_Method:* Vector

*Point\_and\_Vector\_Object\_Information:*  
*SDTS\_Terms\_Description:*  
*SDTS\_Point\_and\_Vector\_Object\_Type:* G-polygon  
*Point\_and\_Vector\_Object\_Count:* 1720

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*Spatial\_Reference\_Information:*  
*Horizontal\_Coordinate\_System\_Definition:*  
*Planar:*  
*Grid\_Coordinate\_System:*  
*Grid\_Coordinate\_System\_Name:* Universal Transverse Mercator  
*Universal\_Transverse\_Mercator:*  
*UTM\_Zone\_Number:* 17  
*Transverse\_Mercator:*  
*Scale\_Factor\_at\_Central\_Meridian:* 0.999600  
*Longitude\_of\_Central\_Meridian:* -81.000000  
*Latitude\_of\_Projection\_Origin:* 0.000000  
*False\_Easting:* 500000.000000  
*False\_Northing:* 0.000000  
*Planar\_Coordinate\_Information:*  
*Planar\_Coordinate\_Encoding\_Method:* coordinate pair  
*Coordinate\_Representation:*  
*Abscissa\_Resolution:* 0.000128  
*Ordinate\_Resolution:* 0.000128  
*Planar\_Distance\_Units:* meters  
*Geodetic\_Model:*  
*Horizontal\_Datum\_Name:* North American Datum of 1983  
*Ellipsoid\_Name:* Geodetic Reference System 80  
*Semi-major\_Axis:* 6378137.000000  
*Denominator\_of\_Flattening\_Ratio:* 298.257222

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*Entity\_and\_Attribute\_Information:*  
*Detailed\_Description:*  
*Entity\_Type:*  
*Entity\_Type\_Label:* FA\_4\_PI  
*Entity\_Type\_Definition:* unknown  
*Entity\_Type\_Definition\_Source:* producer defined  
*Attribute:*  
*Attribute\_Label:* FID  
*Attribute\_Definition:* Internal feature number.  
*Attribute\_Definition\_Source:* ESRI  
*Attribute\_Domain\_Values:*  
*Unrepresentable\_Domain:*  
Sequential unique whole numbers that are automatically generated.  
*Attribute:*  
*Attribute\_Label:* Shape  
*Attribute\_Definition:* Feature geometry.  
*Attribute\_Definition\_Source:* ESRI  
*Attribute\_Domain\_Values:*

*Unrepresentable\_Domain:* Coordinates defining the features.

*Attribute:*

*Attribute\_Label:* CLASS\_ID

*Attribute\_Definition:* unknown

*Attribute\_Definition\_Source:* producer defined

*Attribute\_Domain\_Values:*

*Enumerated\_Domain:*

*Enumerated\_Domain\_Value:* unknown

*Enumerated\_Domain\_Value\_Definition:* producer defined

*Attribute:*

*Attribute\_Label:* ID

*Attribute\_Definition:* unknown

*Attribute\_Definition\_Source:* producer defined

*Attribute\_Domain\_Values:*

*Enumerated\_Domain:*

*Enumerated\_Domain\_Value:* unknown

*Enumerated\_Domain\_Value\_Definition:* producer defined

*Overview\_Description:*

*Entity\_and\_Attribute\_Overview:* unknown

*Entity\_and\_Attribute\_Detail\_Citation:* unknown

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*Distribution\_Information:*

*Distributor:*

*Contact\_Information:*

*Contact\_Person\_Primary:*

*Contact\_Person:* GIS Data Librarian

*Contact\_Organization:*

FWC-FWRI (Florida Fish and Wildlife Conservation Commission-Fish and Wildlife Research Institute)

*Contact\_Position:* GIS Data Librarian

*Contact\_Address:*

*Address\_Type:* mailing and physical address

*Address:*

Fish and Wildlife Research Institute 100 Eighth Avenue Southeast

*City:* St. Petersburg

*State\_or\_Province:* Florida

*Postal\_Code:* 33701-5020

*Country:* USA

*Contact\_Voice\_Telephone:* 727-896-8626

*Contact\_Facsimile\_Telephone:* 727-893-1679

*Contact\_Electronic\_Mail\_Address:* GISLibrarian@MyFWC.com

*Hours\_of\_Service:* 8:00 a.m.-5:00 p.m. Eastern time

*Resource\_Description:* Downloadable Data

*Distribution\_Liability:*

This data set is in the public domain, and the recipient may not assert any proprietary rights thereto nor represent it to anyone as other than a FWC-FWRI produced data set; it is provided "as-is" without warranty of any kind, including, but not limited to, the implied warranties of merchantability and fitness for a particular purpose. The user assumes all responsibility for the

accuracy and suitability of this data set for a specific application. In no event will the staff of the Fish and Wildlife Research Institute be liable for any damages, including lost profits, lost savings, or other incidental or consequential damages arising from the use of or the inability to use this data set.

*Standard\_Order\_Process:*

*Digital\_Form:*

*Digital\_Transfer\_Information:*

*Transfer\_Size:* 0.554

*Fees:*

None. However, persons or organizations requesting information must provide transfer media if FTP is not available and must pay express shipping costs if express shipping is required.

*Ordering\_Instructions:*

Contact GIS Librarian by e-mail, telephone, or letter explaining which products are needed and providing a brief description of how the products will be used. Also, provide name and address of the person or organization requesting the products.

*Turnaround:*

Usually within 10 business days, although, complex requests may take longer

*Available\_Time\_Period:*

*Time\_Period\_Information:*

*Single\_Date/Time:*

*Calendar\_Date:* 2/14/2006

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*Metadata\_Reference\_Information:*

*Metadata\_Date:* 20060213

*Metadata\_Future\_Review\_Date:* unknown

*Metadata\_Contact:*

*Contact\_Information:*

*Contact\_Organization\_Primary:*

*Contact\_Organization:*

FWC-FWRI (Florida Fish and Wildlife Conservation Commission-Fish and Wildlife Research Institute)

*Contact\_Person:* GIS Data Librarian

*Contact\_Position:* GIS Data Librarian

*Contact\_Address:*

*Address\_Type:* mailing and physical address

*Address:*

Fish and Wildlife Research Institute 100 Eighth Avenue Southeast

*City:* St. Petersburg

*State\_or\_Province:* Florida

*Postal\_Code:* 33701-5020

*Country:* USA

*Contact\_Voice\_Telephone:* 727-896-8626

*Contact\_Facsimile\_Telephone:* 727-893-1679

*Contact\_Electronic\_Mail\_Address:* GISLibrarian@MyFWC.com

*Metadata\_Standard\_Name:* FGDC Content Standards for Digital Geospatial Metadata

*Metadata\_Standard\_Version:* FGDC-STD-001-1998

*Metadata\_Time\_Convention:* local time

*Metadata\_Access\_Constraints:* No restrictions on metadata

*Metadata\_Use\_Constraints:* Metadata must be distributed with the data set.

*Metadata\_Security\_Information:*

*Metadata\_Security\_Classification\_System:* FWRI-MC

*Metadata\_Security\_Classification:* Available

*Metadata\_Security\_Handling\_Description:* Metadata must be distributed with the data set.

*Metadata\_Extensions:*

*Online\_Linkage:* <<http://www.esri.com/metadata/esriprof80.html>>

*Profile\_Name:* ESRI Metadata Profile

## **Attachment 4: Galileo Technical Report**

## **Attachment 5: Field Reconnaissance Notes**

Green boundaries indicate area targeted fro field review. Oysters actually observed in field noted in dark ink. When scanned, some of these notes are obscured. Comments have been inserted where appropriate to aid in deciphering these.

## **Attachment 6: Field Sample Maps**

## **Attachment 7: Final Maps**

## **Attachment 8: Historic Maps**