Seagrass Scar Imaging Project Report: Cockroach Bay Seagrass Scar Tracking Project

Prepared For

Hillsborough County Environmental Protection Commission

By Florida Center for Community Design and Research

University of South Florida

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Study Period: October 2009 – January 2011

Background:

Project began as an addition to the existing Hillsborough County Environmental Protection Commissions (HCEPC) Seagrass Monitoring Project in Cockroach Bay in October of 2009. The goals of the Florida Center for Community Design and Research was to support the efforts to identify and quantify motor boat propeller scars in seagrass bed (sea grass scars) within the manatee protection zones of Cockroach Bay (see map insert Figure 1). A second goal was to evaluate the use of a commercially available side-scanning sonar unit (Humminbird 797c^2) to identify and map these scars. The initial focus of the study were 3 transects across passes leading into Cockroach Bay (CB01, CB02, CB03 in Figure 1); however, later in the project four City of Tampa transects were added expanding this scope.

Figure 1. Map of HCEPC transects in Cockroach Bay.

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Approach

Equipment

The study area is tidal and many times quite shallow so one of the requirements of the study was to be able to operate in water less than one foot in depth. Under these conditions, a standard, sonar equipped work-boat would not be feasible. The Florida Center for Community Design and Research (FCCDR) has designed small boats and kayaks with integrated sonar and GPS equipment for lake and river mapping which were ideal for these conditions. A heavily modified Manta Ray 10' sit on top kayak (see title page photo) was selected as the most appropriate platform for the project. Mounted to this vessel was a Humminbird model 797c[2] equipped with a multi-frequency 83kHz, 200kHz and 455kHz transducer and an integrated WAAS enabled GPS and a Lowrance LCX 28CHD bathymetry unit with a dual frequency 50kHz and 200kHz transducer. These units were chosen due to its low cost, data storage capabilities (uses a standard SD memory card) and versatility. The primary sonar employed was the Humminbird and this report will discuss Humminbird results exclusively.

Initial Trail Run October 2009

The initial trials of the side-scanning sonar were conducted using a method that required the field biologist to slowly move the instrumented kayak across the transect until a linear scar feature crossed the transect. At that time the kayak was stopped and a digital image was taken and saved. This technique captured images of the scars, but also resulted in images that had blurred portions because the unit continues to image the same location repeatedly when stationary. This technique also resulted in only capturing the GPS position for the top most return of the image, creating errors in location. Further complications occurred when several scars crossed the transect in close proximity. However, even with these limitations, the method was successful in identifying scar features. Figure 2 is a Humminbird image from transects run in October of 2009. A seagrass scar is visible along the top most portion of the image. Immediately below that is a blurred portion caused by pausing the forward movement of the kayak to image the weak scar feature in the middle to lower portion of the figure. Table 1 provides the results of the assessments for the three transects and Figures 3-5 provide the relative positions of the scars crossing transect CB01, 02, 03.

October 2009 Trial Run Results

Table 1. Results of the October 2009 data collection effort

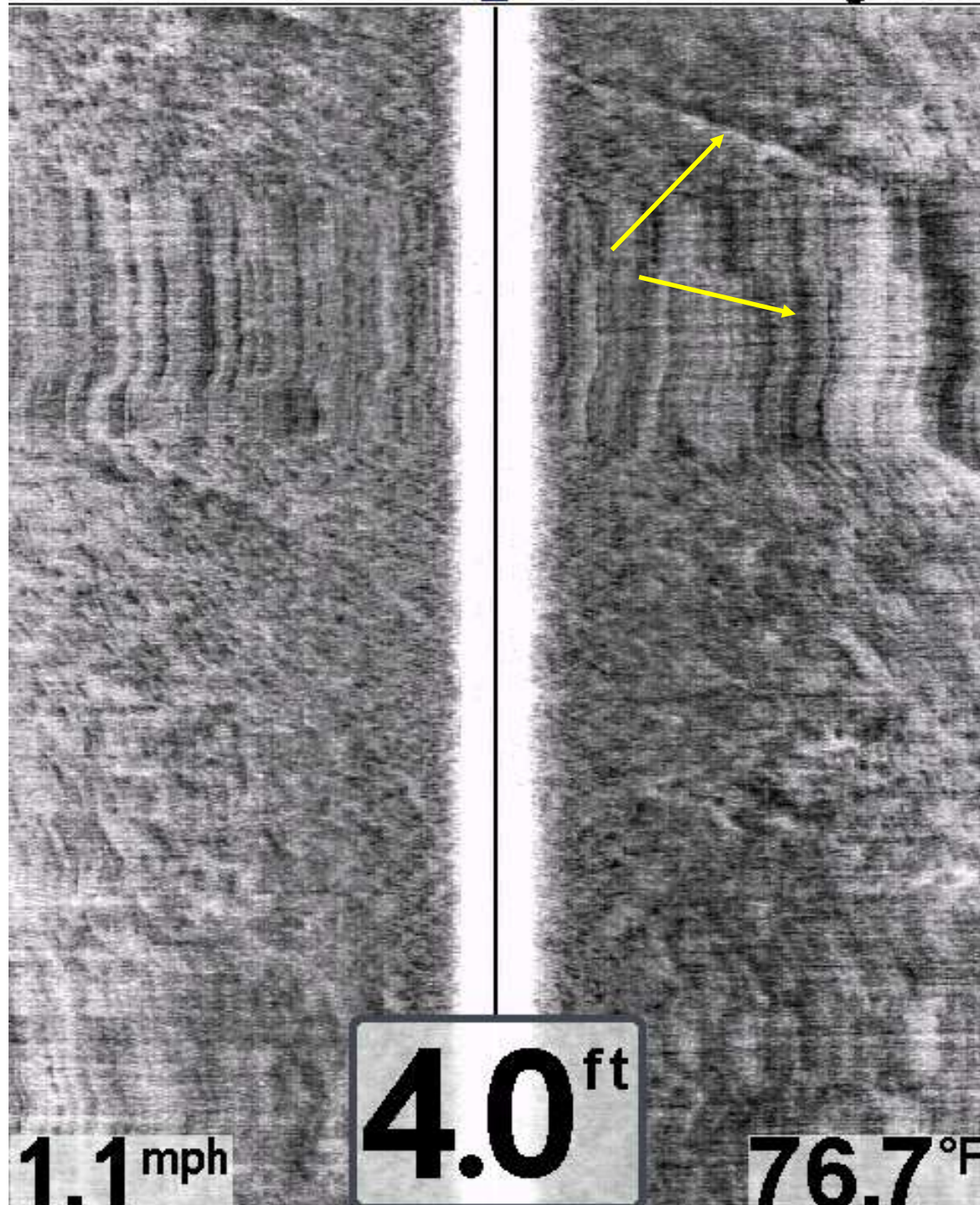| Transect	Number of Scars Documented
CB01	13
CB02	9
CB03	11

Figure 2 Image from transects run in October of 2009.

Figure 3 Map showing the locations of the 13 seagrass scars found on transect CB01 during the October 2009 monitoring effort.
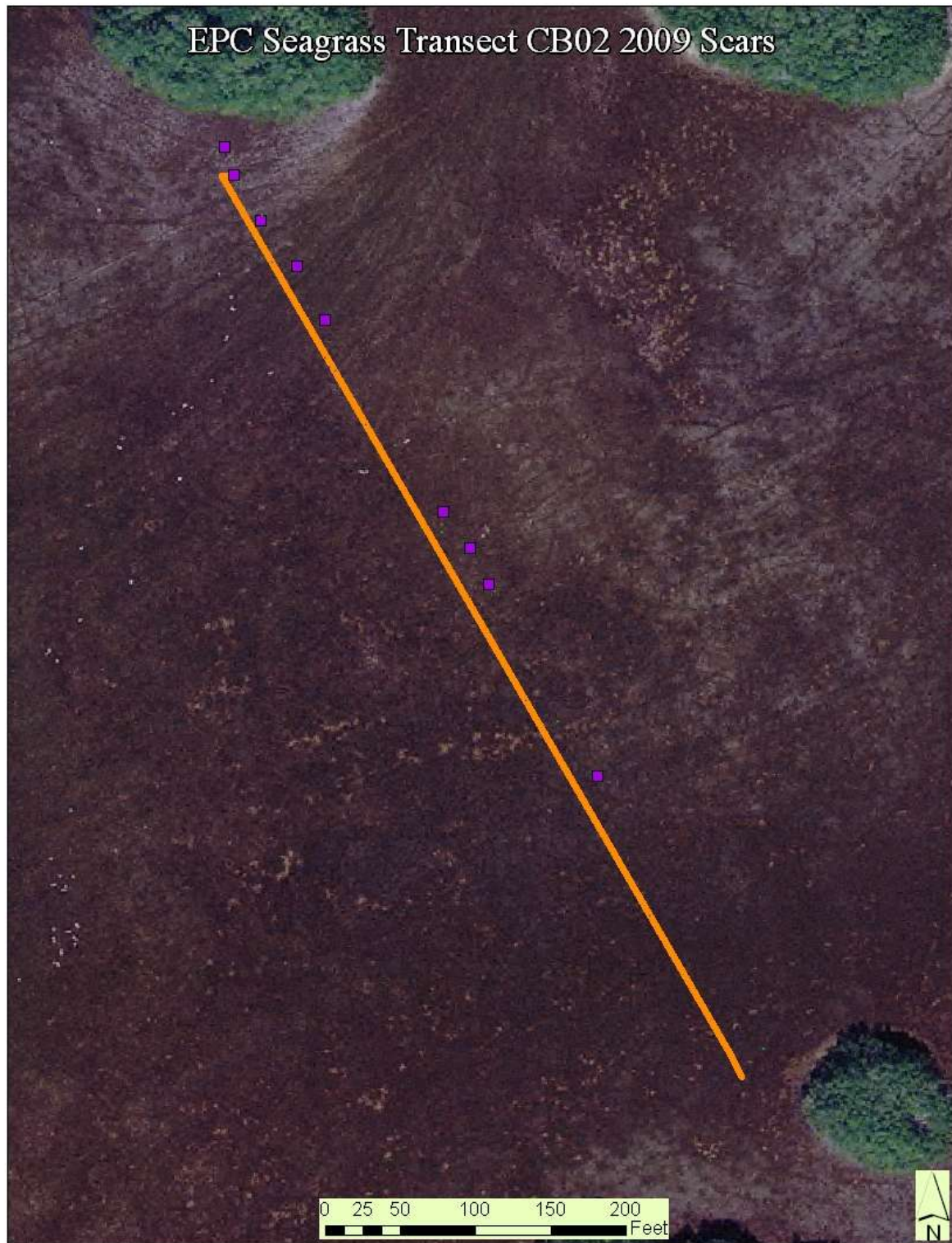
Figure 4. Map showing the locations of the 9 seagrass scars found on transect CB02 during the October 2009 monitoring effort.

Figure 5 Map showing the locations of the 11 seagrass scars found on transect CB03 during the October 2009 monitoring effort.

April 2010 Assessment Runs

In April of 2010 the monitoring effort was expanded to include four City of Tampa Transects (MTB03, B04, B05, B06). Three of these transects are on the outside of Cockroach Bay and are setup perpendicular to the shoreline, while the fourth resides across a pass in inner Cockroach Bay. The methods used for the April 2010 monitoring effort were the same as those used for the October 2009 effort. Figure 6 shows the position of the April Transects in Cockroach Bay. Table 2 provides the results of this field assessment and Figures 7-13 show the position of located scars.

Figure 6. Map showing the locations of EPC seagrass transects used for the April and October 2010 monitoring efforts.

Table 2. Results of April 2010 Assessments

Transect	Number of Scars Documented
CB01	12
CB02	7
CB03	9
MTB03	2
MTB04	2
MTB05	1
MTB06	1

Figure 7. Map showing the locations of the 1 seagrass scar found on transect MTB06 during the April 2010 monitoring effort.
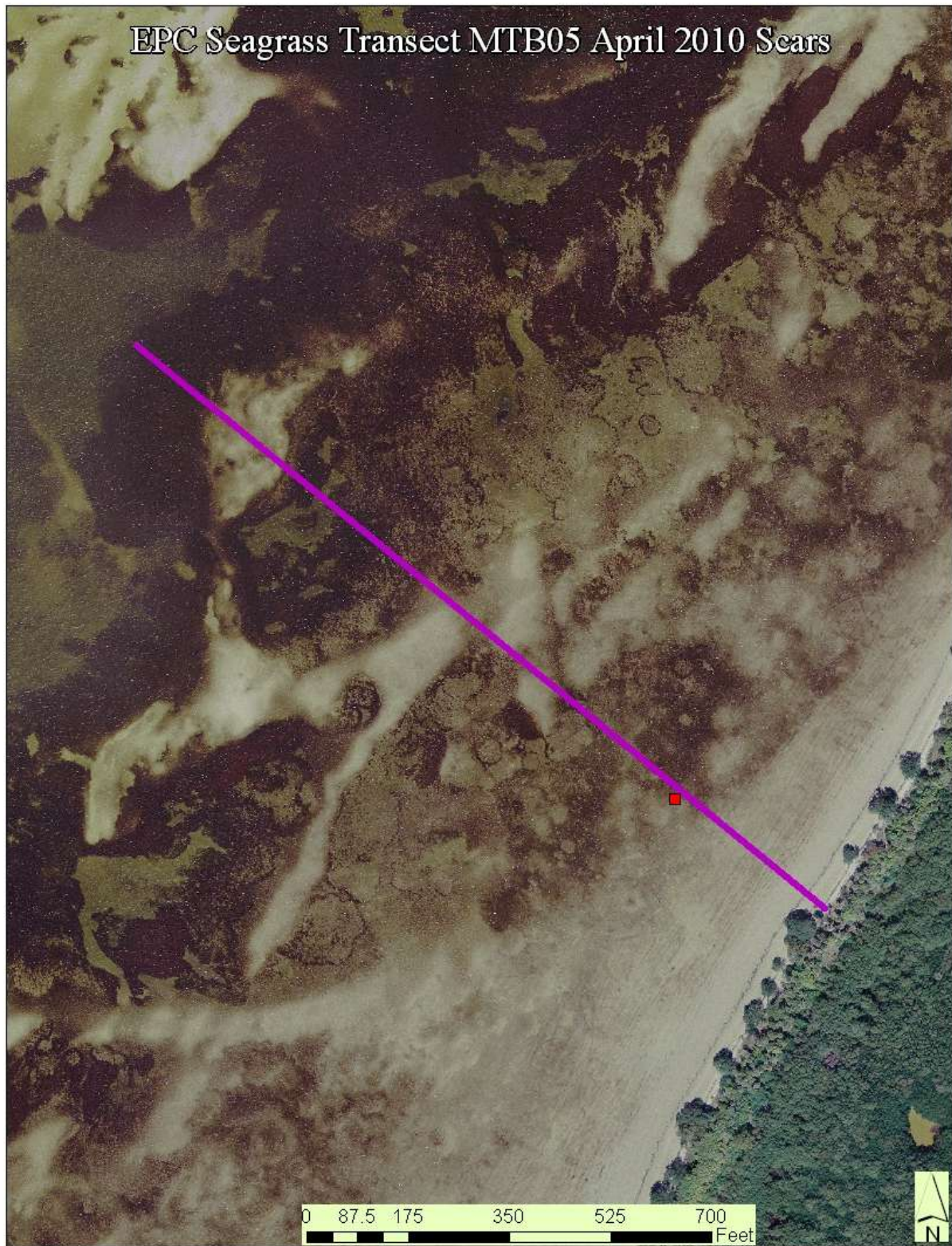
Figure 8. Map showing the locations of the 1 seagrass scar found on transect MTB05 during the April 2010 monitoring effort.
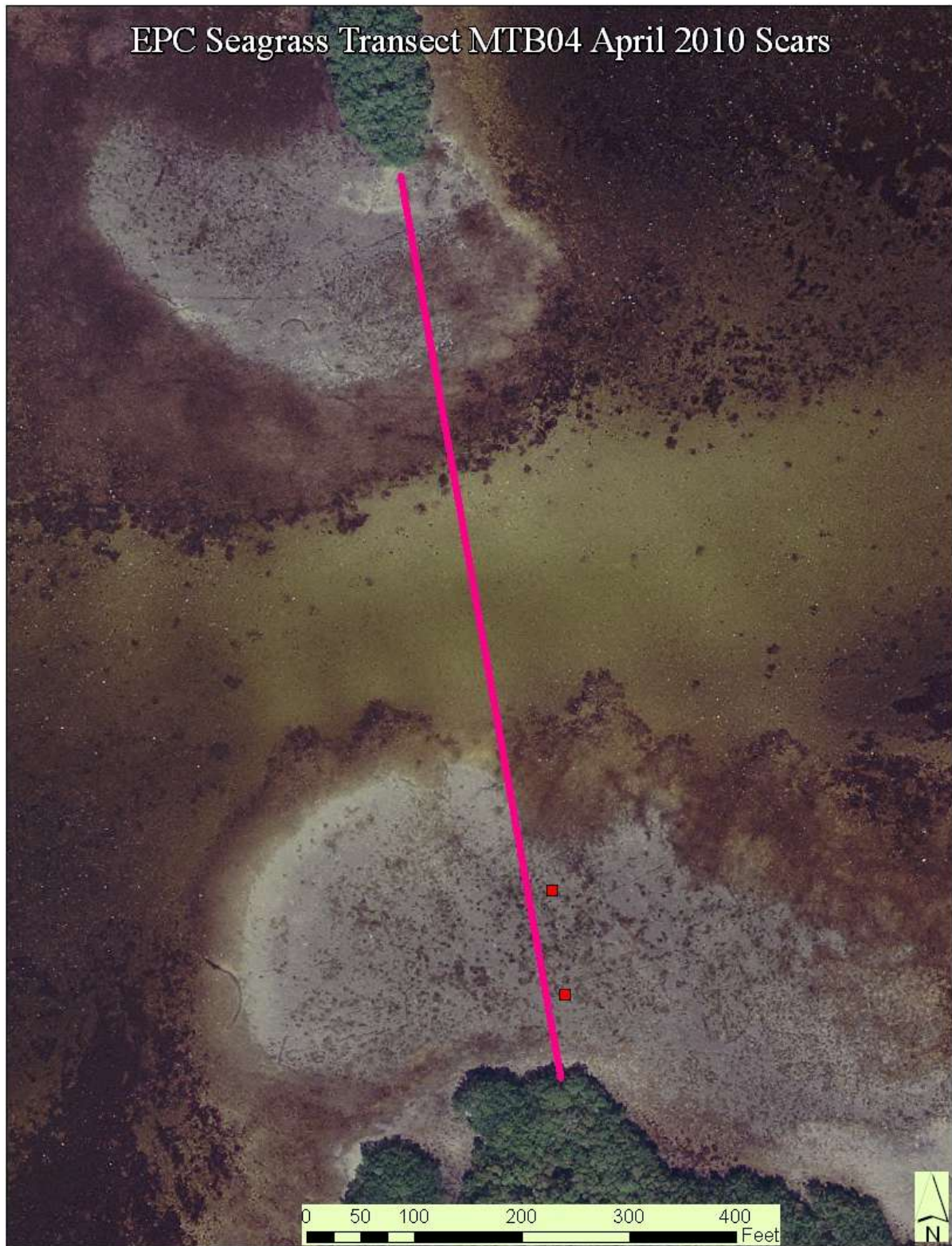
Figure 9. Map showing the locations of the 2 seagrass scars found on transect MTB04 during the April 2010 monitoring effort.
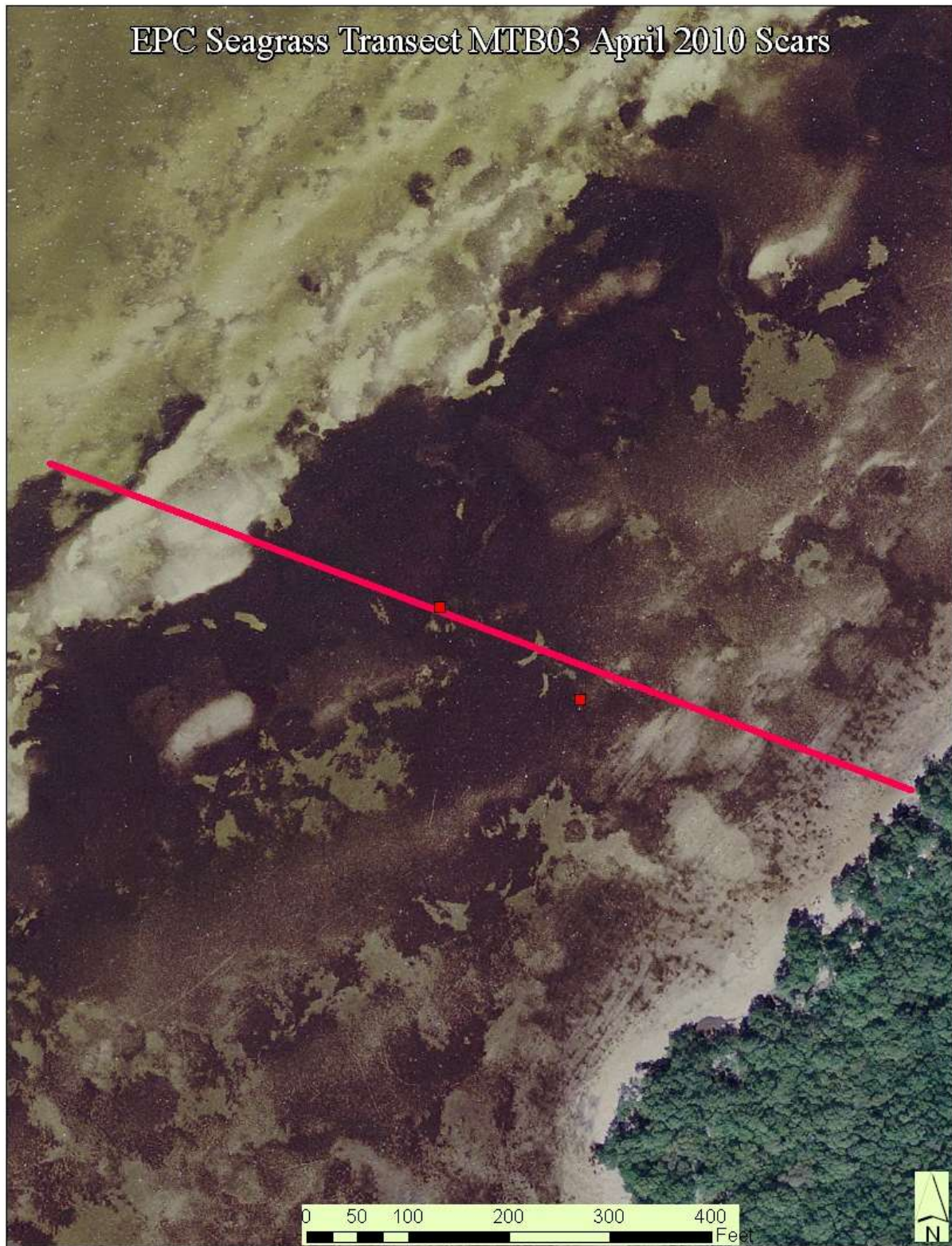
Figure 10. Map showing the locations of the 2 seagrass scars found on transect MTB03 during the April 2010 monitoring effort.

Figure 11. Map showing the locations of the 9 seagrass scars found on transect CB03 during the April 2010 monitoring effort.
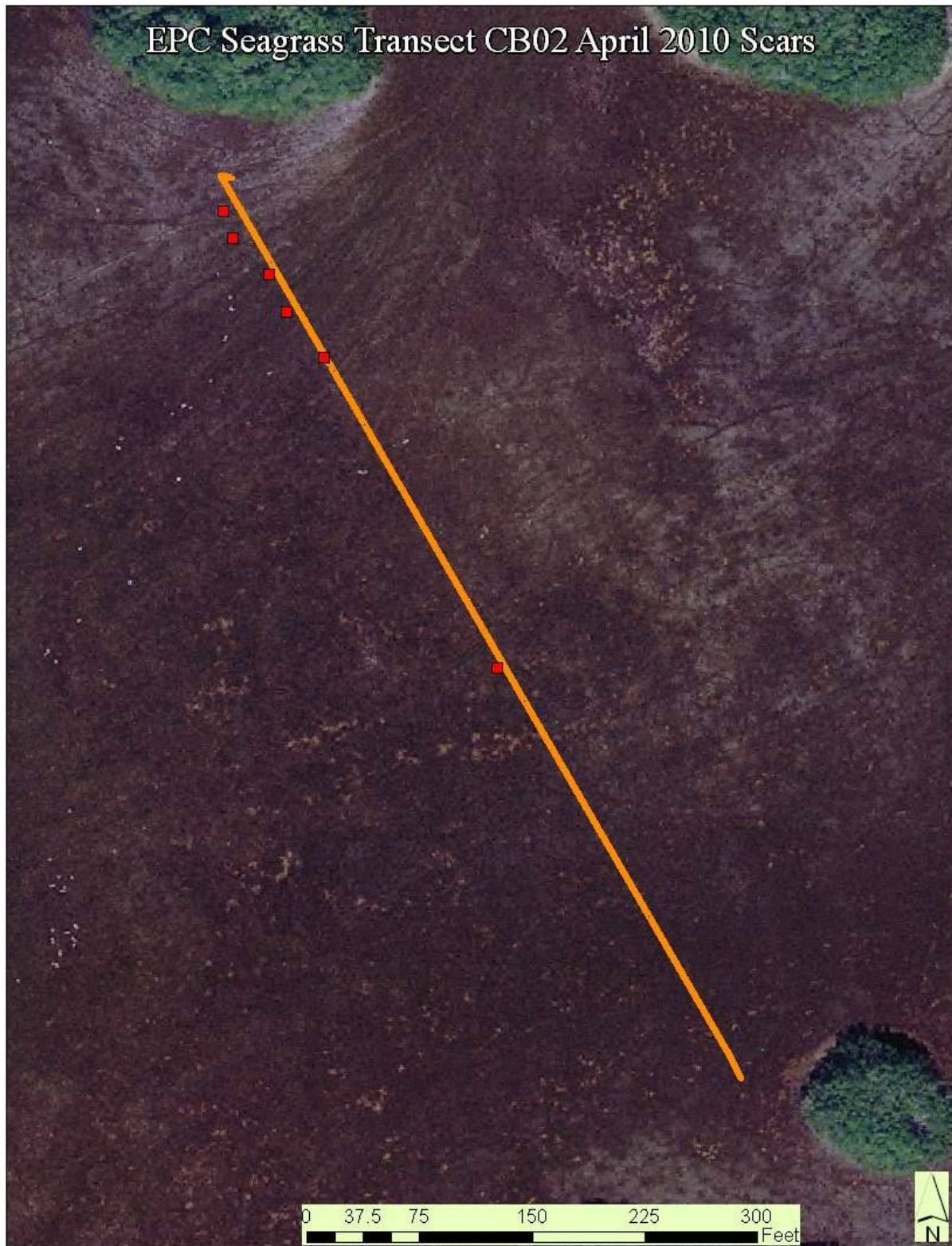
Figure 12. Map showing the locations of the 7 seagrass scars found on transect CB02 during the April 2010 monitoring effort.

Figure 13. Map showing the locations of the 12 seagrass scars found on transect CB01 during the April 2010 monitoring effort.

October 2010 Assessment

Beginning in October of 2010, a new data processing application was utilized to help correct some of the errors created by the previous method. The software is a 3rd party application for the Humminbird sonar system which allows the interpretation of the ".dat" file generated as part of the stored data. The application is named "HumViewer " and is available from the developer at: http://forums.sideimagingsoft.com/index.php?PHPSESSID=qdv3rq8ffshlt68vh3pe26f9o3&topic=155.0

HumViewer allows the user to replay recorded transects on a PC and output data as sub-recording images, snapshot images, .csv data files, or .kml files. In addition, this software includes a tool that displays the GPS coordinates for any point in the side scan recording and allows for adjustment of the brightness and contrast of the image to reveal features.

Appendix A contains the field procedures for use of the Humminbird 797c^2 to record data for later processing using HumViewer. Appendix B contains the analyst procedures for processing recorded data using HumViewer software. Figure 14 shows a typical HumViewer output chart. Table 3 provides the results from the October Assessments and Figures 16-21 show the position of seagrass scars that were discovered during the assessment along the various transects.
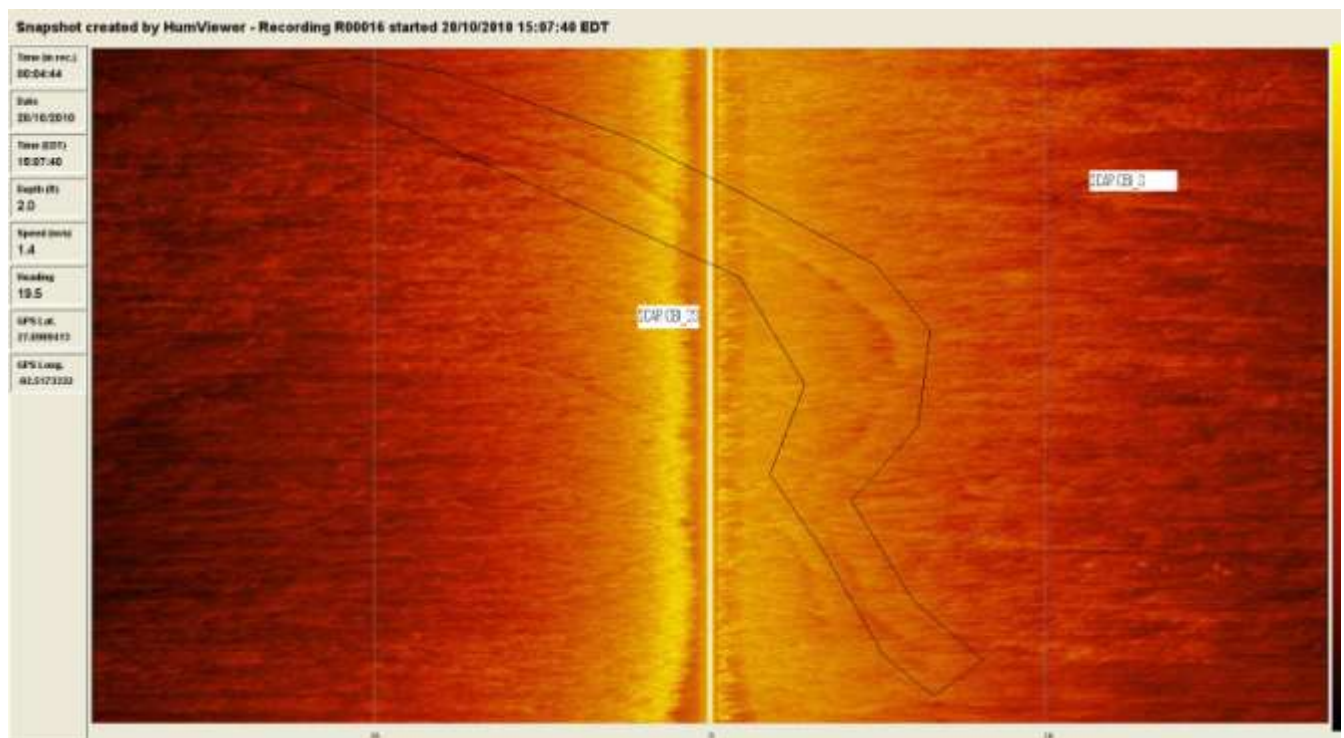

Figure 14. Snapshot image output from HumViewer software from October 2010 monitoring effort on transect CB01.

Table 3. Results from the October 2010 Assessments

Transect	Number of Scars Documented
CB01	20
CB02	9
CB03	13
MTB03	2
MTB04	6
MTB05	4
MTB06	3

Figure 15. Map showing the locations of the 3 seagrass scars found on transect MTB06 during the October 2010 monitoring effort.

Figure 16. Map showing the locations of the 4 seagrass scars found on transect MTB05 during the October 2010 monitoring effort.
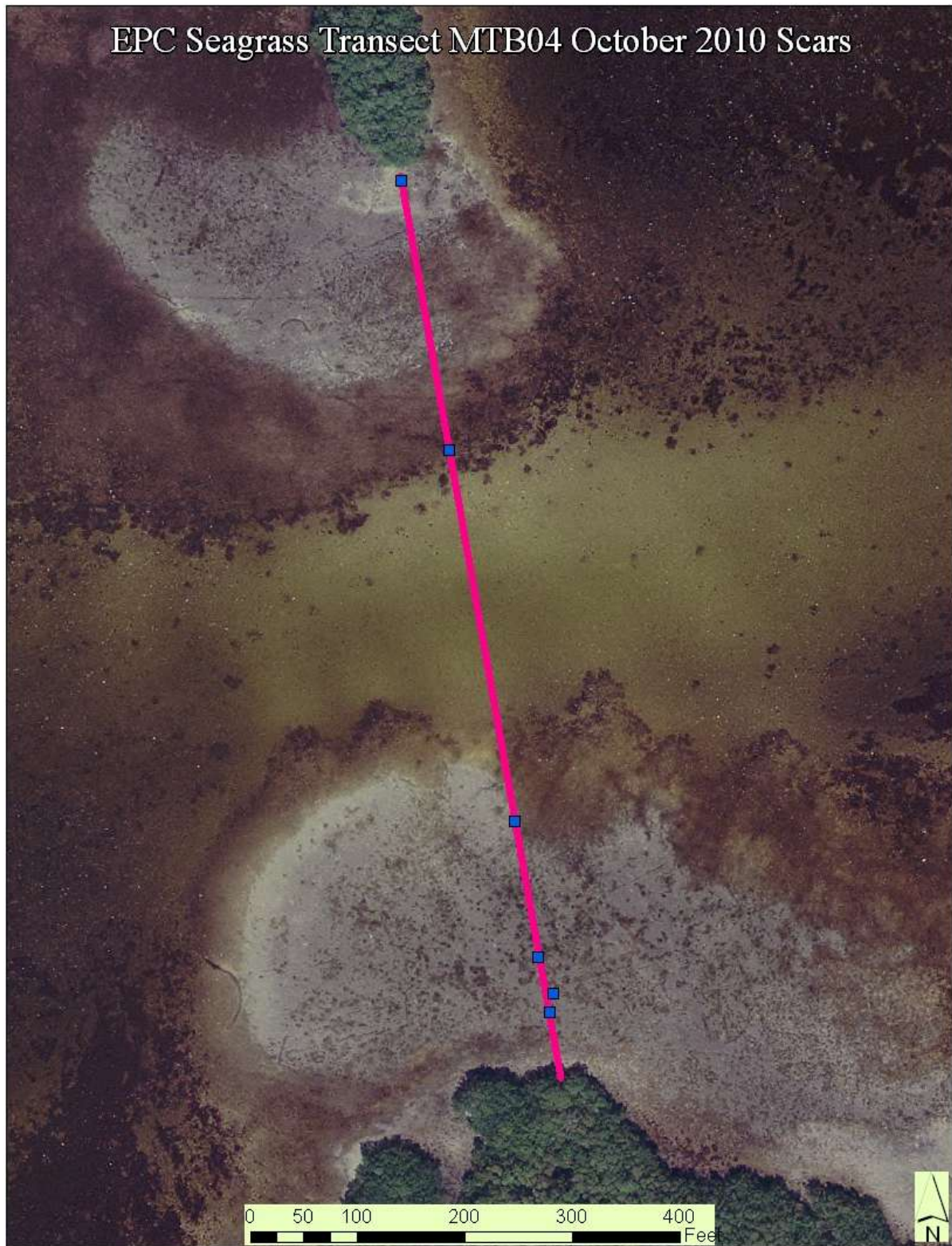
Figure 17. Map showing the locations of the 6 seagrass scars found on transect MTB04 during the October 2010 monitoring effort.
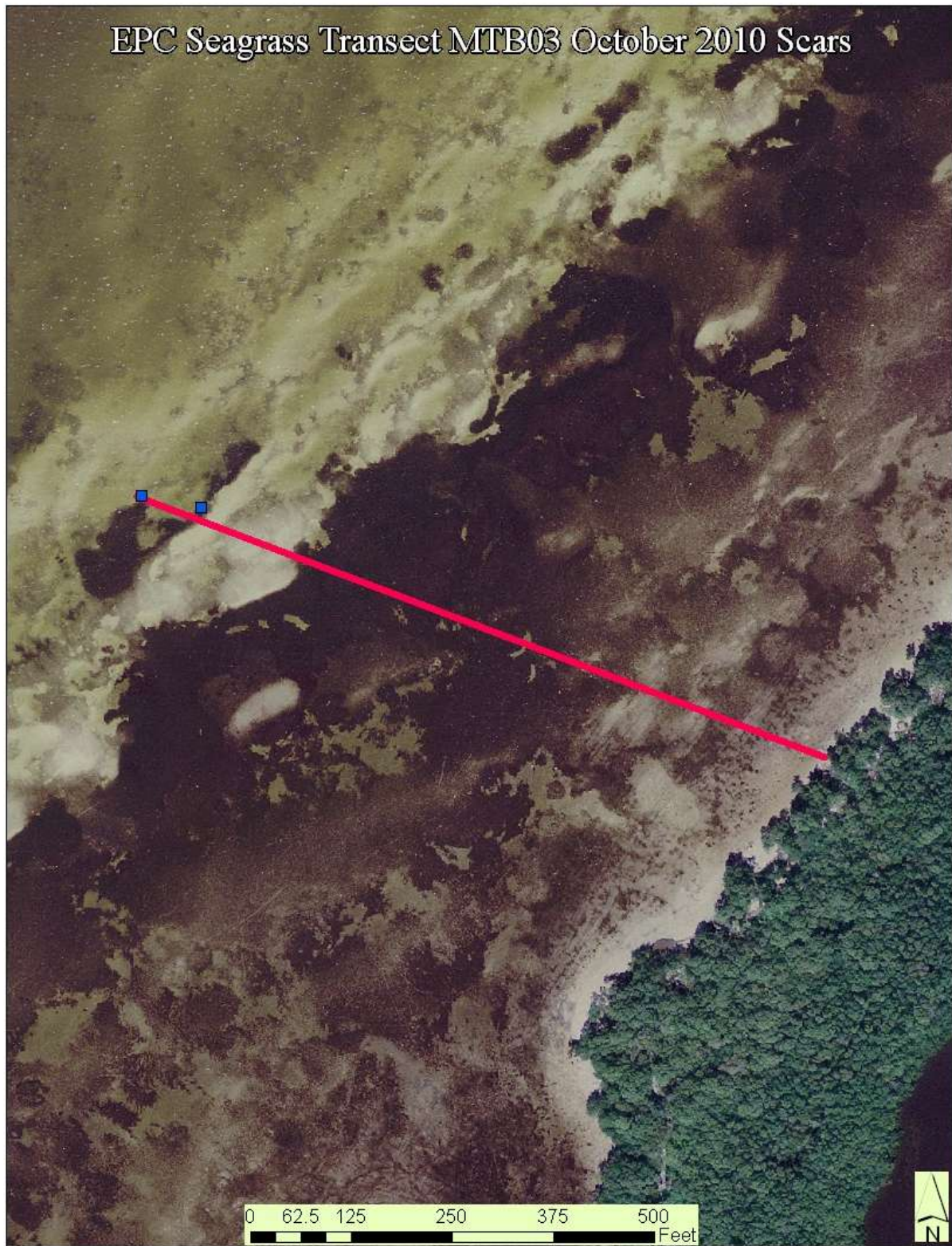
Figure 18. Map showing the locations of the 2 seagrass scars found on transect MTB03 during the October 2010 monitoring effort.

Figure 19. Map showing the locations of the 13 seagrass scars found on transect CB03 during the October 2010 monitoring effort.
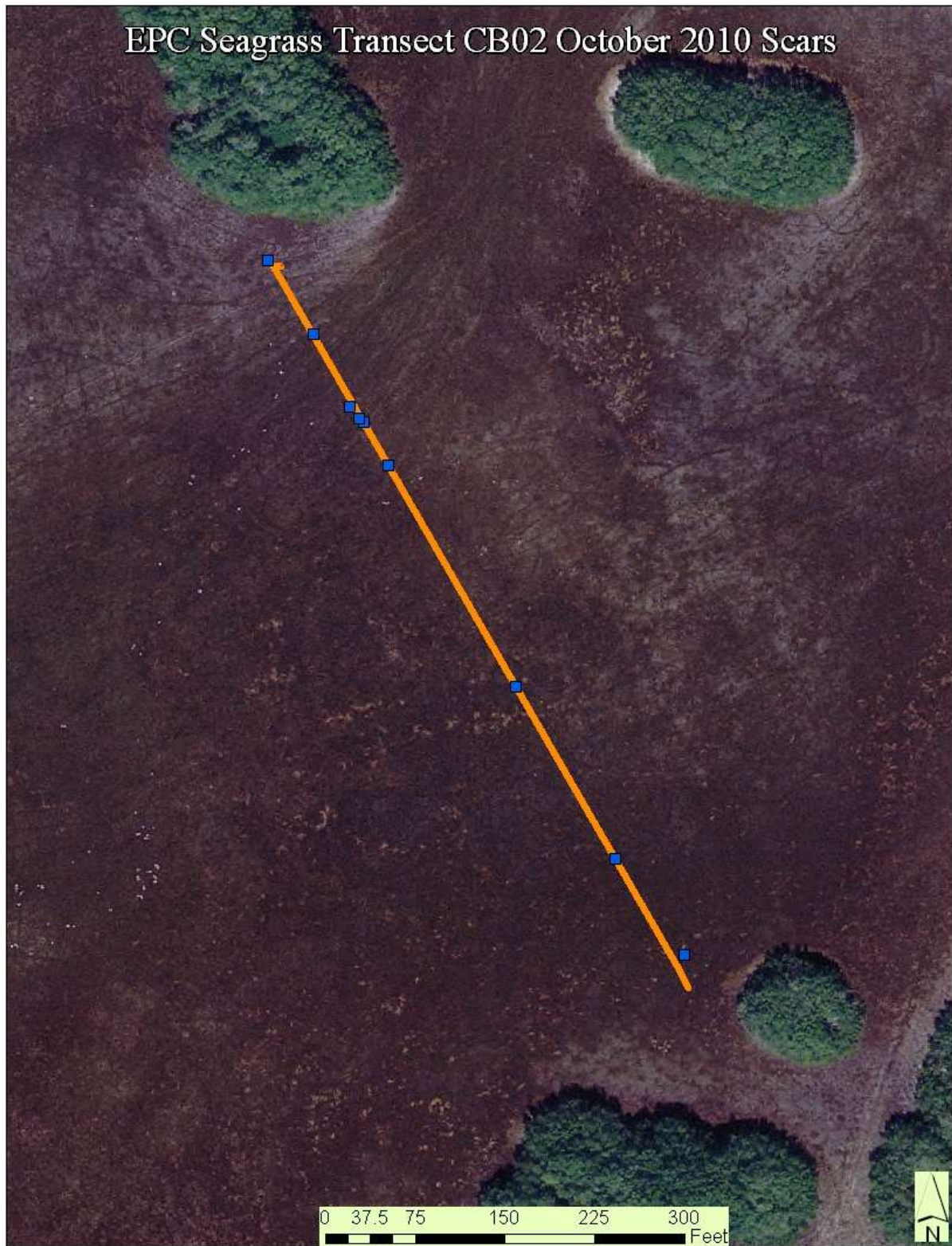
Figure 20. Map showing the locations of the 9 seagrass scars found on transect CB02 during the October 2010 monitoring effort.
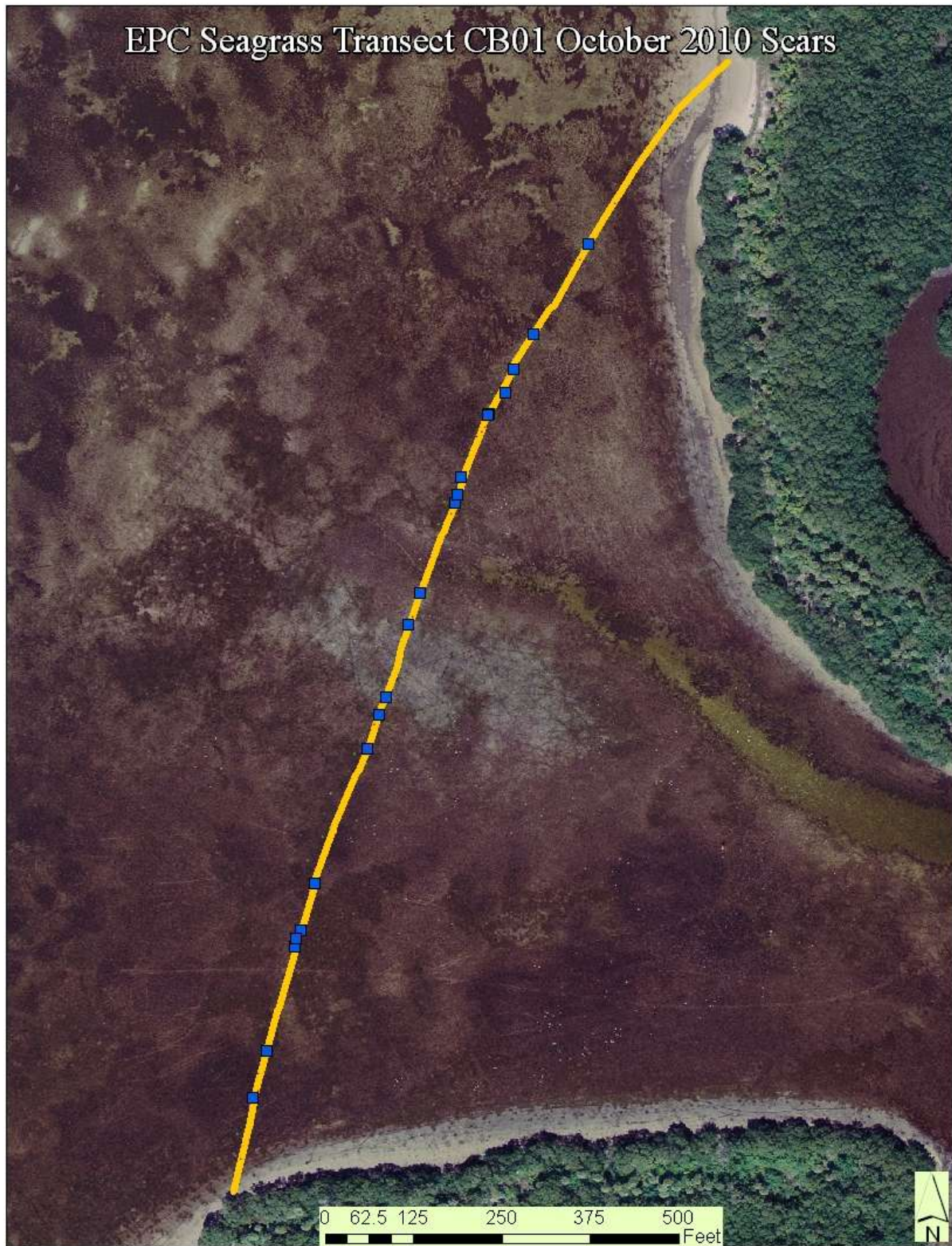
Figure 21. Map showing the locations of the 20 seagrass scars found on transect CB01 during the October 2010 monitoring effort.

January 2011 Assessments

The January 2011 monitoring effort included only the original EPC transects for Cockroach Bay; CB01, CB02 and CB03. The City of Tampa transects were not repeated as the central goal of the project was to monitor boats entering Cockroach Bay through the various island passes. Since the City of Tampa transects, with the exception of MTB03, are aligned perpendicular to the shoreline and not directly related spatially to any of these entry points to Cockroach Bay, it was deemed reasonable to focus the effort on the EPC transects.

Figure 22. Map of seagrass transects used for the January 2011 monitoring effort.

A second goal of the January 2011 monitoring effort was to quality check the results of the Humminbird recordings when the HumViewer software is used. This effort was focused on transect CB03 and showed some varying results. Of the 16 scar features identified through chart analysis on HumViewer, 9 were confirmed as scars, 3 were fully recovered scars with no trough but the canopy height of the seagrasses had not recovered to full extent of the surrounding area, and the remaining 4 scars were results of the seagrass bed changing in density or species. These results show some advantages of the combined Humminbird/HumViewer application and some possible issues which need to be addressed. We are no evaluating a new software package with the potential of exploiting these new categories of scar images.

Dr. Depth is a sonar-data analysis application, developed in Sweden which allows among other things the creation of a mosaic of sidescan charts and to overlay these data in a spatially accurate manner in Google Earth. Development and Implementation of this software for seagrass scar monitoring is still under way by the Florida Center for Community Design and Research at this time. The long term goal for this effort would be to map the entire area surrounding the transect to get a highly accurate count of seagrass scars and to allow the measurement of scar length and direction. This software also show promise for creating visually appealing displays for the data collected during the monitoring events.

Figure 23. The output of a sidescan assessment of CB03 transect. The chart analyzed with the Dr. Depth software and displayed as a KML feature in Google Earth.

Table 4. Results of the January 2011 data collection

Transect	Number of Scars Documented
CB01	15
CB02	6
CB03	16

Figure 24. Map showing the locations of the 16 seagrass scars found on transect CB03 during the January 2011 monitoring effort.
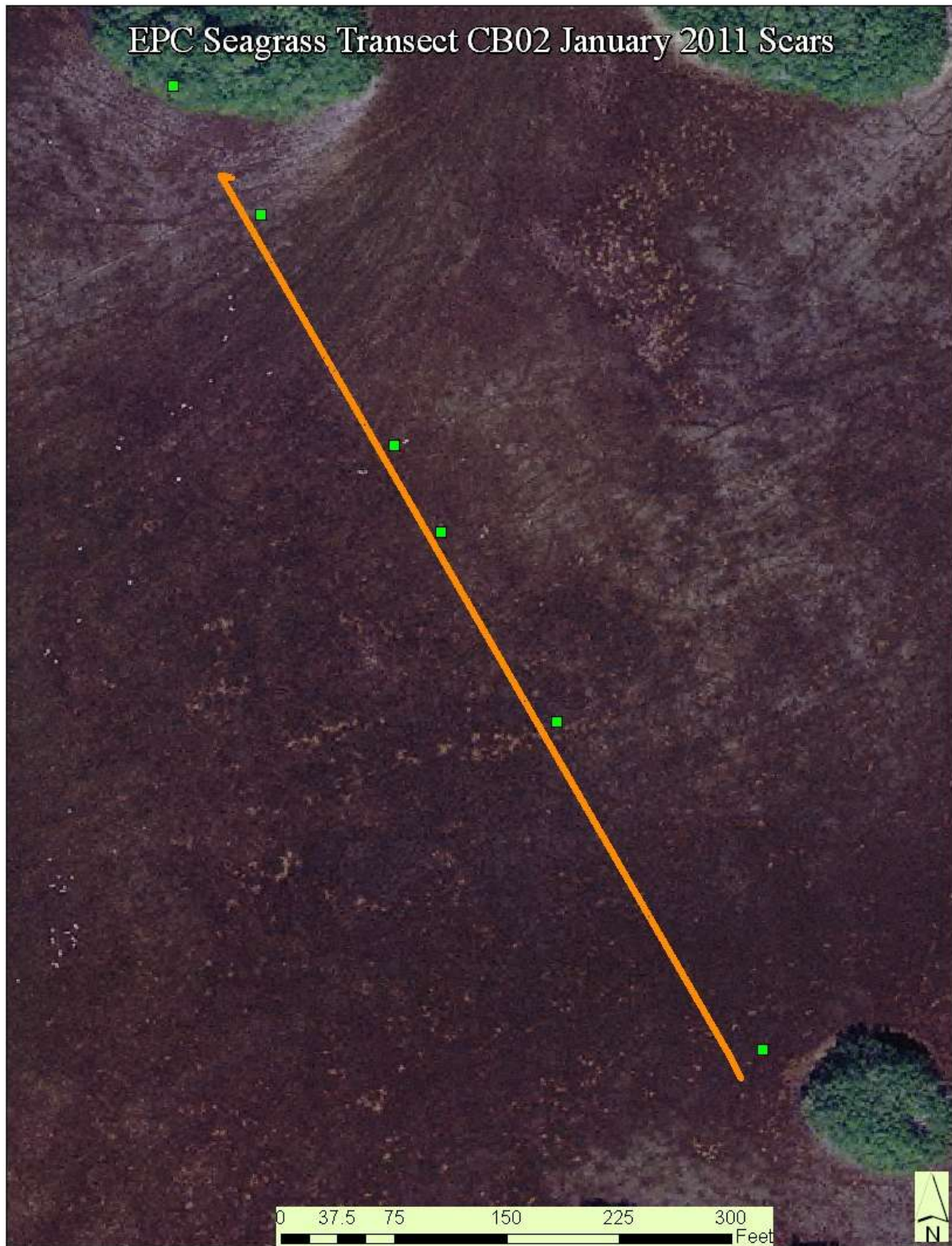
Figure 25. Map showing the locations of the 6 seagrass scars found on transect CB02 during the January 2011 monitoring effort.

Figure 26. Map showing the locations of the 15 seagrass scars found on transect CB01 during the January 2011 monitoring effort.

Conclusions and Recommendations

This project originated from the existing seagrass scar monitoring effort being conducted by the Environmental Protection Commission of Hillsborough County. The project goal was to determine the value added by side-scanning sonar when used in conjunction with traditional monitoring or as a stand-alone approach. Overall it was expected that the use of side scanning sonar would increase the efficiency of such an effort by reducing the number of field hours required and the number of personnel needed for the field observations while still producing accurate counts of seagrass scars across preset transects.

The initial efforts conducted by the Florida Center for Community Design and Research showed that it was possible to image seagrass scars in shallow water using a side-scanning sonar. Further software developments and implementation has resulted in a higher level of accuracy in the detection of the seagrass scar features and differentiation of these features from other artifacts created by changes in bed species and density. Thus far, the project has been successful at the identification of seagrass scars with the aid of HumViewer software and information interpreted by the analyst. The scars which were classified as strong by the analyst have a good correlation to actual features seen in the field. Scar features classified as moderate are still typically correlated to scars in the field with some error caused by re-growth of seagrass within the scar features. Scars classified as weak have varying results influenced by factors such as changes in bed density, changes in dominant species and drift algae conglomerates.

Moving forward, it is recommended that further development of this technique should be focused on the use of the HumViewer and Dr. Depth software to reduce the errors associated with moderate and weak classified scar features. In particular, the Dr. Depth software with its ability to mosaic sidescan images could provide highly accurate representations of the areas surrounding the transect in addition to the transect itself, which would result in an increase in data accuracy for location and number of scars seen in a timely manner.

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Background

The Humminbird 797c^2 system collects three dimensional (3D) spatial data that can be visualized in a Side-Scanning Sonar image. These images reveal features of the bottom such as propeller scars in seagrass beds. This is accomplished using methods described here based on research conducted by the Florida Center for Community Design and Research.

Method

Pre-field planning: Prior to entering the field some basic investigative steps need to be completed to maximize efficiency while in the field. These steps will allow the effort in the field to operate in a logical progression and will yield the highest quality data.

1. Collect the most accurate tidal data for the area of study and plan the field sampling event on a day with ample high tides during the period of time in the field.
2. Load the transect data as a series of waypoints onto the Humminbird unit. Then create a route of the waypoints to follow in the field to ensure that you follow the transect line.
   a. From the navigation menu select Waypoints> Create.
   b. Enter the waypoint coordinates needed for the transect. Then from the Routes menu select create and load the waypoints needed in order.

In-field Set-up: The following are a series of steps necessary to prepare the boat or kayak and Humminbird system for the side-scan imaging effort.

The first steps will set up the boat and Humminbird system hardware for the imaging exercise:. Load all the necessary items for the imaging effort into the boat.

1. Organize the equipment to balance the weight load in the boat or kayak.
2. Equipment that should be included:
   a. Humminbird system (main unit containing SD card, fathometer, GPS receiver and for boat installation the associated cables (kayak has integrated system and power cables) and system manual.
   b. Charged12 volt battery for Humminbird,
   c. Trolling Motor, or 4-stroke gas motor
   d. Two charged, 12volt, gel cell or glass mat batteries for trolling motor, or spare gas can with fresh gasoline for gas motor. Note: it is important to check the loading so that the boat or kayak will be stable in the water.
   e. Water proof electronics box containing:
      i. digital cameras,
      ii. range finder,

        iii. hand-held GPS,

        iv. solid state flash memory cards

   f. Spare batteries.

   g. Two paddles

   h. Life vests

   i. Anchor

   j. Tool kit

   k. Drain plug (for boat).

Assemble the Humminbird System: These steps will be performed in the field.

1. Mount the fathometer unit to the back of the boat. The unit should be below the surface of the water, but it is useful to prevent the unit from hanging below the bottom of the boat. If the fathometer is mounted below the bottom of the boat there is an increased risk of catching the unit on vegetation and debris causing inaccurate readings and possibly damage. Mounting the fathometer too close to the surface may allow air bubbles to exist below the unit, causing error in readings.

2. Connect the Fathometer unit to the main unit using the supplied wiring harness and Sonar connection on the back of the main unit. Mount the GPS receiver on the boat. The ideal location would be as close to the fathometer as possible while ensuring the receiver is secure and is receiving good satellite signal. This will allow for the most accurate spatial correlation between the GPS positional data and the sonar depth data.

3. Connect the GPS receiver to the main unit using the supplied wiring harness and the Network connection on the back of the main unit.

4. Connect the power wiring harness to the back of the main unit using the supplied power wiring harness and the PWR\DATA connection on the back of the main unit.

5. Connect the power cable to the 12 volt worker battery in the Humminbird system.

Preparing the Humminbird system for data collection: This series of steps will turn on the Humminbird system, acquire GPS signal and prepare the unit for collecting accurate data. It is necessary that the boat be in a location where the GPS receiver will be able to receive satellite signal clearly.

1. Turn on the unit using the PWR button on the main display.
2. Adjust the depth offset in the Humminbird main unit.
3. Press Menu> Menu> Setup.
4. Scroll down to User Mode> Advanced
5. Scroll down to Depth Offset
6. Using the secchi disk measuring tape, measure the distance from the surface of the water to the bottom of the fathometer in decimal feet. (Note: all items in the boat including passengers should be in the positions that they will be in until bathymetric mapping is complete.)

7. Enter the decimal feet value for the depth offset as a positive number (depth offset value is the distance that is added to the fathometer reading to account for the amount of water between the surface of the water and the bottom of the fathometer).
8. Ensure that the depth represented on the sonar screen reflects what the depth measured with the secchi disk.
9. If this value is incorrect, adjust the sonar sensitivity. MENU>MENU>SONAR.
10. Scroll down to sensitivity and adjust until the depth value on the sonar screen reflects actual depth.

Prepare the Humminbird Unit for recording data
11. Navigate to the beginning of the Preloaded transect. Menu> Navigation Menu>Routes>Travel.
12. Press View until the Snapshot and Recording view comes up.
13. Press Menu>Start recording>This will immediately begin recording all data on the unit. Data will be stored in a .DAT file on the removable SD card for further processing in the office.
14. Upon reaching the end of the Transect, return to the Snapshot and Recording view. Press Menu>Stop recording>
15. Repeat the transect mapping multiple times in each direction to ensure accurate data has been collected.

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Background

The Humminbird 797c^2 system collects three dimensional (3D) spatial data that can be visualized in a side-scanning sonar image. These images reveal features of the bottom such as motor boat propeller scars in seagrass beds. After Field collection, the data files need to be processed and images exported and brought into ArcGIS software for comparison to previous monitoring events. To accomplish this task, a third party software application called HumViewer (http://forums.sideimagingsoft.com/index.php?PHPSESSID=qdv3rq8ffshlt68vh3pe26f9o3&topic=155.0) is used. This software application supports the playback of recorded ".DAT" files that include side-scan data raster images and includes tools the support the measurement and image exporting of these side-scan files.

Method

The Humminbird system is first used to collect side scan data in the field. These data are collected on an SD card used copy the data files from to a pre-established project folder on the laboratory computer. Once these files are available on the computer, the HumViewer software can be used for analysis. The procedures for the management and processing of these data follows:

1. Open the .DAT file (File>Open> navigate to Project Folder containing .DAT file)
2. In the View toolbar on the top of the screen, select "right top". This will limit the screen to just the Side Scan Sonar Screen.
3. On the playback toolbar, set the speed to "4" and check the box under "play". This checkbox will operate as a "pause and play" button.
4. In the data screen, right click and select color schemes. Our analyst has found that the "SI brown" option is good for distinguishing scar features, however other color patterns may work better for other users and the user should experiment to find the best color pattern for them.
5. To achieve better definition on the side scan viewer, right click in the data frame and select "change brightness\contrast" and adjust as needed.
6. From the utilities menu, select "copy position to clipboard". This will give you a crosshair cursor that when pressed at any point in the side scan image screen print the coordinates for that position.
7. Press the "play" button to start the scrolling of the side scan image.
8. When a linear scar feature is observed, press the "play" button to pause the chart (see Figure 1).

Note: Not all linear features seen on the side scan are seagrass bed scars since, the Humminbird scan will pick up any change in height on the bottom. Some other possibilities include but are not limited to:

- propeller scars in mud or sand
- change in seagrass species or density
- edge of seagrass bed\ sand interface
- edge of drift algae

- aged scars that have re-grown and are no longer discernable by divers

9. Using the "copy position to clipboard" tool, mark (mouse click) where the linear scar feature crosses the transect (See Figure 1).
10. Prepare an excel spreadsheet with the field shown in Table 1 below and past the latitude and longitude coordinate, copied in step 6, above into the Latitude and Longitude fields and add "redording number" and "scar number" to the Recording# and Scar# fields. For example for transect CB01, if you are looking at recording R00031.DAT, then the recording number is "R00031" and the Scar # is "CB1" for first scar recorded in recording R00031.
11. Next add your best estimate of the strength of the sonar return using the key word: "weak", "moderate", and "strong". This classification is a reflection of the likelihood of the feature on the side scan sonar image as being a scar.
12. From the File menu, select save snapshot and save it in the folder for the recording being analyzed using the same naming convention as the scar documentation in excel. **Note**: In heavily scared areas (multiple scars in a snapshot) it will be advantageous to bring the saved snapshots into paint program so that the scars can be highlighted and labeled. To accomplish this, right click on saved file, and open with Paint). Figure 2 is an example of the modified image.
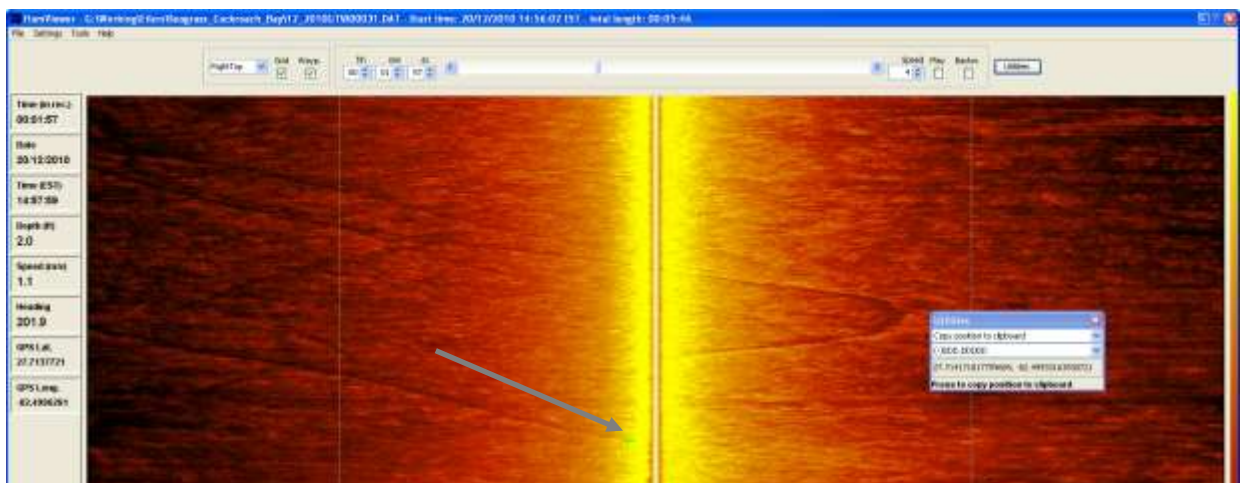13. Continue repeating this process until the end of the recording.

Table 1. Example of an Excel datasheet used tracking seagrass scars

Latitude	Longitude	Recording#	Image #	Scar Strength	Date of Transect
27.69910976	-82.51720172	R00015	CB1_1	MODERATE	10/20/2010
27.69888213	-82.51730847	R00015	CB1_2	WEAK	10/20/2010
27.69880022	-82.51737408	R00015	CB1_3	MODERATE	10/20/2010
27.69798531	-82.51768693	R00015	CB1_4	MODERATE	10/20/2010
27.69770357	-82.51777276	R00015	CB1_5	STRONG	10/20/2010
27.69763644	-82.51779652	R00015	CB1_6	MODERATE	10/20/2010
27.69750405	-82.51784133	R00015	CB1_7	WEAK	10/20/2010

Figure 2. Example of an edited HumViewer Image with multiple scars crossing transects.