

Southeast Coast Network

National Park Service
Inventory & Monitoring Program



Standard Operating Procedure (SOP) #1.3.9

Photoplot-based Monitoring of Salt Marsh Vegetation

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Summary

The following Standard Operating Procedure (SOP) is for assessing salt marsh vegetation composition and abundance on an annual basis using the total vegetation cover and average height of the dominant plant species. The following procedures for salt marsh vegetation monitoring are adapted from a number of sources, including: NERRS SWMP Bio-Monitoring Protocol, Long-term Monitoring of Estuarine Submersed and Emergent Vegetation Communities (Moore 2009); Louisiana Department of Natural Resources Coastal Resource Division protocol (Folse and West 2004); and, Monitoring Salt Marsh Vegetation, A Protocol for the Long-term Coastal Ecosystem Monitoring Program at Cape Cod National Seashore (Roman et al. 2001).

Revision Log

Previous Version #	Revision Date	Author	Changes Made	Reason for Change	New Version #
1	29July2014	L. C. Baron	Minor organizational changes and updates for 2014.	Address reviewers comments and clarify protocol	1.1

Overview

The species composition and abundance will be estimated for vegetation as well as key surface characteristics such as bare ground, detritus, or crab burrows. Cover is a common measure of species abundance in vegetation studies. This will be performed using point-intercept counts of digital imagery (100 points per 1-m² image). In brief, the observer records each species/surface that is intercepted at 100 points randomly located within each 1-m² plot. The area within the 1-m² plot is sampled using a frame-mounted digital camera and the image is analyzed in the office following the methods of Booth et al. (2004). The image is analyzed in SamplePoint software, in which a minimum of 100 points are randomly selected and manually classified into one of several pre-determined classes.

This protocol contains the information on how to establish and collect data at 1 vegetation plot. This procedure is conducted at each of the 5 vegetation plots located around the platform, as shown in Figure 1. The Southeast Coast Network has 3 platforms per site, and therefore, these steps are conducted at the all 3 platforms totaling 15 vegetation plots per site.

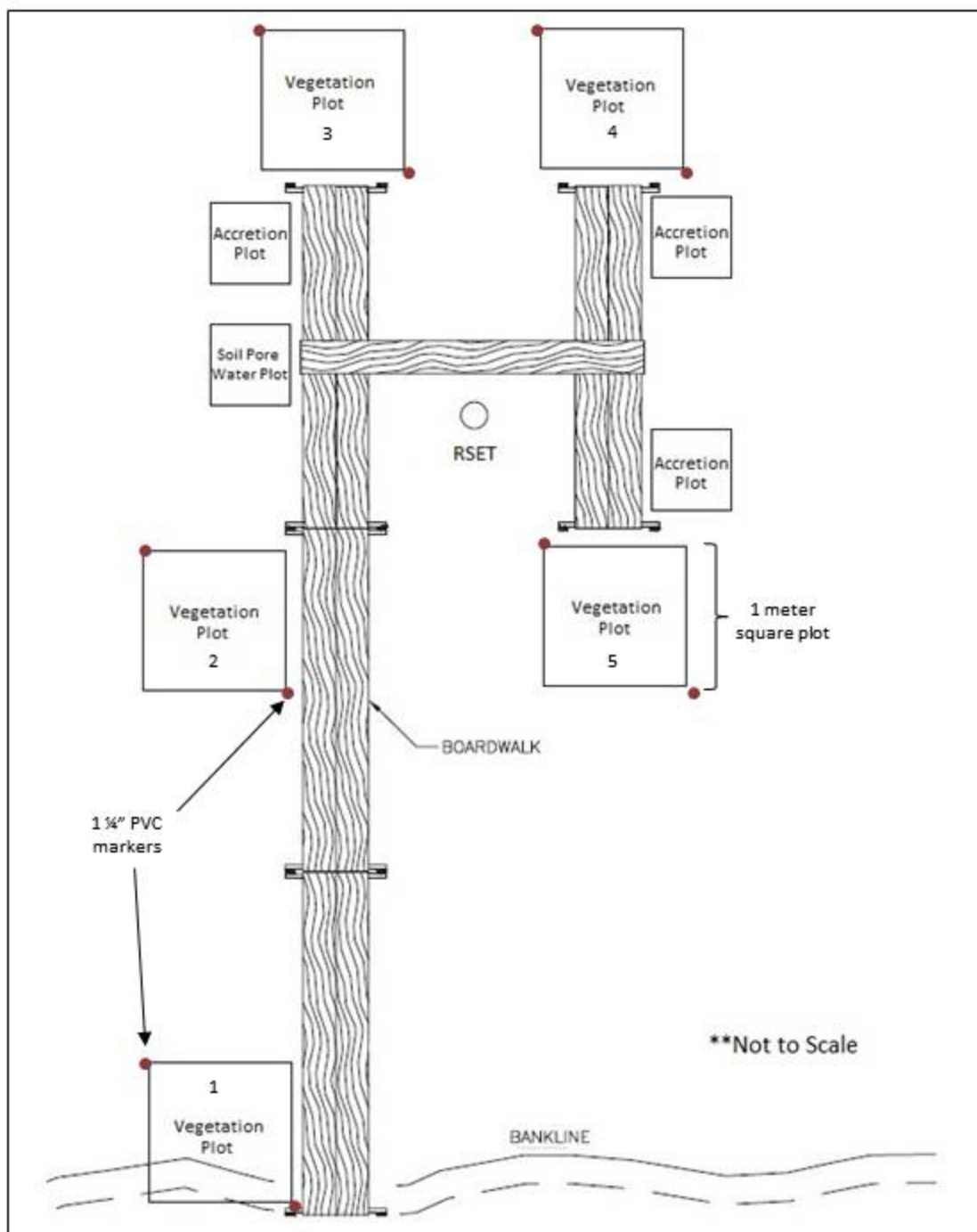


Figure 1. Illustration of a platform and sampling plots. The vegetation plots are numbered 1 through 5 and the red dots represent the location of the PVC markers. (Modified from Folse and West 2004)

Procedures

Plot Establishment

The vegetation plots are positioned external to both the long and short platforms. A total of five vegetation plots are established per platform (Figure 1). Plot 1 is located at the water/vegetation edge or at the first tooth, whichever is further inland, 15 cm from platform edge. Plot 2 is located such that the far side from water's edge is in line with the third tooth from the water, again, 15 cm from platform edge. Plot 3 is located at the end of the long platform, 15 cm from the tooth. Plot 4 is located at the inland side of the short platform, 15 cm from the tooth and plot 5 is located at the water side of the short platform, 15 cm from the tooth.

All plot establishment procedures must be performed from the platform.

Materials

- 10 - 1.25 in. PVC pipe, 5 ft. in length
- 1 m × 1 m PVC square
- Meter stick
- Tape measure (meters)
- Mallet
- Level
- GPS receiver, range pole and antenna
- Field forms (Appendix A)

Instructions

1. Fill out the top portion of the Salt Marsh Vegetation Establishment Field Form (Appendix A).
2. Place the 1 m × 1 m square on the marsh surface as close to the predetermined location as possible (Figure 1).
3. On the water side, right corner, outside the PVC square, push in or gently hammer one piece of PVC pipe vertically into the marsh, until approximately 2.5 ft is visible above the marsh surface.
4. Push or gently hammer the second piece of PVC pipe outside the PVC square diagonally opposite the first piece of PVC pipe.
5. Repeat steps 1-4 for each vegetation plot according to the PVC marker position shown in Figure 1.
6. Collect a GPS point at each PVC marker location for each vegetation plot and record the GPS information on the Salt Marsh Vegetation Establishment Field Form (Appendix A).

Camera Frame Construction

The following is an overview of the construction of the camera frame (Figure 2). The frame is based on a USDA design, Technical Note: Lightweight Camera Stand for Close-to-Earth Remote Sensing (Booth et al. 2004). The frame is constructed of 1-in. stainless steel (SS) tubing (Figure 3, Figure 4).

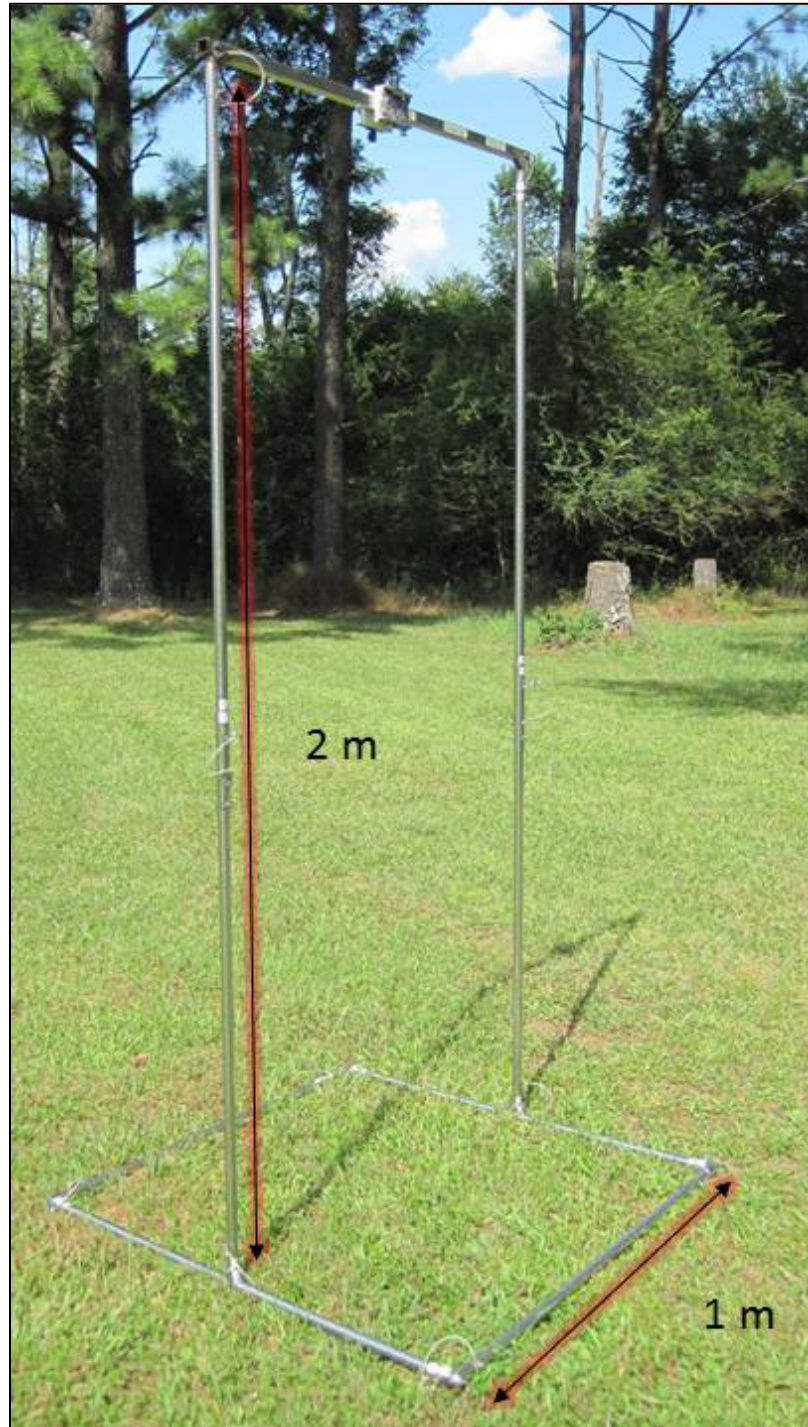


Figure 2. Picture of camera frame constructed by USDA design using stainless steel, with dimensions.

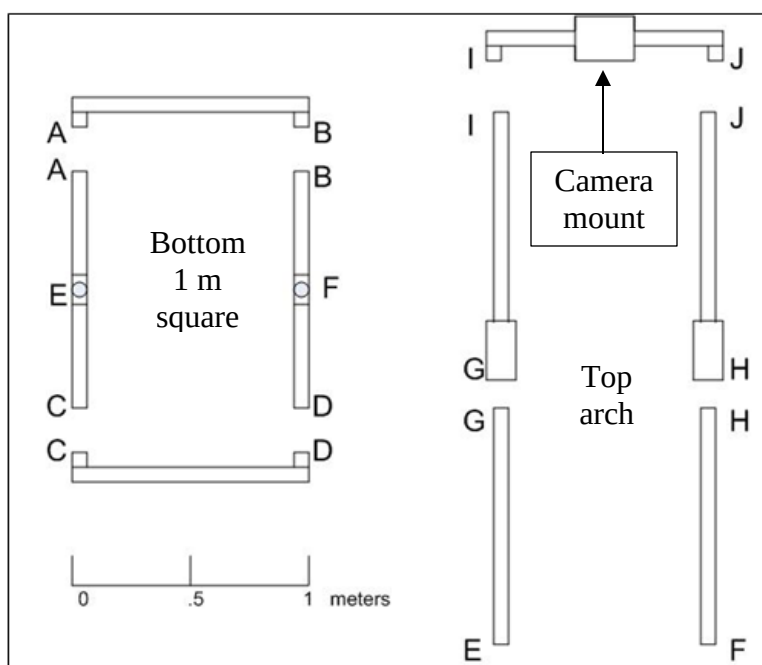


Figure 3. Diagram of the camera frame construction.

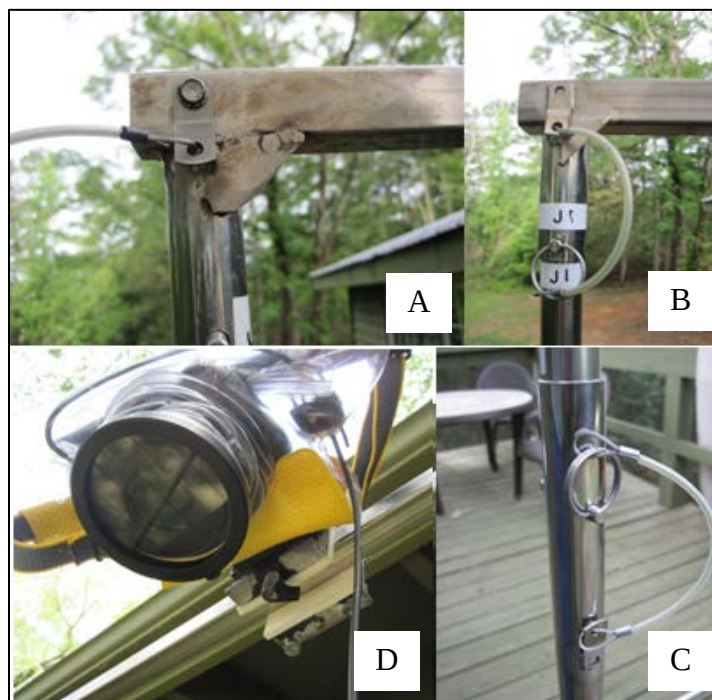


Figure 4. Photos illustrate various aspects of the camera frame, including: the corner of the top arch (A), the J connection (B), the H connection (C), and the camera attached in the camera mount (D).

Materials

- 8 m, 1-in. stainless steel (SS) round tubing

- 4, 1-in. SS 90° elbows
- 2, 1-in. SS T-joints
- 1.25 in. SS round tubing (for upright joint)
- 1 m, 1-in. SS square tubing
- 10 Clevis pins with wire stays
- Camera mount (Manfrotto 577)
- Pelican storage case (rifle case)
- Saw with blade capable of cutting SS
- Drill
- Drill bits

Instructions

1. Cut the SS tubing as illustrated in Figure 3 to create a 1-m² square, including the four elbows and two T-joints.
2. Cut and drill the 1.25-in. SS tubing into two 8-in. sections and drill holes for the upright joints.
3. Have a welding or machine shop weld two 4-in. sections of 1.25-in. SS tubing to the ends of the one meter long 1-in. SS square tubing which acts as the upper cross piece.
4. Attach the camera mount to the 1-in. SS square tubing upper cross piece in the center.
5. Attach clevis pin wire stays.
6. Assemble as illustrated in Figure 3.
7. Mount camera to test stability, and ensuring the camera/lenses package captures the entire 1-m square frame with limited exposure outside the camera frame.
8. Disassemble and store in Pelican case.

Photographing Vegetation Plots

In short, NADIR images are collected at each vegetation plot and analyzed using SamplePoint software. A NADIR image is an image collected with the camera located directly over the area photographed. Additionally, for each species of vegetation present in the 1 m² square, the tallest 5 heights are recorded and averaged.

Materials

- Camera frame
- Digital single lens reflect (DSLR) camera

- Waterproof camera case (EWA-Marine or equivalent)
- Remote shutter release, either powered or cabled (24 in. or greater)
- Wide-angle fixed focal length lens, 24 or 28 mm (*see note below)
- Memory card (with ample space)
- Point and shoot digital camera
- Compass
- Meter stick
- Meter tape measure
- Field forms

NOTE: The ideal wide angle fixed focal length lens will capture the one meter frame with minimal area outside the frame.)

Instructions

1. Fill in the top portion of the Salt Marsh Vegetation Sampling Data Sheet (Appendix A).
2. Assemble the camera frame according to Figure 3.
3. Check the settings on the camera to make sure the images are collected as RAW.
4. Put the DSLR camera in the waterproof camera case, if not already.
5. Lock the waterproof camera case onto the camera mount and turn the camera ON.
6. Lower camera frame into the plot, ensuring the frame remains between the two PVC pipe markers and the frame is parallel to the platform (Figure 4).
7. Take 3–5 NADIR photographs (Figure 5), using the shutter release. Prior to taking photo, remember to partially squeeze the bulb to allow the lens to focus.
8. Remove the waterproof camera case from the camera mount and ensure photos taken are clear, focused and properly exposed (Figure 5).
9. If not, re-install the waterproof camera case on the camera mount and repeat steps 7-8.
10. Record photo numbers on Salt Marsh Vegetation Sampling Field Form (Appendix A).
11. Turn off camera and store.
12. Identify the plant species within the frame.
13. List the species that are present on Salt Marsh Vegetation Sampling Field Form (Appendix A), starting with the most abundant species.

14. For each species, record the height of the five tallest specimens by placing the meter stick vertical and gently extending the top-most leaf. Record the height measurements on the Salt Marsh Vegetation Sampling Field Form (Appendix A).
15. Remove camera frame.
16. Using the point and shoot digital camera:
 - a. Take a close up photo of the field form (capturing the site number and date) and record photo numbers on the field form.
 - b. Take horizontal photos of the site shooting in the sequence of north, east, south and west and record photo numbers on the field form.
17. Verify completion of the field form.
18. Repeat steps 1-17 for each vegetation plot.



Figure 4. Camera frame in use.



Figure 5. Uncropped photo of the one-meter camera frame quadrat in a *Spartina alterniflora* marsh with the PVC markers outside the quadrat on the corners (Photo taken by Scott Eastman, courtesy of Guana Tolomato Matanzas National Estuarine Research Reserve).

Preparing photos for analysis

1. Upload vegetation plot photos to computer.
2. Open Adobe Photoshop then click on the edit icon.
3. When the Adobe Photoshop window appears, click File > Open.
4. The Open window will appear.
 - a. Navigate to the picture that needs to be cropped.
 - b. Select the picture to be cropped.
 - c. Click Open.
5. Click on the Crop Tool .
6. Crop the photo area so that the area just inside the aluminum frame is shown.

Notes on how to crop an image:

Move the Crop Tool to one of the top corners inside the aluminum frame. Press and hold the left mouse button while moving diagonally to the opposite corner of the frame. This will give you a highlighted area on your photograph. Adjust the cropping lines for a better fit by moving the black pointer to the small white square located in the middle of the line to be moved. Press and hold with the left mouse button to move the selected line. You can also rotate the cropped area by moving the pointer to any corner of the highlighted area and then press and hold as above.

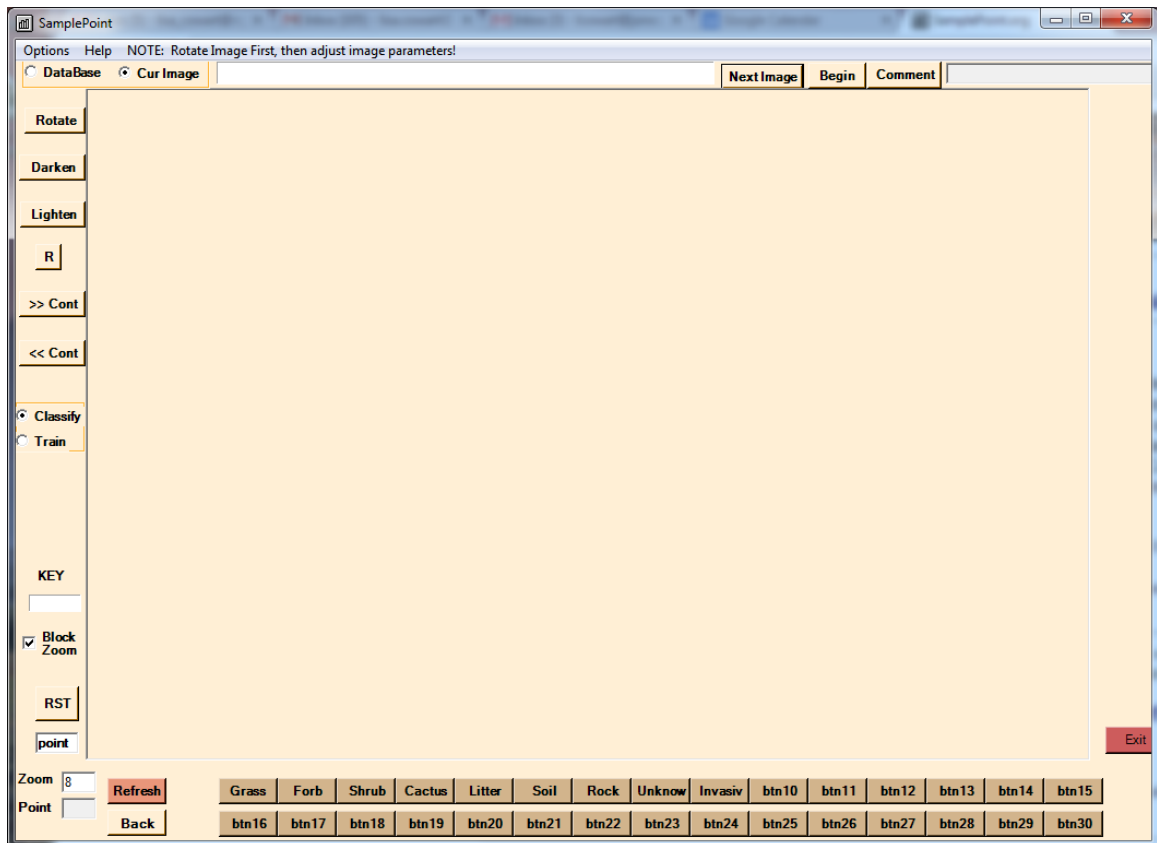
7. Once you are satisfied with the cropped area, hit ENTER.
8. Click File > Save As.
9. Rename the cropped photo using the format below:
SampleSiteID_VegPlotID_DayMonthYear.jpg.
An example of this would be TIMU054A_1_20Jun2011.jpg
10. Click Save.
11. Choose the following settings:
 - a. Quality: 12 Maximum
 - b. Baseline (“Standard”): Toggle ON
12. Click OK.
13. Repeat steps 2-12 to crop the remaining photographs.

Analyzing photos

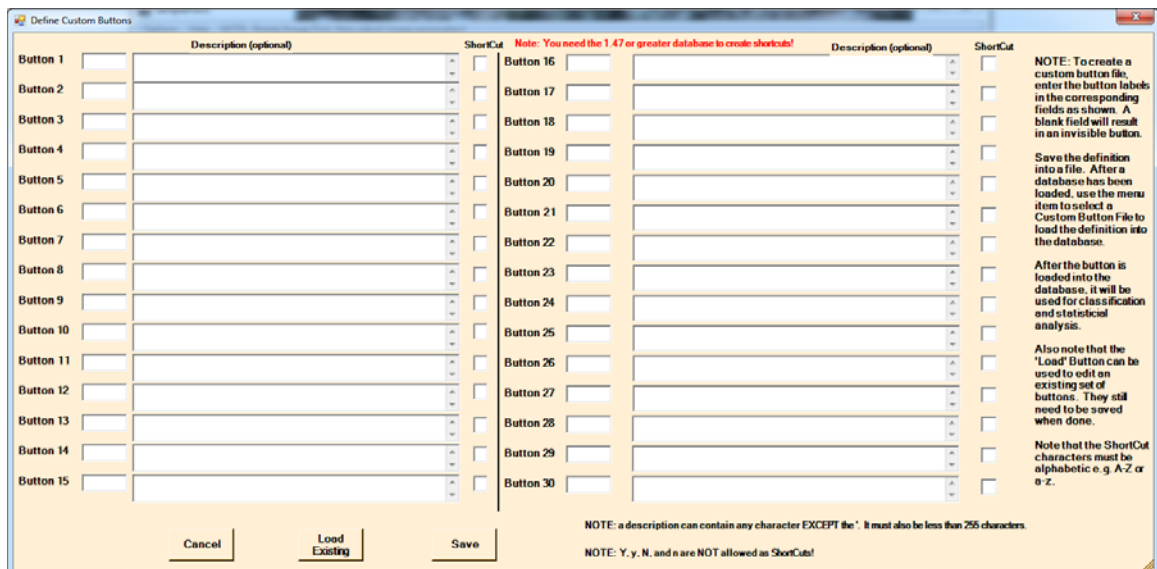
SamplePoint software is used to analyze the cropped vegetation photos. SamplePoint is image analysis software for natural resources and is freeware, available for download from the website: <http://samplepoint.org/>. Because SamplePoint is continuously being updated, the latest version may be different than the instructions listed below. The instructions listed below were created using version 1.56, released on 18 Sept 2012. Refer to the SamplePoint webpage for the current software version, tutorial, processing, and “how to” steps. Before attempting the steps below, install the SamplePoint software.

Create Classification Buttons

1. Open SamplePoint by clicking Start > Programs > SamplePoint.



2. Click Options > Custom Buttons > Create Custom Button Files



3. Enter the button label and button description information found in Table 1 into the Define Custom Buttons window.

Define Custom Buttons

NOTE: You need the 1.47 or greater database to create shortcuts!

Button	ShortCut	Description (optional)	Button	ShortCut	Description (optional)
Button 1	☐	Spar a. <i>Spartina alterniflora</i> (smooth cordgrass)	Button 16	☐	Water
Button 2	☐	Juncus <i>Juncus roemerianus</i> (black needle rush)	Button 17	☐	Detritus
Button 3	☐	Distich <i>Distichlis spicata</i> (saltgrass)	Button 18	☐	Debris
Button 4	☐	Sal b. <i>Salicornia bigelovii</i> (dwarf saltwort)	Button 19	☐	Unknow
Button 5	☐	Sal d. <i>Salicornia depressa</i> (Virginia glasswort)	Button 20	☐	Dead
Button 6	☐	Sarcoc <i>Sarcocornia perennis</i> (chickenclaws)	Button 21	☐	
Button 7	☐	Avicen <i>Avicennia germinans</i> (black mangrove)	Button 22	☐	
Button 8	☐	Batis <i>Batis maritima</i> (saltwort or turtleweed)	Button 23	☐	
Button 9	☐	Zizania <i>Zizania aquatica</i> (annual wild rice)	Button 24	☐	
Button 10	☐	Borrich <i>Borrichia frutescens</i> (bushy seaside oxeye)	Button 25	☐	
Button 11	☐	Phrag <i>Phragmites australis</i> (common reed)	Button 26	☐	
Button 12	☐	Rhizoph <i>Rhizophora mangle</i> (red mangrove)	Button 27	☐	
Button 13	☐	Lagunc <i>Laguncularia racemosa</i> (white mangrove)	Button 28	☐	
Button 14	☐	Spar c. <i>Spartina cynosuroides</i> (big cordgrass)	Button 29	☐	
Button 15	☐	Bare Bare soil	Button 30	☐	

NOTE: To create a custom button file, enter the button labels in the corresponding fields as shown. A blank field will result in an invisible button.

Save the definition into a file. After a database has been loaded, use the menu item to select a Custom Button File to load the definition into the database.

After the button is loaded into the database, it will be used for classification and statistical analysis.

Also note that the 'Load' Button can be used to edit an existing set of buttons. They still need to be saved when done.

NOTE: a description can contain any character EXCEPT the * it must also be less than 255 characters.

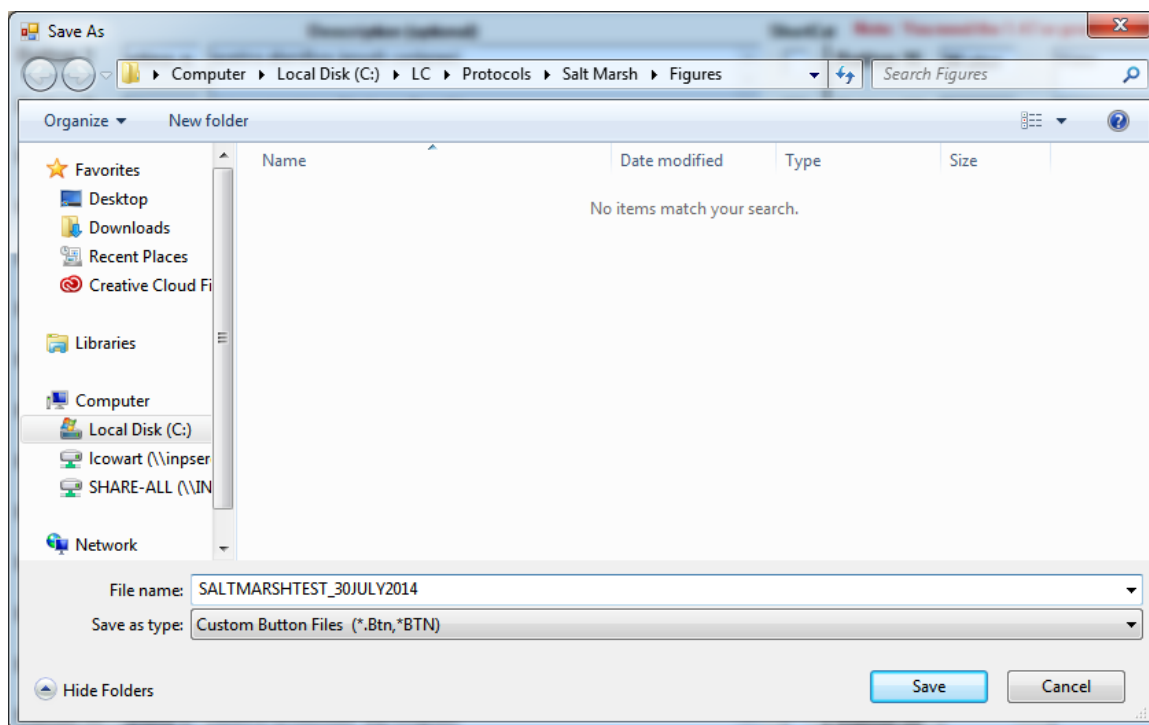
NOTE: Y, y, N, and n are NOT allowed as ShortCuts!

Cancel Load Existing Save

Table 1. Button Lists and Descriptions. This table represents the minimum list of possible selections of vegetation and non-vegetated classes used in SamplePoint when conducting analysis. Additional species should be added as appropriate.

Button Label	Button Description
Spar a.	<i>Spartina alterniflora</i> (smooth cordgrass)
Juncus	<i>Juncus roemerianus</i> (black needle rush)
Distich	<i>Distichlis spicata</i> (saltgrass)
Sal b.	<i>Salicornia bigelovii</i> (dwarf saltwort)
Sal d.	<i>Salicornia depressa</i> (Virginia glasswort)
Sarcoc	<i>Sarcocornia perennis</i> (chickenclaws)
Avicen	<i>Avicennia germinans</i> (black mangrove)
Batis	<i>Batis maritima</i> (saltwort or turtleweed)
Zizania	<i>Zizania aquatica</i> (annual wild rice)
Borrich	<i>Borrichia frutescens</i> (bushy seaside oxeye)
Phrag	<i>Phragmites australis</i> (common reed)
Rhizoph	<i>Rhizophora mangle</i> (red mangrove)
Laguncul	<i>Laguncularia racemosa</i> (white mangrove)
Spar c.	<i>Spartina cynosuroides</i> (big cordgrass)
Bare	Bare soil
Water	Water
Detritus	Detritus or leaf litter
Debris	Debris, litter or other non-natural substance, such as paper.
Unknown	Unknown or unidentifiable.
Dead	Standing dead vegetation.

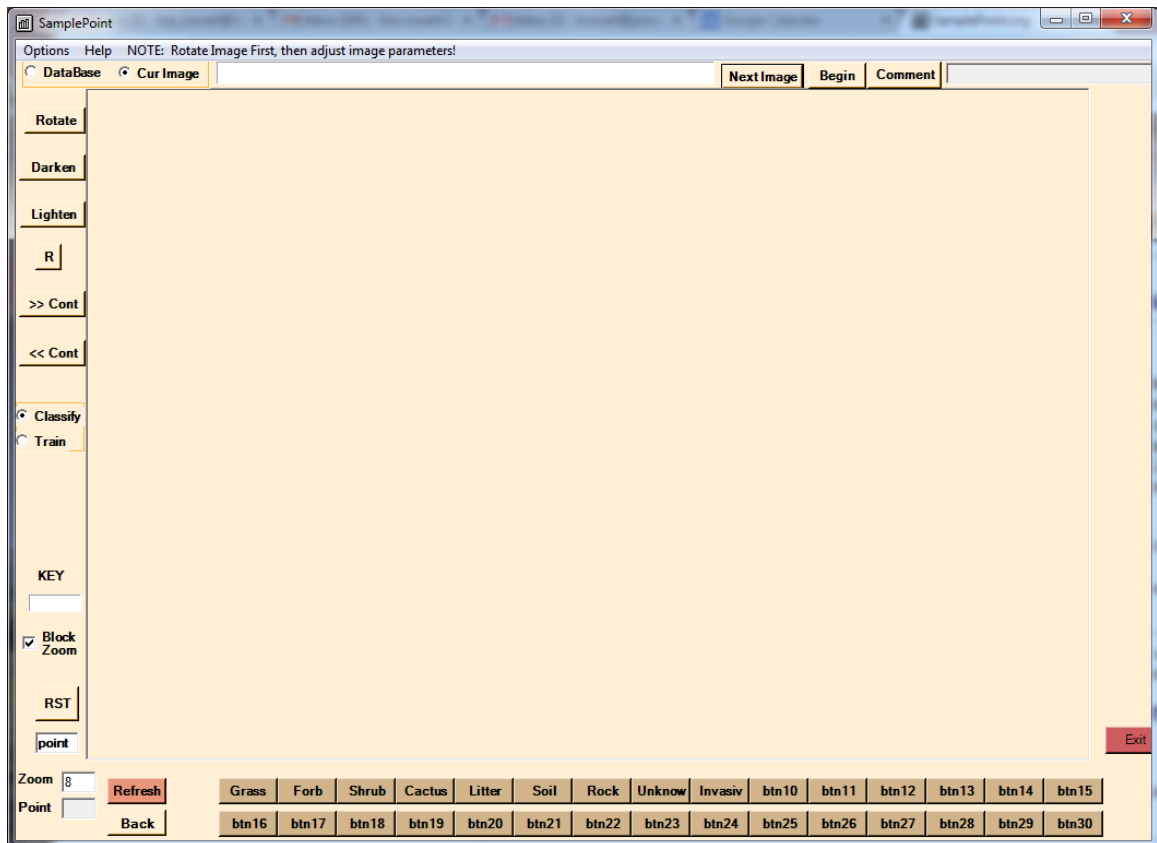
4. Click SAVE. A SAVE AS window will appear



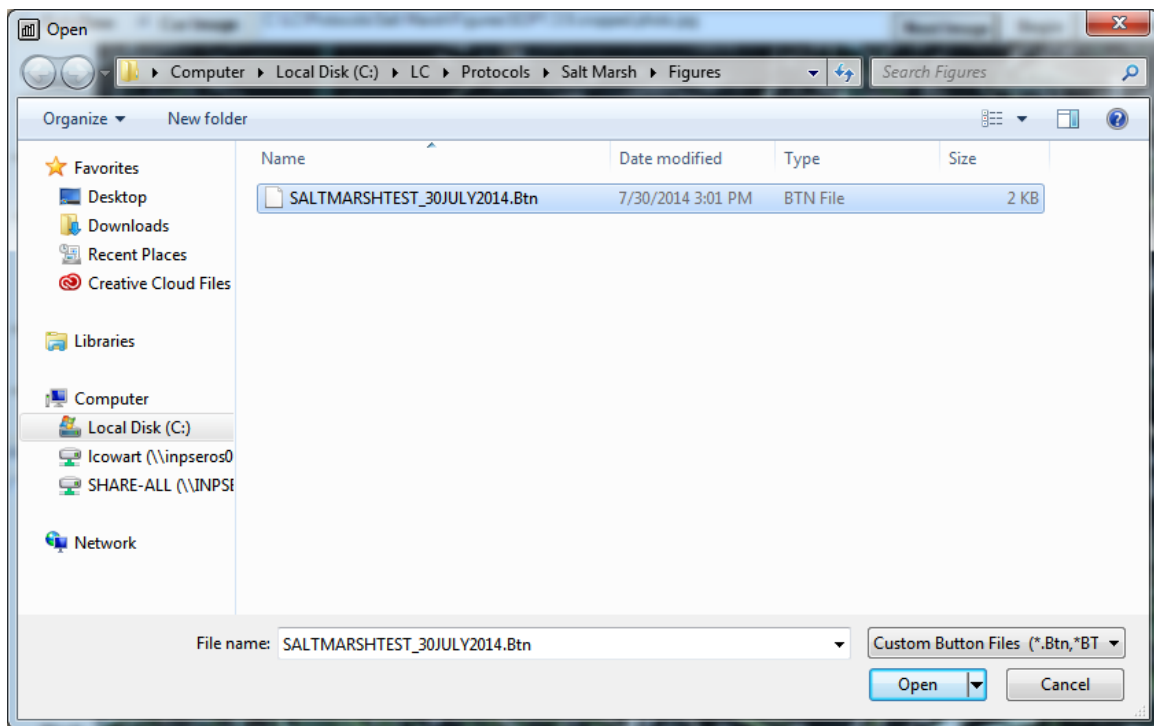
5. Enter the custom button file name and click SAVE.

Analysis Instructions

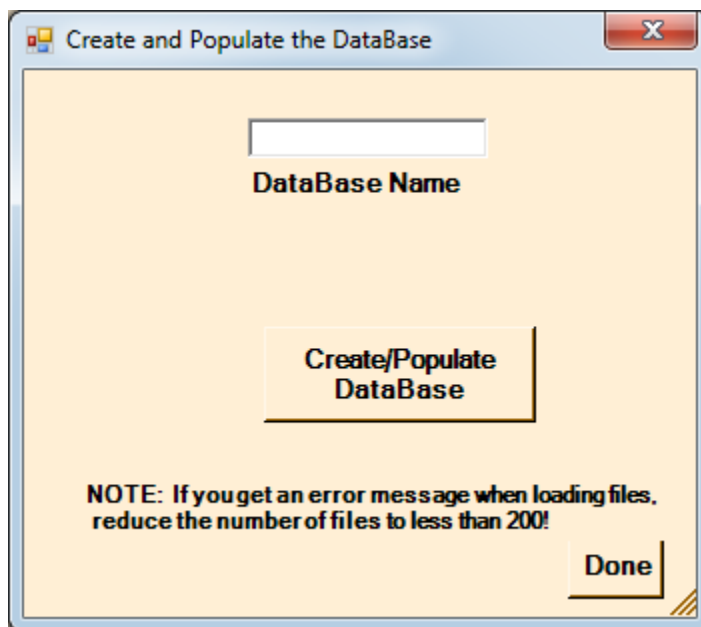
1. Open SamplePoint by clicking Start > Programs > SamplePoint.



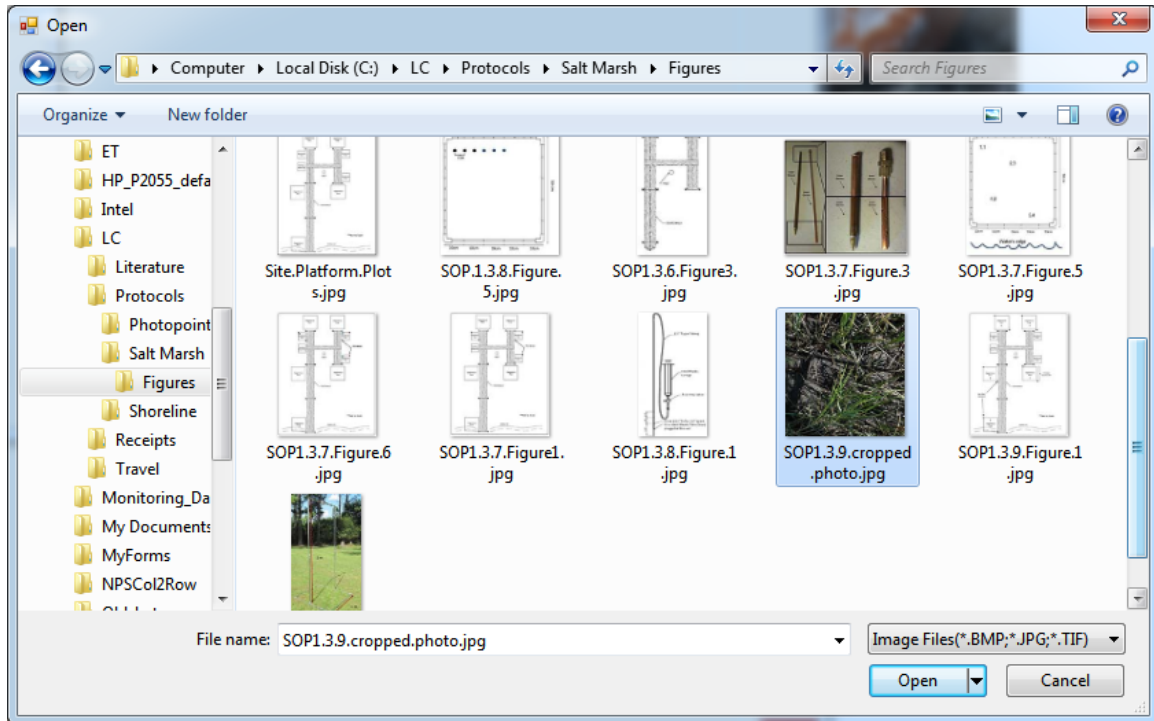
2. To load the custom buttons, click Options > Custom Buttons > Load Custom Button File. An OPEN window will appear



3. Select the custom button file and click OPEN. The buttons will be loaded into the SamplePoint window.
4. Click Options > Database Wizard – Create DB



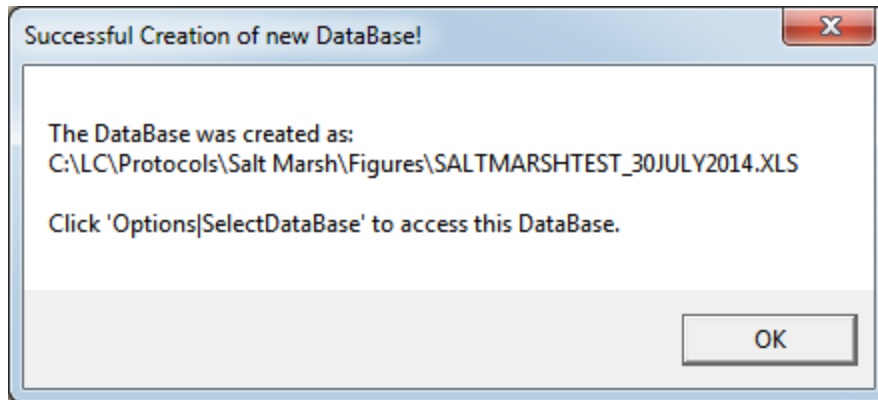
5. Enter the database name in the box using the following standard:
SampleSiteID_VegPlotID_DayMonthYear. An example of this would be
TIMU054A_1_20Jun2011
6. Click 'Create/Populate DataBase. The OPEN window will appear.



7. Select the photos you want to analyze.

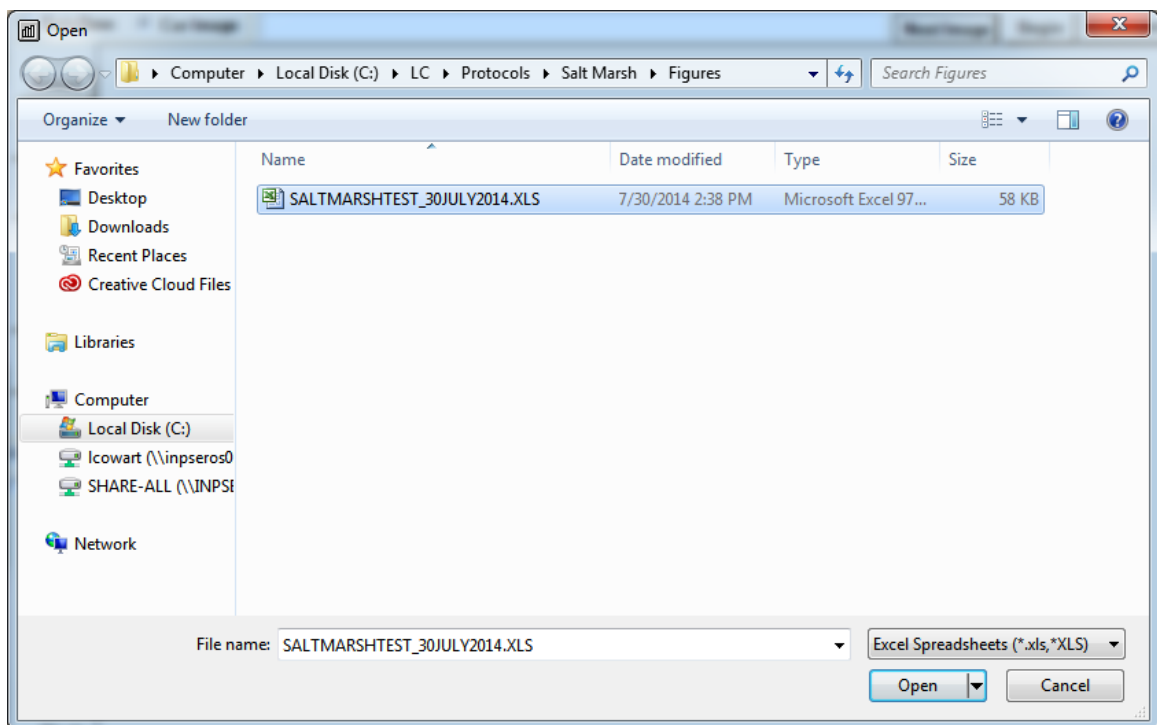
NOTE: Images may only be selected from one folder. All images must be selected at once. You cannot populate the database twice using the wizard

8. Click OPEN
9. Click DONE. A confirmation window will appear



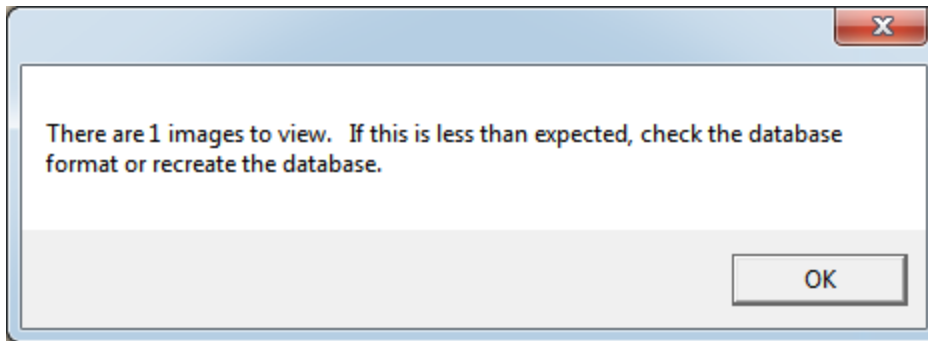
10. Click OK

11. Click Options > Select Database. An OPEN window will appear



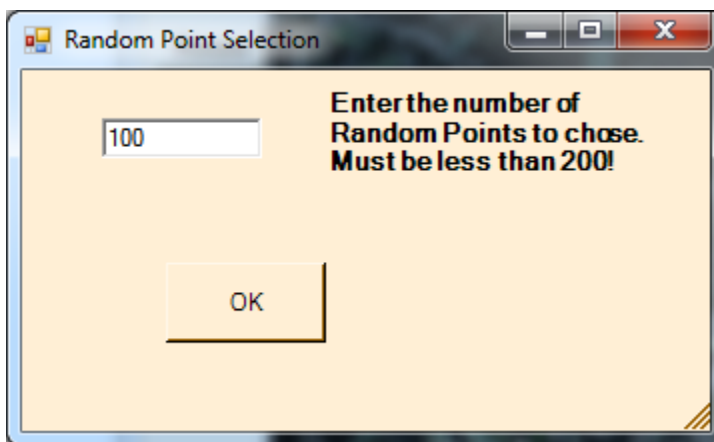
12. Navigate to the image folder and select the .xls file.

13. Click OPEN. A window will appear stating the number of images in the database



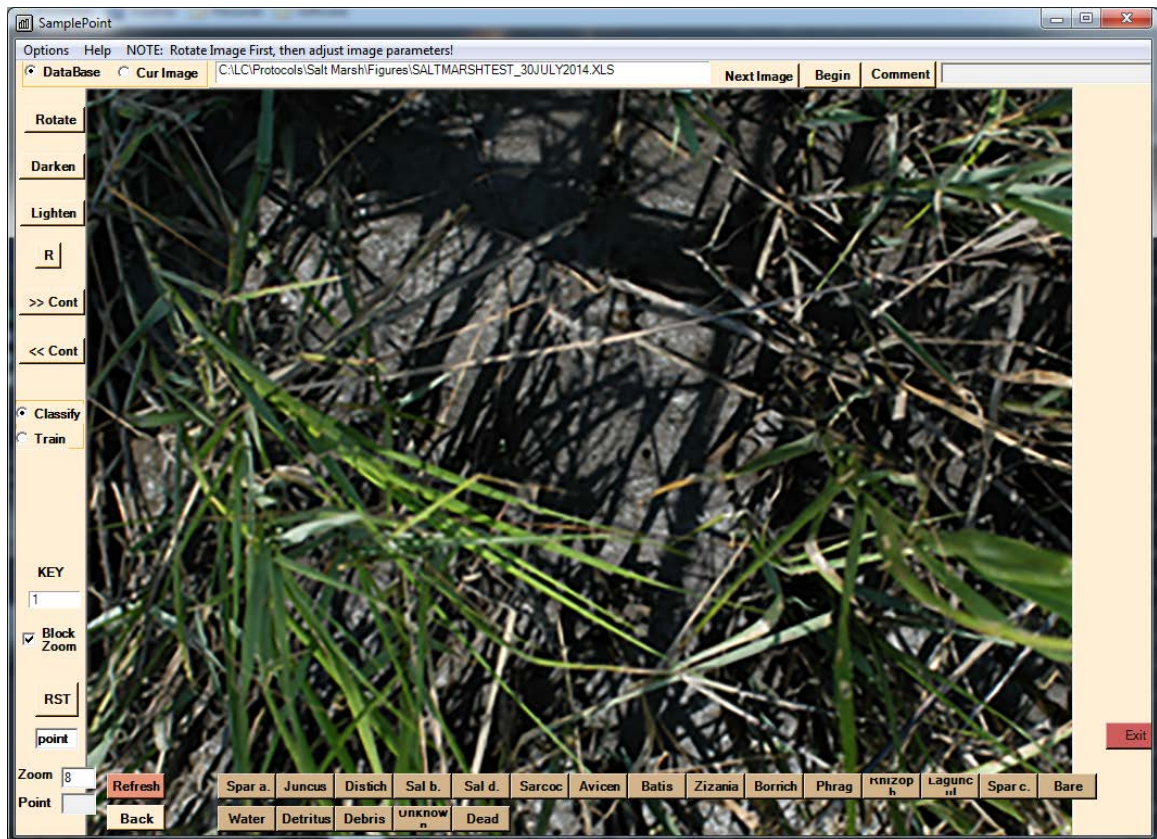
14. Click OK

15. Click Options > Select Grid Size > Random Points. A RANDOM POINT SELECTION window will appear.

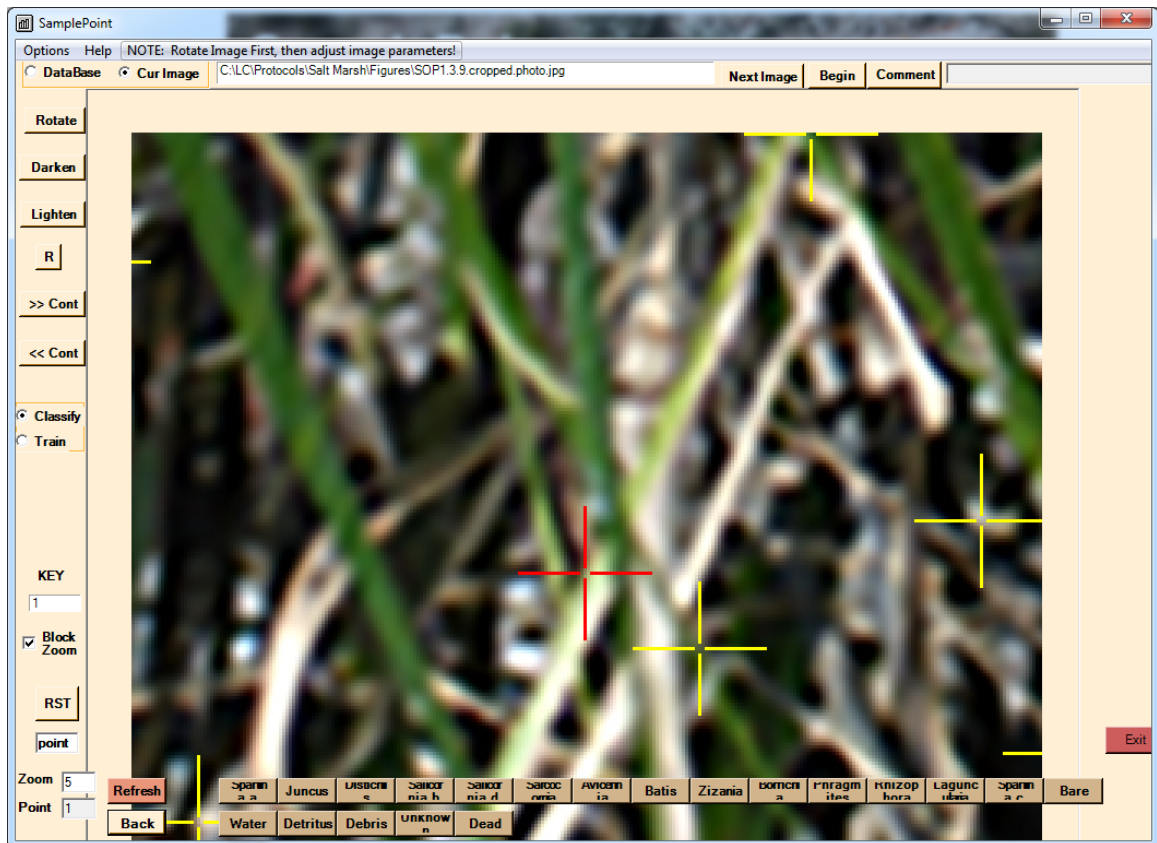


16. Enter '100' into the box and click OK.

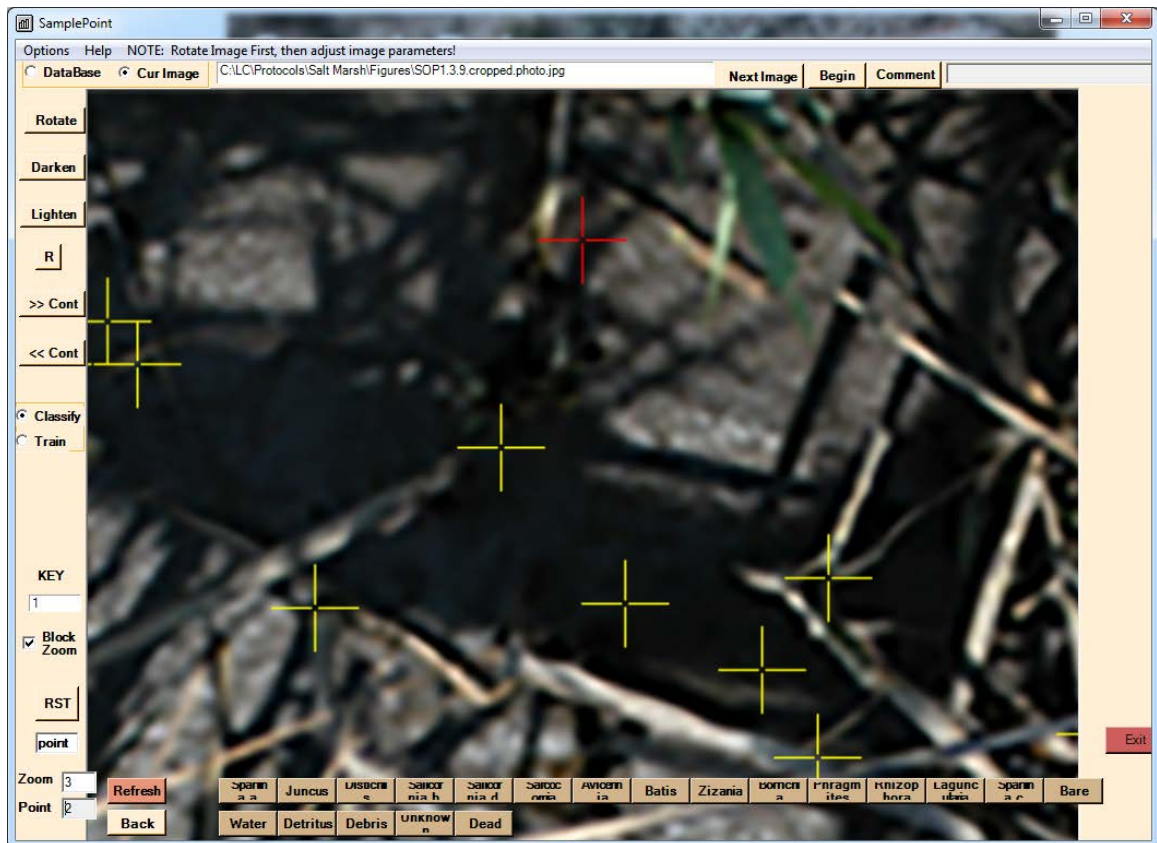
17. Click BEGIN to start classification. The 100 random points will be displayed on the photo. The software automatically starts you off at point 1 (shown in bottom left corner of screen).



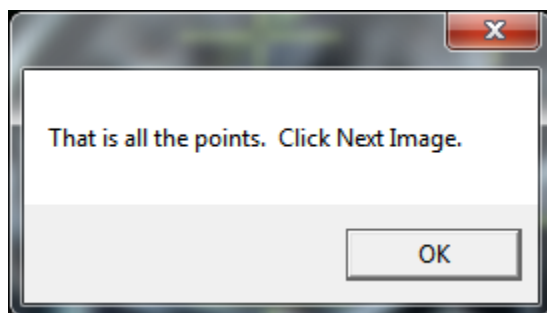
18. Click the up arrow on the keyboard to zoom into the first point



19. Enter any additional information associated with the point in the COMMENT box. This information will be saved in the excel database for that point.
20. Click the correct button to classify the location of the red hatch mark. Notice the screen automatically moves to point 2 (shown in the bottom left corner of the screen)

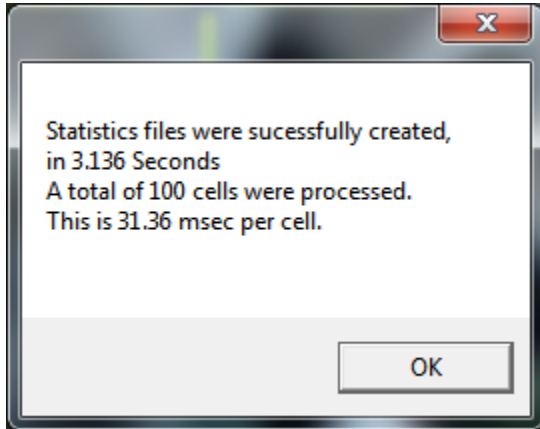


21. Continue zooming and classifying the points, repeating steps 18-19 until all 100 points have been classified. When finished, you a confirmation window will appear



22. Click OK
23. Click NEXT IMAGE and the next image in the database will appear in the SamplePoint Window.
24. Repeat steps 17-23 until all images have been classified.
25. Click Options > Create Statistics Files. Two csv files are generated, one with the same name as the photo and one with '_Summary' at the end of the filename. A window

appears to confirm the statics were generated.



26. Click OK

27. Open the _Summary csv file just created and record the percent cover of each species for each photo.

28. Enter form data into Database following the procedures in the salt marsh database manual (SOP 2.3.6; Wright and Thompson 2013).

Literature Cited

- Booth, D. T., S. E. Cox, M. Louchaichi, and D. E. Johnson. 2004. Technical Note: Lightweight Camera Stand for Close-to-Earth Remote Sensing. *Journal of Range Management* 57:675-678.
- Folse, T. M. and J. L. West. 2004. A Standard Operating Procedures Manual for the Louisiana Department of Natural Resource's Coastal Restoration Division: Methods for Data Collection, Quality Assurance / Quality Control, Storage, and Products. Louisiana Department of Natural Resources, Baton Rouge, LA.
- Moore, K. 2009. NERRS SWMP Bio-Monitoring Protocol, Long-term Monitoring of Estuarine Submersed and Emergent Vegetation Communities. National Estuarine Research Reserve System Technical Report.
- Roman, C. T., M. J. Jamies-Pirri, and J. F. Heltshe. 2001. Monitoring salt marsh vegetation, a protocol for the long-term coastal ecosystem monitoring program at Cape Cod National Seashore. Cape Cod National Seashore. Wellfleet, MA.
- Wright, C. J. and E. Thompson. 2013. Southeast Coast Network salt marsh elevation monitoring database user manual. Standard Operating Procedure NPS/SECN/SOP-2.3.6. National Park Service, Athens, Georgia.

Appendix A – Field Forms

Salt Marsh Vegetation Establishment Field Form

RSET ID: _____ Veg Plot ID: _____ Feature Name: _____

Sample Date: _____ Time: _____ Tide Gauge Used: _____

Field Personnel / Organization: _____

GPS Survey

	UTM Zone	Easting	Northing	Z (meters)	Equipment Used	Surveyor (name)
Raw						
Processed						

Site Notes:

Salt Marsh Vegetation Sampling Field Form

RSET ID: _____ Veg Plot ID: _____ Feature Name: _____

Sample Date: _____ Time: _____

Field Personnel / Organization: _____ Tide Gauge Used: _____

Plot Lighting conditions (circle one): Sunny or Shady

Opacity/Cloud Cover (%) : _____

Clear (0%)
Scattered (25%)
Broken (75%)
Obscure (100%)

Site Photo Numbers:

Vertical					
Horizontal	N	S	E	W	

Site Notes:

Salt Marsh Vegetation Sampling Data Sheet

RSET ID: _____ Veg Plot ID: _____ Feature Name: _____ Sample Date: _____

Time: _____ Field Personnel / Organization: _____

Scientific Name	Height 1 (cm)	Height 2 (cm)	Height 3 (cm)	Height 4 (cm)	Height 5 (cm)	Average Height (cm)	SamplePoint % Cover	Additional Species Description

RSET ID: park four letter code plus 3 digit site code plus one letter code, i.e., CUIS001A. When conducting site assessments, use the letter “z” to denote the site is a vegetation plot unrelated to a semi-permanent RSET site.

Veg Plot ID: two digit numerical code identifying the plot. Plots are number consecutively from water’s edge to the end of the long platform and from the inland side toward the water’s edge for the short platform.

Feature Name: Text from the GNIS data, a description of the water body site is located, such as Great Island Bay. When using this form for site assessments, access to the GNIS data is unavailable. Enter the Feature Name.

Sample Date: Date

Sample Time: military time (Eastern Standard Time)

Tide Gauge Used: Name of tide gauge used to assess low time data. Use only sites currently listed on the Tides Protocol which are long term sites such as NWLON.

Field personnel / Organization: Name of other field members and respective organization, up to six letter code, i.e., CUIS or SECN or SCA or GADNR.

GPS Survey: The field form represents raw, pre-processed position of the installed PVC pipe representing the plot location. **When uploading the data, only insert the processed position.**

- o UTM Zone: Two digit
- o Easting: numeric
- o Northing: numeric
- o Z: elevation in meters
- o Equipment used: Text of GPS unit serial number.
- o Surveyor: Name

Site Photos: Horizontal (360 degree photos of site) photo numbers and vertical (from camera frame) photo numbers

Plot Lighting Conditions: Select either sunny or shady This supports image processing.

Opacity/Cloud Cover: Clear(0%) Scattered(25%) Broken (75%) Obscure (100%). Selection one. Percentages reflect cloud cover.

Average Height: Enter the average height of the dominant plant species in each cover type in cm.

Scientific Name: Enter scientific name for each species in the plot and visual within 10 meters of the plot.

SamplePoint %Cover: Provide the percent cover of each species within the plot. (two digit). This number comes from SamplePoint.

Present/Absent: Note whether the species or describer (bare ground, algal mat, litter) listed is within the one meter plot or outside the plot.

Additional Species Description: Include additional comments such as *Spartina* height, overwash, damage, etc. (text)

Notes: Additional notes concerning the site. (text)