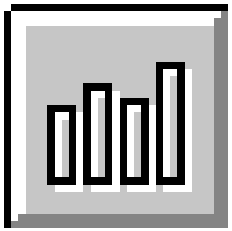
SamplePoint Tutorial



SamplePoint is a tool that facilitates point-sampling of digital images.

This presentation will demonstrate how to use SamplePoint 1.54 to collect cover data. Note that the program is updated more often than this tutorial, and thus some features may not be explicitly described here. Menu and interface may also change slightly with new versions. See the HELP menu for information about features not described in the tutorial.

REQUIRED:

- SamplePoint Installation file
- 18 MB free space on hard drive (performance increases with free space)
- Digital image files taken from a nadir perspective (looking straight down).
- Minimum 1024x768 monitor resolution (Control Panel>Display>Settings)
- Microsoft .NET Framework 2.0 installed (www.microsoft.com)
- Unfettered write access to the image directory

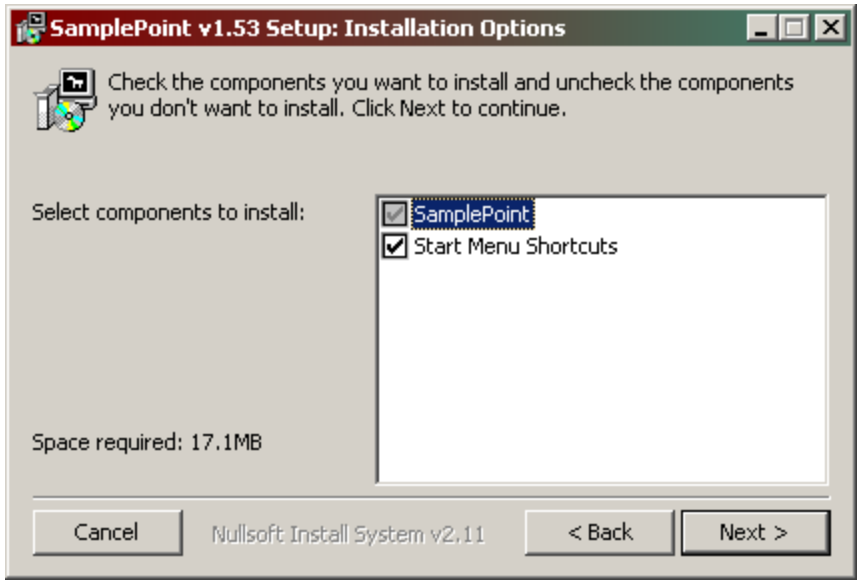
RECOMMENDED:

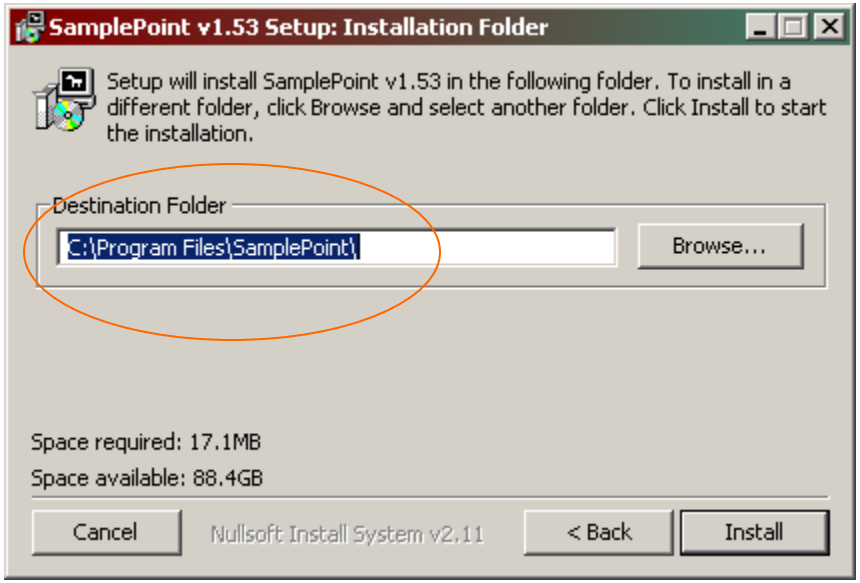
19” color display

Obtain the SamplePoint installation file and double-click to begin installation. Follow the on-screen directions. The following files will be loaded onto your PC into the specified directory:

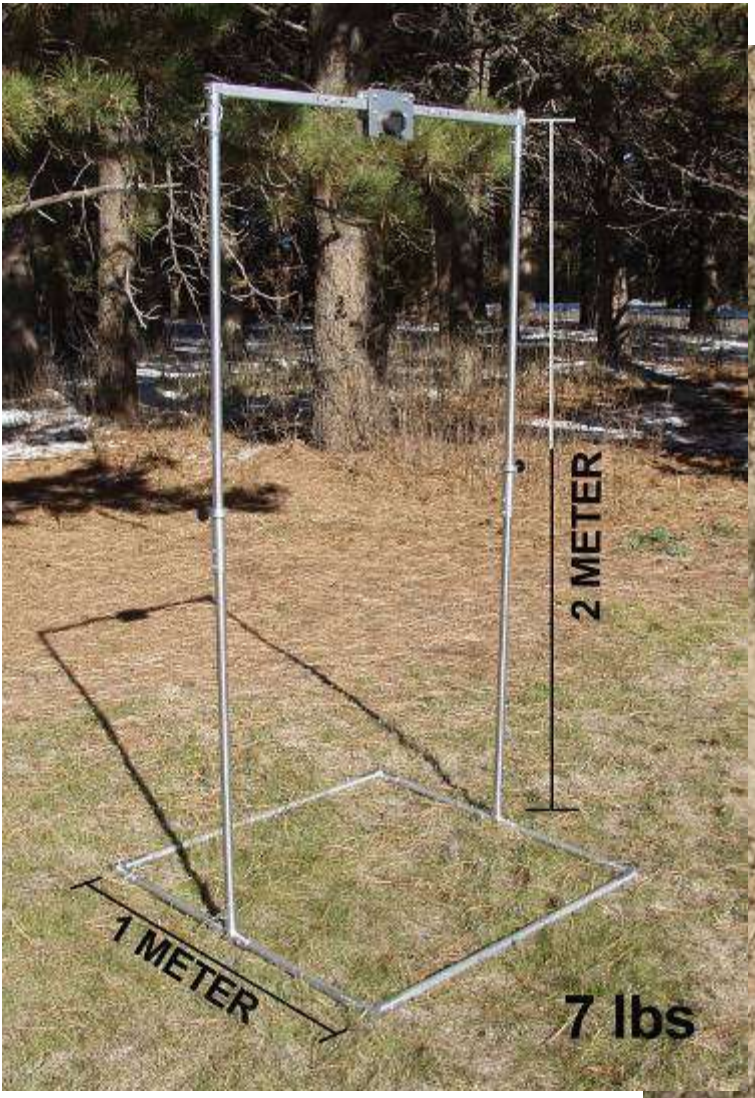
SamplePoint.exe
SamplePointTutorial.pdf
SamplePointHelp.pdf
SPDB.xls
Nadir Sample Image : dubois_41.bmp

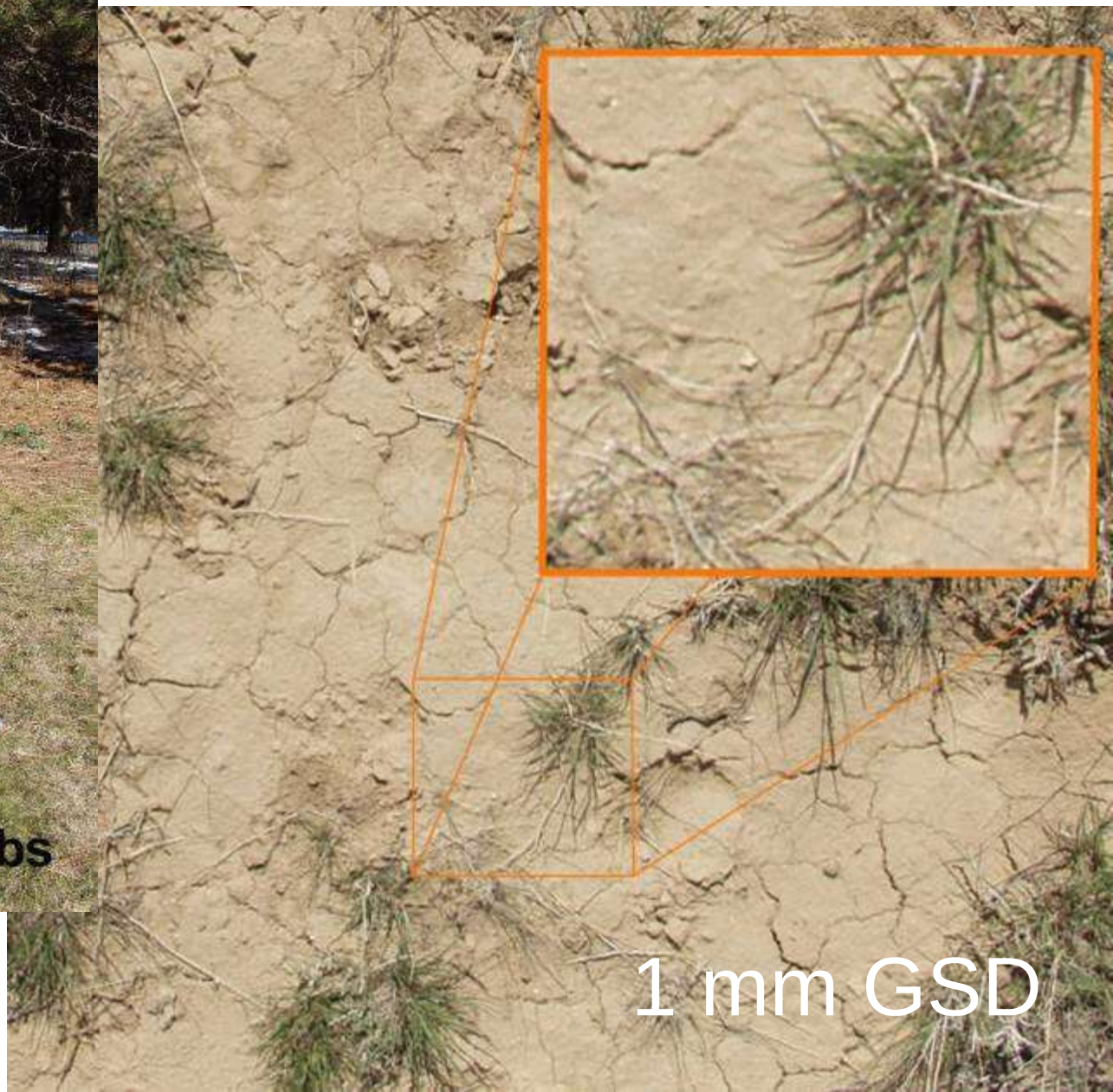
The Nadir Sample Image is one of the images used in this tutorial. It was acquired from 2m above ground level using an aluminum camera stand and an Olympus E20 digital SLR camera, and covers approx. 1m x 1m with a ground sample distance of 0.9 mm.





Use a camera stand to acquire nadir images using a digital camera.





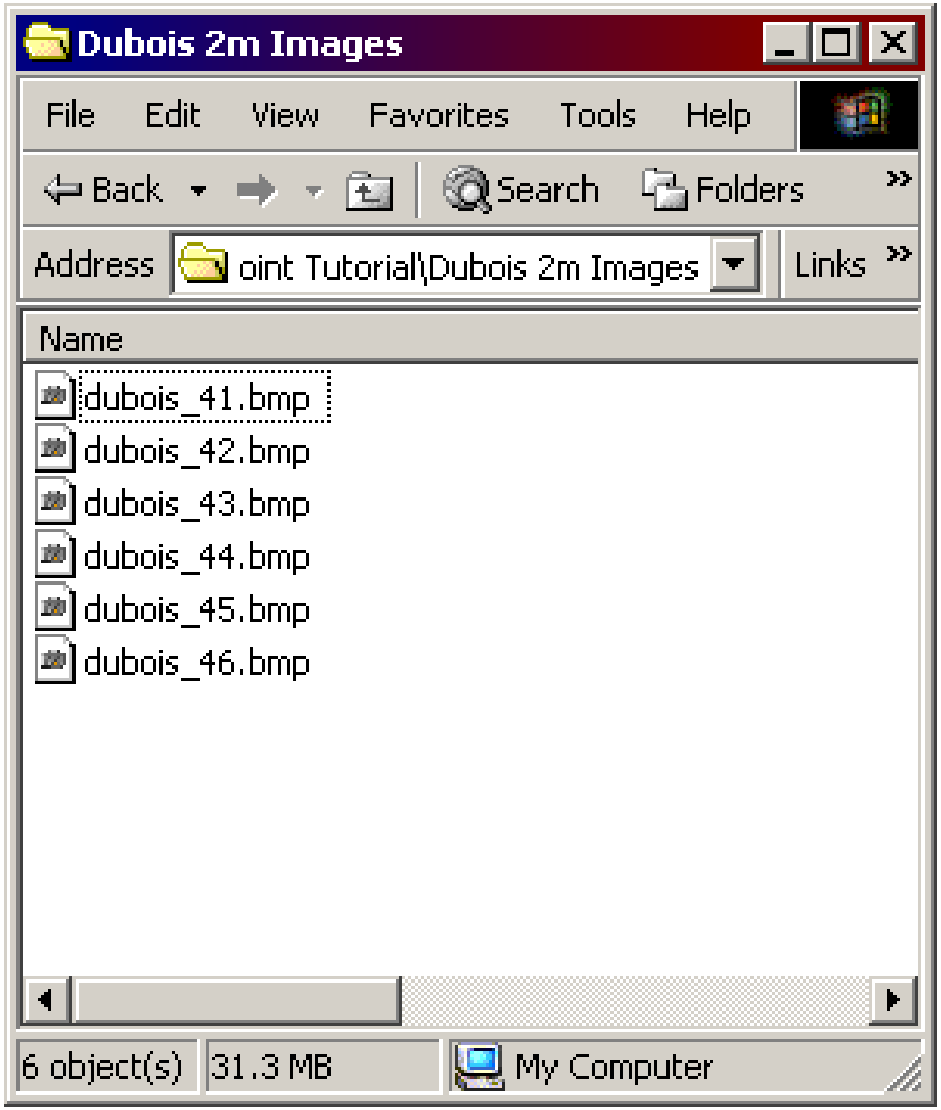
Use a light airplane to acquire large-scale nadir images

2 mm GSD

Use an airplane or helicopter to acquire small scale nadir images

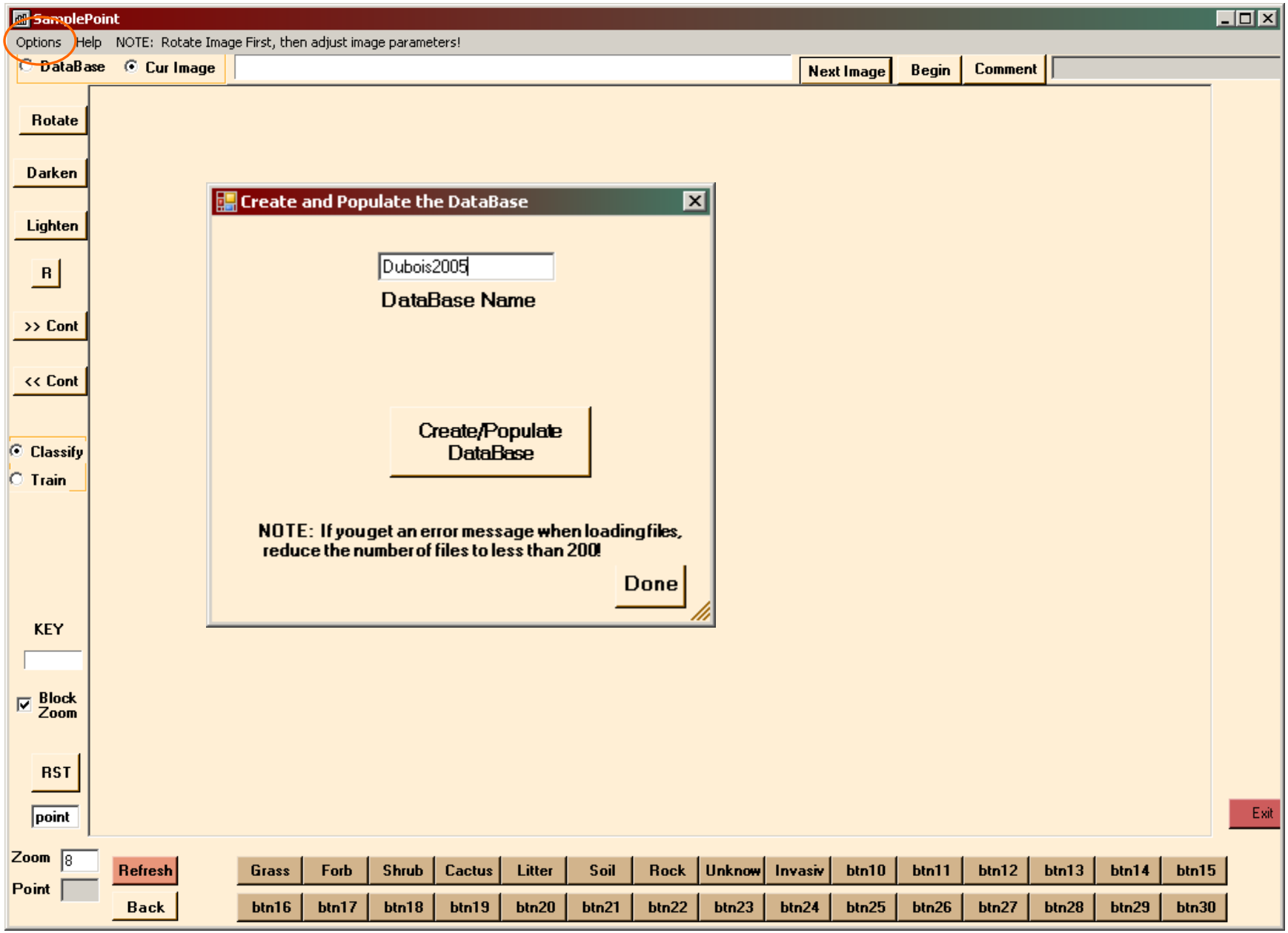
1 m GSD

Save digital images to your hard drive in TIFF or BMP form. JPEG is a lossy-format but works as well as TIF at low compression ratios. Highly-compressed JPG files are not useful. Images MUST be nadir!

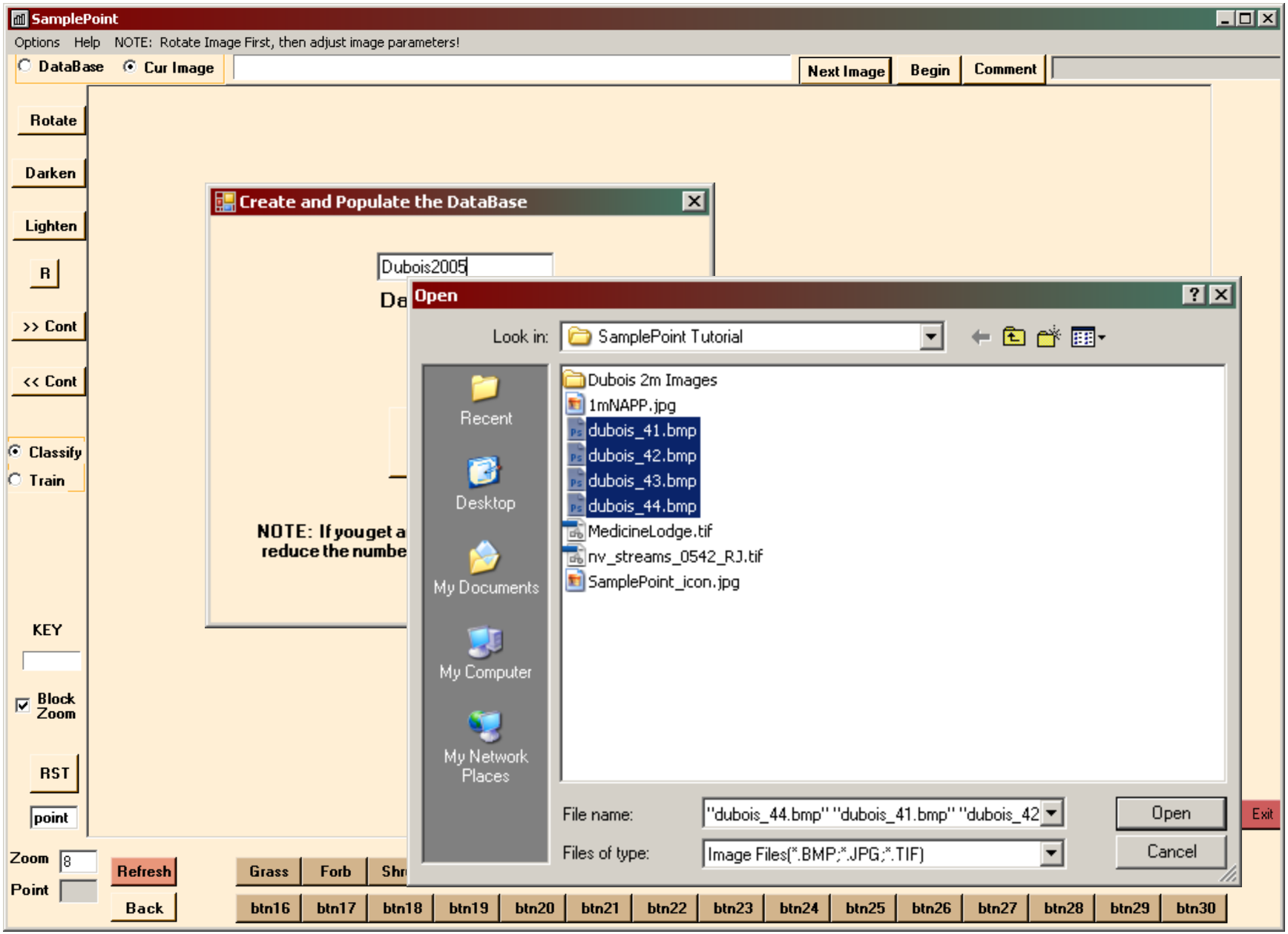


Open SamplePoint by clicking Start>Programs>SamplePoint>SamplePoint.exe.
If you encounter trouble, please reference “SamplePointHelp.PDF” in the program directory.

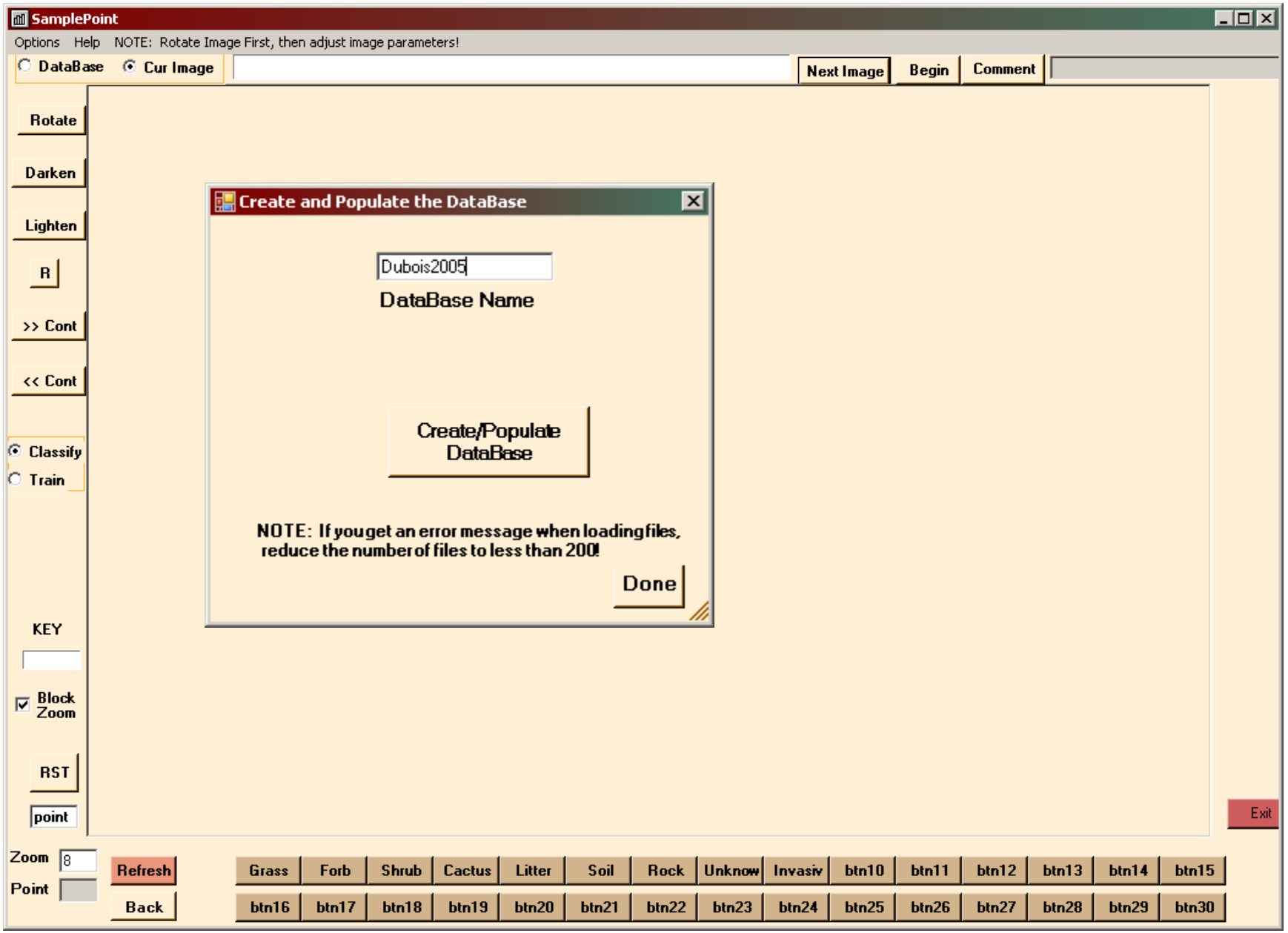
Click Options>Database Wizard.
Provide a name for the database, then click Create/Populate Database.



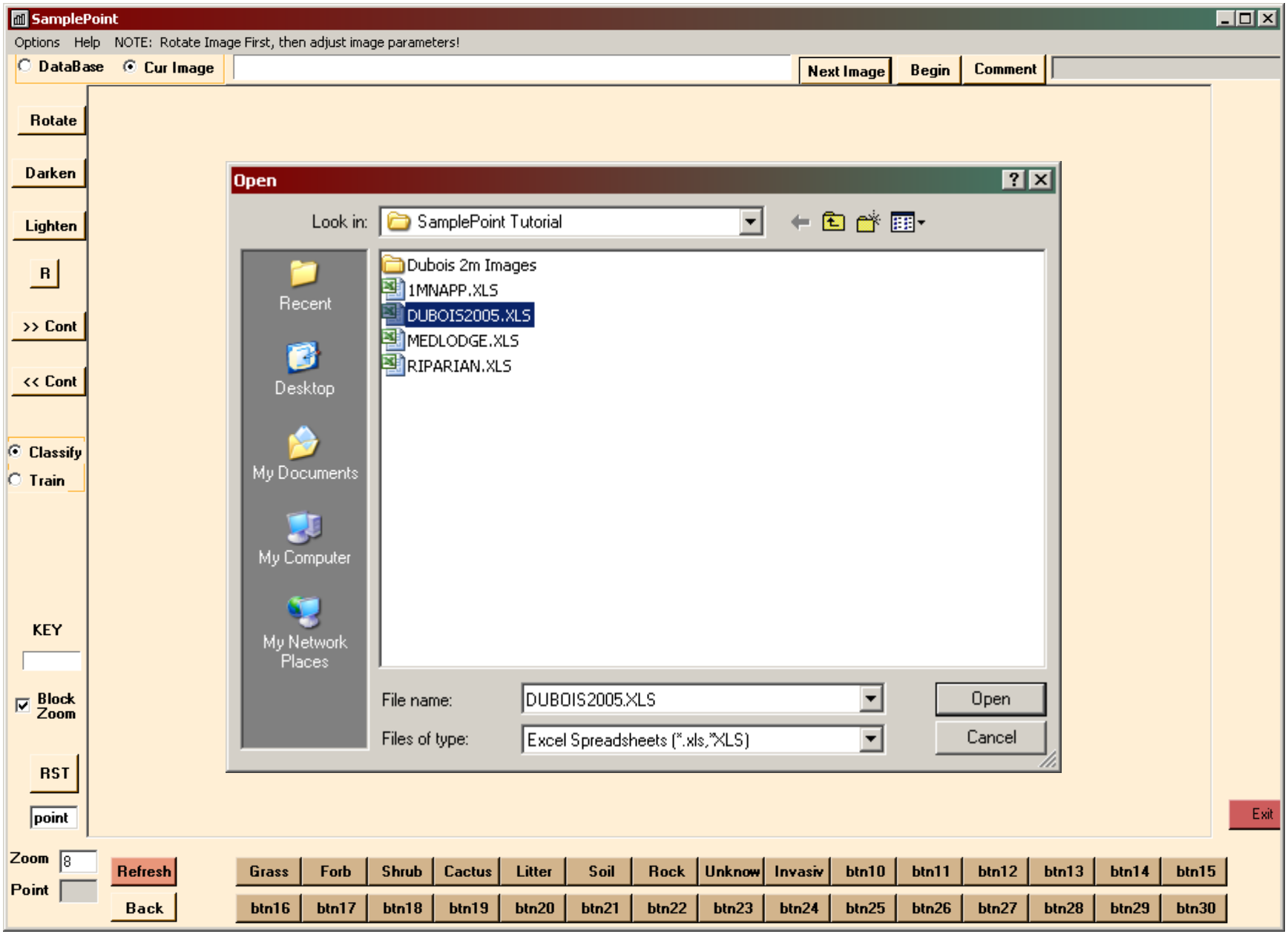
Navigate to the folder containing the images you wish to classify. Select the images you want to classify. Click Open.



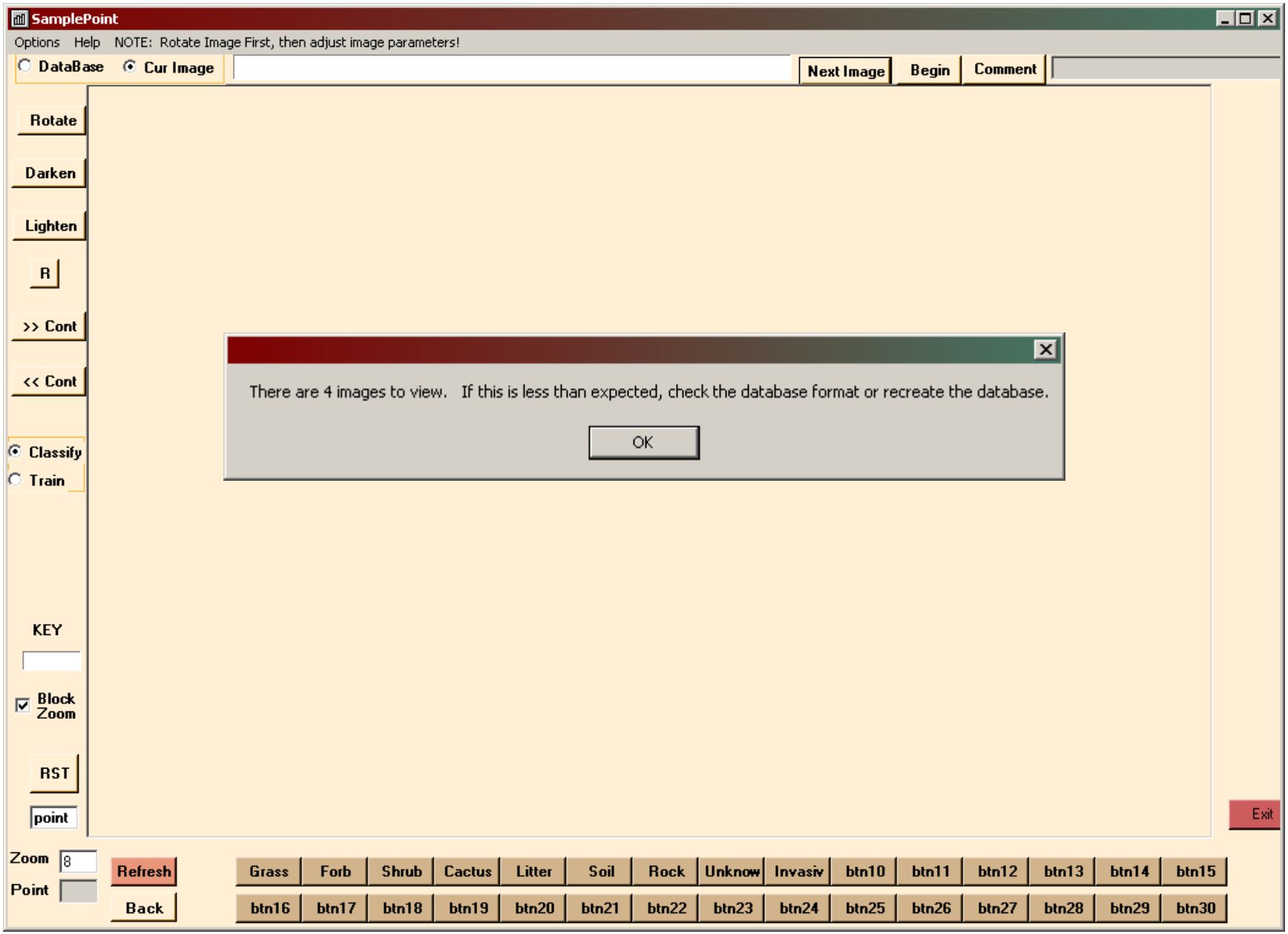
Images may only be selected from one folder. All images must be selected at once (you cannot populate the database twice using the wizard). After images have been selected, click Done. The database is saved to, and must remain in, the folder containing the analysis images.



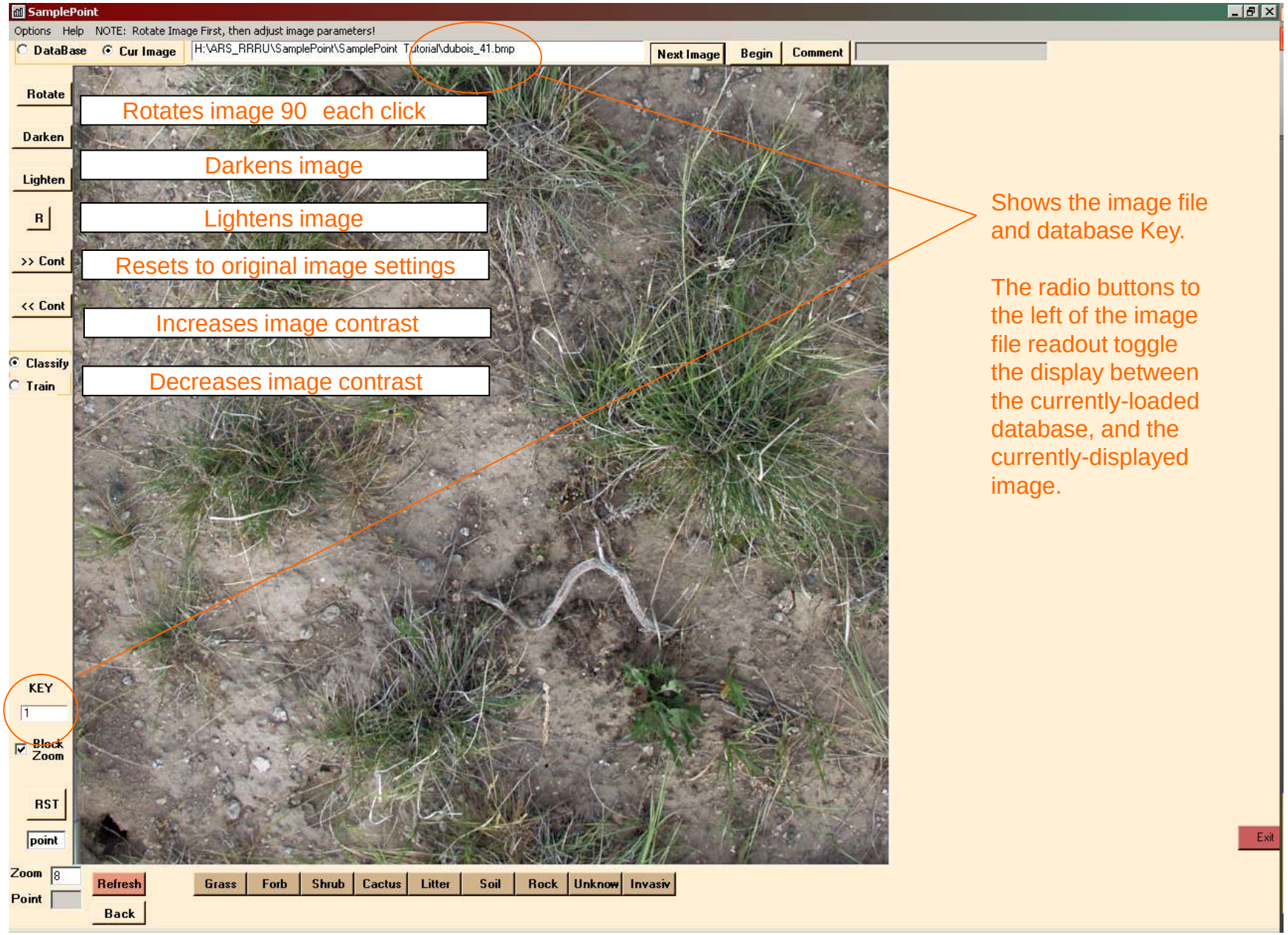
Click Options>Select Database and navigate to the image folder and select the *.xls file. Click Open.



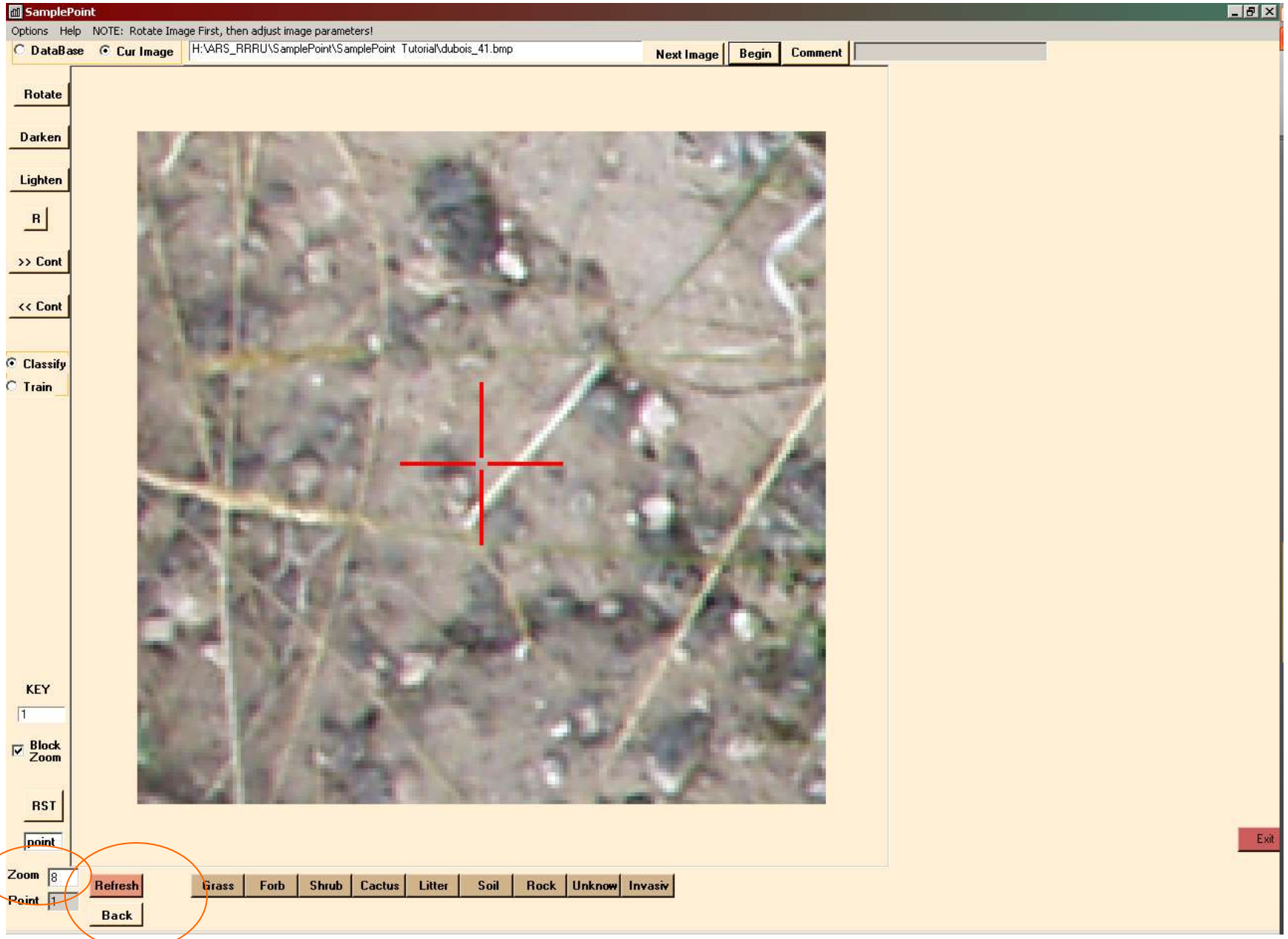
A Pop-up box will confirm the number of images in the database. Click OK if this is correct.



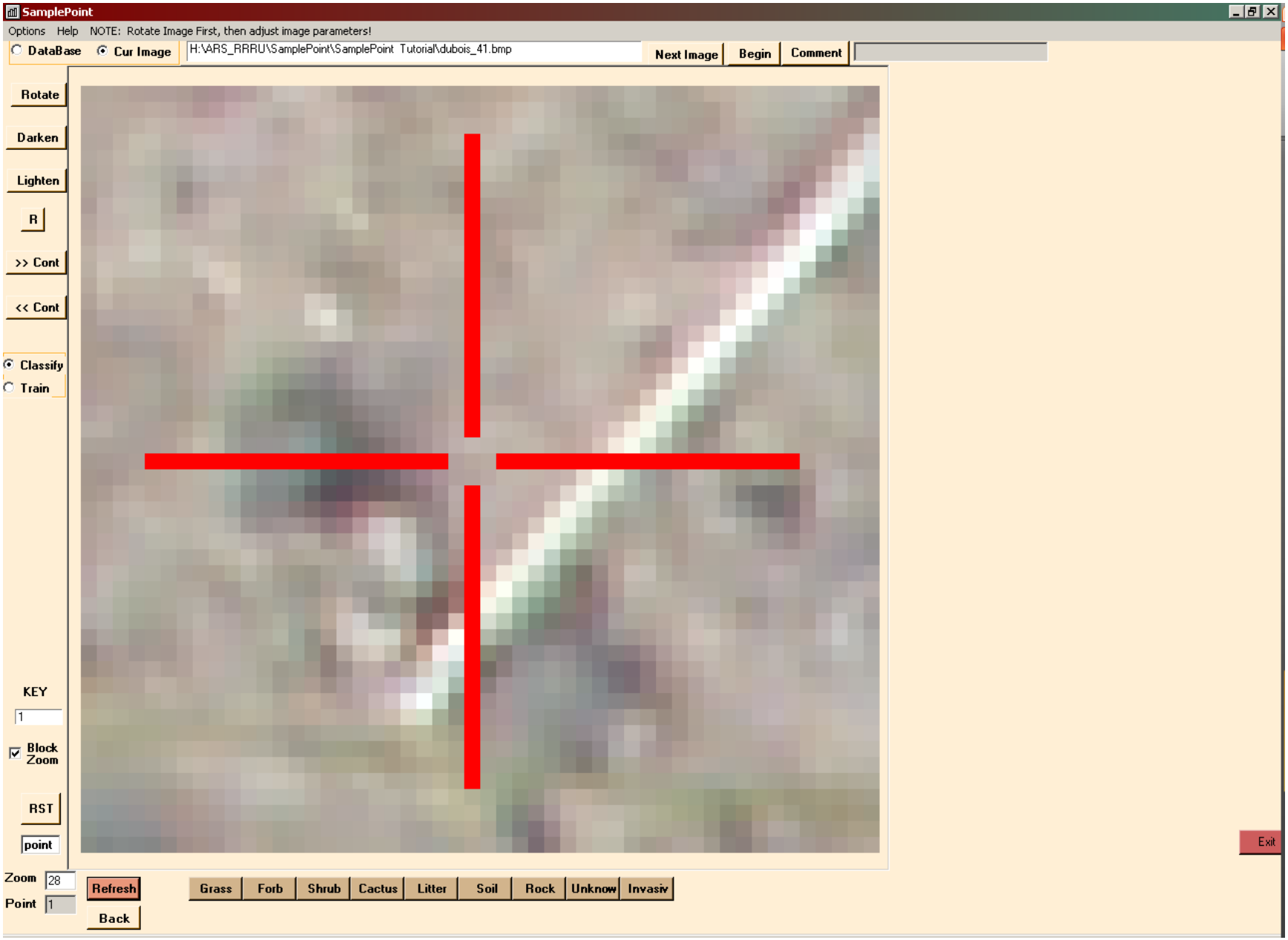
The first image listed in the database (Image Key 1) will appear in the screen at full-view. To begin classification using default settings of 100 systematic points and 8 default classes, click Begin.



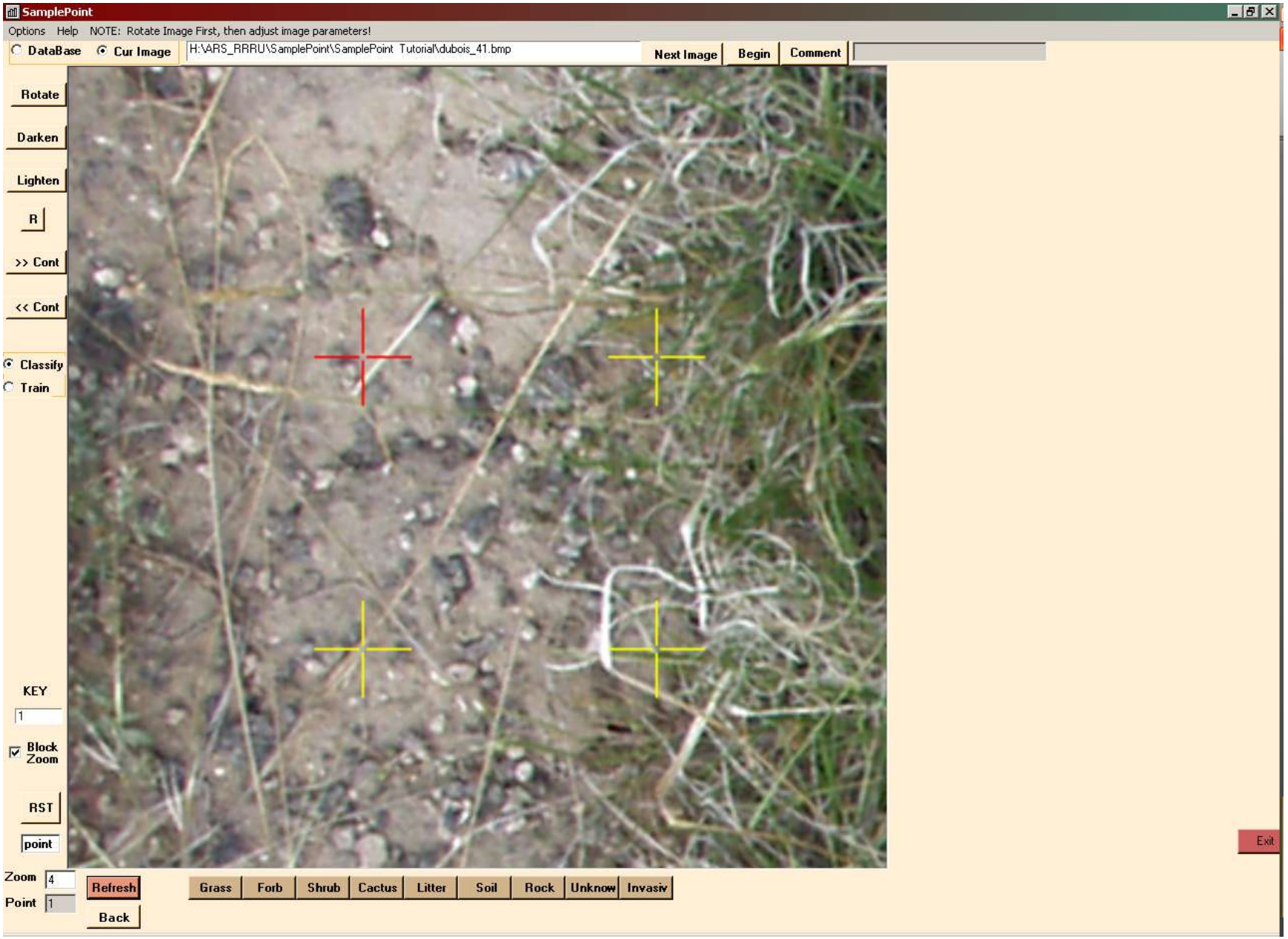
You are taken to point 1 in the upper left corner of the grid. Zoom in by pressing the ↑ key on your keyboard, zoom out by pressing ↓ key, zoom by typing a value in the Zoom box and pressing Refresh, or zoom by using a scroll wheel mouse.



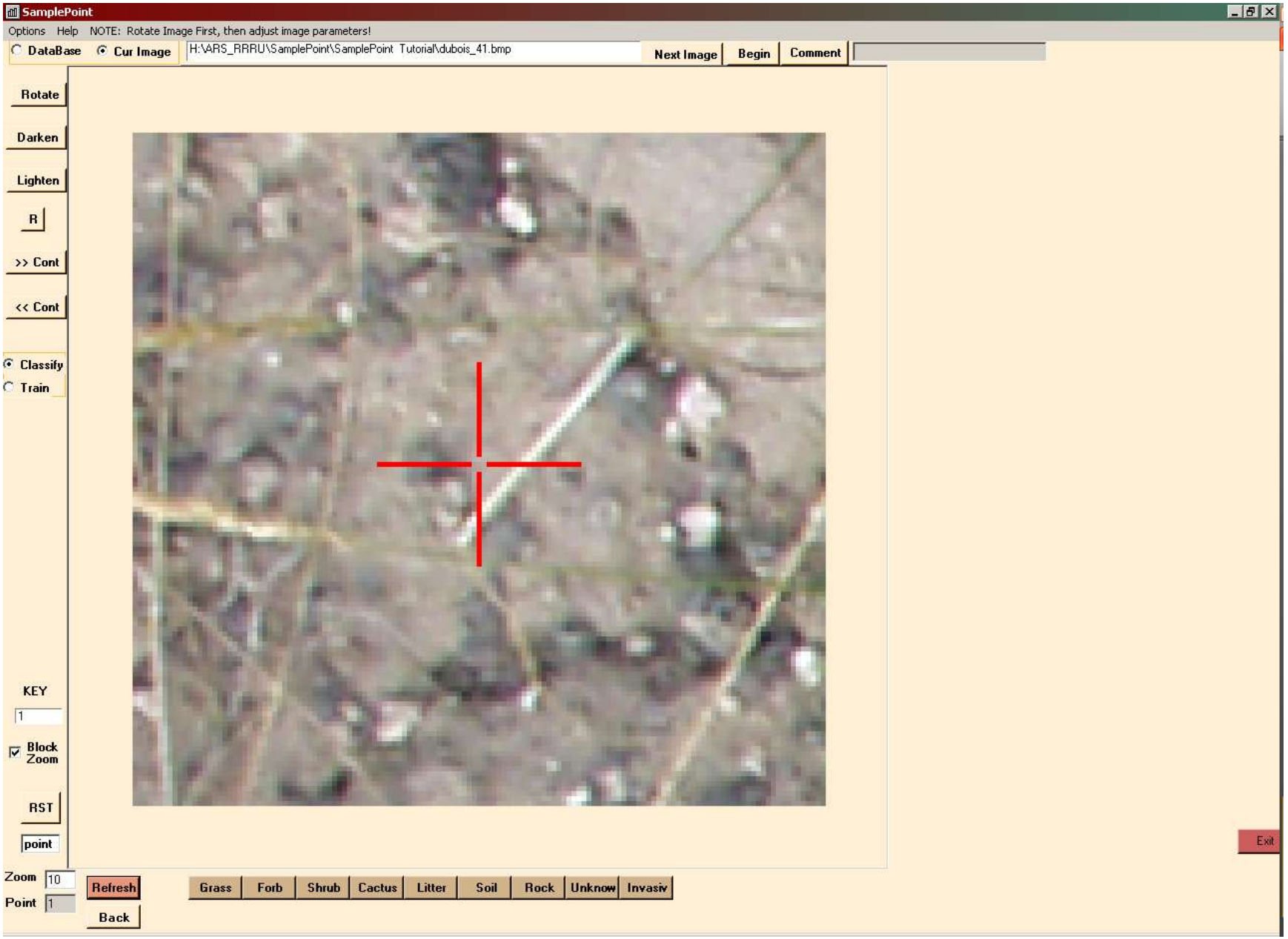
Zoomed in to 28X.



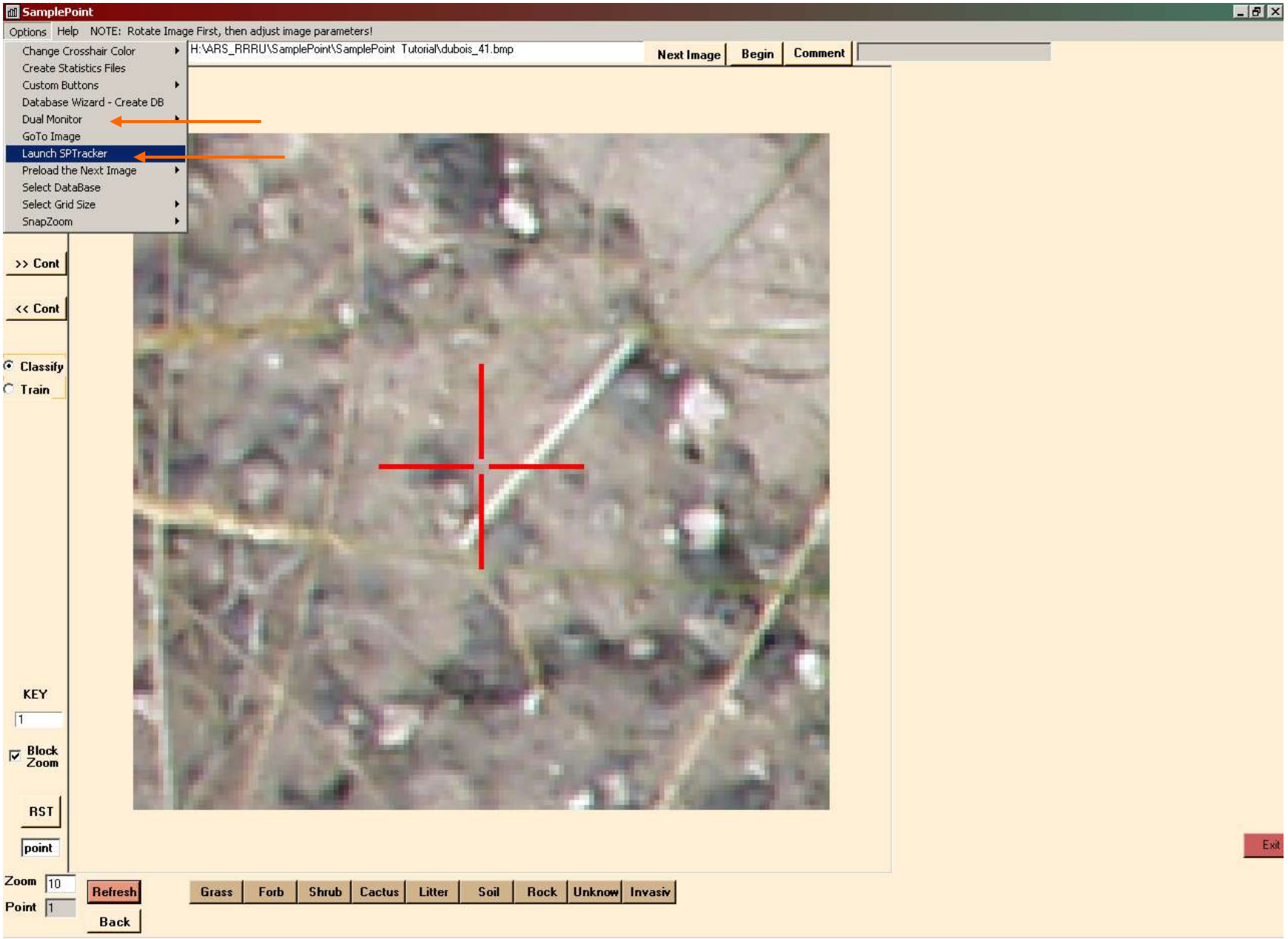
Zoomed out to 4X. Note that the point is no longer centered as you zoom further out and are on the edge of the image. Current point is red, all others are yellow.



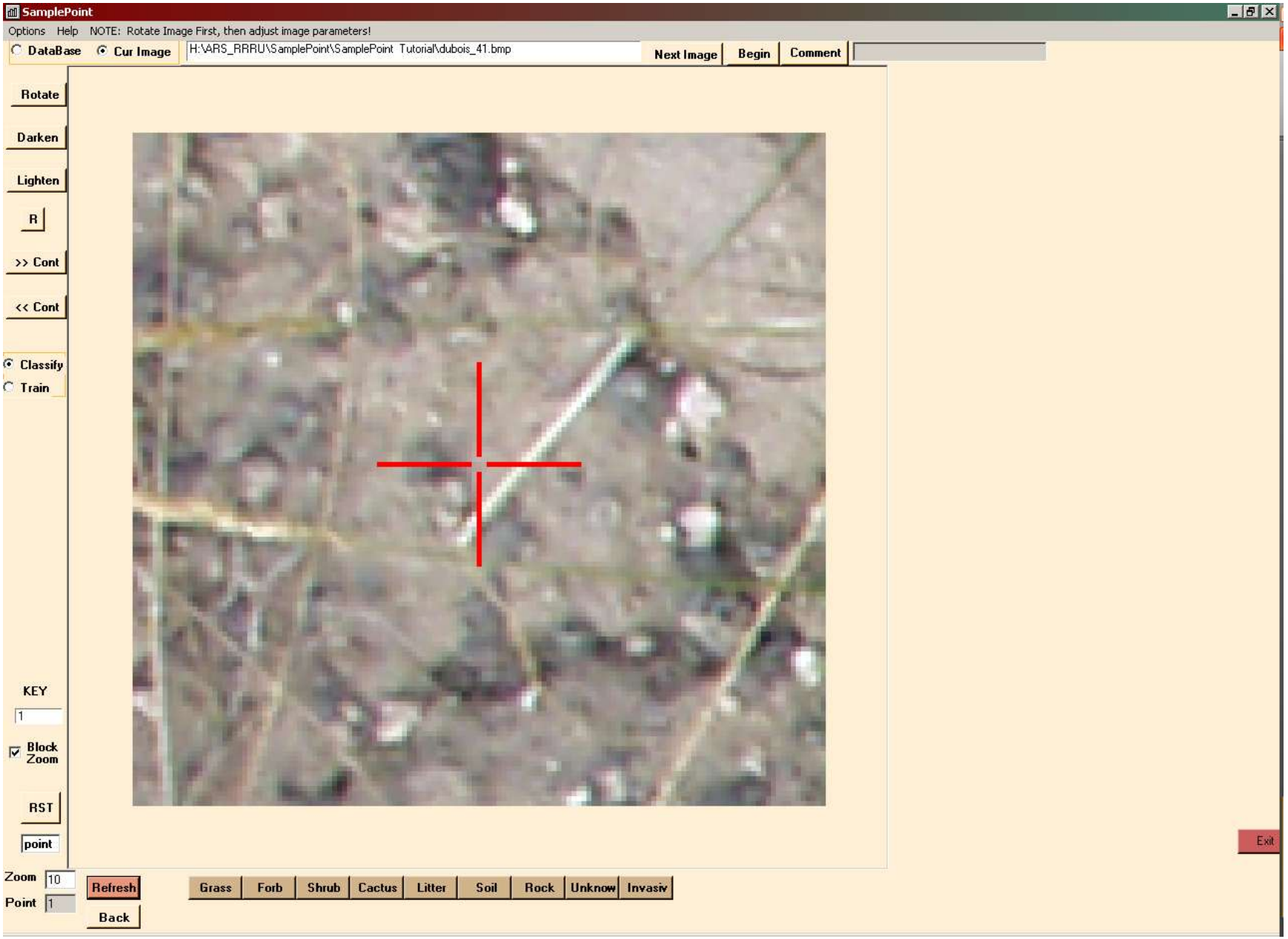
You should be able to distinguish individual pixels. The goal is to classify the single pixel in the center of the crosshairs. Zoom out if needed to gain perspective.



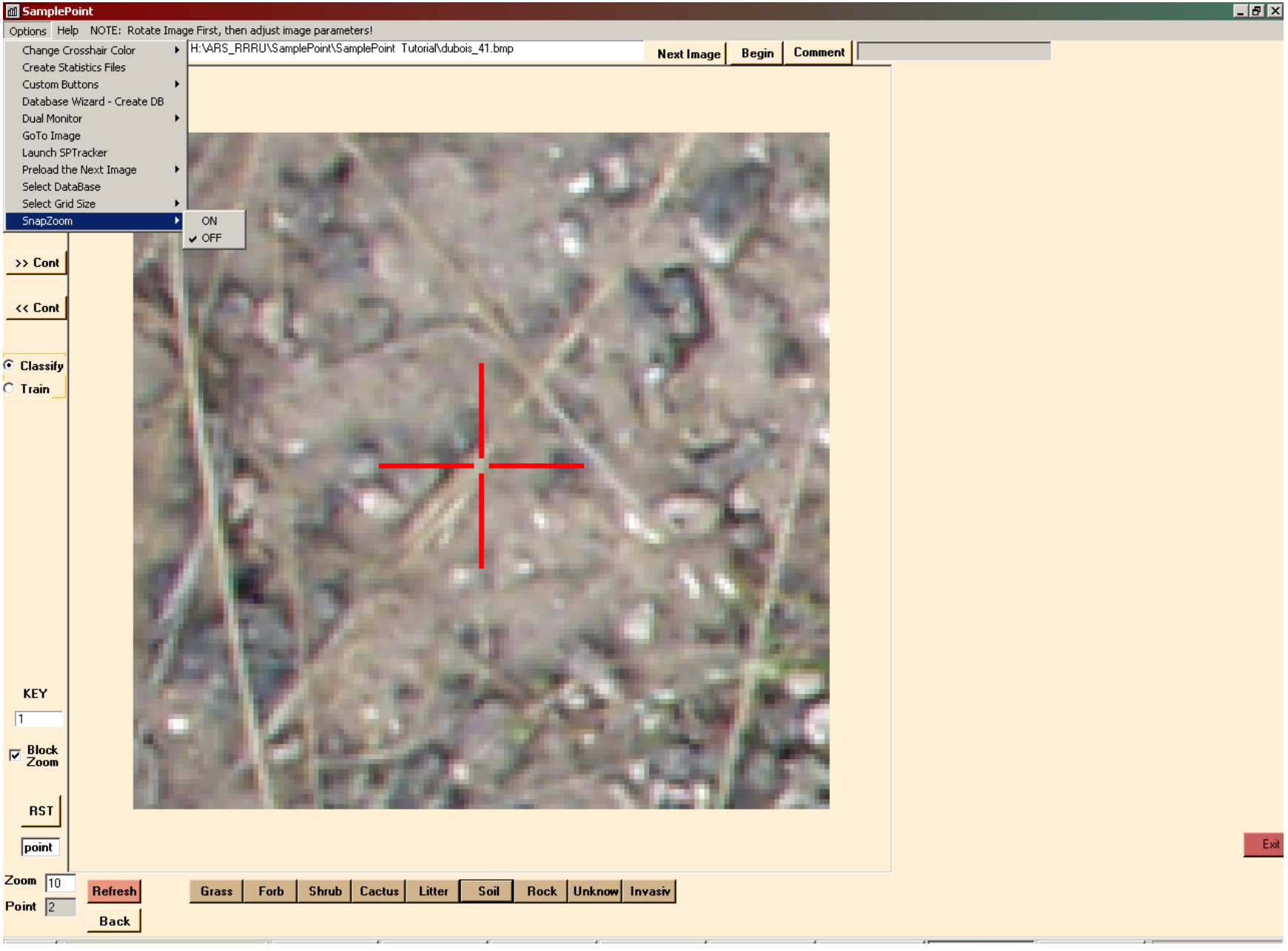
If you have a 2- or 3-monitor array, you can view multiple zoom levels on different screens by launching SP Tracker, and/or selecting Dual Monitor mode. This saves the time required to zoom in and out.



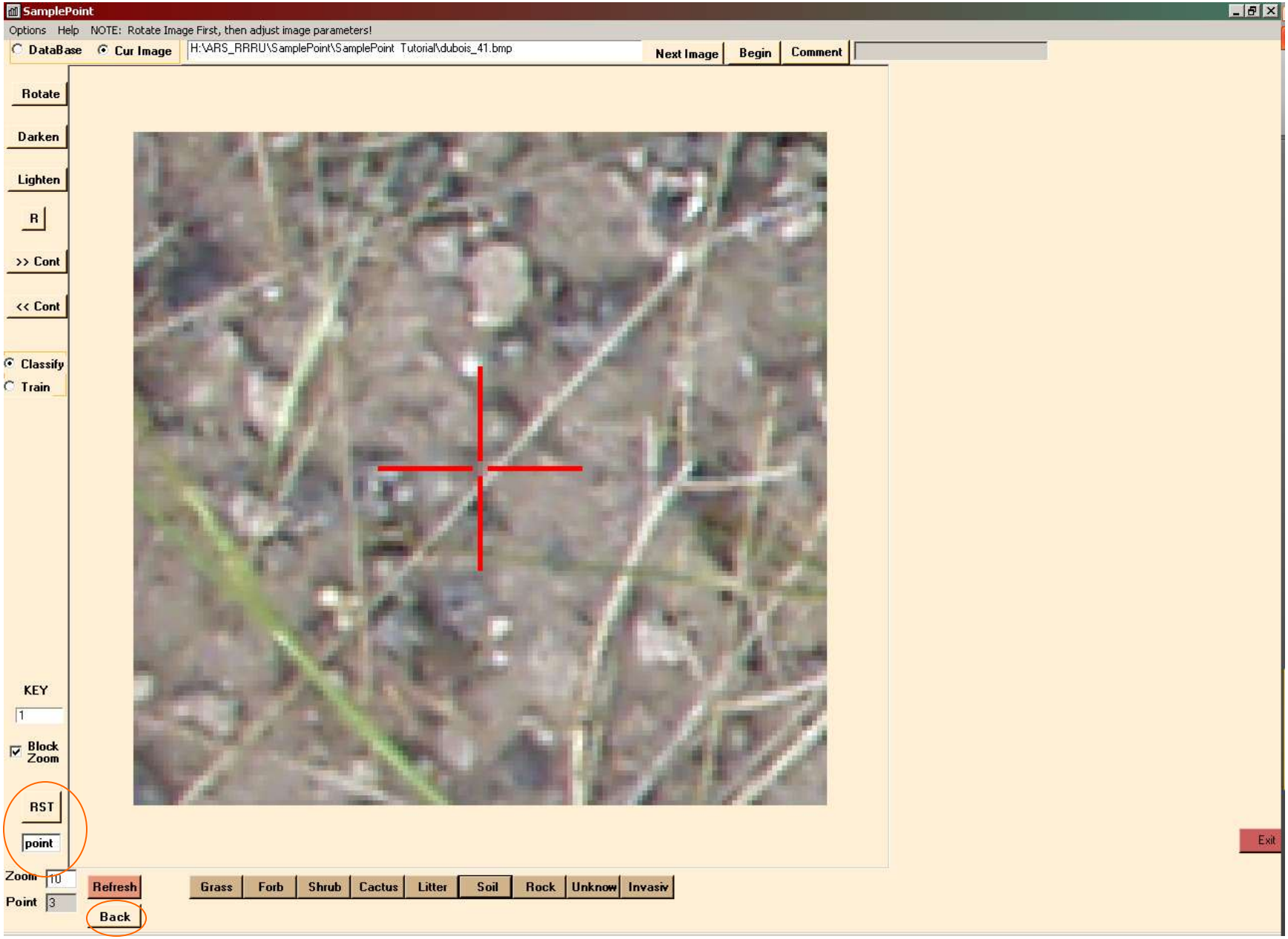
Classify by clicking on the button below the image which describes the point. In this case, Soil. The button will flash red, then you will be taken to point 2. The classification is automatically saved to the database.



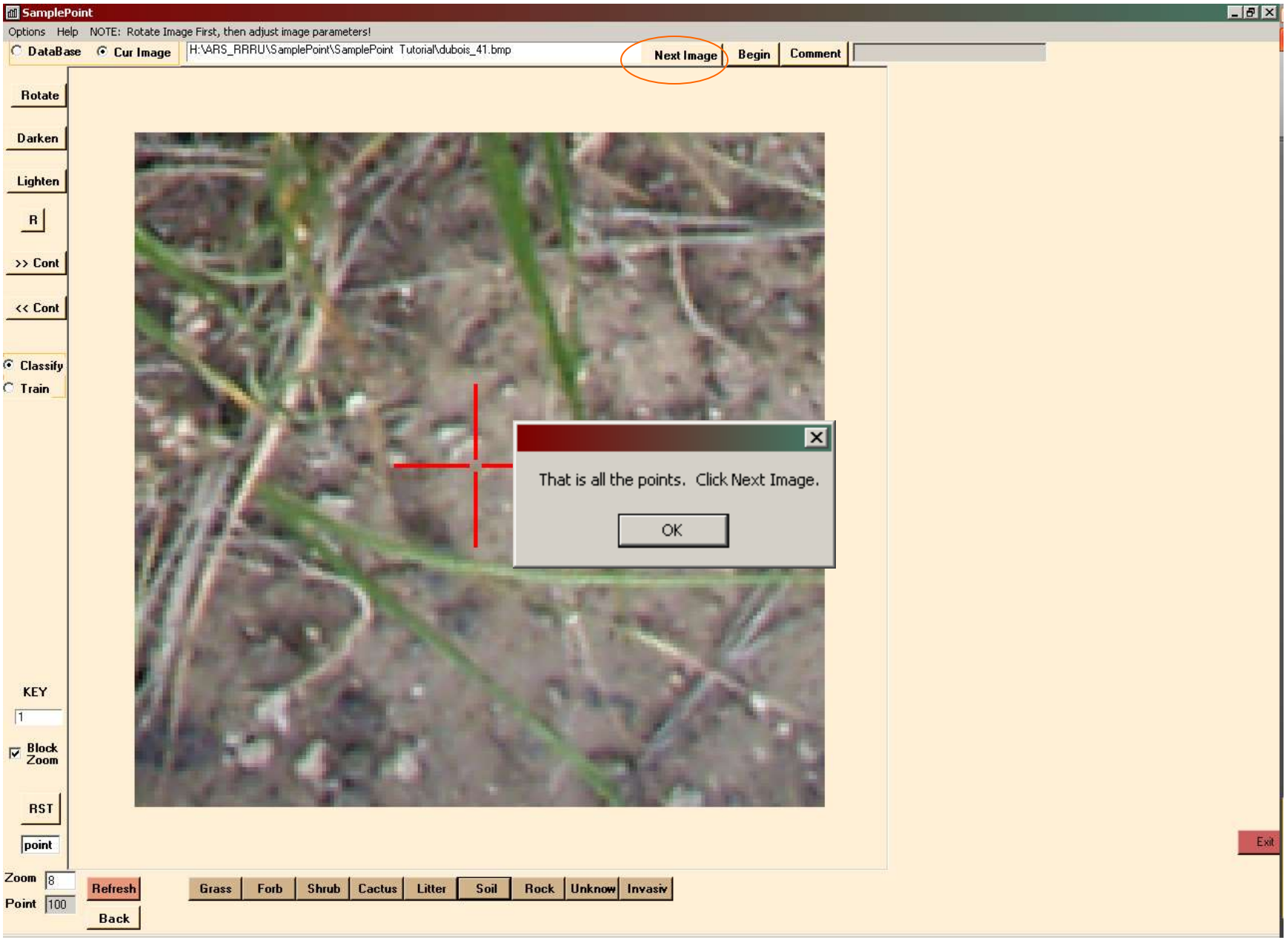
Note that the point number is displayed in the lower left corner. The zoom setting stays the same from point to point unless you change it. If you want the zoom to always return to a certain level, click Options>Snap Zoom>On and specify zoom level.
Classify point 2: It is close to a piece of litter, but the center pixel is in fact soil. Zoom in if you are unsure.



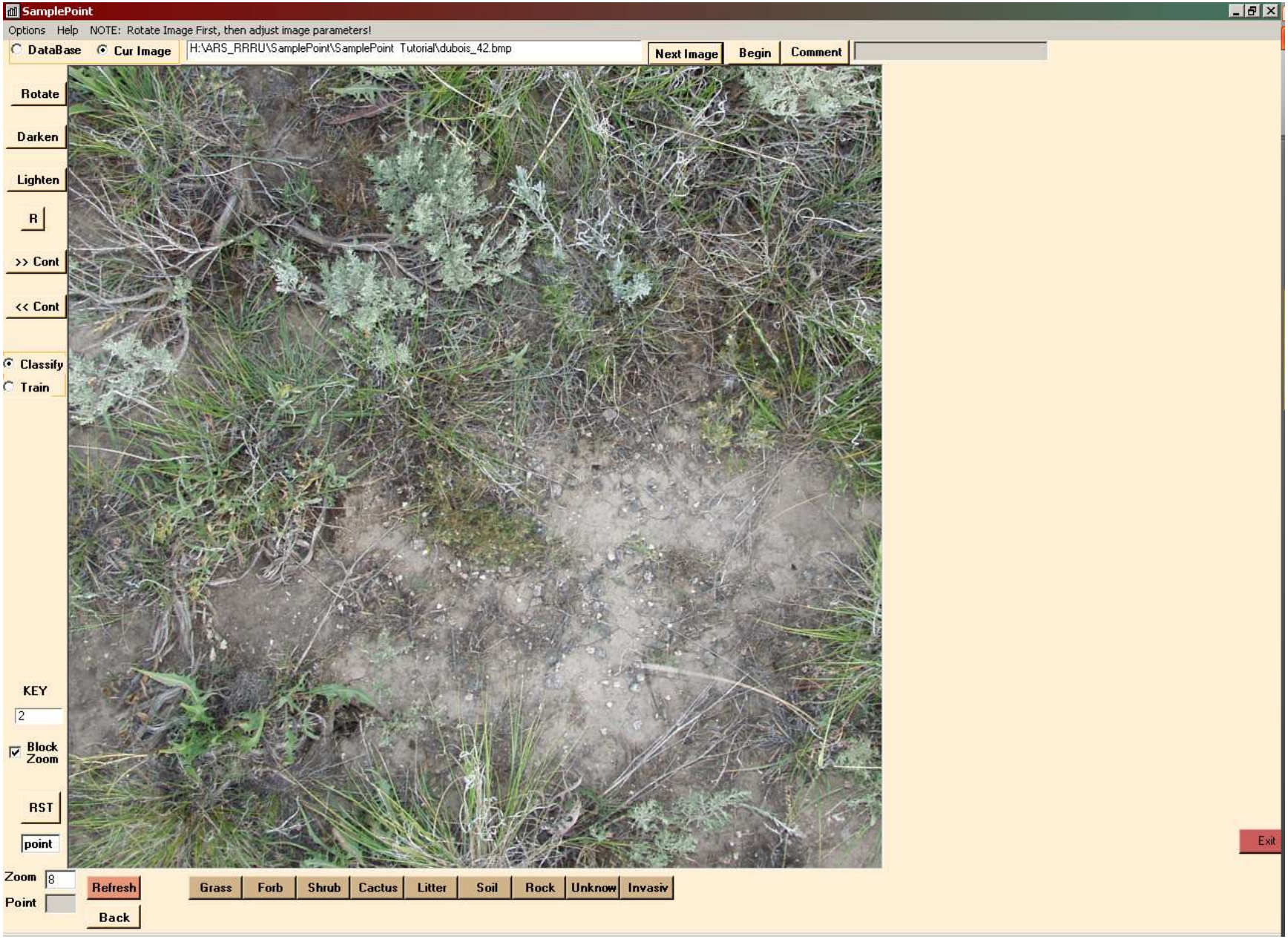
Now you're on point 3. If you feel you made a mistake on point 2, you can click the Back button to go back and reclassify point 2. If you want to start over at point 1 or go back 10 points at once, type in the target point number in the lower left corner "point" box, then click the RST (reset) button. Point location is constant for each image unless you alter the grid size.



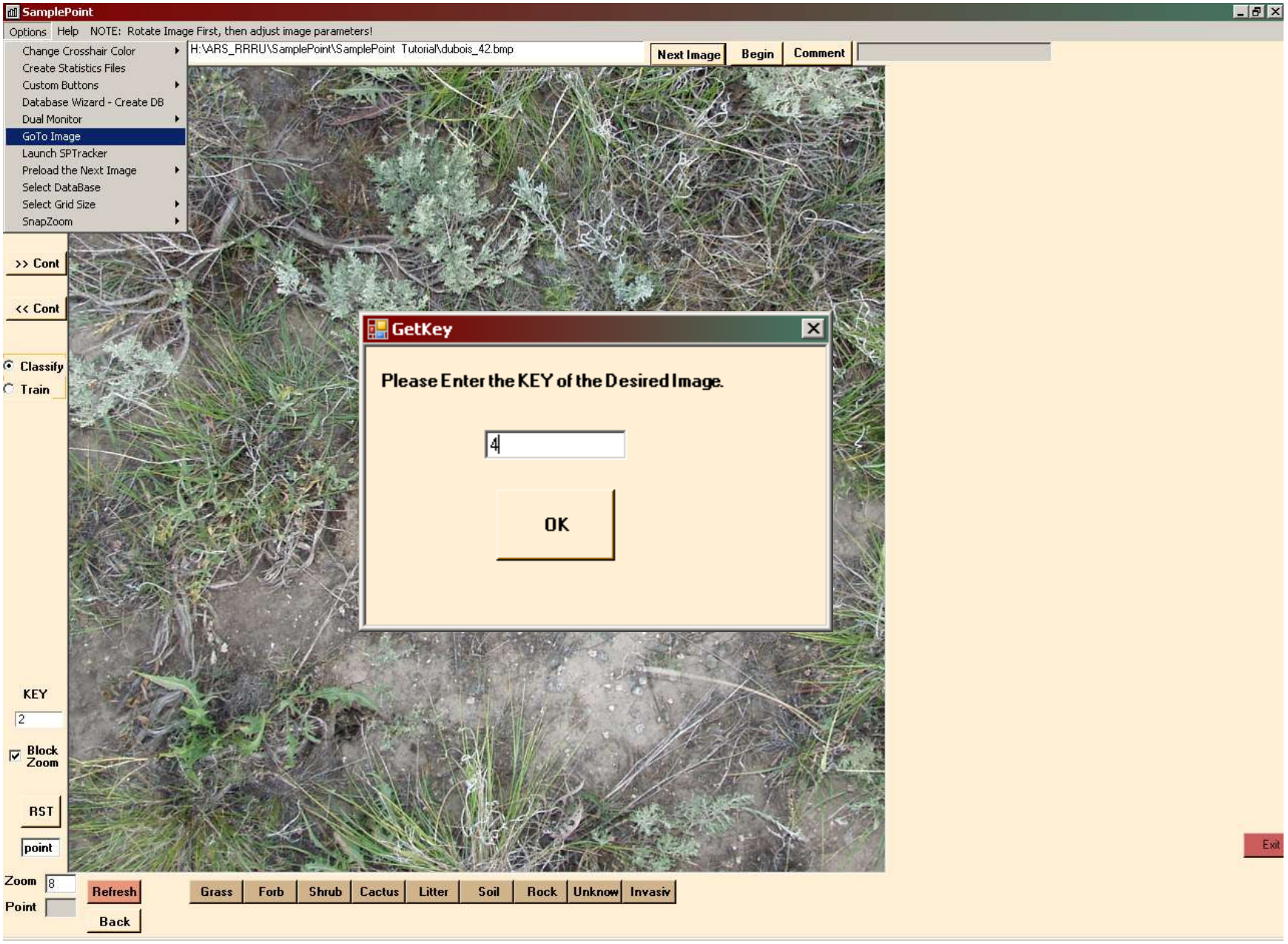
A notification pop-up appears when the final point for each image is classified.
Click OK, then click the Next Image button to continue to the Image Key 2.



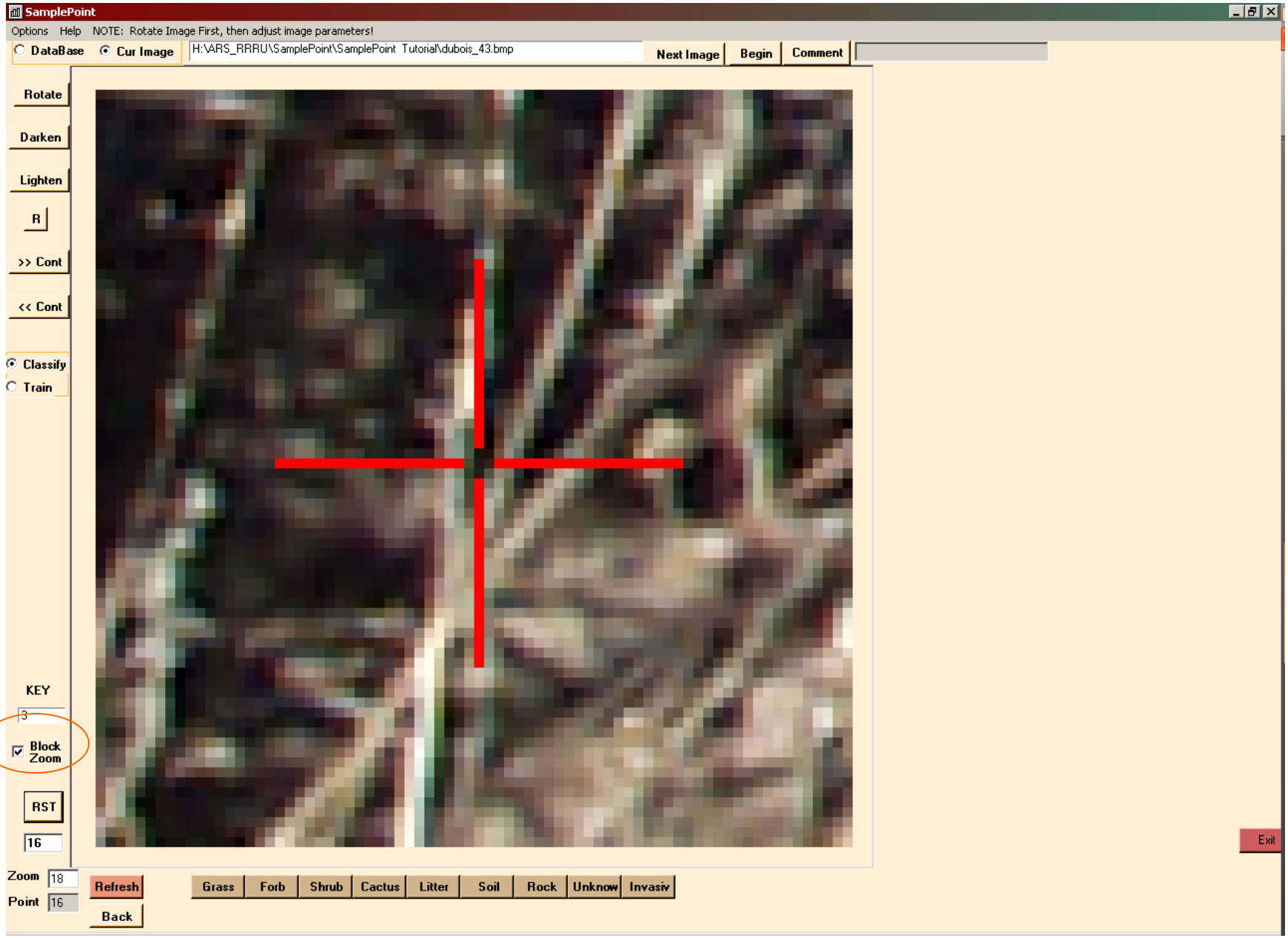
The next image will appear at full size. Note the Key now reads 2. Click Begin to start classification.



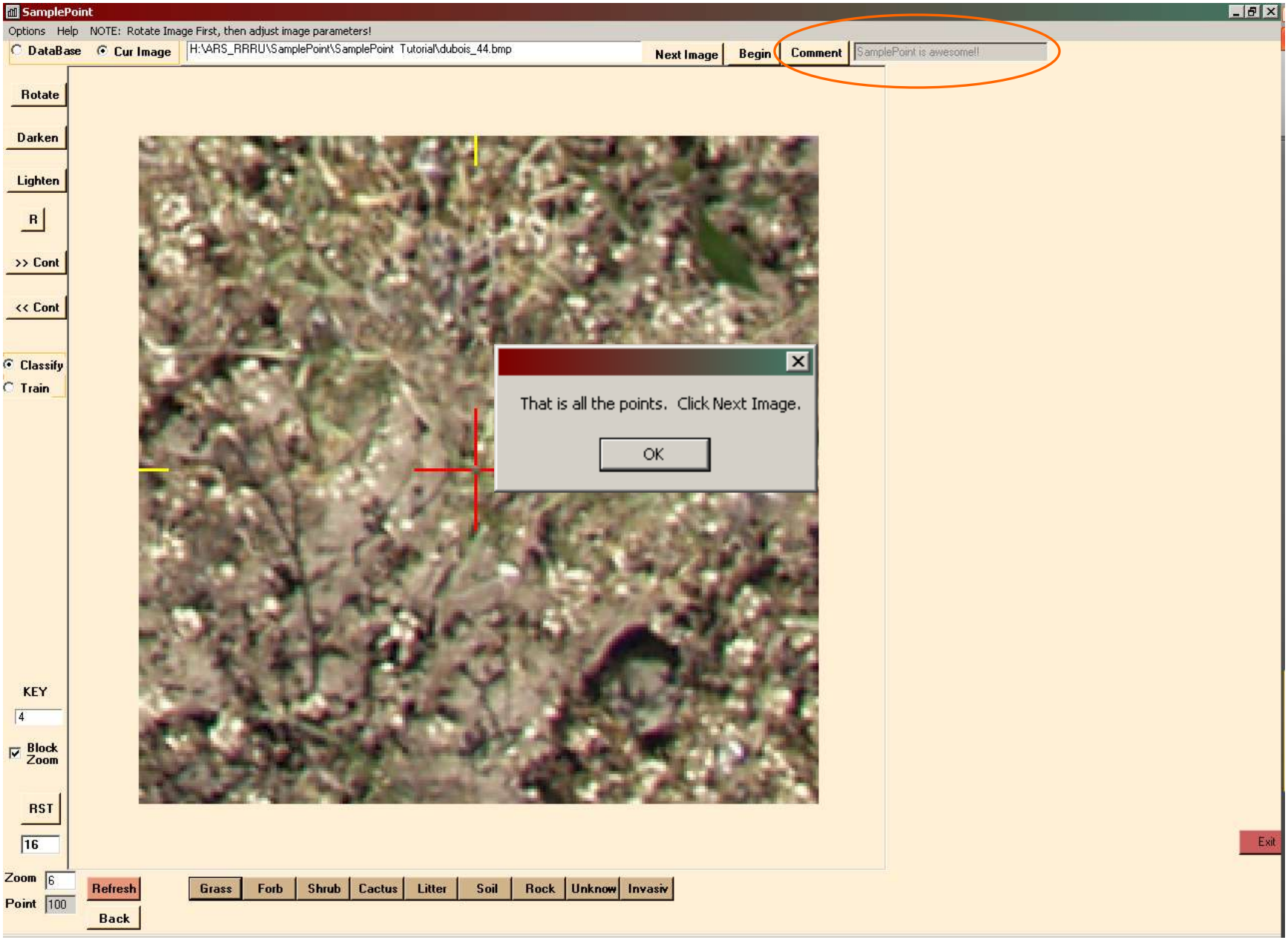
At no point do you need to save anything. All classification is saved automatically and instantly by SamplePoint. You can Exit at any time, even in the middle of an image, without losing any data. To restart at a different time on a particular image, select the database, then click Options>Go To Image, and type in the KEY of the image you want to start with. Click OK and the image will load.



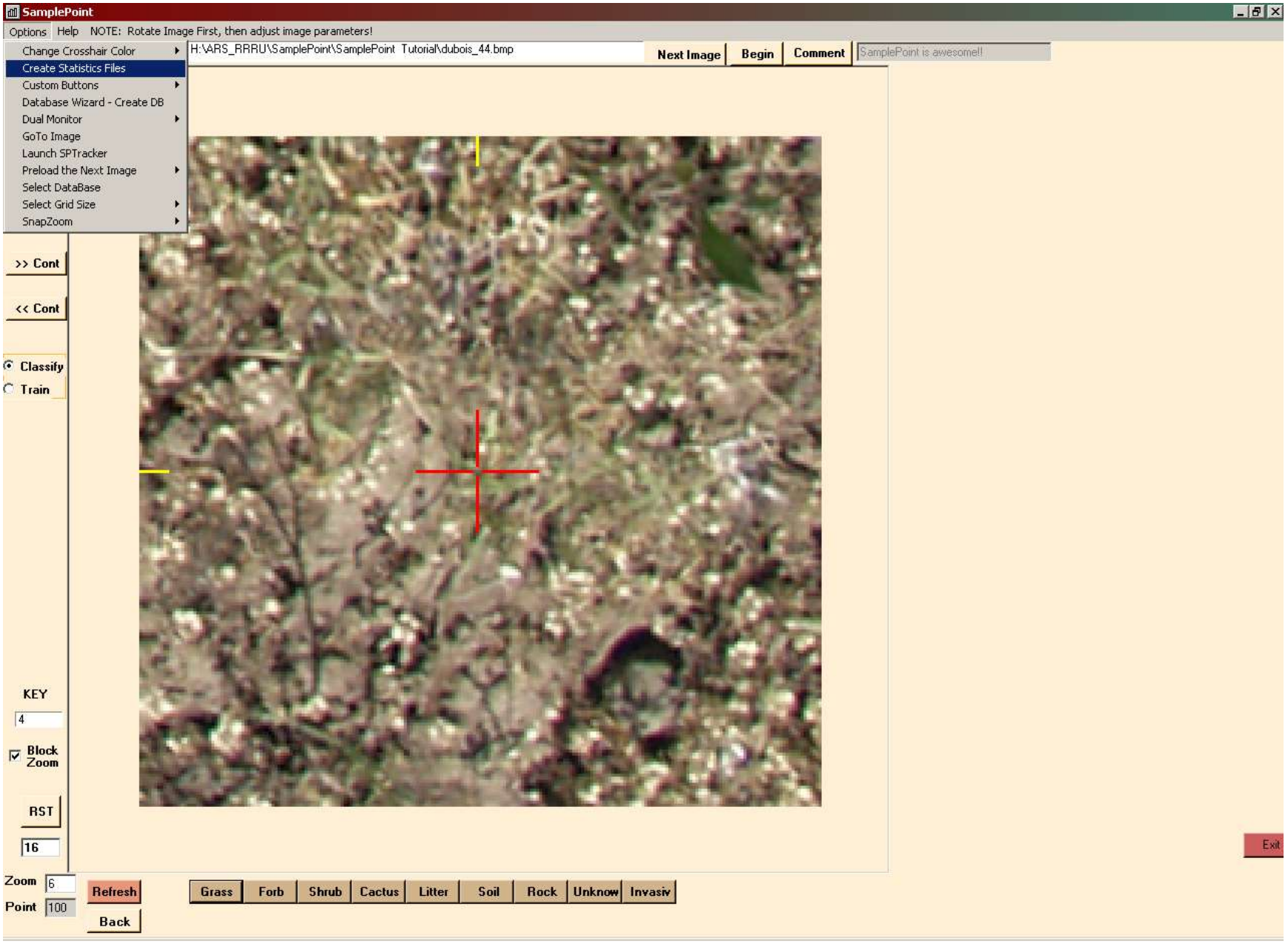
The Unknown button is useful for places like shadow, where the actual groundcover cannot be discerned.
Toggling between pixelated and interpolated view is accomplished with the Block Zoom check box. Default is for block zoom.



Comments typed into the Comment field are also saved to the Excel database. When you've completed the last image, a notification pops up to tell you so. Click OK.



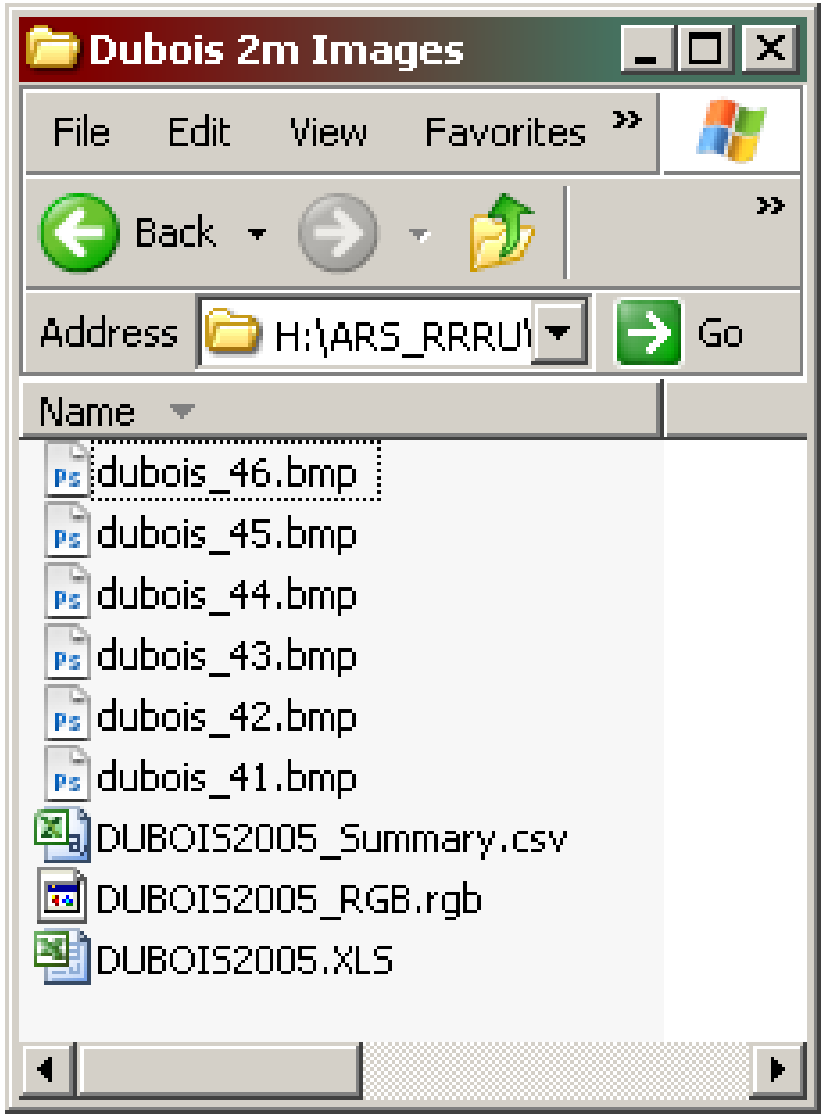
Click Options>Create Statistics Files. This generates two comma-delimited text files with a summary of the results. You can create these files at any time during the classification process, instead of waiting until all images are classified. These files are saved to the image folder.



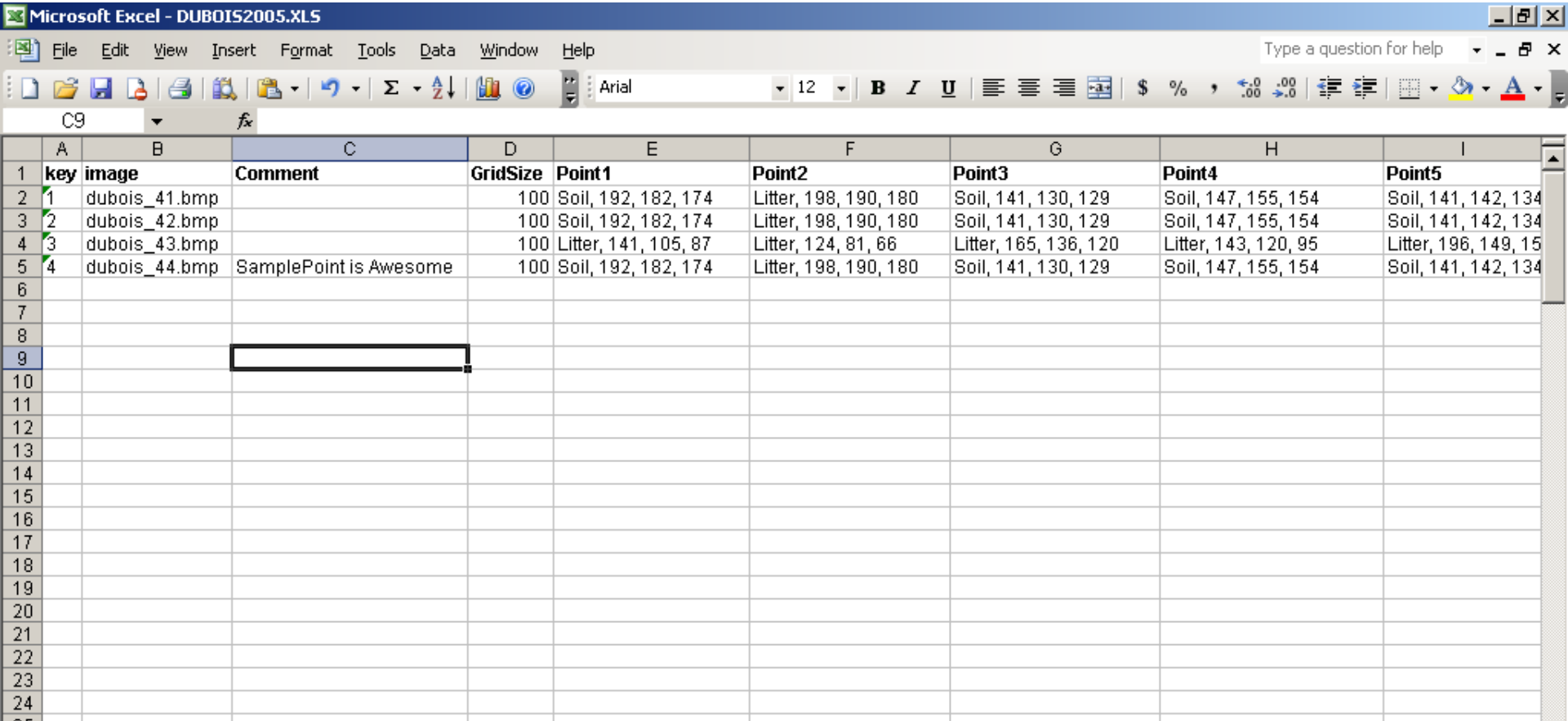
After the Statistics Files are created, look in the image folder. You'll see the database Excel file (DUBOIS2005.XLS), the data summary file (DUBOIS2005_Summary.csv) and a text file listing the red green blue values of every classified pixel (DUBSOI2005_RGB.rgb).

The .csv file is the summary that can be opened in Excel. It simply calculates % cover for each class for all images and is the starting point for statistical comparisons.

The .rgb file is simply a comma-delimited list of each classification with respective red, green and blue pixel values. This is sometimes useful to compare pixel color distribution among different classes. It can be opened in either Notepad or Excel.



If you Exit SamplePoint, you can examine the database using Excel. It shows the Key, Image file, Gridsize and classification of each point. The numbers beside the classification are the RGB values for the classified pixel. Custom button information is also stored in the database in columns HV-HX. You cannot open the database in SamplePoint if it is open in Excel on your PC, and vice-versa. You can add image files to the database manually using Excel by typing in additional keys and filenames or pasting them from a list. Filenames are case sensitive.



	A	B	C	D	E	F	G	H	I
1	key	image	Comment	GridSize	Point1	Point2	Point3	Point4	Point5
2	1	dubois_41.bmp		100	Soil, 192, 182, 174	Litter, 198, 190, 180	Soil, 141, 130, 129	Soil, 147, 155, 154	Soil, 141, 142, 134
3	2	dubois_42.bmp		100	Soil, 192, 182, 174	Litter, 198, 190, 180	Soil, 141, 130, 129	Soil, 147, 155, 154	Soil, 141, 142, 134
4	3	dubois_43.bmp		100	Litter, 141, 105, 87	Litter, 124, 81, 66	Litter, 165, 136, 120	Litter, 143, 120, 95	Litter, 196, 149, 15
5	4	dubois_44.bmp	SamplePoint is Awesome	100	Soil, 192, 182, 174	Litter, 198, 190, 180	Soil, 141, 130, 129	Soil, 147, 155, 154	Soil, 141, 142, 134
6									
7									
8									
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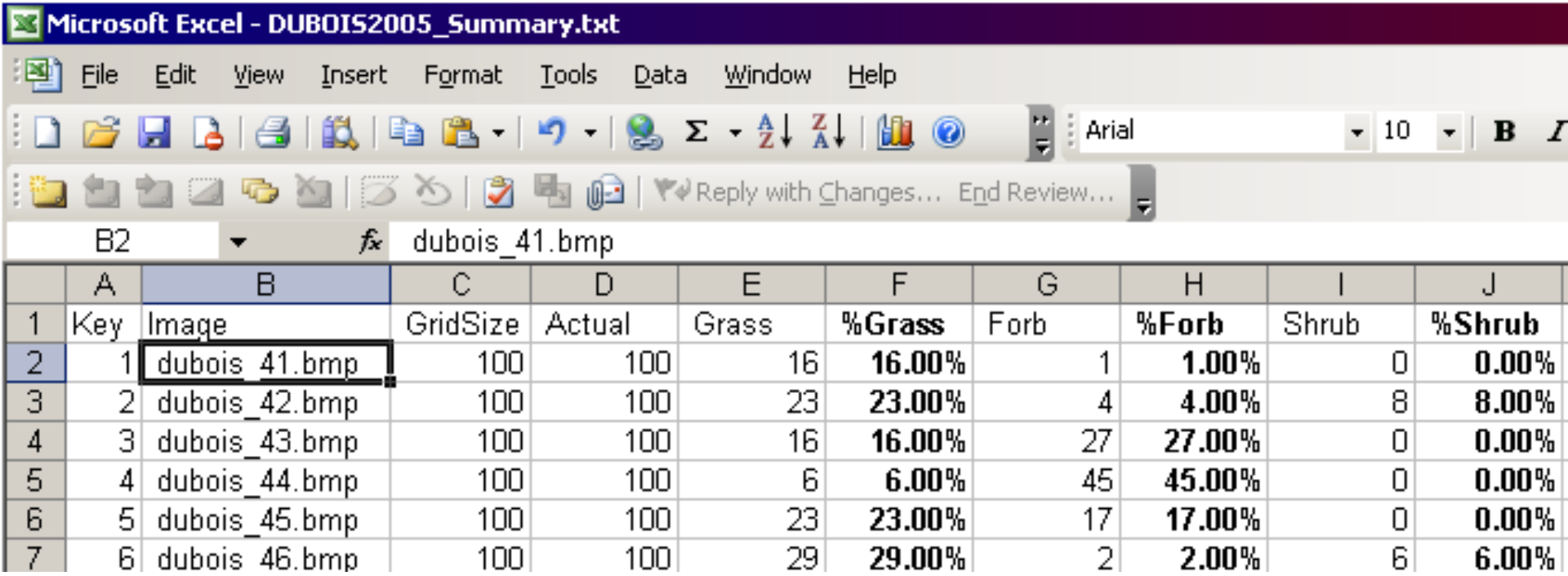
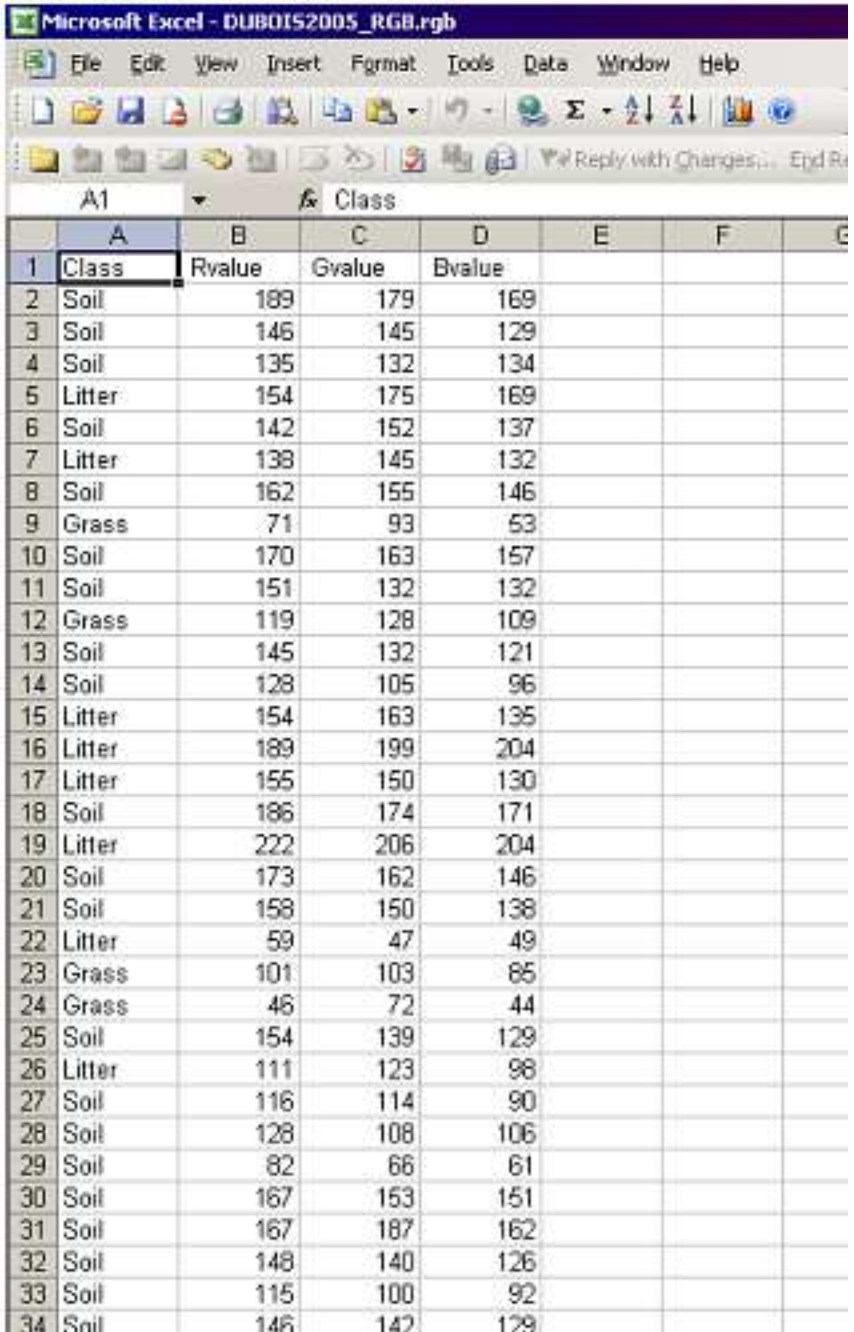
24									

This is the Summary file displayed in Excel. It shows the % cover for each image by cover type. For each cover class, the first column shows the actual number of hits, and the second column shows the percent of hits in the image.



	A	B	C	D	E	F	G	H	I	J
1	Key	Image	GridSize	Actual	Grass	%Grass	Forb	%Forb	Shrub	%Shrub
2	1	dubois_41.bmp	100	100	16	**16.00%**	1	**1.00%**	0	**0.00%**
3	2	dubois_42.bmp	100	100	23	**23.00%**	4	**4.00%**	8	**8.00%**
4	3	dubois_43.bmp	100	100	16	**16.00%**	27	**27.00%**	0	**0.00%**
5	4	dubois_44.bmp	100	100	6	**6.00%**	45	**45.00%**	0	**0.00%**
6	5	dubois_45.bmp	100	100	23	**23.00%**	17	**17.00%**	0	**0.00%**
7	6	dubois_46.bmp	100	100	29	**29.00%**	2	**2.00%**	6	**6.00%**

This is the RGB file in Excel. This file allows easy mathematical summary and analysis of the class color characteristics.



Microsoft Excel - DUBOIS2005_RGB.rgb

File Edit View Insert Format Tools Data Window Help

A1 Class

	A	B	C	D	E	F
1	Class	Rvalue	Gvalue	Bvalue		
2	Soil	189	179	169		
3	Soil	146	145	129		
4	Soil	135	132	134		
5	Litter	154	175	169		
6	Soil	142	152	137		
7	Litter	138	145	132		
8	Soil	162	155	146		
9	Grass	71	93	53		
10	Soil	170	163	157		
11	Soil	151	132	132		
12	Grass	119	128	109		
13	Soil	145	132	121		
14	Soil	128	105	96		
15	Litter	154	163	135		
16	Litter	189	199	204		
17	Litter	155	150	130		
18	Soil	186	174	171		
19	Litter	222	206	204		
20	Soil	173	162	146		
21	Soil	158	150	138		
22	Litter	59	47	49		
23	Grass	101	103	85		
24	Grass	46	72	44		
25	Soil	154	139	129		
26	Litter	111	123	98		
27	Soil	116	114	90		
28	Soil	128	108	106		
29	Soil	82	66	61		
30	Soil	167	153	151		
31	Soil	167	187	162		
32	Soil	148	140	126		
33	Soil	115	100	92		
34	Soil	146	142	129		

OPTIONS

- Defining custom buttons
- Changing the number of classification points
- Random classification points

The classification buttons can be defined by the user. To create up to 30 custom classes, click Options>Custom Buttons>Create Custom Button Files. Define the button labels with titles of 6-7 characters each, perhaps using NRCS species codes as button titles and including species and common names in the description field. Create one letter shortcuts for keyboard classification. Click Save when complete and name the button file.

Define Custom Buttons

		Description (optional)	ShortCut
Button 1	PASM	Pascopyrum smithii (Rydb. A. Love (western wheatgrass)	w
Button 2	HECO	Hesperostipa comata (Trin. & Rupr.) Barkworth ssp. comata (needle and thread)	t
Button 3	PSSP	Pseudoroegneria spicata (Pursh) A. Love (bluebunch wheatgrass)	p
Button 4	FEID	Festuca idahoensis Elmer (Idaho fescue)	i
Button 5	BRTE	Bromus tectorum L. (cheatgrass)	c
Button 6	POSE	Poa secunda J. Presl (Sandberg bluegrass)	s
Button 7	VUOC	Vulpia octoflora (Walter) Rydb. (sixweeks fescue)	f
Button 8	Grass	Any grass not specifically covered by previous grass buttons	g
Button 9	Forb	Any broadleaf herbaceous plant	o
Button 10	Shrub	Any woody plant	h
Button 11	Rock	Minimum diameter 1"	r
Button 12	Litter	Any senesced, detached portion of the plant	l
Button 13	Soil	Bare mineral soil and rocks <1" diameter	b
Button 14	Shadw	Areas of unknown identity due to shadow	d
Button 15	????	Unknown item	k

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

		Description (optional)	ShortCut
Button 16			
Button 17			
Button 18			
Button 19			
Button 20			
Button 21			
Button 22			
Button 23			
Button 24			
Button 25			
Button 26			
Button 27			
Button 28			
Button 29			
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 statisticial 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.

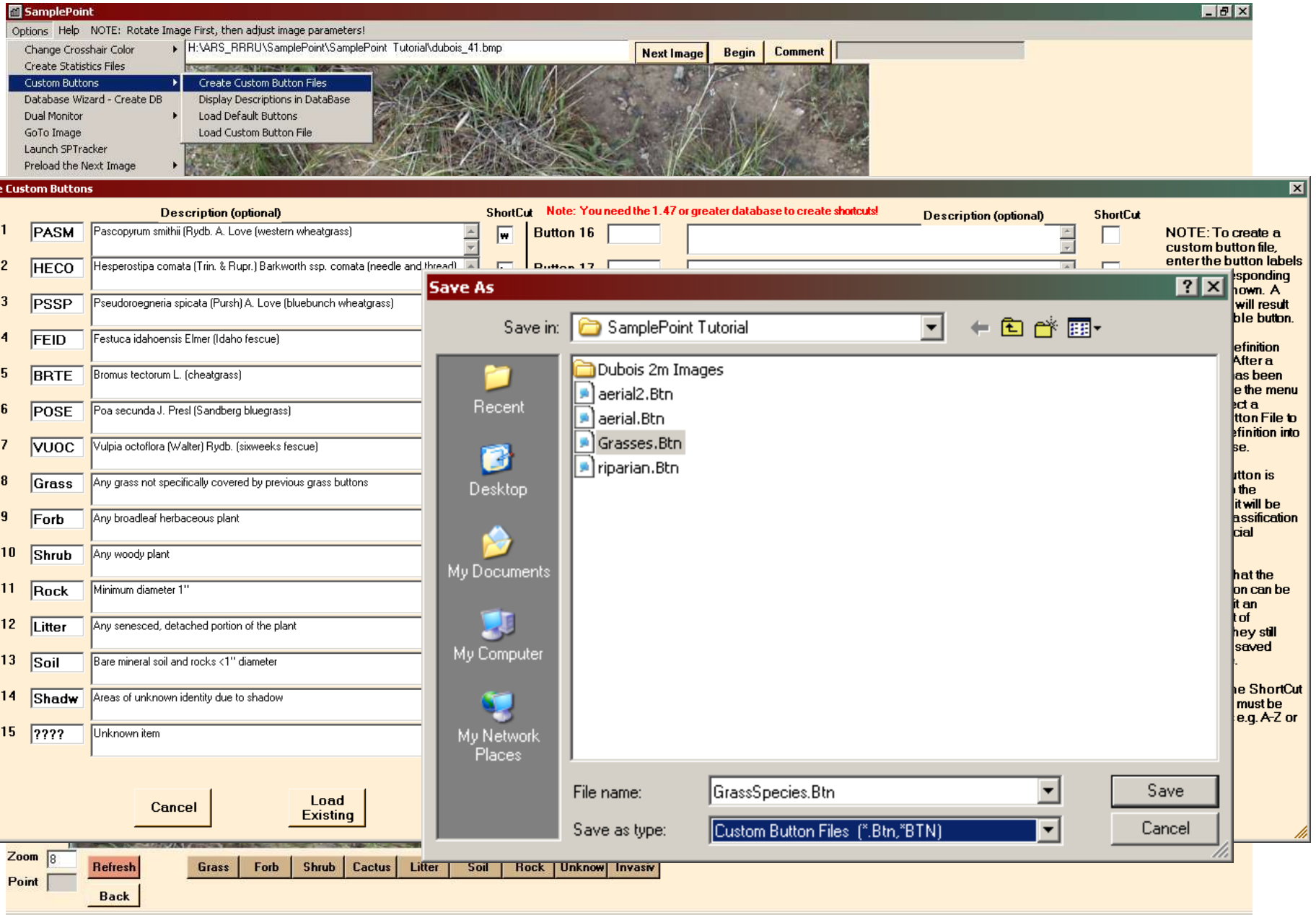
Note that the ShortCut characters must be alphabetic e.g. A-Z or a-z.

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

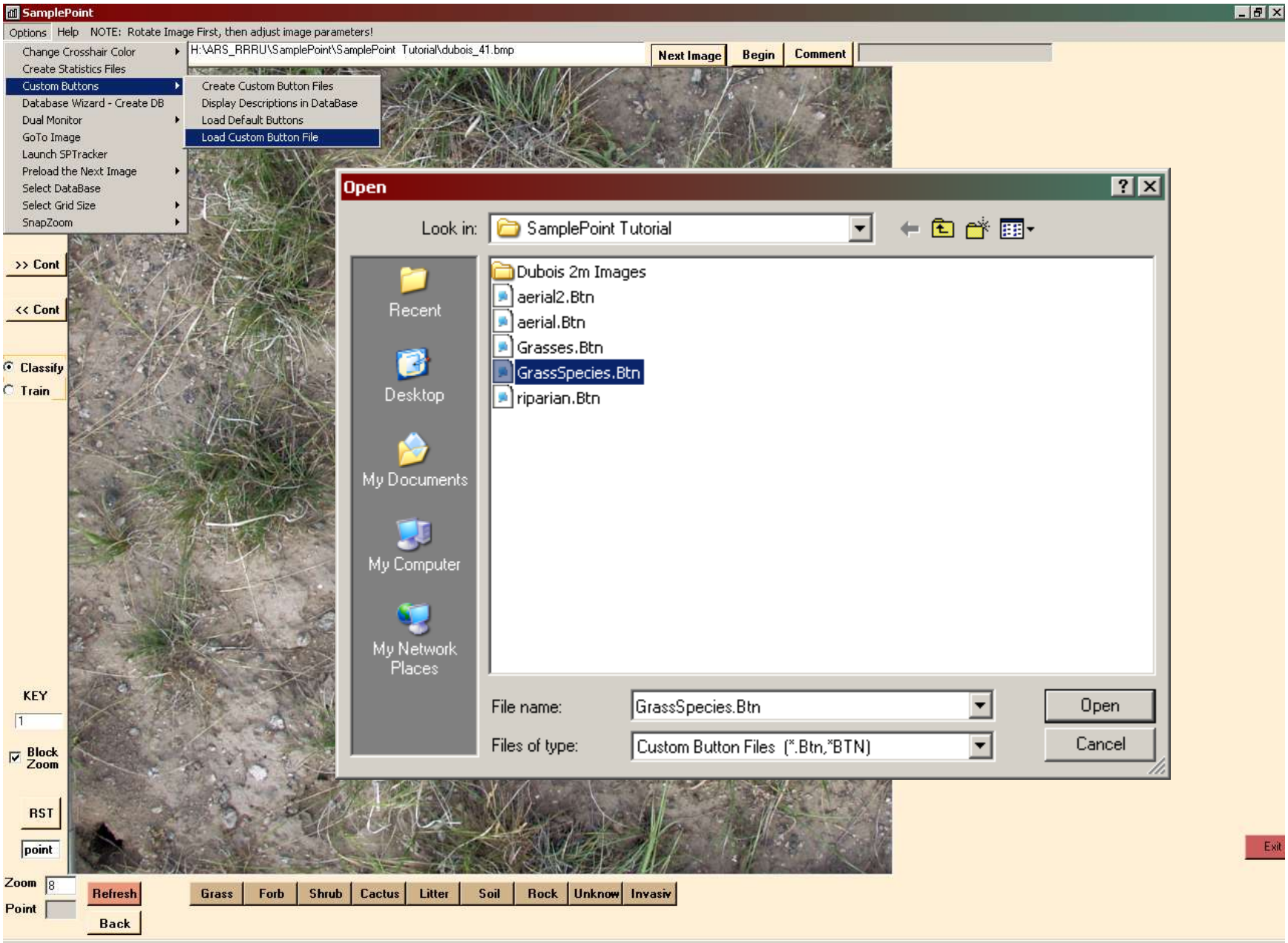
NOTE: Y, y, N, and n are NOT allowed as ShortCuts!

Cancel | Load Existing | Save

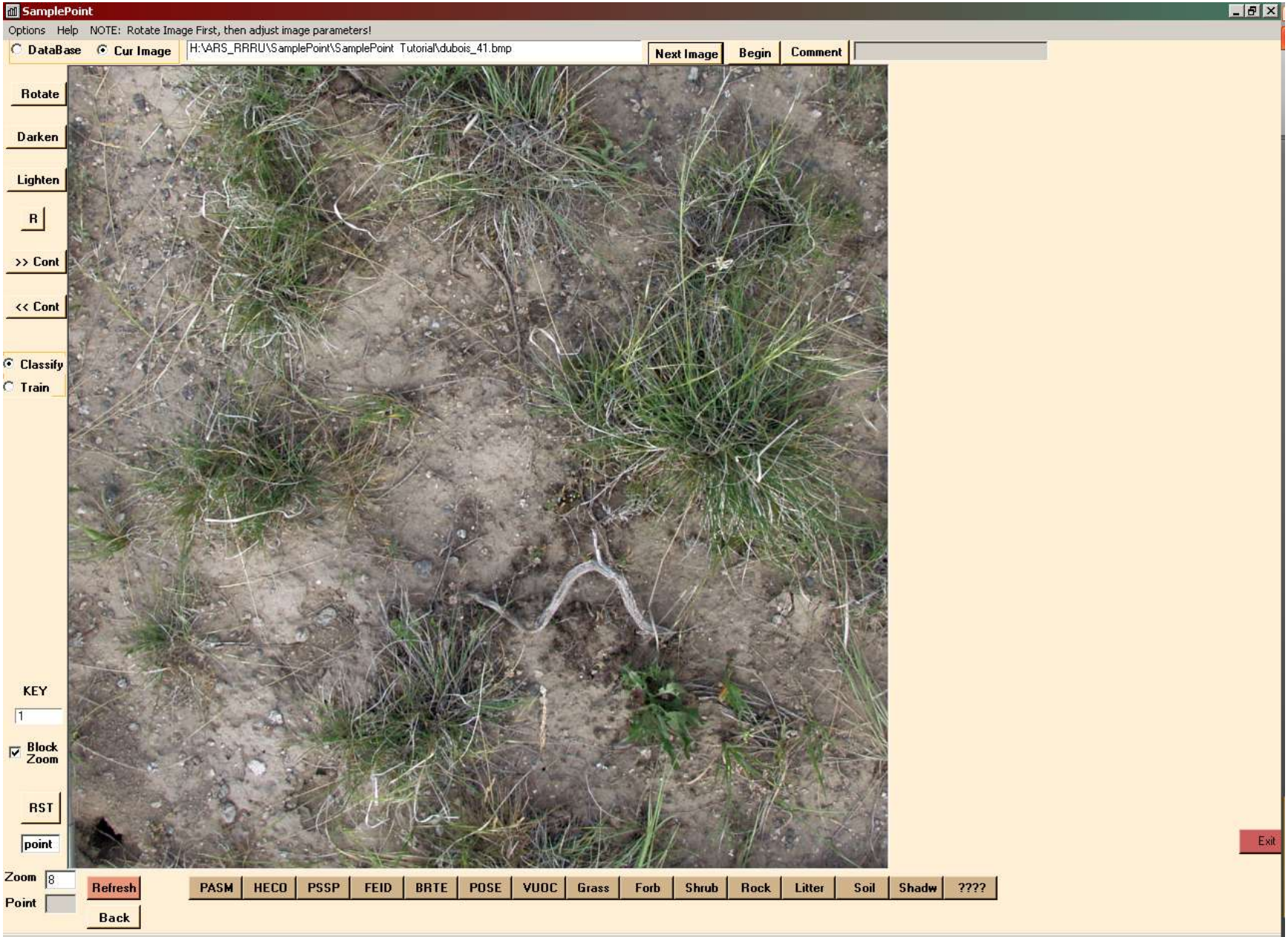
Navigate to the Image folder, name the button class file, then click Save.



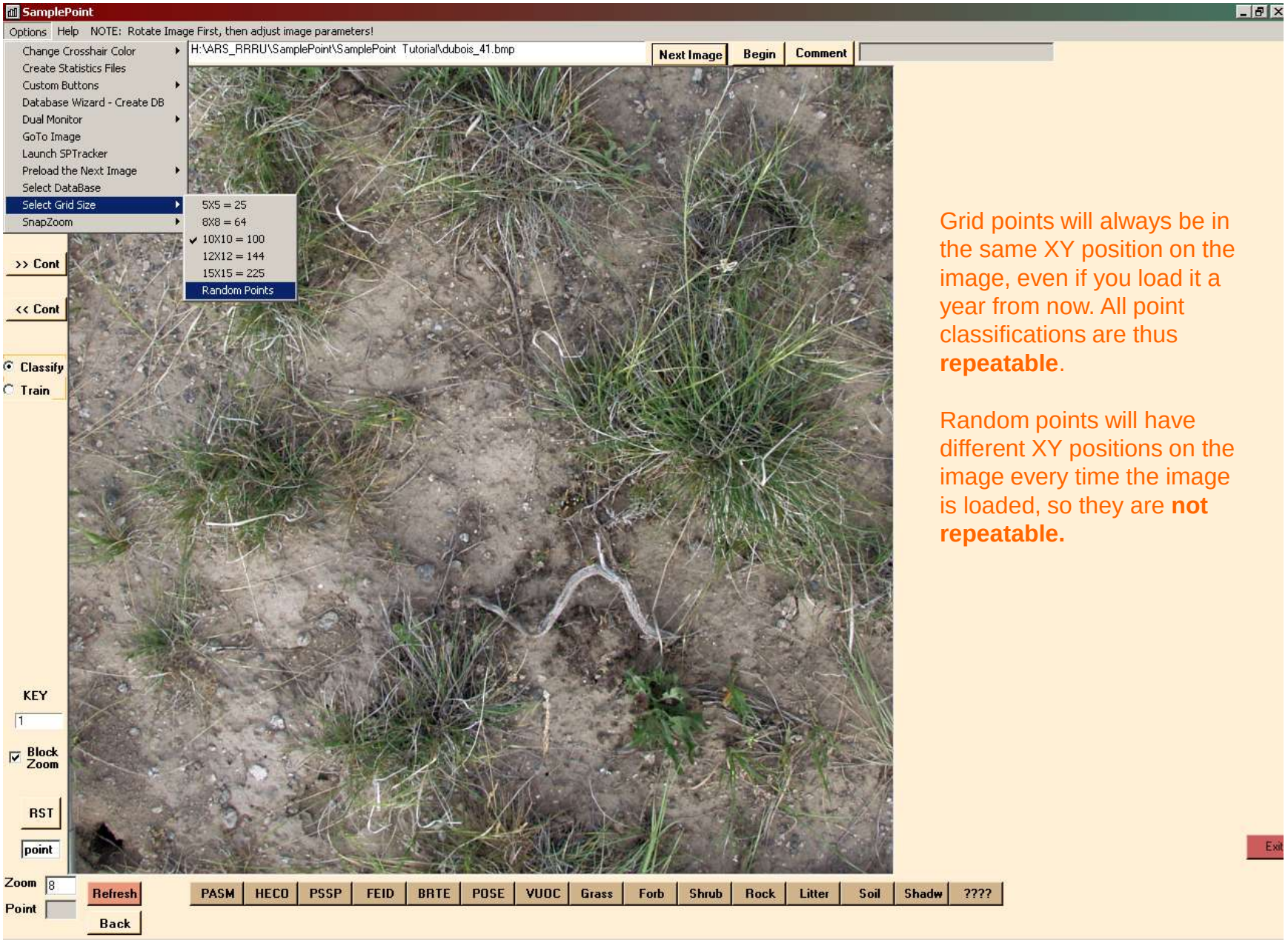
To activate the custom buttons, click Options>Custom Buttons>Load Custom Button File. Select the file you just created, or some other *.btn file. Click Open. **You must have a database loaded before you can load a custom button file.**



The custom classes are now ready to use. The data saved to the database will be saved using these classes. The custom buttons must be in place prior to classification, with one exception: A class can be added to the end of a custom button file at any time with no adverse effect. Just follow the same steps as above and overwrite the old button file.



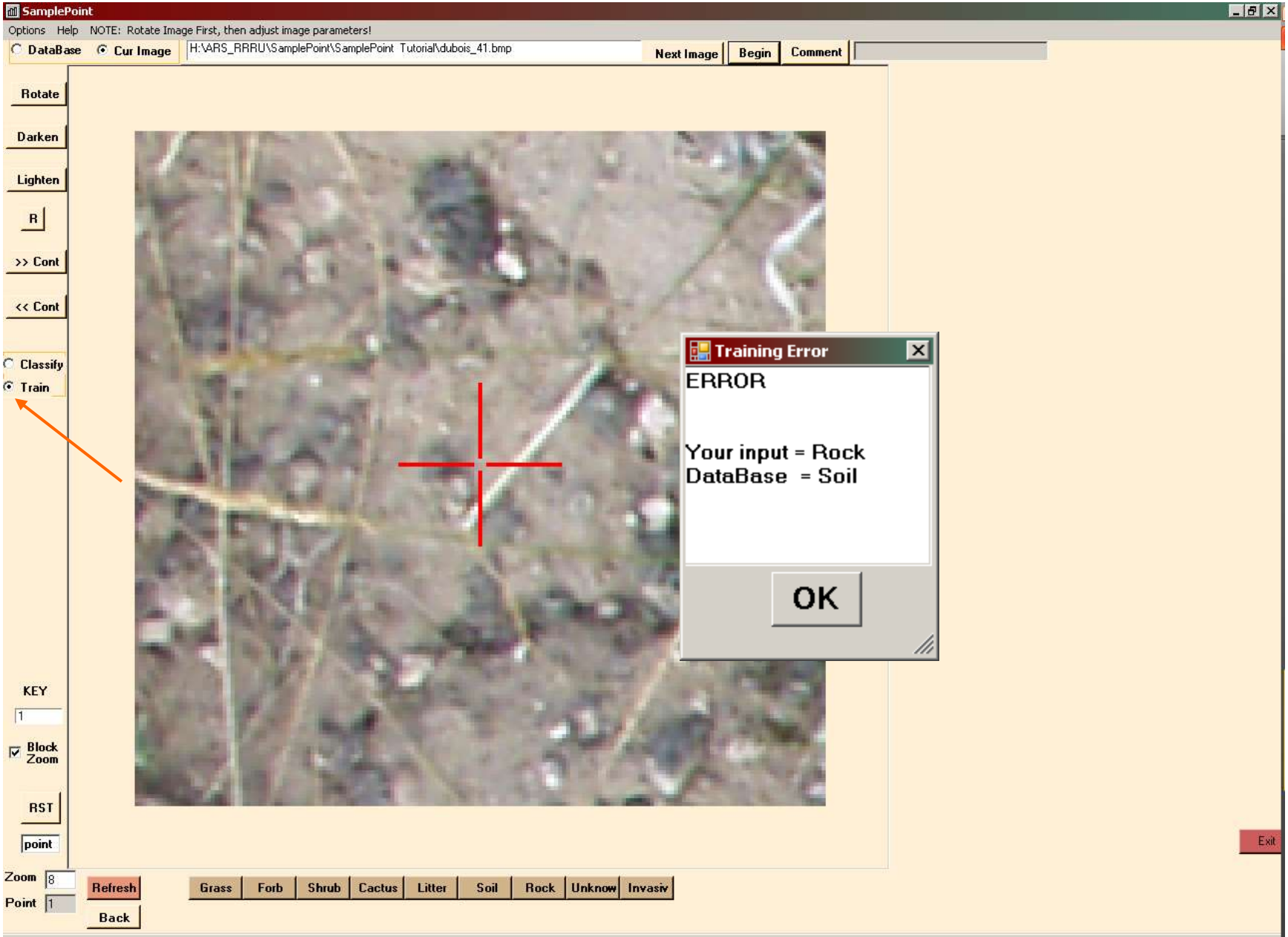
To change the number of classification points from the default of 100, click Options>Select Grid Size> and select the desired number of points. All points are systematically placed with equal points in rows and columns. The selected grid is used for all subsequent images unless you change it, or exit the software. Random point placement is also available for 25 to 200 points.



Grid points will always be in the same XY position on the image, even if you load it a year from now. All point classifications are thus **repeatable**.

Random points will have different XY positions on the image every time the image is loaded, so they are **not repeatable.**

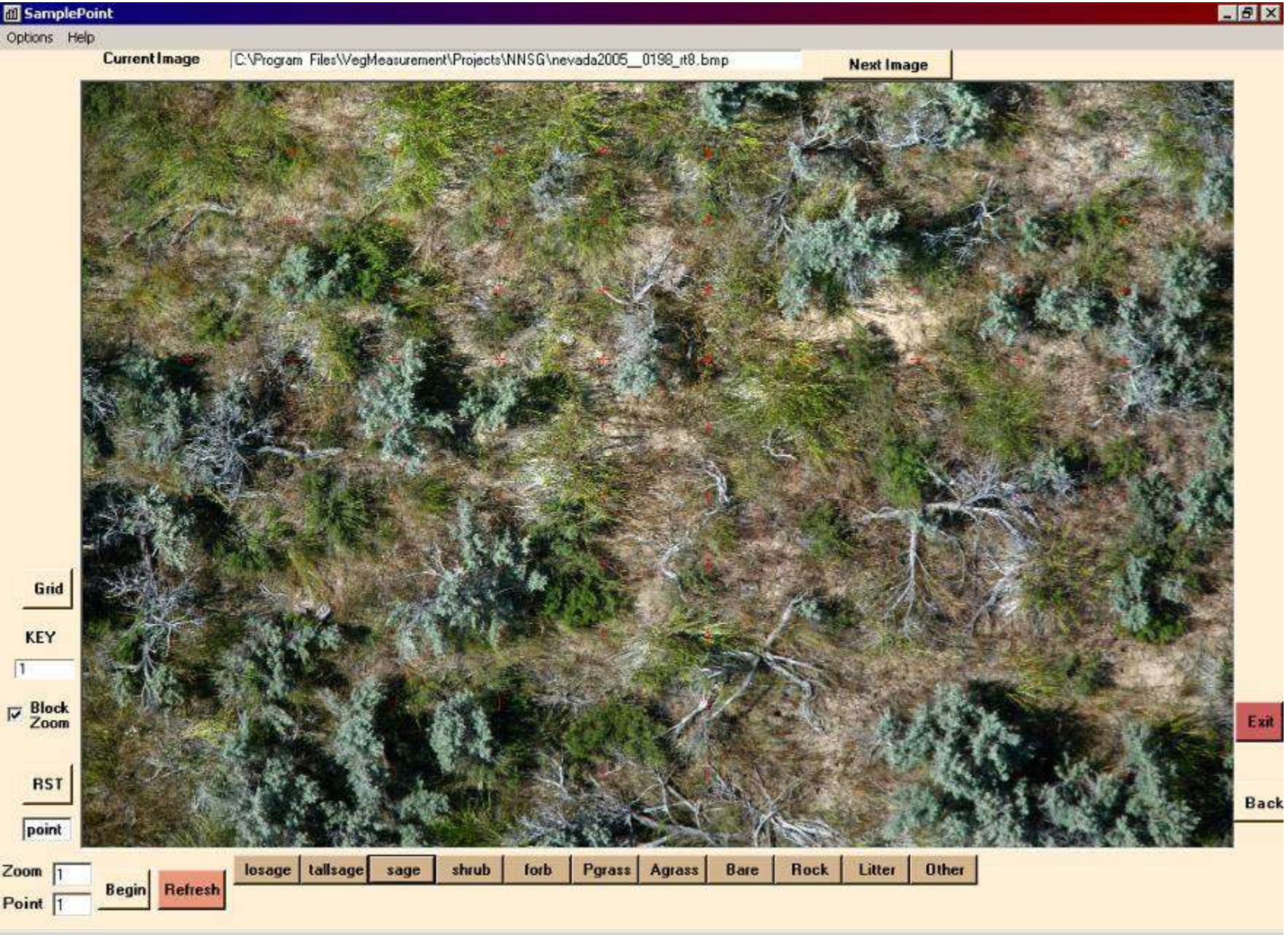
To ensure classification consistency across users, you can train users with a completed database. When any completed database is loaded, click the Train radio button. In Train mode, data is not written to the database, but is instead simply compared to the database and the user is given feedback on their classification. This is a good step to take when someone takes over SamplePoint classification duties from someone else.



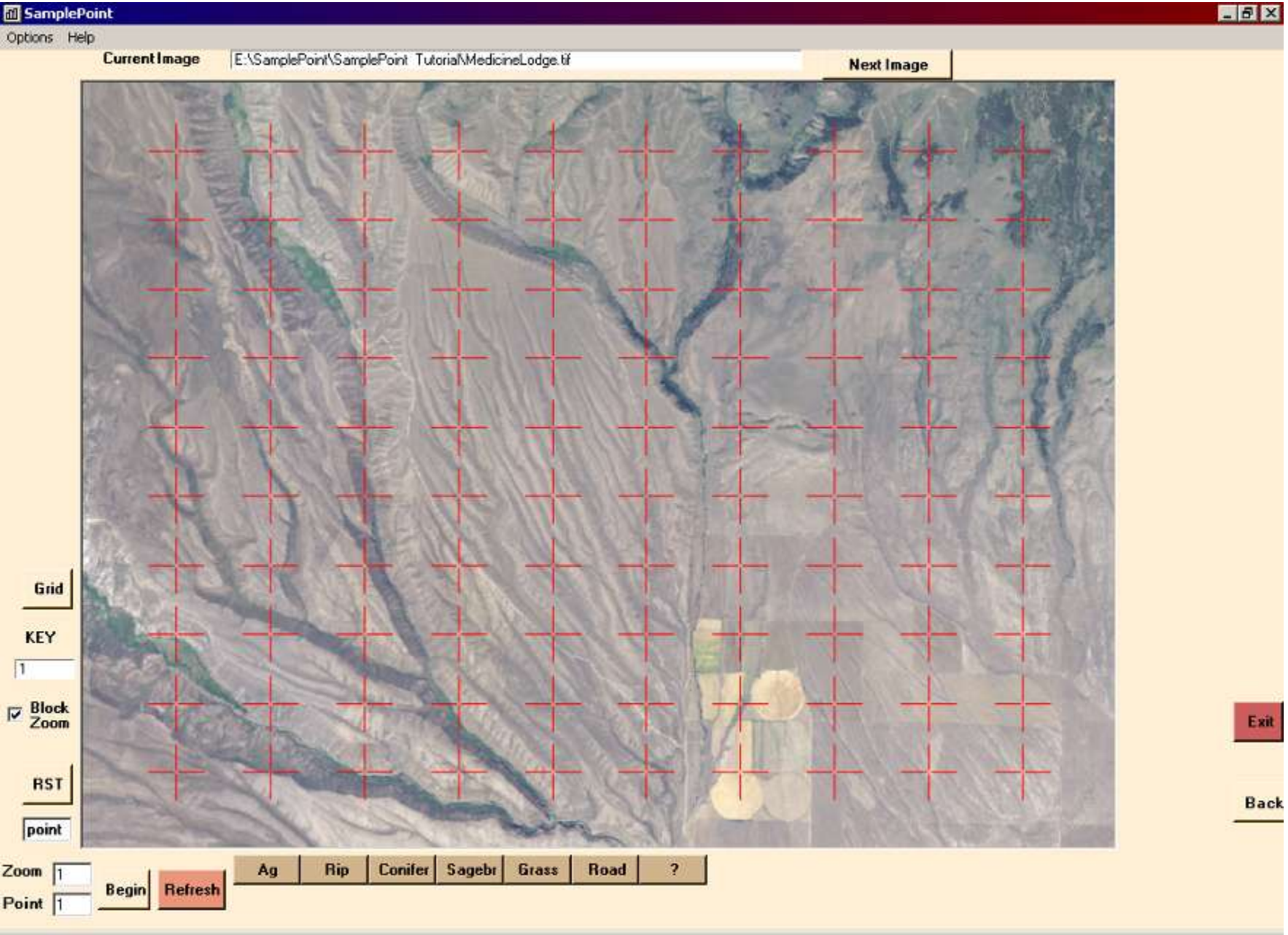
APPLICATIONS

The previous example utilized images taken with the camera positioned 2m above ground level (AGL) using a camera stand. Aerial images are also easily analyzed using SamplePoint.

This aerial image was acquired 100m AGL from a light airplane. SamplePoint operates in the same way regardless of the image type. Note the new custom buttons specific to this project.



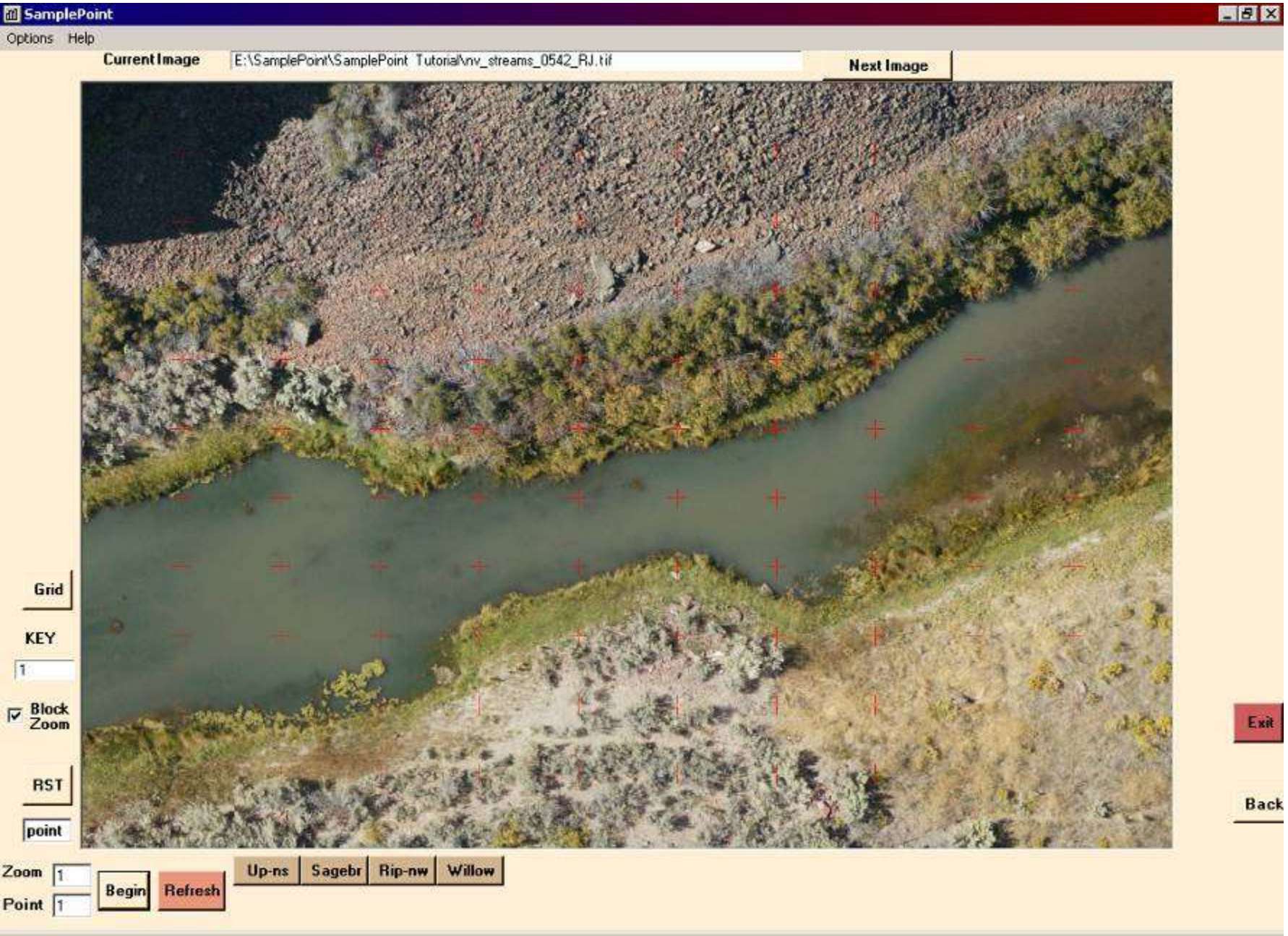
This image was acquired from 3000m AGL. Landscape-scale cover types, such as riparian zone, conifer forest, sagebrush steppe, etc., can be obtained using SamplePoint.



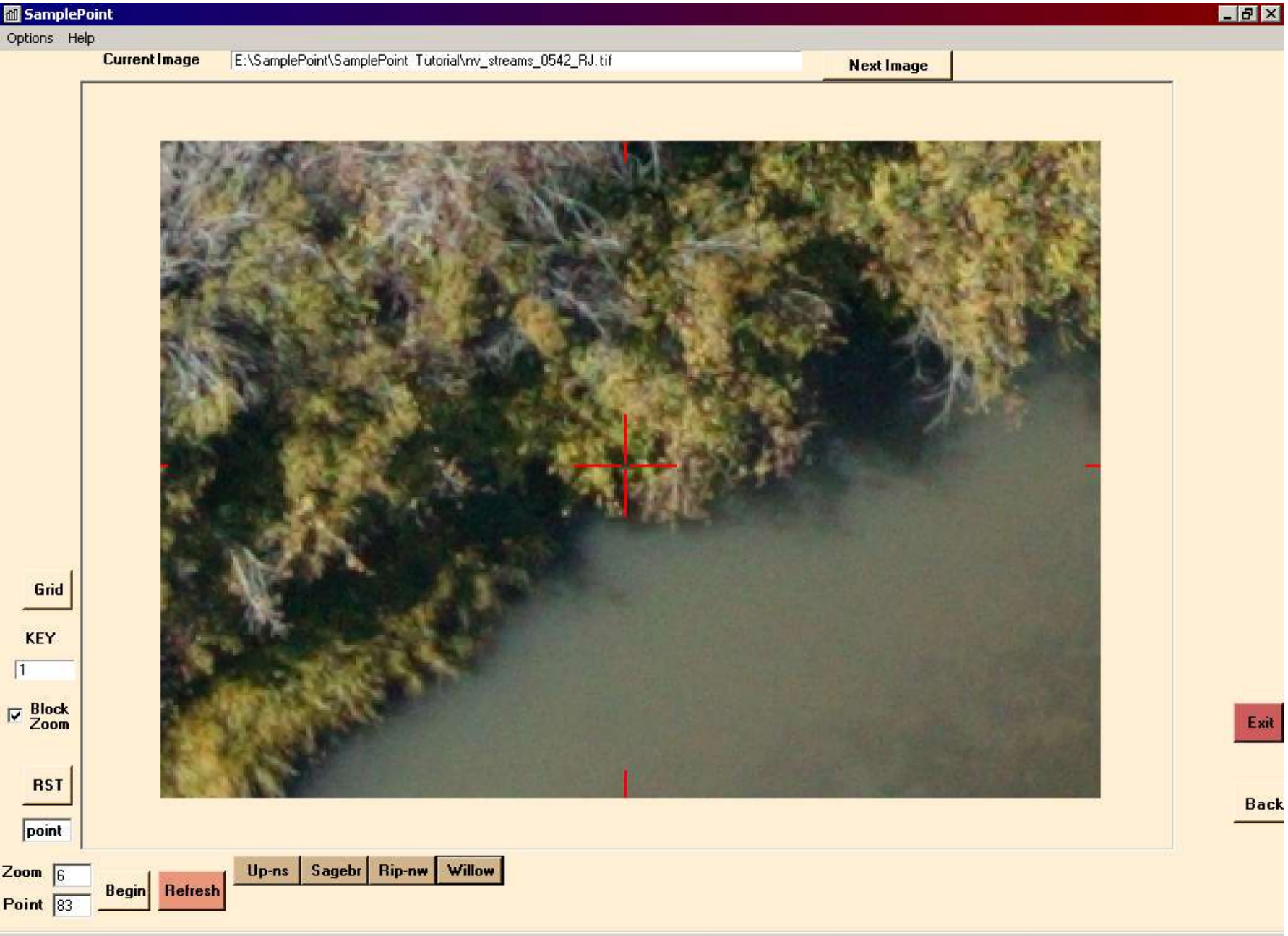
APPLICATIONS

Previous examples demonstrate how to obtain cover measurements over an entire image, but cover measurements can also be made within a specific area of the image. For example, a user wants to measure the % willow cover within the riparian area, and the % sagebrush cover in the surrounding upland area. This can be done using 4 customized buttons: Willow, Sagebrush, Riparian-not willow (Rip-nw) and Upland-not Sagebrush (Up-ns). Demonstration made with SamplePoint v1.25.

The custom buttons are created and loaded,and a database is created with a single aerial image (≈ 2cm GSD).



Points falling in water are here classified as “Riparian-not willow” but it would be a simple change to add a separate water class for those points.



Classification results:
Sagebrush = 6%
Upland Non-sagebrush = 39%
Willow = 15%
Riparian Non-willow = 40%

An implicit assumption is that sagebrush are found only in upland areas, and willows are found only in riparian areas. If this assumption is true, then any point classified as willow is inherently classified as riparian. Thus, willow cover in the riparian area is calculated as:

Willow / (Willow + Riparian Non-Willow) = 15 / (15 + 40) = 27%

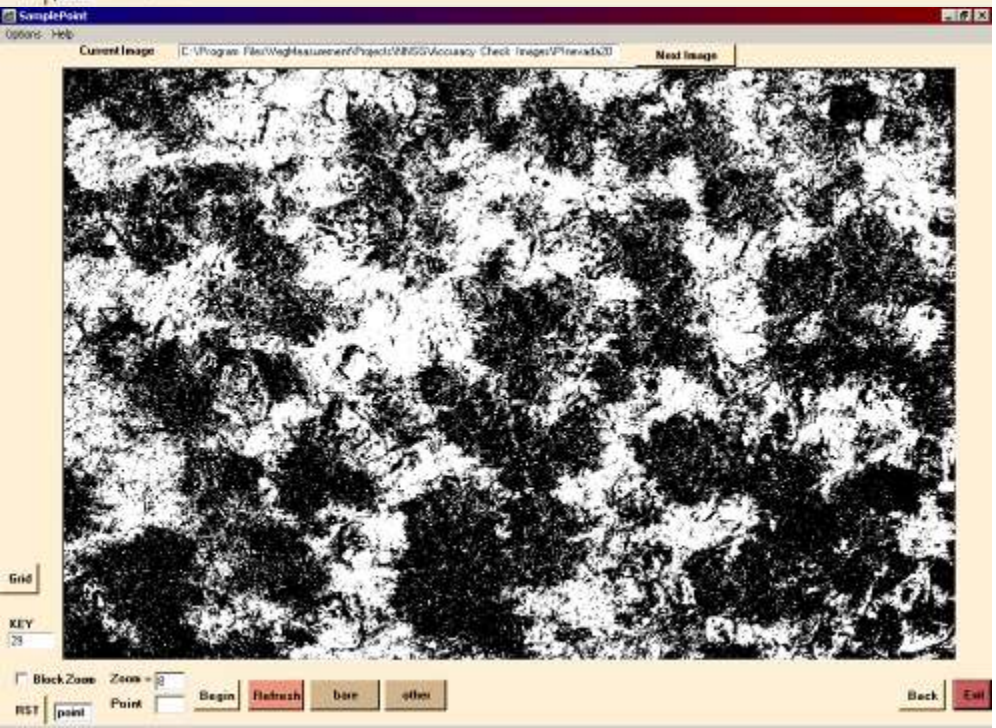
And, sagebrush cover in surrounding upland area is calculated as:

Sagebrush / (Sagebrush + Upland Non-sagebrush) = 6 / (6 + 39) = 13%

Conclusion of this classification:
Willow cover in the riparian area is 27%, and Sagebrush cover in the surrounding upland area is 13%.

APPLICATIONS

Because systematic classification points are assigned based on image size, and are always located in the same X,Y position for images of equal size, SamplePoint provides a simple way to perform accuracy assessments on image classification by software like Erdas Imagine or VegMeasurement.

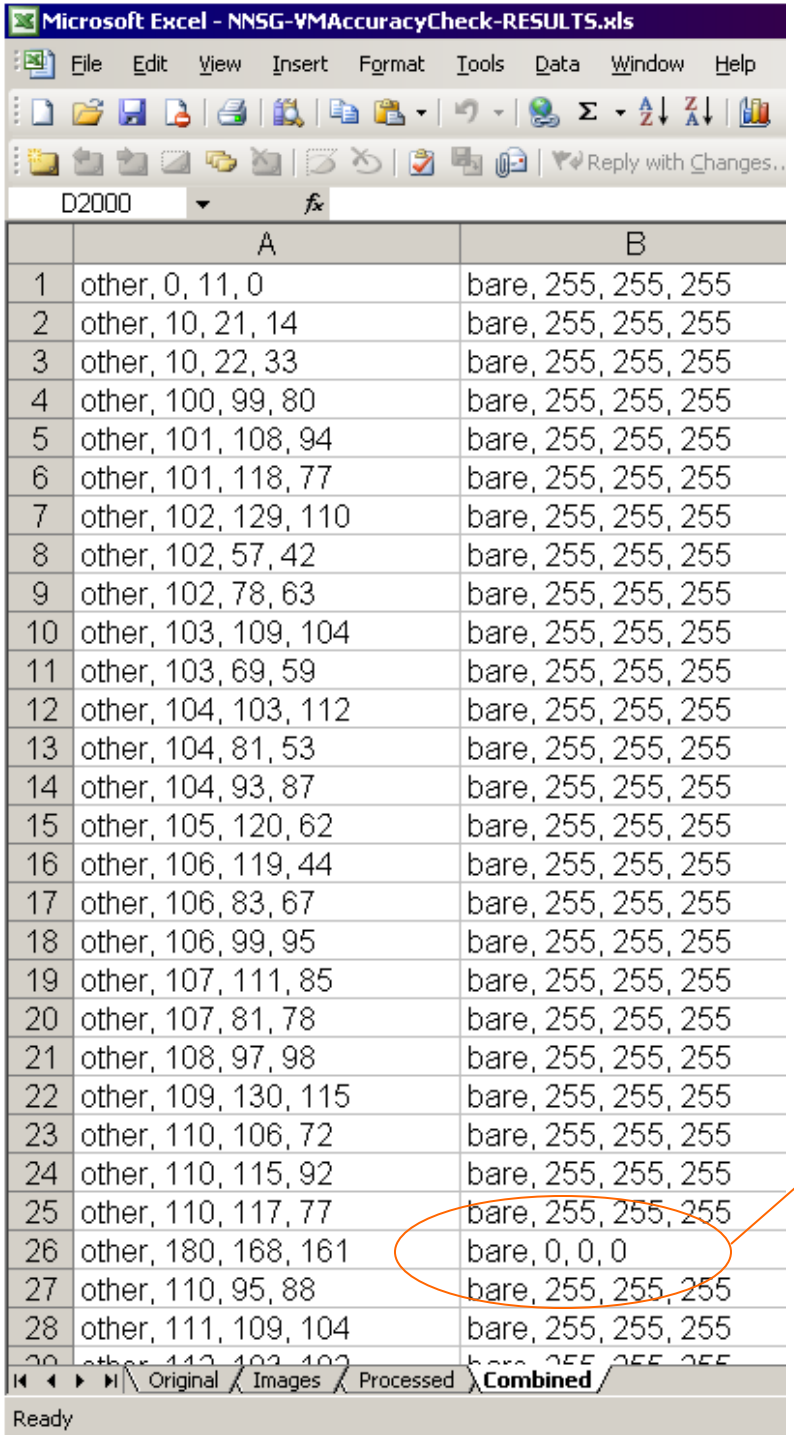


Export the processed image from VegMeasure or Imagine as a TIF or BMP, and run both the original and processed images through SamplePoint. In this example, a processed image from VegMeasurement was used. Since point 1 will occupy the same X,Y location on both images, classification accuracy can be determined by comparing the known to classified for a number of points over a number of images.

For example, point 1 in the original image is classified as bare ground. Point 1 in the classified image is white, so point 1 was correctly classified.

To perform the assessment, the first step is to classify all points into the classes of interest, though you cannot change buttons mid-assessment. In this example, white color is classified as bare ground, black is classified as other.

REMEMBER: You must use systematic point distribution for this operation.



	A	B
1	other, 0, 11, 0	bare, 255, 255, 255
2	other, 10, 21, 14	bare, 255, 255, 255
3	other, 10, 22, 33	bare, 255, 255, 255
4	other, 100, 99, 80	bare, 255, 255, 255
5	other, 101, 108, 94	bare, 255, 255, 255
6	other, 101, 118, 77	bare, 255, 255, 255
7	other, 102, 129, 110	bare, 255, 255, 255
8	other, 102, 57, 42	bare, 255, 255, 255
9	other, 102, 78, 63	bare, 255, 255, 255
10	other, 103, 109, 104	bare, 255, 255, 255
11	other, 103, 69, 59	bare, 255, 255, 255
12	other, 104, 103, 112	bare, 255, 255, 255
13	other, 104, 81, 53	bare, 255, 255, 255
14	other, 104, 93, 87	bare, 255, 255, 255
15	other, 105, 120, 62	bare, 255, 255, 255
16	other, 106, 119, 44	bare, 255, 255, 255
17	other, 106, 83, 67	bare, 255, 255, 255
18	other, 106, 99, 95	bare, 255, 255, 255
19	other, 107, 111, 85	bare, 255, 255, 255
20	other, 107, 81, 78	bare, 255, 255, 255
21	other, 108, 97, 98	bare, 255, 255, 255
22	other, 109, 130, 115	bare, 255, 255, 255
23	other, 110, 106, 72	bare, 255, 255, 255
24	other, 110, 115, 92	bare, 255, 255, 255
25	other, 110, 117, 77	bare, 255, 255, 255
26	other, 180, 168, 161	bare, 0, 0, 0
27	other, 110, 95, 88	bare, 255, 255, 255
28	other, 111, 109, 104	bare, 255, 255, 255

The second step takes place in Excel. Sort the data from the database into two columns, where original images line up with processed images precisely. For example, point 56 of original image 28 lines up with point 56 of processed image 28. Sort both columns in ascending order. For a binary classification, this will lump the data into 4 groups:

Other – Other (Correct classification)
Bare – Bare (Correct classificaiton)
Other - Bare (Omission error)
Bare – Other (Commission error)

Overall accuracy is calculated as:

Correct / (Correct + Incorrect)

The use of an error matrix will facilitate the calculation of user's and producer's accuracy rates (Congalton 1991).

This technique allows, by default, an assessment of user classification accuracy. If bare ground is always white in the processed image, then any point with black RGB values that is classified as bare ground is an error, and vice versa. This yields the user error rate, as opposed to the software error rate.

Congalton, RG. 1991. A review of assessing the accuracy of classification of remotely sensed data. Remote Sens. Environ. 37:35-46.

		Original Images (Reference Data)		
		Bare Ground	Other	Total
Processed	Bare Ground	60	134	194
Images	Other	434	1372	1806
	Total	494	1506	2000

A simple error matrix set up with original image classification data in columns, and processed-image classification data in rows. For example, a total of 494 points were classified as Bare Ground in the original images, but only 194 points were so classified by the automated analysis.

Overall Accuracy = (60 + 1372)/2000 = 71.6%
This is often a misleading statistic if what you're really interested in is a small class, such as bare ground. Measures of accuracy that ignore other classes are more useful.

Bare Ground:
Producer's Accuracy: Probability that a point of known cover type is correctly classified by the software.

60/494 = 12.1%

User's Accuracy: Probability that a point classification made by the software is correct.

60/194 = 30.9%

The SamplePoint concept was developed by the USDA Agricultural Research Service, Rangeland Resources Research Unit in Cheyenne, Wyoming, and the USDI Bureau of Land Management Wyoming State Office, Cheyenne, WY. Software code was written by Robert Berryman of Boulder, CO. Installation file was generated using Nullsoft Install System v 2.11. SamplePoint is free software available at www.SamplePoint.org

For user information not covered in this tutorial, click Help>Contents to open the PDF Help File. For publications on SamplePoint, go to www.SamplePoint.org.

This Tutorial is current as of February 1, 2012.

For technical assistance, email support@samplepoint.org