Photo Monitoring Vegetation for Small Acreages

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Homeowners with acreage face a challenge that urban homeowners don't: effective management of acres of vegetation for aesthetic, recreational, and/or livestock use. Effective management of the land, particularly for grazing, begins with accurate measurements. Simply eyeballing the situation frequently provides too little data to address vegetation deficiencies and mismanagement.

This guide will demonstrate how small-acreage landowners can quickly gather and analyze statistically valid vegetation data on their rural homestead using nothing more than a cell phone and free software. Armed with robust vegetation monitoring data, landowners can make informed decisions about seeding for diversity, controlling weeds, grazing management, or mitigating erosion to achieve a lush, inviting, and healthy landscape.

Monitoring vegetation has traditionally been accomplished using pen and paper and various point-sampling methods to manually record the vegetation or bare ground. These point sampling methods provide a high degree of precision but can be time consuming and difficult to analyze.

An alternative method captures images of the ground from directly above and uses point sampling software to classify cover types or plant species.

Required equipment:
1. Smart phone or tablet
2. Windows computer
3. Microsoft Excel
4. SamplePoint software (free at www.SamplePoint.org)

Steps described in this guide:
1. Determine optimal spacing for capturing vegetation monitoring images.
2. Capture vegetation monitoring data using a smart phone.
3. Classify vegetation cover in captured images using SamplePoint software.
4. Interpret and use monitoring data.

DETERMINE OPTIMAL SPACING FOR CAPTURING VEGETATION MONITORING IMAGES

Since accuracy increases with more samples, collect at least 20 images for analysis. Each image is a sample. Samples should be spread out in a balanced way across the area of interest (e.g. a pasture). Clumping samples in one area will not yield information about the entire acreage. There are many ways to achieve a spatially balanced sample. We suggest a simple four-transect sampling pattern. (A transect is a line used to sample an area.)

Steps:

1. Imagine four lines (transects) crossing the property from edge to edge and spaced equally across the area of interest. For example, if your pasture is 400 feet long, try to set up a transect every 80 feet. See Figure 1 for an example.
2. Walk one of the transects in a relatively straight line and count your steps.
3. Divide your total steps by six. This number is your photo interval.
4. Re-walk the transect from the beginning and capture one photo at every photo interval.
5. When you've acquired five photos, move to the next transect and repeat.
6. Capture photos along all four transects to yield 20 samples.
7. Mark or note transect ends so they can be resampled in the future.

Property shapes vary, of course, so some transects may be longer than others. Transects may pass through buildings or fences, and in such cases, one need only walk around the obstacle and resume the transect. If a photo station falls in an area of cultivation, pavement, or intended disturbance, add a few extra paces to the photo interval to capture the photo on the native vegetation you are seeking to monitor. In all cases the goal is to acquire 20 images that represent the resource you want to monitor. It is counterproductive to acquire images that do not represent the natural resource (e.g. an image of a gravel driveway isn't helpful).
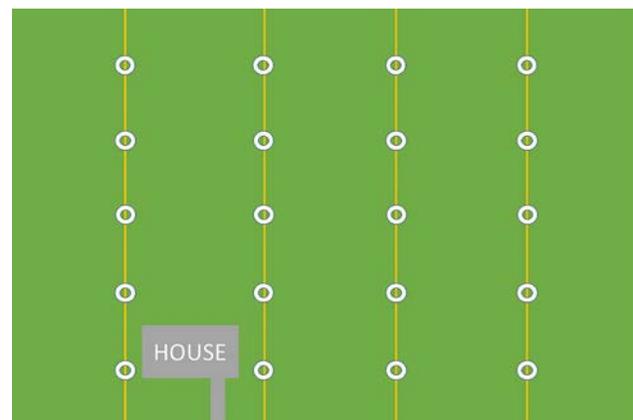
Figure 1. Hypothetical 20-plot layout along four transects.

CAPTURE VEGETATION MONITORING DATA USING A SMART PHONE

Each image sample should be acquired at the highest possible image resolution. Most phone cameras have at least 12-megapixel sensors, which is perfectly adequate for photo monitoring.

Steps:

1. Open the camera app on the phone.
2. Use the default zoom level of 1 (not wide angle).
3. Hold the phone with extended arms at chest level, camera lens facing straight towards the ground (nadir-orientation). Try to keep shoes out of the image.
4. Touch the shutter button on the screen to acquire an image.
5. Examine the image to ensure it is well-lit and in focus.
6. Save the images to a folder on a Windows PC, either via USB cable or online transfer.

Figure 2. Capturing vegetation monitoring images is simple with a smartphone.

Figure 3. This 16-megapixel image was acquired using the technique shown in Fig 2: a handheld smartphone held steady in a nadir position (looking down at the ground) about 4.5 feet above ground level. Each pixel represents about ½ x ½ millimeter of ground.

CLASSIFY VEGETATION COVER USING SAMPLEPOINT SOFTWARE

SamplePoint software facilitates manual, pixel-based image classification that is useful for vegetation monitoring. The software requires no special skill to operate. It was developed by the USDA Agricultural Research Service and the USDI Bureau of Land Management in 2004 and has been widely used internationally for land cover classification. It is available at no cost from www.SamplePoint.org. A Windows computer and Microsoft Excel (any version) are required. Download the SamplePoint installation file and run it to install SamplePoint. SamplePoint software contains many options and additional features that are not described in this manual but are described in detail in the SamplePoint User's Manual and online tutorials. The following is a stepwise procedure for generating basic monitoring data.
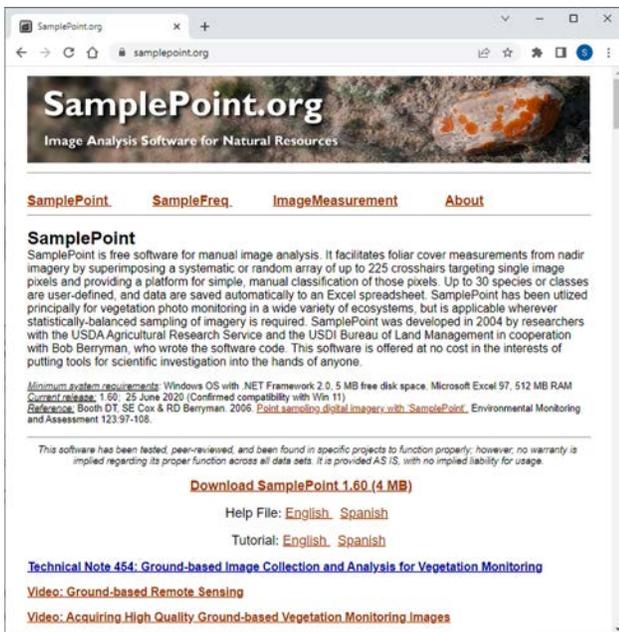
Figure 4. SamplePoint software is available at no cost from www.SamplePoint.org. Downloadable tutorials and manuals detail the operation of the software.

Steps:

1. Define the images to classify.
   - Open SamplePoint.
   - Click Options>Database Wizard.
   - Name the database with the Location and Year.
   - Click the Populate Database button to select all the images collected over the property of interest for the date of interest (Ctrl+A selects all the images in a folder).
   - Click Done to close the Database Wizard.
   - A window will ask if the database should be loaded now. Click Yes.
   - A dialogue will confirm the number of images in the database. Click OK to confirm.

2. Define classification categories.
   - There are nine default classification categories: Grasses, Forb (plants with showy flowers), Shrubs (small woody bushes), Cactus, Litter, Soil, Rock, Unknown, Invasive. If these categories are suitable to the monitoring objective, no further category definition is required.
   - If customization of the classification categories is desired, click **Options>Custom Buttons>Create Custom Button Files.**
     - Define the button codes. User preference drives this step. Broad categories like **PGrass** (perennial grasses such as blue grama or western wheatgrass) and **AGrass** (annual grasses such as Japanese brome or downy brome) may be useful. For finely-tuned data, individual species may be coded, such as **WWheat** or **BGram**a. Up to 30 categories may be coded into the classification buttons. The analysis can be repeated with different classification buttons at any time.
     - Include descriptions for the button codes, such as which species are included in the **AGrass** category, or how large gravel in soil can be before it is considered rock.
     - Click Save and name the button file. This file can be used for future classifications.
   - A window will ask if the button file should be loaded now. Click Yes.

3. Define the number of points to classify in each image.
   - Click Options>Select Grid Size.
   - The minimum number of points for classification is 25, which works well for broad classification categories like shrub, grass, bare ground (e.g. the default nine). Use more points if the classification categories are narrow, such as species. The maximum number of points possible is 225.

4. Classify the images.
   - Click the Begin button in the top center of the screen.
   - The first classification crosshair will appear in the middle of the screen. Use the scroll wheel on the mouse to zoom in or out and determine the identity of the pixel in the center of the crosshair.
   - Click the button on the bottom of the screen corresponding to the identity of the pixel in the center of red crosshairs (Fig 4). This will save the classification to the database and move the focus to the next crosshair.
   - Continue classifying each point in the image.

- Once all the points in the image are classified, a dialogue box will appear that says, "That is all the points. Click Next Image". Click OK to exit the dialogue box.
- Click the Next Image button at the center top of the screen to open the next image in the database.
- Repeat classification steps for all images in the database.
- Upon completion of the last image, a dialogue box will appear that says, "You have exhausted all the images!" Click OK to exit the dialogue box.
- Click **Options**>**Create Statistics Files.** A confirmation box will appear. Click OK to exit.
- Open the folder where the images are stored. Open the *.csv file that has the filename <DatabaseName>_Summary.csv in Excel.
- This file shows the cover values for each of the classification categories for every image.
- To calculate average cover, in the first blank cell at the bottom of a "% cover" column of values, type in "=average(G2:G21)" where G=column name and the numbers represent the first and last row of cover data.

Figure 5. Use free SamplePoint software and a Windows computer to classify cover in the monitoring images.

USING MONITORING DATA

You can't manage what you don't measure. Quantitative cover data can be used to make data-driven land management decisions. A lack of quantitative data can lead to management that is counterproductive or unnecessarily costly. Define goals for the property and use the monitoring data over time to gauge progress towards — or deviation from — those goals. For example, is bare ground increasing, decreasing, or staying the same? If bare ground is increasing, you may need to change your land management.

Photo monitoring allows you to "go back in time" to evaluate the trend of any individual species; as long as you have monitoring photos, you can always repeat the classification with different categories. Consider the following hypothetical examples of how quantitative data support management decisions.

	A	B	D	E	F	G	H	I	J	K	L	M	N	O
1	Key	Image	GridSize	Actual	PGrass	%PGrass	AGrass	%AGrass	PForb	%PForb	AForb	%AForb	Thistle	%Thistle
2	1	20210602_104921.jpg	25	25	5	20	0	0	1	4	0	0	1	4
3	2	20210602_105000.jpg	25	25	10	40	0	0	4	16	0	0	0	0
4	3	20210602_105040.jpg	25	25	5	20	0	0	0	0	0	0	0	0
5	4	20210602_105253.jpg	25	25	6	24	0	0	5	20	0	0	1	4
6	5	20210602_105317.jpg	25	25	3	12	0	0	3	12	0	0	0	0
7	6	20210602_105338.jpg	25	25	4	16	0	0	2	8	0	0	0	0
8	7	20210602_105401.jpg	25	25	9	36	0	0	0	0	0	0	0	0
9	8	20210602_105424.jpg	25	25	4	16	0	0	6	24	1	4	0	0
10	9	20210602_105541.jpg	25	25	2	8	0	0	0	0	0	0	0	0
11	10	20210602_105600.jpg	25	25	3	12	0	0	1	4	0	0	0	0
12	11	20210602_105633.jpg	25	25	4	16	0	0	2	8	0	0	0	0
13	12	20210602_105704.jpg	25	25	6	24	0	0	1	4	0	0	0	0
14	13	20210602_105731.jpg	25	25	4	16	0	0	2	8	2	8	0	0
15	14	20210602_105831.jpg	25	25	7	28	0	0	0	0	0	0	0	0
16	15	20210602_105934.jpg	25	25	5	20	0	0	1	4	0	0	0	0
17	16	20210602_110009.jpg	25	25	3	12	0	0	0	0	0	0	0	0
18	17	20210602_110118.jpg	25	25	3	12	0	0	4	16	0	0	0	0
19	18	20210602_110200.jpg	25	25	11	44	0	0	0	0	0	0	0	0
20	19	20210602_110226.jpg	25	25	3	12	0	0	1	4	0	0	0	0
21	20	20210602_110316.jpg	25	25	8	32	0	0	3	12	0	0	0	0
22		Average				21		0		7.2		0.6		0.4

Figure 6. SamplePoint produces a spreadsheet showing the percent cover for each category of interest.

Figure 7. Take the guesswork out of grazing management with simple data collection. Photo Credit Olha Rohulya / Adobe Stock Images.

Example 1. A landowner has a few horses that graze the property. Perennial grasses are the primary plants providing forage for the horses. SamplePoint cover data over four years demonstrate a trend of perennial grasses decreasing and bare ground increasing. This prompts the landowner to take action by developing a grazing management plan.

The landowner decides to stop giving the horses unrestricted access to the property. Rather, the landowner decides to let the horses graze the property only during late summer and early fall, allowing the perennial grasses the full opportunity for spring growth and seed production. To mitigate heavily impacted areas where bare ground is the majority of surface cover, the landowner may decide to re-seed. During dry years, the landowner might more closely restrict grazing if key perennial grasses are being negatively affected. Quantitative data takes the guesswork out of all these management decisions to help maintain a productive pasture.

Figure 8. Thistle can rapidly expand if not kept in check.

Example 2: A landowner wants to keep thistle on their property under control. A local contractor recommends annual broadleaf herbicide application to accomplish this. Herbicide application is expensive and has ecological consequences, so the landowner decides to apply herbicide sparingly and is willing to tolerate up to 2% average thistle cover.

In the first summer of monitoring, the landowner uses the method described in this manual to determine there is 8% thistle cover, and contracts for a fall broadleaf herbicide application to kill thistle. The following year, mid-summer thistle cover is measured at only 0.4%, and the landowner decides no herbicide application is warranted, saving several hundred dollars in chemical and application costs. The year after, thistle cover is measured at 1.1%, and again the landowner defers treatment and saves money.

By the third summer after herbicide application, thistle cover looks pretty much the same as the previous year. However, the monitoring data show it has in fact increased to 1.8%. The landowner can expect that without intervention, thistle cover will exceed the 2% threshold the following summer. Based on these data, the landowner decides to contract for a broadleaf herbicide application in the fall to meet the thistle management goal for the following year.

By utilizing quantitative monitoring data, the landowner was able to skip two years of herbicide treatment — with corresponding financial and ecological benefits — while staying on target to meet their management goal.

Example 3: A landowner enjoys having a landscape that is dense with a diversity of native forbs, both for their aesthetic value and their benefit to pollinators and wildlife. Over time, the landowner notices what they believe to be a reduced number of perennial forbs.

Examining quantitative cover data for the last five years, a trend of reduced perennial forb cover becomes apparent, with a corresponding increase in annual invasive grasses. Based on these data, the landowner concludes that the observed reduction in perennial forbs is not just imagined. Furthermore, the increase in annual grass tells the landowner that controlling annual grass is critical to recovering the high perennial forb cover.

Rather than purchasing and raking in expensive native forb seed, a more effective way to increase native forb cover may be to simply control the annual invasive grass with a pre-emergent herbicide treatment. The landowner takes this action. The following summer, monitoring data confirm that perennial forb cover has rebounded in the absence of annual grass.

Quantitative data allowed the landowner to avoid purchasing and planting expensive seed that would not have performed well because of the competition from annual grasses, and instead helped them achieve their management goal through a less-expensive herbicide treatment.

Call in the Professionals:

Having quantitative data never hurts and often helps when developing a management plan. For landowners unsure of their plan, specialists with county conservation districts, weed and pest districts, or local extension offices can assist in mapping out an efficient and productive land management plan.

Figure 9. Managing for native forbs can enhance aesthetics and ecological resilience of a small pasture.