Land Cover Sample Site Protocol

Purpose

To determine the major land cover type at a Land Cover Sample Site

Overview

Students classify a homogeneous land cover site by visually examining the site. If necessary, students take biometry measurements following the *Biometry Protocol* to support their choice of MUC classification. Students locate the site using a GPS receiver and photograph the site.

Student Outcomes

Students will learn how to scientifically describe and classify a Land Cover Sample Site.

Science Concepts

Physical Science

Objects have observable properties that can be measured using tools.

Position of an object can be located by reference to other objects.

Life Science

Earth has many different environments that support different organisms.

All populations living together and the physical factors with which they interact constitute an ecosystem.

Geography

How to use maps (real and imaginary)

The physical characteristics of place

The characteristics and distribution of ecosystems

Scientific Inquiry Abilities

Use appropriate field instruments and techniques to gather Land Cover Sample Site data.

Make observations in order to determine the appropriate land cover type.

Communicate the results of land cover classification to reach a consensus.

Identify answerable questions.

Conduct scientific investigations.

Develop descriptions and predictions using evidence.

Recognize and analyze alternative explanations.

Communicate procedures, descriptions, and predictions.

Level

All

Time

20 – 60 minutes (excluding travel time) for each Land Cover Sample Site

Frequency

Collect data once for each Land Cover Sample Site but data can be collected as frequently as you choose.

Materials and Tools

Compass
GPS receiver
Camera
Pencil or pen
Landsat TM images of your 15 km x 15 km GLOBE Study Site
Local and topographic maps (if available)
Aerial photos (if available)
Local vegetation field guides
MUC Field Guide or *MUC System Table* and *MUC Glossary of Terms*
GPS Protocol Field Guide (from *GPS Investigation*)
Land Cover Sample Site Data Sheet
Biometry Protocol materials as needed
50 m tape measure
Markers for permanent sites
Clipboard

Preparation

Make copies of appropriate *Data Sheets*.

Review *Site Selection and Set-Up.*

Identify MUC classes that are applicable to your local area.

Select the site(s).

Prerequisites

Concepts and technique in *Leaf Classification Learning Activity*

Ability to use the *MUC System Table* and *MUC Glossary of Terms* and/or the *MUC Field Guide*

GPS Protocol

Ability to take appropriate biometry measurements from *Biometry Protocol*

Ability to pace

Ability to use a compass

Ability to use a camera

Land Cover Sample Site Protocol – Introduction

If that was you standing in the middle of the picture below, how would you describe what was around you? Are there trees? If so, what kind are they? Are there any shrubs? Is there vegetation on the ground? What kind it is? Is it alive or dead? Broad-leaved or grass-like? Are there any buildings or roads? Would the site look different if you were in a hot air balloon above it? If you went back to school and someone asked you what the site looks like, what terms would you use? If your friend from another country called and asked you to describe what you saw, what would you say to him or her? Would you change how you describe it? How would you tell someone where you were? Would you use the names of local roads? Your friends from other places might not know the roads. How could you tell them so they could find it on a map?

You may have used words such as evergreens, deciduous trees, grasses, and shrubs to describe what the site looks like. What do all of those words mean? Scientists need to use terms that mean the same things to other scientists. For example, to many scientists a forest has specific qualities. If scientists can agree on what a forest is, they know that they are talking about the same thing.

What if you had a way to describe what an area looks like in one term? The GLOBE Program uses a system called MUC for describing *homogeneous* land cover. A homogenous site is an area that has only one type of land cover on it. MUC stands for Modified UNESCO (Underlined: United Nations Educational, Scientific and Cultural Organization)

Classification. With MUC, you can describe a site with up to a four-digit class. When you use MUC all of GLOBE will know what you are talking about. The first level of MUC is chosen as if you are looking down on your site from a hot air balloon. After that, the higher levels are also from above but start to get more specific.

How do you describe where your site is? In GLOBE, all sites are located using a GPS (Global Positioning System) receiver. The GPS receiver tells you the latitude, longitude and elevation of where you are standing. This way, anyone can locate where you are on a map.

With your location and description of the land cover, you can tell others about your site. When you report your data, other scientists will know where you were and what it looked like. Scientists can use your data to make maps from satellite imagery and measure how accurate they are. Scientists rely on your data because they cannot personally *validate* what is on the ground. *Validation* is the process of seeing how close you are to the real value. In this protocol, it is how well a map represents what is actually on the ground.

Scientists cannot always go to a place and see what is on the ground. This is why your *metadata* are important to scientists. *Metadata* are important field observations and notes about the data. For Land Cover, this includes historical information, weather conditions, weather effects, and other observations about the site. Metadata can provide insight about an area that may not be clear in the image scientists are looking at.

Teacher Support

The Measurement

Perform the *Land Cover Sample Site Protocol* when you visit one of your Land Cover Sample Sites. The protocol guides you through the process of collecting data at a site and determining the land cover type.

The *Land Cover Sample Site Protocol* is the cornerstone of the *Land Cover/Biology Investigation.* Remote sensing scientists all over the world can use the land cover classification data that you and your students collect. You will also use these data to help map your 15 km x 15 km GLOBE Study Site. Additional Land Cover Sample Site data are used to verify the accuracy of the maps. You can also use these data when looking at the change detection maps that you create from two satellite images, one from the 1990's and one from the 2000's. Remote sensing scientists may use your data and photographs of Land Cover Sample Sites to map and assess the accuracy of maps of larger areas. They may use the scale of a city, county, state, province, region, country or continent, depending on their focus. The *Land Cover Sample Site Protocol* is a very simple process in comparison to its importance, but it must be carefully followed. See Figure LAND-SA-1.

Students and teachers classify a 90 m x 90 m homogeneous land cover site using the MUC System (by using the *MUC Field Guide* or *MUC System Table* and *MUC Glossary of Terms*) and record the latitude, longitude and elevation using a GPS receiver. Pictures are taken in the four cardinal directions for data quality purposes.

A *classification system,* like the MUC System, is one of the ways to communicate about similarities and differences. A classification system is a comprehensive set of classes used to group similar objects. It has four characteristics: *Labels and definitions* that are arranged in a *hierarchical* (multiple levels of classes) or branching structure. It is totally *exhaustive*, meaning there is a class for every data point and *mutually exclusive*, meaning there is one and only one appropriate class for every data point. By using MUC, a common "language" of land cover types, scientists will know exactly what land cover is on the ground in a specific place. MUC is a classification system that has an ecological basis, is useful for remotely sensed data, and follows international standards. By using this same system all over the world, it is easy for scientists to compare data for any place on Earth. Students may have to use the *Biometry Protocol* in order to discriminate between MUC classes. You and your students should be prepared for this.

Follow-Up to Report Data

- Compile the field data and report it to GLOBE.
- Develop or print two copies of the photos (one copy is for your school) and label each photo with your school ID, the Land Cover Sample Site Name and directional aspect (N, S, E or W).
- Follow the directions in the *How to Submit Photos and Maps* section of the *Implementation Guide* on how and where to submit these photos to GLOBE.

Supporting Measurements

Biometry Protocol
GPS Protocol (from *GPS Investigation)*

Student Preparation

Concepts and technique in *Leaf Classification Learning Activity*

Ability to use the *MUC System Table* and *MUC Glossary of Terms* and/or the *MUC Field Guide*

Ability to carry out *GPS Protocol*

Ability to make appropriate biometry measurements from *Biometry Protocol*

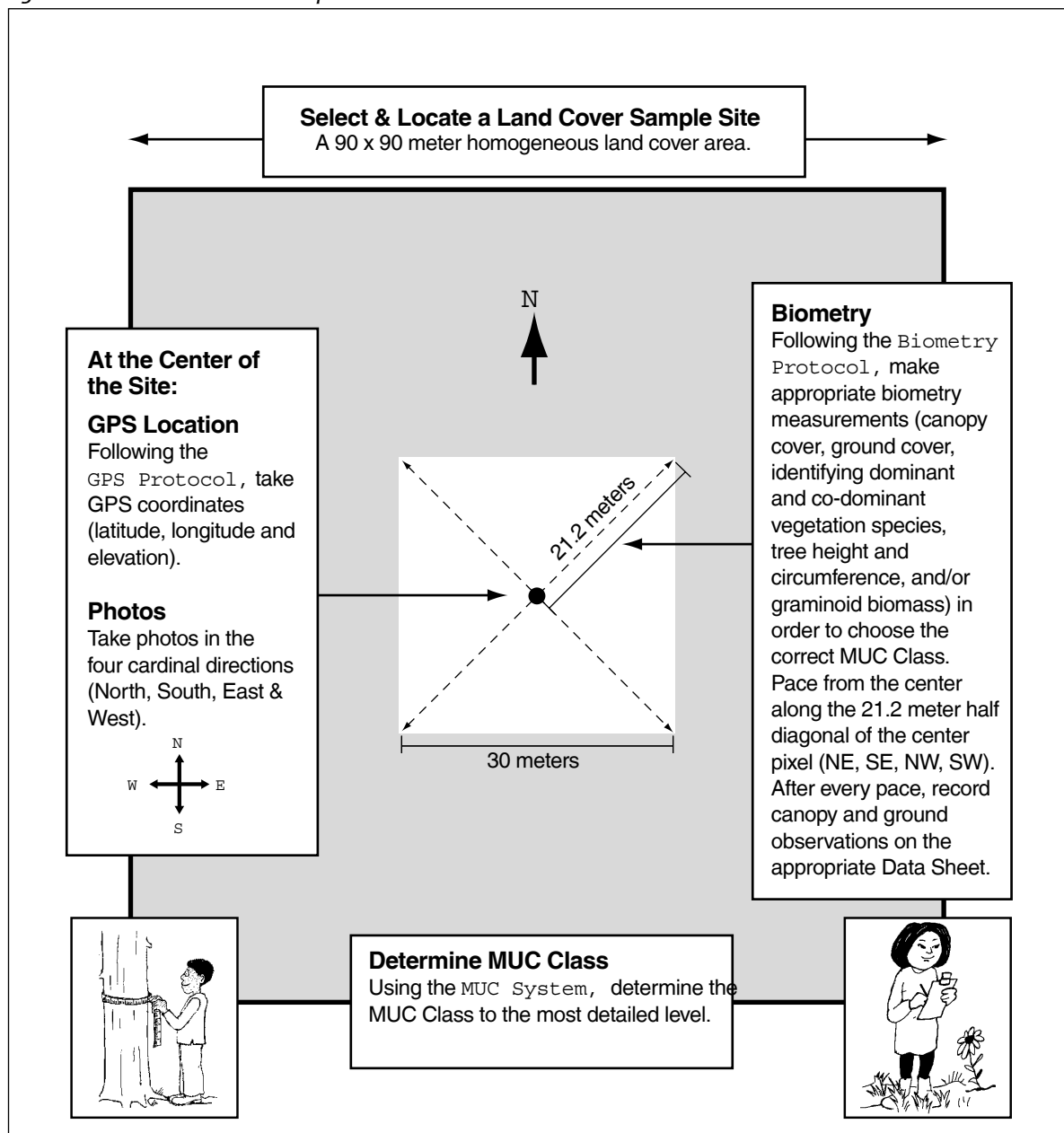Ability to pace

Ability to use a compass

Ability to use a camera

Helpful Hints

- Before going into the field, teach your students how to use your local vegetation field guides.
- Select the 90 m x 90 m area using the Landsat TM images and/or your local knowledge. Remember that it must have homogeneous land cover.

Figure LAND-SA-1: Land Cover Sample Site Protocol Overview

Select & Locate a Land Cover Sample Site
A 90 x 90 meter homogeneous land cover area.

N

At the Center of the Site:

GPS Location
Following the `GPS Protocol`, take GPS coordinates (latitude, longitude and elevation).

Photos
Take photos in the four cardinal directions (North, South, East & West).

N
W   E
S

21.2 meters

30 meters

Biometry
Following the `Biometry Protocol`, make appropriate biometry measurements (canopy cover, ground cover, identifying dominant and co-dominant vegetation species, tree height and circumference, and/or graminoid biomass) in order to choose the correct MUC Class. Pace from the center along the 21.2 meter half diagonal of the center pixel (NE, SE, NW, SW). After every pace, record canopy and ground observations on the appropriate Data Sheet.

Determine MUC Class
Using the `MUC System`, determine the MUC Class to the most detailed level.

- In order to determine if your site is at least 90 m x 90 m have your students pace out 90 m from one of the corners of the site. They should pace in two directions, either North or South AND either East or West. This will give you an estimate of where two additional corners are. Estimate the location of the fourth corner. If the entire area is homogeneous, the site is appropriate. For instructions on *Pacing,* go to *Investigation Instruments.*
- Get help from local experts in plant identification or land cover mapping (e.g., botanists, foresters, horticulturists, surveyors).
- Take enough biometry measurements using the *Biometry Protocol* to accurately classify a land cover site.
- Your students should refer to the definitions in the *MUC Field Guide* or *MUC Glossary of Terms* when determining MUC for an area.
- Distinguishing among some MUC classes requires measurements of the percentage of your site that is covered by different types of vegetation. You can identify the appropriate MUC class by calculating the percentages of the vegetation types observed at the land cover site. Use the *Tree Canopy and Ground Cover Data Sheet.*

Questions for Further Investigation

What natural changes could alter the MUC class of these sites?

Is this MUC class typical for its latitude, longitude and elevation?

If someone only had photos of your site, what MUC class would he/she think this site is?

What other MUC classes are most similar to your site?

How will the land cover of your site affect local climate?

How will the land cover at your site affect your local watershed?

The Landsat TM image provided to your school may be several years old. If an image was acquired today, in what ways would it be different from your old one?

Does the nearest water body affect the vegetation of this site?

What types of animals do you think live here?

How are the land cover and soil characteristics of this site related?

How are the land cover and soil characteristics related?

Land Cover Sample Site Protocol
Field Guide

Task

Locate and photograph a Land Cover Sample Site and classify the land cover type according to the MUC System.

What You Need

❏ GPS

❏ Compass

❏ *MUC Field Guide* or *MUC System Table* and *MUC Glossary of Terms*

❏ Camera

❏ *Student Field Guide for GPS Protocol* and *GPS Data Sheet*

❏ *Land Cover Sample Site Data Sheet*

❏ Pencil or pen

❏ *Student Field Guides for Biometry Protocol* and materials (some sites)

❏ 50 m tape measure

❏ Local vegetation field guides

❏ Markers for permanent sites

❏ Clipboard

In the Field

1. Locate the approximate center of the 90 m x 90 m homogeneous site. **Note:** The site can be much larger than 90 m x 90 m as long as it is homogeneous.

2. Complete the top of the your *Sample Site Data Sheet* (School Name, Measurement Time, Recorded By, Site Name).

3. Identify the latitude, longitude and elevation of the center following the *Field Guide for GPS Protocol.* Record the average latitude, longitude and elevation from the *GPS Data Sheet* on the *Sample Site Data Sheet.*

4. Determine MUC class to the most detailed level using either the *MUC Field Guide* or the *MUC System Table* in combination with the *MUC Glossary of Terms*. Take any measurements necessary following the *Field Guides for Biometry Protocol* to help determine the class.

5. Note any unusual or helpful metadata. Record this in the appropriate place on your *Sample Site Data Sheet.*

6. Using the camera, take a photo in each cardinal direction – north, south, east and west. Use your compass to determine the directions. Record each photo number in the correct arrow on your *Data Sheet.*

Land Cover Sample Site –Looking at the Data

Are the data reasonable?

After collecting Land Cover Sample Site data, you should determine whether the types and locations of land cover are reasonable and accurate. For instance, if you are located in a mid-latitude temperate climate, does your data include land cover types only found in the equatorial tropical zone? Does it make sense to have land cover types only found in extremely dry desert-like areas? Do you have classes for mountainous areas when you are located in a coastal lowland? Ask yourself questions like these about the land cover types in your area. Check the MUC classes and definitions to determine whether the land cover classes you chose make sense for your GLOBE Study Site.

Next, think about where each of these land cover types are located. Using your knowledge of the area and other sources of information, like a print-out of your Landsat image, topographic maps and aerial photos (if available), do the locations of the land cover types make sense? If not, which land cover type(s) do(es) not make sense?

After looking at your data and seeing whether it is reasonable, you are now ready to compare your land cover types to other schools' land cover types. Graphs can help answer questions you might have thought of while you were collecting Land Cover Sample Site data. What is it like in other places? How does your data compare to other schools? Using the visualization pages of the GLOBE Web site, you can graph your data with data from other schools that have Land Cover Sample Sites similar to yours.

What do scientists look for in these data?

Land Cover Sample Site data is a "snapshot in time" of the land cover type in a particular area. These data can be used by anyone creating a map where land cover type is needed. Maps of habitat areas, topography, fire fuel amounts, urbanization, forest types, species locations, etc. use data such as GLOBE Land Cover Sample Site data for reference to create or assess a map. Students who collect Land Cover Sample Site data in a single area over a long period of time assist scientists in monitoring change over time in a region. In order for scientists to use GLOBE Land Cover Sample Site data, the MUC class must be as detailed as possible and have accurate GPS coordinates. The photographs that students take in the four cardinal directions are important for quality assurance.

An Example of Student Inquiry

Students from a school in Stockholm, Sweden had been collecting Land Cover Sample Site data for a few months. They did a search on the GLOBE Web site to see if other schools had also been collecting land cover data and found that one of their MUC classes was reported frequently by other schools. MUC 0192, Temperate and Subpolar Needle-Leaved Evergreen Closed Forest with Irregularly Rounded Crowns, was found in several states in the US, and other countries throughout the world. The students were curious to discover if there were correlations between the schools' latitudes, weather patterns and/or soil moisture readings. Each group in the class chose a different GLOBE measurement to research including latitude and elevation, temperature, precipitation and soil moisture. They hypothesized that MUC 0192 would be found in areas that had similar data to theirs.

In order to explore their hypothesis, the group that researched the temperature similarities first located the other schools that had submitted sites with the same MUC code, 0192. Using the GLOBE visualizations, they graphed one year's worth of temperature data for all the schools. Once all the data were graphed, they carefully studied any trends they saw. They also noted what the high and low temperatures were for each school and if they could determine if the school went through different seasons during the year. If a school had GLOBE temperature data from more than one year, they adjusted the graph to include that data also. They found that all the schools had a cold and warm season.

They wrote up their findings and made a display of the graph to be used in a presentation to the class. They looked forward to finding out if other groups had found trends in their data comparisons.

For a more detailed description of this activity, refer to the *Using GLOBE Data to Analyze Land Cover Learning Activity*.