Department: GEOG

Course No.:1302

Credits: 4

Title: GIS Modeling of Environmental Change

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Content Area: CA 3 Science and Technology

Catalog Copy: GEOG 1302. GIS Modeling of Environmental Change. Fall semester. Four credits. Three class periods and one 3-hour laboratory period.
An introduction to environmental processes and patterns, especially assessing change in environmental systems using spatial analysis techniques. Students will map field sites using GPS technology and aerial photographs, collect field data on various environmental systems, and build and test a GIS-based environmental model.

Justification**:** a) Reasons for adding this course:

There is a shortage of courses for scientific inquiry into environmental processes at the freshman level and the modern technologies used in the investigation of these processes. Students who complete this course will be better prepared for the intellectual rigor required of them at the junior and senior levels. The course will also acquaint students with modern methods of investigation used in geography and broaden their appreciation of this discipline.

b) The course will introduce students to a range of topics and techniques at a basic level that have only been available currently at the upper divisional level. It will provide a gateway to more advanced courses in physical geography and geographic techniques.

c) The course will enhance the department's offerings at the freshman level. Currently there are only two physical geography courses at the freshman level and there are no methodology courses at the freshman level.

d) This course will increase the number of introductory environmental courses available to students of any department.

Syllabus: Grading: A midterm, final exam and 12 laboratory assignments will be used to determine a student's grade for the course.

Week 1: Systems Approach to Environmental Change

Week 2: Introduction to Mapping Environmental Systems

Week 3: Basic GIS Concepts

Week 4: Examining/Mapping Microclimate and Topography

Week 5: Examining/Mapping Vegetation Systems

Week 6: Examining/Mapping Soils

Week 7: Examining/Mapping Hydrologic Systems

Week 8: Examining/Mapping Land Use/Land Cover

Week 9: Air Photo Interpretation

Week 10: Documentary/Archival Evidence of Environmental Change

Weeks 11-14: GIS Synthesis

CA Justification: a) The course is an introduction to environmental processes and assessing change in environmental systems using spatial analysis techniques. A major goal of this course is to develop the critical skill of spatial literacy and its role in scientific investigation. It will help students understand geography as a basis for organizing and discovering information. Students will acquire the concepts of spatial thinking and reasoning and a better understanding of how humans visualize and interpret the world around them. The course brings together two distinct fields in Geography—physical geography and geographic techniques—and introduces students to how both fields may be integrated and applied to current scientific problems. In particular, the applied, hands-on component of the course involves learning outcomes that have typically been limited to upper-division courses in GIScience and physical geography.

b) The midterm and final exam will be a combination of definitions, short answers, an brief essays. There are no specific writing assignments but students must writeup the results for each of their laboratory assignments. Students will read about the equivalent of one book chapter each week.

c) The weekly topics around which materials will be developed include: Systems Approach to Environmental Change, Introduction to Mapping Environmental Systems,

Basic GIS Concepts, Examining/Mapping Microclimate and Topography, Examining/Mapping Vegetation Systems, Examining/Mapping Soils, Examining/Mapping Hydrologic Systems, Examining/Mapping Land Use/Land Cover, Air Photo Interpretation, Documentary/Archival Evidence of Environmental Change, and GIS Synthesis.

Meets Goals of Gen Ed: By the end of the course, students should be able to:

• define the fundamental physical processes that contribute to the spatial variability of environmental systems (KNOWLEDGE)

• describe the interconnections between environmental systems (COMPREHENSION)

- explain the influence of physical processes and associated spatial patterns in the local watershed (COMPREHENSION)
- collect environmental data from the field in accordance with the scientific method (APPLICATION)
- use geographic technologies to acquire, process, and report information about environmental change (APPLICATION)
- analyze the spatial organization of environments in a local watershed (ANALYSIS)
- hypothesize the influence of changing land cover on environmental systems (SYNTHESIS)

CA3 Criteria:

1) Students will explore both an area of science (physical geography) and technology (GIS, GPS, Remote Sensing). Students will be introduced to field-based research that uses modern technologies such as GPS to provide a spatial perspective in scientific inquiry.

2) In examining environmental change, students will not only investigate and test hypotheses regarding the current environment using field-based research but also must make use of historical records regarding the environment to examine how present and past activities have impacted the environment.

3) It is known that humans impact their environments and environmental change occurs from both natural and human-induced processes. However, there is debate regarding the degree and direction of these impacts. By conducting local field research as well as archival research, students should be able to answer some of these questions for their local area.

4) Changes in the environment is a major current concern of society from global climate change to urban sprawl. This course will give students the competence to investigate past patterns which can be compared against the present and increase their awareness of potential future environmental problems.

Lab Course Description: GIS Modeling of Environmental Change: Labs

1. Introduction to Map Reading, Topographic Maps
2. Compass Use and Basic Field Mapping/Orienteering
3. GPS Field Mapping
4. Data collection: Field mapping of microclimates related to topography
5. Data collection: Field mapping of vegetation cover
6. Data collection: Field mapping of soil properties

7. Data collection: Field mapping of hydrologic features

8. Data collection: Field mapping of land use/land cover

9. Historic analysis: Air photo interpretation

10. Historic analysis: Analysis of Archival/documentary records

11. Data analysis: Inputting data into GIS, parts I-II

12. Data synthesis and interpretation of environmental change

Lab 1: Introduction to Map Reading, Topographic Maps.

Introduction:

Topographic maps ("topos") are important sources of spatial geographic information. Knowing how to read and use topos is important in almost all areas of geography. Topographic maps are two-dimensional, but show the third dimension (height, elevation or altitude) by contour lines (brown on land, blue under water). Elevations are marked on some contour lines (e.g. 600 feet) and you have to count numbers up or down based on the contour interval written at the bottom of the map to derive the elevation of the lines not labeled. Also the spacing of contour lines indicates if the topography is flat (contour lines are widely spaced apart) or hilly (contour lines are closely spaced).

Note that the term "natural features" refers to the shape or appearance of natural objects such as lakes rivers, hills, nature preserves, etc., symbolized on maps. The term "cultural features" refer to objects in the environment created by humans, like buildings, city parks, shopping malls, roads, railroads, etc.

Goals: The purpose of this lab exercise is to acquaint you with topographic maps and the information available on them, and to introduce you to Moss Sanctuary where we will be undertaking our field study later in the semester.

Objectives:

1. Describe and use the legend, marginal labels, symbols, and information on a topographic quadrangle map.

2. Determine the elevation, aspect, and slope for selected points on the Spring Hill quadrangle.

3. Construct a topographic profile.

Moss Sanctuary: Locate Moss Sanctuary on the Spring Hill topographic quadrangle provided by the instructor.

First, acquaint yourself with the symbols, markings, and legend on the map and map borders.

How are marshes and forested areas designated on the map?

What do the dashed blue lines found in Mansfield Hollow State Park symbolize?

To prepare you for our field investigation, answer the following questions about Moss Sanctuary.

Imagine that the university has allowed us to park along Highway 195 in front of Mirror Lake. Approximately how far will you have to walk, bike, or drive to reach the circular drive behind Mansfield Apartments at the northern corner of Moss Sanctuary?

________ feet ________ miles

What types of features, both natural and cultural, would you expect to find in and around Moss Sanctuary?

What is the geographic grid (latitude and longitude) coordinates of Tift Pond as estimated to the nearest minute?

What is the highest elevation in Moss Sanctuary? (estimate within 5 ft.) __________

What is the lowest elevation in Moss Sanctuary? (estimate within 5 ft.) __________

What is the elevation of the surface of Tift Pond? (estimate within 5 ft.) __________

What is the local relief (vertical distance between high and low points) of the highest hill in Moss Sanctuary?___________

Leaving Moss Sanctuary for the moment…

What is the lowest elevation represented on the Spring Hill quadrangle? What particular place name found on the map might help you find this lowest point more quickly?

Slope and Aspect

The aspect of a slope is the compass direction which it faces downhill. A line drawn perpendicular to the contour lines of a slope determines its aspect. Slope steepness is indicated by the spacing of contour lines. The closer the lines are to one another, the steeper the slope and vice versa. Slope steepness may be expressed as an angular measure or as a percentage

We will calculate slopes as a ratio of vertical change to horizontal change. For example, an increase in elevation of 1000 feet over a horizontal distance of 1000 feet would be a 100% slope. Use the following formula to calculate the percent slope:

$$\% \text{ slope} = (\text{vertical distance} \div \text{horizontal distance}) \times 100\%.$$

What is the aspect of the steepest slope of Horse Barn Hill (located on the far north end of campus?

____

What is the percent slope of Horse Barn Hill's steepest slope? _______

What is the aspect of the steepest slope of Rattlesnake Hill (located on the eastern edge of the map)?

____

What is the percent slope of Rattlesnake Hill's steepest slope? _______

What is the aspect and percent slope of the worst (steepest) slope we might have to walk up in Moss Sanctuary? __________ aspect __________ % slope

Describe as precisely as you can where in Moss Sanctuary this hill is located.

Topographic Profile

To get a better understanding of the slope and shape of the land surface, you can transform the plane view of the contour lines into a cross-section, or profile, of the topography. Hikers and mountain climbers often draw a cross-section of their planned hike paths to get an idea of the steepness of their climb.

On graph paper, draw the topographic profile of Moss Sanctuary from SE to NW. Label your x-axis (distance) and y-axis (elevation) and draw your profile in units of feet (instead of miles or kilometers).

Big Questions and Practicalities

How old is this map? (1/2 pt.)

What challenges or problems might the age of this map pose for a field researcher? (1 pt.)

How do you suggest we compensate for such challenges? (1 pt.)

Lab 2: Compass Use and Basic Field Mapping/Orienteering.

Introduction:

You should now be familiar with using latitude and longitude to find a point's absolute location on Earth's surface. There are times when relative direction between two places is desired, for example, if you want to navigate from one point to another. You can indicate relative direction using compass points and azimuths. Understanding and being able to use these direction-finding methods are important for interpreting topographic maps and marking your location in the field. These measurements are in the horizontal direction, as if you were in the air looking down at Earth from above.

The lab is divided into two sections. Section 1 is on basic compass use to find compass points and azimuths on a map. Section 2 introduces you to the basics of orienteering.

Objectives:

- Understand the different methods of indicating direction using various types of compass readings.
- Apply the aforementioned methods to determining directions on a topographic quadrangle.
- Learn how to measure distances by pacing.
- Develop your skills in measuring azimuths with a compass.
- Map out your navigated route on graph paper.

SECTION 1: DIRECTIONS AND COMPASS READINGS

Compass Points

The directional system familiar to most people is that of compass points. The symbol that you find on many maps and is featured below is a compass rose. The compass rose has four cardinal points—in a clockwise direction—north, east, south, and west, separated by four intermediate points: NE, SE, SW, NW. These are split into 16 and then, sometimes again into 32 compass points.

Label 16 compass points on the compass rose. Use different letter sizes to indicate the different categories of division (e.g., write the four cardinal directions in the largest letter size, the next four intermediate points in medium letters size, and then the next eight points in the smallest letter size).

Azimuths

While useful, compass points are not extremely accurate, and most often the direction between two points does not fall exactly on one of the 32 points. Degrees of an arc are used for more precise directions.

Azimuths are read from the north in a clockwise direction, from 0° to 360° (with 0° and 360° being the same point – north). For further precision, the degrees can be broken down into minutes (’).

(1) The figure below has a few azimuths drawn and labeled as examples. Using your protractor or the circle of degrees on the compass, determine the azimuth readings for A and B, labeling the value for each on the diagram.

(2) Measure, draw, and label the following azimuths on the diagram: 230°, 78°

Compass Bearing

Compass bearing between two points on a map may be determined by using a protractor or a magnetic compass. To accomplish this, lightly draw a line through the specified points, extending the line to the edge of the map.

To use a protractor, place the straight edge of the protractor along the margin of the map, with the origin of the protractor at the point where the line intersects the map margin. The extension of the drawn line indicates the compass bearing.

To use the compass, simply align the margin of the map with the 0°/360° and 180° points on the compass. The bearing can be read from the compass dial. (Pay no attention to the compass needle.)

Using the Spring Hill quadrangle, complete the following.

What is the azimuth from the center of Tift Pond to the center of Mirror Lake? _______ degrees.

In last week's lab, we determined the aspect of slopes using compass direction. Aspect can also be reported in degrees of arc (azimuth). What is the azimuth aspect of the steepest slope of Horse Barn Hill?

______ degrees

SECTION 2: ORIENTEERING WITH PACE AND COMPASS

Introduction:

Orienteering is the process of locating your position and following a pathway using basic navigation tools. You navigate numerous times in day-to-day life, such as when you use a map to go backpacking, follow signs to drive to a new destination, or follow detailed directions to find a new classroom on campus. Once you leave the road or trail, however, there are no signs to guide you or pathways to follow. In this case, hopefully you have a map and a compass because you will want to know how to measure directions and distances in order to determine your position and plot a route to your destination.

This exercise introduces you to some of the basic skills required for off-trail orienteering. In addition, skills learned in this exercise will be used to construct a map. Yes, you're going to become a field cartographer!

Part 1: Measuring Your Pace Distance

You will be measuring distance using your walking pace. There are numerous other techniques for measuring distance that are more accurate than pacing, but almost all of these techniques require more sophisticated instrumentation and are more time consuming. Pacing is an appropriate technique for making rough maps of an area and for estimating approximate distances of travel. Over smooth terrain and with experience, distances measured by pacing can be accurate within 2-3%.

Directions:

a. Go outside to where we will lay out a 100-foot tape measure.

b. Starting at one end, pace (walk) to the other end counting your paces as you go. Walk naturally! Important to keep in mind: 2 steps=1 stride, 1 step=1 pace.

c. Once you reach the end of your first 100-foot pacing exercise, write down the number of paces you took in the chart on the next page.

d. Follow this same routine 3 more times; walk back down the tape, walk back up, and finally, walk back down. Write down the number of paces you took after each time you complete the 100-foot pace.

e. After you have completed your four pacing exercises, calculate your average number of paces that you took during your 100-foot walks. (Add each "# of paces" together and divide by four.)

f. Now calculate your average pace by dividing 100 by your "average number of paces." Your answer can be read as such: I travel "X" feet per step.

Distance	# of paces	Average # of paces	Average pace
100 ft	___________		
100 ft	___________		
100 ft	___________		
100 ft	___________	________________	______________

Now that you have determined the average length of your pace, all you need to do to measure distance is to count how many paces you take while walking to a destination.

Part 2: Surveying

You will begin using orienteering techniques to gather baseline and azimuth data.

Directions:

a. Measure the distance between the two trees indicated as point A (large spruce near CLAS) and point B (large oak diagonally across lawn from spruce) using the average length of your pace. (Number of paces multiplied by your average pace length in feet). Enter this distance in the chart below. The distance between these two points will serve as your baseline when you begin to construct your map during the last part of this lab.

b. Go back to point A (spruce) and shoot an azimuth to point B (oak) (called the foresight azimuth). Enter this measurement in the chart below.

c. Go to point B and shoot an azimuth back to point A (called the backsight azimuth). Enter this measurement in the chart below.

d. While standing at point B, shoot azimuths to the following locations and record your readings on the chart below.

- lamppost

- also pace the distance from point B to the lamppost and record the distance on the chart below. When you're constructing your map later, you may need to refer back to this distance to accurately map the lamppost.

- center flagpole

- a second lamppost

e. While standing back at point A, shoot azimuths to the following locations and record your readings on the chart below.

- lamppost

- center flagpole

- second lamppost

Distance between point A and point B _______ paces = ________ feet

Foresight azimuth from A to B _________

Backsight azimuth from B to A _________

Azimuth from B to: Lamppost _______ Flagpole _______ Second Lamppost _______

Distance from B to Lamppost _________ paces = _________ feet

Azimuth from A to: Lamppost _______ Flagpole _______ Second Lamppost _______

Part 3: Gathering data about your field area.

Directions:

a. Place yourself somewhere in the middle of your field area, and on the next page, sketch a map of the area. Include the following on your map:

- north arrow

- major features (buildings, etc)

- objects surveyed (label them by “point A”, “lamppost,” etc.)

b. If you were to include the sidewalks surrounding the lawn in your map (to scale), from where and to where would you shoot azimuths?

SKETCH MAP:

Part 4: Creating Your Map

You will now go inside and construct an accurate map of your field area. Although you worked in groups, each of you is required to construct your own map. You will construct the map using the graph paper provided to you.

Directions:

a. Orient north to be at the top of your page. Draw a north arrow.

b. Your map scale will be 1:100.

Knowing this, 1 inch equals how many feet? _________ feet.

c. To map the area so that it all fits on your graph paper, you’ll need to start with plotting point A near a corner of the page.

d. Plot your baseline: point A to point B. You already measured the distance, so use your scale (1 inch equals X feet) to configure the exact length of it on the graph paper.

e. You will now use triangulation to plot the lampposts, flagpole, and second lamppost in their exact location on your map. Triangulation is a method whereby you locate an unknown location by knowing the azimuths from two known points to that unknown point. You’ve already done the first step required to do triangulation: you measured azimuths from two known points (points A and B) to your unknown point (the lamppost, flagpole, and monument).

- Place a protractor or compass at point A. Refer back to your azimuth readings from point A to all three objects and make a tic mark on the edge of your graph paper for each reading you recorded. Draw a line (lightly) from point A to all of these tic marks (three lines in all).

- Repeat this process for point B.

- Your objects are located where the line from points A and B intersect. Label these locations as lamppost, etc.

f. Determine the distance from point A to the flagpole and second lamppost using your scale. Label this information on your map by drawing lines between these points and writing the distance on the line somewhere.

g. Determine the distance from point B to the lamppost, flagpole, and second lamppost using your scale. Label this information on your map in the same manner as the previous direction states.

h. Next to your measured distances, write down the azimuths you took from points A and B to the objects.

i. Label the following on your map to make it complete:

- Scale	- Members of your mapping party
- A title	- Relative location of CLAS
- Date	- A legend for any symbols you might have used

Field Notes:

When orienteering techniques are used by professionals, they are usually surveying locations for specific reasons (i.e., laying out trails, mapping trees in a plot, etc.). Field notes are always an important component of surveying. They help the surveyor remember what the conditions were like out in the field and can help the surveyor figure out why some measurements may not match up later.

What is the purpose of completing the sketch map, besides turning it in?

What methods and equipment were used in the field?

Give a brief description of the field area.

Lab 3: GPS Field Mapping.

Purpose: In this exercise you will learn the basics of operation for one of the standard GPS units used in the field today. You will also check critical configurations of the unit to avoid potentially errors.

1. Go to http://www.pbs.org/wgbh/nova/longitude/gps/ "GPS-the new navigation" and complete the short exercise how GPS works from a "hands on" approach.

2. Sources of Error: (Source: Trimble)

Typical Error in Meters

(per satellite)	Standard GPS (m)	Differential GPS (m)
Satellite Clocks	1.5	0
Orbit Errors	2.5	0
Ionosphere	5.0	0.4
Troposphere	0.5	0.2
Receiver Noise	0.3	0.3
Multipath	0.6	0.6

3. Tracking a GPS satellite: Go to Real Time Satellite Tracking http://www.n2yo.com/ and report on the current location of NAVSTAR 57

Creating a Waypoint

A named location representing a point on earth is called a “waypoint.” Coordinates and waypoints are datum dependent. You can save your current position, a cursor position, or a coordinate location. We will create 2 waypoints and then navigate to our first waypoint.

1. Press the WPT button, highlight the WPT label at the top of the screen using arrow key, use left or right arrow until you get to waypoint 1.

2, Highlight “create wpt” option, press right arrow, a menu appears, highlight “current position”, press right arrow, a “waypoint created” message briefly appears.

Navigating to a Waypoint

1. Press the WPT button. Highlight the WPT button at the top of the screen, use the right arrow to select wpt.

2. Scroll down to the “Go to WPT” label, press right arrow. You will automatically be placed in the NAV2 screen mode. We will navigate to WPT. Record the number of feet “off” the receiver is to the actual waypoint location. What accounts for error?

Checking our accuracy with the Acme Mapper Web Site

http://mapper.acme.com/?

Preliminary Steps

1. Turn on the GPS unit. Make sure you have at least 25% battery power. If not, leave the unit in the charger for a couple of hours to recharge the battery.

2. Go outside. Have a clear view of the sky. Don't block with your hand the internal antenna, which is located above the screen. While the unit doesn't need to be held level, try to keep the antenna facing upwards, not sideways or downward. Satellite signals can be blocked by powerful transmitters, heavy tree canopy, buildings, people, or large vehicles. Satellite signals can travel through leaves, glass, or plastic, but the signal will be degraded (multipath error).

3. View the satellites currently tracked and those actually being used to calculate position. By pressing the unit's "OPTION" button (located on the upper right hand portion of the unit) and entering on "Advanced" option you can find out Position Dilution of Precision Values (PDOP) and whether your daily almanac was successfully downloaded—it should display the current date if you successfully captured the almanac. Record the PDOP and almanac date

___________________________ ______________________________

B. Configuring the Unit

Check List

Item Procedure

• Power levels ____

____

• Units (use ft) ____

____

• Datum (use WGS 84) _____________________________________

____

• Accuracy (intermediate) _________________________________

____

• Feature Logging Rate

(1 s for pt) (5 s for line and area) _________________________

____

• Elevation Mask (15 d) __________________________

• Date and Time Format _________________________(your choice for date but

use 24 hr clock-military time)

_____________________________• Coordinates _____________________________

(UTM)

____

Lastly: Convert the following military UTM times and day to current time and day

0:00 Monday _________

5:00 Monday _________

17:00 Monday _________

Assume daylight saving begins in October, convert the following military UTM times and day to current time and day

16:00 Wed. _________

4:30 Friday _________

23:00 Monday _________

Before being able to collect GPS data in the field you need to create a new file for data collection. Make sure that the unit is tracking satellites (the satellite marker on the upper right hand of the screen is not flashing).

A. Collecting Point Features—Gates in historic stone walls

1. In the case of this exercise, point features will be old gates in stone walls, located in Moss Sanctuary. Begin collecting points on the GPS unit at the first gate. Remain stationary at the gate and record between fifteen and twenty GPS positions. Look for the message, “Feature stored” to briefly flash across the bottom of the screen to indicate that you have successfully collected the feature.

2. Make sure that "Point" features are again highlighted. Now head exactly to the north end of the wall to the next gate and collect between fifteen and twenty GPS positions. Make sure that "Point" features are again highlighted then go directly south to the southern gate of the current wall. Collect between fifteen and twenty GPS positions at the southern gate.

B. Collecting Line Features—Stone walls

Walk due north to the east-west trending stone wall immediately north of the first gate. You will collect a line feature. The first point (start point) of the line feature will be on the wall immediately north of the north end of the first gate. Follow the wall to its end.

Once on the start point, begin collecting data. Pressing “ENTER” on the unit will initiate point collection associated with a line feature. Like a stream, walk in a meandering path within the confines of the wall toward the west. If, when configuring the unit, you chose a feature collection interval of five seconds for a line feature, you will miss some of the meanders you create. If you chose a feature collection interval of one or two seconds, you will record the curves of the wall more faithfully. The drawback is that there is that more processing time is required.

Return to the start point for your line feature above. Walk approximately three meters north. Now you will simulate recording the path of a strictly linear, instead of meandering, line feature. We’ll pretend this is a drainage ditch. Repeat steps above. Again, don’t collect points between the start point and the end point.

C. Collecting Area Features—historic pastures

1. From the “Collect new data” screen highlight "Create new file" and press "Enter." A "New feature" window will appear. This time highlight "Area"

2. Based on instructor input, walk to the northeast vertices for a rectangle that will encircle the first historic pasture. This will be the starting point of an area feature. Vertices are marked by small black dots.

3. Once at the corner begin collecting data. Head south to the southeast vertices of the pasture. Stop at the southwest vertices of the pasture then head north.

4. Stop at the northwest vertices of the square. The GPS unit will join the first and last positions recorded to close the area so there is no need to return to the original starting point. Be sure to remember the file name which is the date and time of the data collection session.

Follow instructions posted in the computer lab for post-processing the data you collected data.

Lab 5: Data collection: Field mapping of vegetation cover

Walk to an area of the forest and select a spot from which to quietly observe and take notes. Be sure to be at least 100 feet away from any other students in the class. Describe the location of your spot in your field notes.

Complete Parts I, II, and III, re-grouping after each section with your fellow students. At these three re-groupings, discuss your observations with each other.

PART I: Species Composition and Diversity

Sit quietly in your field site for 15 minutes. Listen, look. Make a list of all the different organisms or signs of life that you observe (not just plants). It is neither expected nor important that you know the correct name of everything; only that you can distinguish when you are observing something new and different. The challenge will be to come up with a way to recorded unknowns. Make a total count of the different kinds of plants, fungi, and animals in your habitat. Are any kinds more prevalent than others

Take a break and compare your results with your fellow forest observers nearby.

PART II: Vertical Structure

Return to your observation post and try to discern a pattern to the way life is distributed vertically. Can you subdivide your habitat into strata (vertical layers)? Sketch a profile of the vegetation. Add animals where appropriate. Calculate the percent canopy cover using the densitometer, taking multiple readings in your habitat area to come up with an average percent cover.

Take another break after 20 minutes and compare results with those of your fellow observers in your forest cover type. Is there any apparent relationship between structure and total diversity of lifeforms? Describe what pattern or lack of pattern is evident.

Once you have discussed Part II with your fellow forest observers, return to the instructor for Part III.

PART III: Horizontal Structure

For this section, we will divide the class into groups. With your group, see if you can identify a pattern to the distribution of different vegetation in relation to differing abiotic environments.

Look at the borders of vegetation communities. Are there sharp and distinct borders between different kinds of communities? Are there transition zones where certain species and abiotic factors may be found in two or more communities? Make a sketch map of what you see, including at least as many different communities as there are observers in your group, and record each forest type as an area with your GPS unit.

Lab 6: Data collection – Field mapping of soil properties.

Materials:

Soil auger

Auger bucket

Munsell Color books

A large, dull spatula to help remove soil from auger.

A measuring tape

A 500-mL squeeze-type water bottle

A plastic dishpan for catching soil from the auger

A soils map of the area and soil series descriptions

Go to each site marked on the topographic map and fill out the appropriate charts. Record the point location of each site using your GPS unit.

In each profile box, draw in the approximate horizon boundaries and label each horizon (A, B, etc.). To the right of each profile box, note the textural class (e.g., sandy clay loam) and Munsell color (e.g., 7.5YR3/4). Under Soil Taxonomy, write in the Soil Order, Suborder, Great Group, and Subgroup, if these are known. Under Interpretations, describe the drainage class and vegetation characteristics.

Procedure for collecting soil samples:

Take turns turning the soil auger to dig a hole in the ground. Usually, three or four rotations of the auger are required to fill the auger bucket. Before removing the soil from the auger, the student handling the auger should point the bit end of the auger toward the group and the students should closely inspect the relatively undisturbed soil exposed. The patterns of color, roots, pores and, to some degree, the soil structure, are more clearly visible here than in the soil after being removed from the bucket.

Invert the auger so that the T-handle meets the ground at about a 45 degree angle. While one student taps the T-handle gently against the ground causing the soil to fall out of the back of the bucket, a second student should hold a dishpan (or two hands cupped together) under the auger opening to catch as much of the soil as possible as it falls out. A third student can use the steel tape to measure the depth of the hole, and determine the length of the soil increment just collected. The catcher then lays the soil from this increment in the trough so that the soil sample takes up the same length as the increment of profile from which it came.

Look for horizon boundaries by observing differences in soil properties and discuss the probable horizon designations. In particular, the features to look for in the well-drained position would be the thickness of the A horizon and the O horizon (if one is present), and the presence of subsurface horizons, particularly the color of these subsurface horizons. In a well-drained soil, these colors should be fairly bright browns, reds, or yellows (having a high Munsell chroma number). These bright colors indicate good drainage and aeration.

The horizon designations and boundaries should be added to the appropriate profile diagram in the chart. Use the hand texture chart and squeeze water bottle to estimate soil texture. The main properties should be noted on the chart.

Finally, once you are finished with the lab, it is important to go back to each auger hole with the appropriate trough of soil and pour the soil, bottom horizon first, back into the hole. Students can also use any soil remaining around the hole to fill the holes and prevent a hazard to people or animals that might be walking through the area. Filling of the holes is also important to protect ground water from surface contaminants that might wash in.