

# ForestWatch Monitoring Manual

## What is a Forest?

A forest may be defined as a biological community dominated by trees and other woody vegetation. The diversity in climate, topography and geology in Illinois, along with natural and anthropogenic disturbance factors, resulted in a variety of wooded communities which exhibit a wide range in the density of the tree canopy in wooded areas. Such areas range from savannas (grassland with scattered trees), to open canopy woodlands (predominantly tree-covered but with some light penetration), to dense forests (heavily wooded). In addition to the variety of upland forests, a variety of bottomland (i.e. floodplain) forests occur throughout the state.

## Safety

The following information provides a brief overview of how to stay safe and comfortable when monitoring. Remember, your safety is far more important than the data you collect.

### • **Things to Bring:**

insect repellent  
water bottle  
rain gear  
warm clothes as needed  
first aid kit

### • **General Precautions:**

Always tuck in your shirt. When possible, tuck your pants into your socks to avoid ticks. Wearing light-colored clothing can help to locate ticks. Many insects, including mosquitoes, are attracted to dark colors, particularly red and black. Use insect repellent to help keep mosquitoes and other insects from biting you. Do not allow any repellent to come in contact with plastics, like watches or contact lenses.

Be careful of steep or variable terrain, or various objects which may be dangerous, such as fallen trees, holes, or human artifacts (old fences, broken glass, etc.).

### • **Appropriate Dress:**

boots or athletic shoes (never open-toed shoes)  
long pants  
long-sleeved shirt when possible  
long socks  
hat with brim

Never monitor when there is lightning or thunder. If the weather conditions worsen while you are outside, seek shelter. Never stand in the open, under an isolated tree, or in water during periods of lightning. If you cannot get to an indoor shelter, seek shelter among small trees.

- **Monitoring During Hunting Seasons:**

It is best to avoid monitoring during hunting seasons. Do **not** monitor during firearm seasons for white-tailed deer. It is a good idea to wear bright colors (orange or yellow - avoid white) when monitoring. Before monitoring, check with the landowner to make sure that hunters will not be using the land when you plan to monitor.

- **Animals:**

All ticks should be removed if found, whether attached or not. There are several types of ticks in Illinois, but the deer tick is the most common carrier of diseases, like Lyme disease. Know what a deer tick looks like. Always check your clothing after being outside. Also, closely check your skin for ticks.

The forests of Illinois contain many other animals that may be harmful to humans, including the cottonmouth (or water moccasin), massasauga rattlesnake, timber rattlesnake, copperhead (snake), black widow spider, brown recluse spider, mosquitoes, biting flies, bees, and wasps. Some animals that may not appear dangerous, like a stray dog or a squirrel, can carry rabies (though this is rare). Know where people can receive prompt medical care. It is best to observe animals, not touch.

- **Plants:**

**Poison ivy** is found throughout the state and grows in many forms. It can be a small erect ground layer plant, shrub, climbing vine, or trailing vine. Vines tend to appear hairy, but not always. Poison ivy has three leaflets, with the center leaflet having a long stalk and the two side leaflets having very short stalks. The fruits of poison ivy are small white berries. All parts of the plant contain the oil that causes a reaction. The reaction is generally swelling, blistering, and itchiness of the infected area. People vary in their reaction but direct contact with the plant should be avoided. If exposed, promptly (within 1-2 hours) clean the area with hot, soapy water. The oil from poison ivy can remain active for weeks on clothing; launder all field clothes after contact. If available, use a strong alkali soap or naphtha. Also, alcohol will dissolve and remove the oily substance from the skin and if applied soon enough will prevent irritation.

**Poison sumac** mainly grows in bogs and swamps and is not widespread across the state. Chances of exposure are minimal.

**Stinging nettle** (genus *Urtica*) usually grows in moist areas, such as bottomland forests. It grows erect up to 4 feet, and is covered with small, stiff, stinging hairs which can irritate the skin on contact. Leaves are opposite, heart-shaped, with a long stalk and large teeth.

**Wood nettle** (genus *Laportea*) also grows in moist areas. It resembles stinging nettle, but has alternate leaves. This species is also covered with stinging hairs which can irritate the skin.

## **Forest Etiquette**

Forest ecosystems are important for many reasons. Our forests provide more than 75% of the state's wildlife habitat, they are home to over 60% of the state's native plants, including over half of the state's threatened and endangered species, and they protect watersheds from excessive soil loss. But forests are delicate systems which can be easily disturbed, even by people who are not intentionally trying to harm them. Therefore, it is important to minimize the amount of damage inflicted when monitoring.

People are often responsible for unintentionally spreading the non-native, invasive plant, garlic mustard (*Alliaria petiolata*), a major threat to the quality of our forests. The seeds of garlic mustard are distributed when people track mud bearing the seeds. Thus, it is important to clean your boots/shoes before you enter the woods to monitor, and again when you are finished.

### **Forest Monitoring Tips**

#### **DO**

carry a first-aid kit.

obtain written access permission from the landowner.

make sure the landowner knows when you are in the forest. Let others know where you will be and when you plan to return.

stay near established trails. Minimize trampling of vegetation.

look out for potential dangers and avoid them.

try to be quiet. The forest is home to many animals that are frightened by humans, particularly by loud noises.

be polite to anyone you encounter in the forest.

wear appropriate clothing.

pick up garbage found in the forest, when possible.

enjoy nature and being outside.

clean all mud off of your boots/shoes before you enter the woods and again when you are finished monitoring.

#### **DON'T**

DON'T attempt to monitor a site without written access permission from the landowner.

DON'T intentionally damage vegetation.

DON'T work alone.

DON'T touch any plant believed to be poisonous. Most plants can be identified without touching them.

DON'T bother animals. Some may be dangerous, and excessive stress may be harmful.

DON'T work during dangerous weather conditions.

DON'T go near waterways during rain. Flash flooding may occur.

DON'T leave anything behind.

## Site Establishment

### **Task:**

Establish forest monitoring site.

### **Purpose:**

Transects are laid in order to mark the site location.

### **Materials:**

*ForestWatch Monitoring Manual*

copy of access permission letter

three 101-m ropes marked at 5- and 10-m intervals

one 20-m rope

2 meter sticks

12 plastic or metal tent stakes

1 hammer or mallet

3 compasses

topographic map, directions and/or site sketch

local road map

### **Get Transects Set Up Ahead of Time!**

Establishing your forest site involves scouting your site for a safe and accessible location with sufficient forest buffer, carefully laying three straight 100 m transect lines and marking them with stakes, and drawing a sketch of the site. This work can take up to one-half day for some sites, so it is recommended that this work not be done on the same day as monitoring.

Don't rush it - take your time and make sure your lines are straight and well-documented on your site sketch.

### **Procedure- Establishing a New Site:**

Beginning from any forest edge or trail, lay the three 100-m transects. The transects will run perpendicular to the edge or trail from which you enter the forest, they will be laid in parallel and spaced 20 m apart, with a 50-m buffer zone on each side and at the far end, and they will be permanently marked with tent stakes. (The 50-m buffer includes the first 50 m of the transects). See Figure 1.

Please note that accurate line placement and being able to re-lay the transect lines in precisely the same location each time you monitor are **essential!** This is the **only way** that data you collect will be useful for identifying trends in forest conditions. Follow the site establishment procedures exactly and carefully document your stake locations on your site sketch.

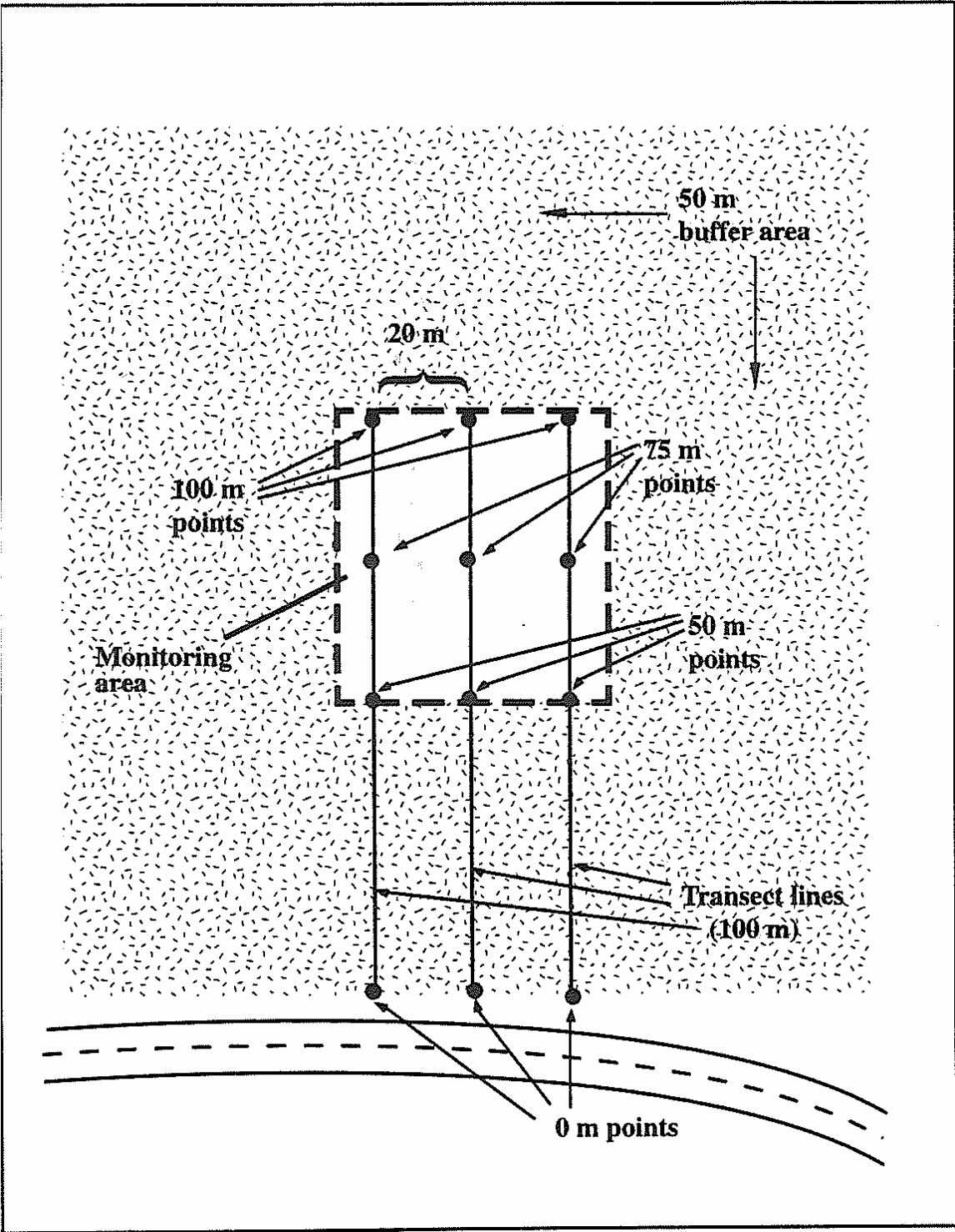


Figure 1. The three transects will be 100 m long and 20 m apart, with a 50-m forest buffer zone along the sides and end of the transects. This will give a 50-m buffer completely around the area that is monitored, since data are only taken from the last 50 m of each transect line.

## **1. Determine the general location of your three transects.**

Go to the site. You need to walk the ground and make sure that there is a place where you can lay three parallel 100-m transect lines spaced 20 m apart, with at least 50 m of forest buffer on each side and at the far end. The minimum dimensions for setting up a site are 150 m deep and 150 m wide.

## **2. Locate the starting point of the first transect.**

When selecting a starting point for your first transect, the important considerations are to find a place that is **easy to get to**, and one which will be **easy to find** in the future. Avoid the temptation to select a starting point based on your impression of what may be “good” or “bad” forest habitat. Also, you need to be sure that you begin where your transects will have at least 50 m of forest buffer on both sides and at the far end. If you are using a global positioning system (GPS unit), you should take a latitude/longitude reading right where you enter the forest, then record these coordinates.

Once you decide where to enter your forest, the starting point of your first transect should be at the interior edge of the crown of the canopy tree that is closest to where you enter. Optionally, you may choose to place the stake near the base of the tree if you feel it would be easier to find in the future. A canopy tree is a tree whose leaf-bearing branches, or crown, reach the canopy, which is the layer of foliage of the tallest trees. Once you have found the nearest canopy tree, look up at its branches, and walk into the forest until you are standing directly under the last of its interior branches (Figure 2).

Tap one of the stakes into the ground at the starting point of the transect. Pick a spot which is easy to find but which is also out of the way so that the stake will not be easily discovered by others or perhaps trip an unsuspecting hiker. Then tie one end of the 101-m rope so that the 0-m mark is right at the stake.

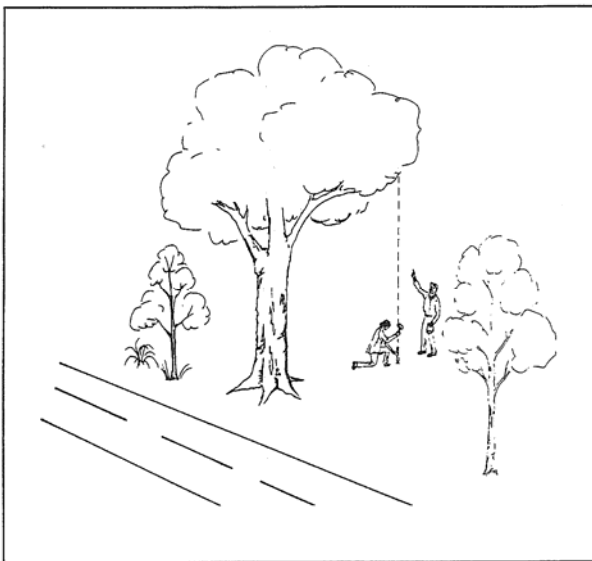


Figure 2. The transect should start a little way into the forest, at the inner edge of the crown of the first large tree that reaches the canopy.

### **3. Determine the direction the transect will follow.**

Determine a direction that is perpendicular to the forest edge or trail from which you entered. Set your compass to determine the precise bearing the transect will follow. To use your compass, simply point the base plate in the exact direction you want to go, and turn the dial (keeping the baseplate still) until the needle is lined up with N on the ring. Determine your bearing from the ring of your compass, and record the bearing on your data sheet.

### **4. Lay the transect line.**

Identify a large tree or other landmark directly on line with your bearing, walk directly toward it with the rope, then repeat as necessary until you reach 100 m.

An easy way to do this is to have one person stand over the stake with the compass and direct a person with the rope, who walks in the direction indicated. The compass director then tells the rope layer to stop when nearly out of sight, so the director can catch up and repeat the process. If a third person is available, have them walk ahead of the rope layer and act as a “target,” standing right on the transect bearing as instructed by the compass director.

Run the 101-m rope from the starting point of the transect to the 50-m point, making sure the line is straight along the compass bearing. Pull the line tight and then drive a stake into the ground at the 50-m point directly under the rope. Attach the rope so that the 50-m mark is right at the stake. Repeat the process from 50 to 75 m, proceeding directly on line with your compass bearing. Pull the line tight, tap the third stake into the ground at exactly 75 m, and attach the rope so that the 75-m mark is right at the stake. Repeat the process from 75 to 100 m, proceeding directly on line with your compass bearing, pull line tight, and tap the 100-m stake into the ground so that the 100-m mark is right at the stake. Finally, mark each stake to identify the site, transect and stake.

#### **Note:**

If a stream or small road cuts right through the area where you are trying to establish your transects, and it would be large enough to disrupt your sampling, move the transects over to one side to avoid running into the stream or road, provided that you still have a 50-m buffer zone on all sides. If this is not possible, you will have to stop monitoring before the stream or road, then continue on the other side. You will have to mark the transect rope at the point where the stream or road begins, then slide the rope forward until the mark on the rope is on the other side, and re-anchor your line.

### **5. Draw a map.**

Draw a detailed map of your site, including the precise location of all stakes. This resource will enable you to find your stakes the next time you monitor.

Make notes on how to locate the stakes at the beginning, middle and end of the transect. Make a sketch of the site showing the location of each stake. Include any distinctive, reasonably permanent landmarks in your sketch, such as proximity to roads, fence posts, road signs, buildings, land forms, streams, rocks, and possibly large trees. Don't use ephemeral landmarks such as a bird's nest or vines which may not last from season to season. (See Figure 3.)

For each stake, locate a distinctive feature close to the stake (a large tree, for example) and determine the compass bearing from the feature toward the stake. You can do this by going to the feature, pointing the direction arrow on the base of the compass at the stake and twisting the dial until the needle lines up with North. The compass bearing will be the number of degrees right below the direction arrow on the compass.

Now, measure the distance to the stake with a meter tape, a 20-m rope, or a meter stick. On your map, you should sketch the feature, the compass bearing, and the distance in meters. Repeat this procedure for two other features for that stake, if available. It is important to identify at least one reference feature for each stake! This information will make the job of finding your stakes much easier in subsequent years.

**Repeat steps two through five for the second and third transect lines.**

The beginning stake for the second transect should be placed exactly 20 m from the beginning stake for the first transect. Use a meter tape or 20-m rope and compass to make sure that you are exactly 20 m from the first stake, on a perpendicular course from the first transect. Then, using the exact same compass bearing as for the first transect, run the second transect parallel to the first.

Laying parallel transects can be challenging. To make sure that you are staying in parallel to the first line as you lay the second line, take the 20-m rope, go back to the 50-m point on the first line, and walking a perpendicular course in the direction of the second transect, measure the correct distance over from the first line. This should also be done at 75 and 100 m. Have a “spotter” stand right on the 50-m spot while the rope is being laid. (If a third person is not available, just measure over and put a stake in the ground at 50, 75, and 100 m before laying the second line). When you are done laying the second transect, the end stake should be exactly 20 m from the end stake for the first transect (stakes may not line up exactly on sites with variable terrain). Now lay the third transect in the same manner, exactly 20 m from the second transect.



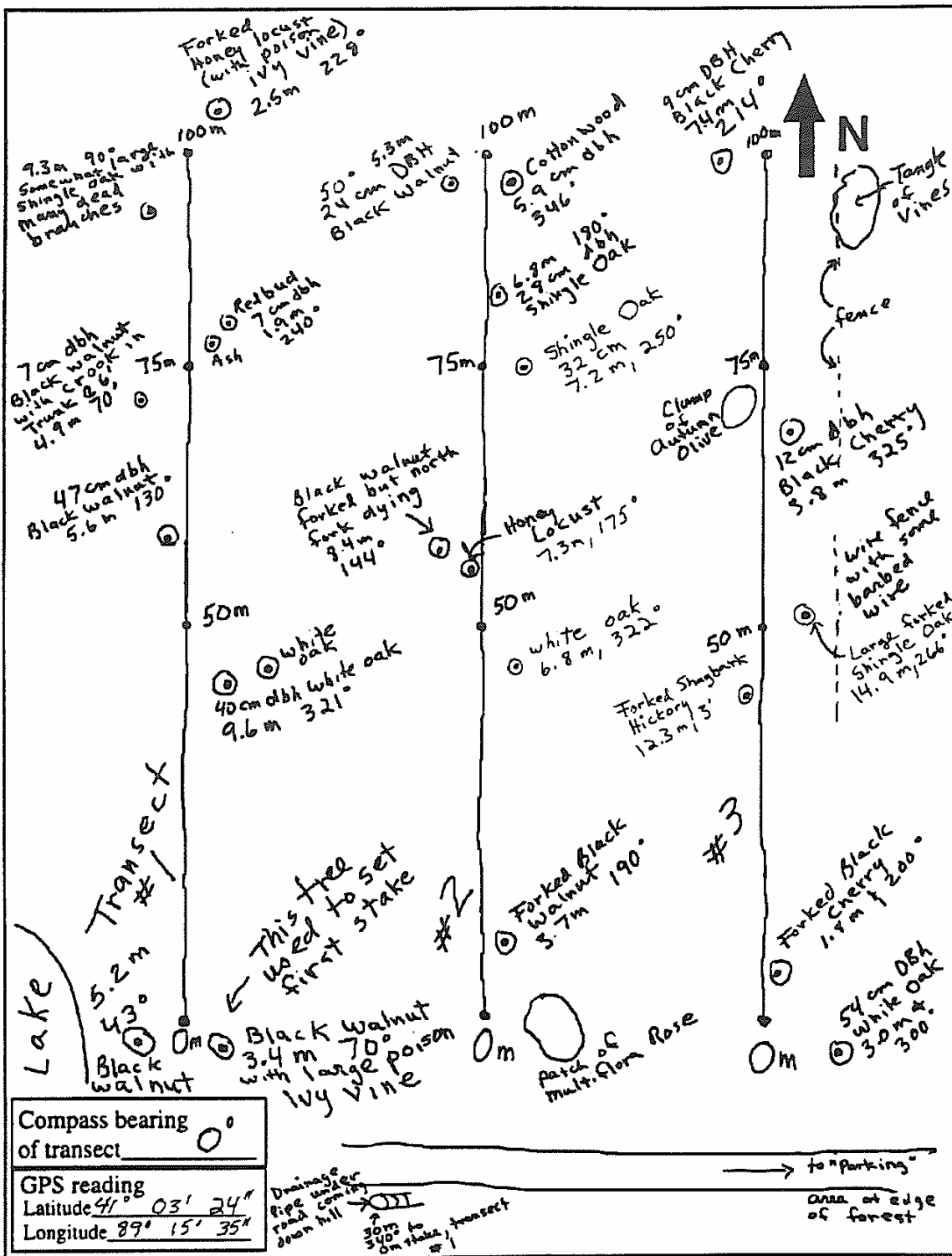


Figure 3. Make a drawing of the site and include all important features that will aid in locating the transects in the future. At ALL the stakes, including those at 50 m and 75 m, include references to landmarks so the stakes can be located again in the future.

### **Procedure Summary: Establishing a New Site**

1. Determine the general location of your three transects.
  - Locate an accessible spot that is 150 m by 150 m.
  - Make sure that the 50 m by 50 m monitoring area is all upland or all bottomland forest.
2. Locate the starting point of the first transect.
  - Spot must be accessible and easy to find.
  - Need 50-m buffer on each side and at end of transects.
  - If using GPS unit, take reading where you enter the forest.
  - Start at interior crown edge of first canopy tree or at base of tree.
3. Determine the direction the transect will follow (should be perpendicular to edge or trail.) Determine exact compass bearing and record on site sketch.
4. Lay the transect line.
  - Have one person with the compass stand over the stake and direct the person with the rope.
  - At 50 m drive stake into ground, pull the line tight, and attach rope.
  - At 75 m drive stake into ground, pull the line tight, and attach rope.
  - At 100 m drive stake into ground, pull the line tight, and attach rope.
  - Move away from obstacles such as streams or roads.
5. Draw a map so that others may find the transect stakes.
  - Sketch the site showing the location of each stake.
  - For each stake, identify nearby features and note distances and bearings from features to stake.
6. Repeat steps 2 through 5 for the second and third transect lines.
  - Each transect is 20 m from the adjacent transect(s).
  - Use 20-m rope and compass to make sure that you are parallel to the other transect(s).

### **Procedure Summary: Re-establishing an Existing Site**

1. Locate the stakes for all three transects on your site. (Use GPS unit to help locate site if GPS readings were taken previously.)
2. Mark the transects with the 101-m ropes. Lines must always be re-laid so that they go directly to the stakes and follow the correct compass bearing!
3. Mark the 50- and 75-m points with a stake, if not already marked.

## Monitoring Procedures

### Tree Survey – Fall Session

#### **Purpose:**

The data collected in this procedure will be used to examine the composition and ages of the different species of trees in the forest. By looking at the mixture of seedlings, saplings, subcanopy trees, and canopy trees, you may be able to tell whether the forest composition is changing, or whether the forest is regenerating. Large shrubs and vines will also be included in this procedure.

One common trend in many Illinois forests is that sugar maples are slowly replacing oak and hickory trees (a process known as “maple takeover”). The most likely explanation for this process is that people have vigorously prevented fires in the state for over a century. Preventing fires allows forests to become extremely dense and overgrown with vegetation. The shade-intolerant oaks and hickories are unable to grow under these conditions, whereas sugar maples are very shade-tolerant and derive a competitive advantage. Oaks and hickories survive fires better and often resprout even when the aboveground stems are killed. Both maple forests and oak-hickory forests are ecologically valuable, and in some forest types maple dominance is perfectly natural. However, many native plants and animals of Illinois are adapted to live in oak-hickory forests with their associated food resources, light levels, nesting/resting areas, and other ecological attributes. Given the ecological value of oak-hickory forests, as well as their aesthetic appeal and resource value, scientists are concerned with the gradual loss of these forests.

The data from this procedure will show the age distribution of trees in the forest. Multi-aged stands of trees provide a diversity of habitats for wildlife and are typical of high-quality woodlands. In contrast, stands of trees which are all the same age allow only particular groups of plants and animals to survive.

Large shrubs, vines, and standing *dead* trees (referred to as “snags”) will also be surveyed in this procedure. Snags represent an important habitat and food source for birds and other forest animals.

#### **Materials (for one transect):**

*ForestWatch Monitoring Manual*

two 10-m ropes marked at 5 m (see figure 4)

2 meter sticks with DBH interval marks

tree identification key

pencils

clipboard

Tree Survey data sheet (plus some extras)

airtight plastic bags or plant press for specimens, specimen labels

binoculars

10 wire flags

hand lens (optional)

50-m tape (optional)

### Procedure:

On three transects between 50 and 100 m, you will identify trees to genus or species and measure their trunk diameter at breast height (DBH). All trees with a DBH  $\geq 5$  cm and within 5 m of the transects are recorded in this procedure. Any shrub or vine encountered with individual stems  $\geq 5$  cm DBH will also be included in this procedure if it is rooted within 5 m of the transect.

Go to the 50-m point of the first transect. One person will record data, while others identify and measure DBH of trees, shrubs and vines. It is helpful to have one ID/DBH person working on each side of the transect.

Walk along the transect from the 50-m point toward 100 m, working in each 10-m interval, and **record the name and DBH class for all trees, large shrubs and large vines within 5 m on either side of the transect (10 m-wide belt) and  $\geq 5$  cm DBH. Also record DBH for all snags  $\geq 5$  cm.** Trees that are on the edge of the 10 m-wide belt are not tallied if the trunk base is less than half-way inside the 10 m-wide area. **Use wire flags to mark the edge of the 10 m-wide sampling area.**

### Tips for Monitoring Trees

Be sure to count only those trees, shrubs, and vines that lie within 5 m of the transect line! To help keep the sampling area well-defined, we strongly recommend the use of wire flags to mark corners of each 10 m by 10 m plot. To do this, lay out two 10-m ropes at the start and end of each 10 m segment, perpendicular to the transect line. (Make sure that the middle of each 10-m rope crosses over the transect line; see Figure 4.) Wire flags are then placed at the corners of each 10 m by 10 m plot (5 m to each side of the transect line) to define the sampling area. Simply run out and line up the corner flags with any tree that appears to be near the edge of the 10 m-wide sampling area, and determine whether the trunk base is more than half-way inside the plot. Alternatively, you can just measure out to the tree using a meter stick or one of the 10-m ropes.

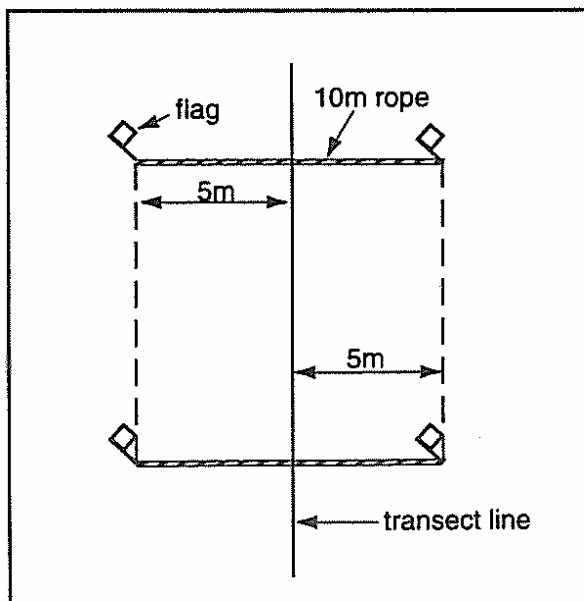


Figure 4. Use 10-m ropes to set wire flags on the corners of each 10-m by 10-m plot. Use the flags to make sure that only trees, large shrubs, and large vines that are within 5 m of the transect line are counted.

For every leaf-bearing tree, large shrub or large vine that is within 5 m of the transect line and has a DBH  $\geq$  5 cm, you will perform the following steps.

### **1. Identify the Tree, Large Shrub or Large Vine.**

#### **Trees—**

You will identify all trees either to genus or to species. If you cannot identify the tree to species with confidence, identify and record the tree to the *genus level*.

If you can't reach a leaf-bearing twig, or collecting is not allowed by the landowner or land manager, identify the tree to the level to which you are confident. Note your inability to access a specimen on the data sheet and include a written description of the tree.

Several oak species can be difficult to distinguish from one another and often have leaves that are unreachable. Try looking for acorns under the tree in question; often acorns are very helpful in identifying oaks.

#### **Large Shrubs—**

You will also be looking for large shrubs ( $\geq$  5 cm DBH) rooted within 5 m of the transect. Very few shrubs will be found with a DBH  $\geq$  5 cm. Stem counts are tallied individually for the following invasive shrubs.

- **bush honeysuckle** (*Lonicera* spp.)
- **common and glossy buckthorn** (*Rhamnus cathartica* and *R. frangula*)
- **multiflora rose** (*Rosa multiflora*)
- **European high-bush cranberry** (*Viburnum opulus*)
- **autumn olive** (*Elaeagnus umbellata*)
- **Missouri gooseberry** (*Ribes missouriense*)

All other large shrubs (including *native* buckthorn, if encountered) will be coded as “Other Shrub.”

#### **Large Vines—**

You will also tally all large woody vines ( $\geq$  5 cm DBH) rooted within 5 m of the transect. Vines are plants that wrap around trees or trail along the ground. Large vines will be counted as a group and not identified further; record as “Vine.” Count each vine once, at the point where it is rooted.

**What's the Difference Between a Tree and a Shrub?** A tree is a woody plant which has a single stem or trunk coming out of the ground. Trees usually grow to a height of at least 12 feet (3.5 m), and they branch well above the ground. A shrub is a woody plant that is multiple-stemmed at or near the base. Shrubs seldom attain a height greater than 10 feet (3 m). Some woody plants do not neatly conform to these definitions.

#### **No Need to Panic!**

While there are over 250 species of trees in Illinois, most forest sites will have a relatively small number of species (e.g., 10 to 20); once you have learned to identify the limited number of species present on your site, tree identification will be much easier. The use of recognized tree keys, such as *Tree Finder* by May Watts, will help with identification. For a brief introduction to tree identification, refer to the appendix entitled, “Tree Identification Basics.” Remember, tree identification is a developed skill: it is essential that you practice identifying trees before you monitor.

## 2. Measure DBH.

All trees, other large woody plants, and snags  $\geq 5$  cm DBH are recorded in the following DBH (cm) size classes:

A	B	C	D	E	F	G(#cm)
5-10	10.1- 20	20.1- 30	30.1-40	40.1-50	50.1-60	> 60

For trees  $> 60$  cm DBH, the exact DBH is measured (to the nearest whole cm).

For trees, large shrubs and large vines with a DBH less than 60 cm, you don't need to measure the exact diameter; you only need to find out the DBH *interval* in which they fall. For example, it makes no difference whether a tree is 12 cm or 13 cm DBH – either way, it falls in DBH class “B.” The use of meter sticks on which the DBH intervals have been clearly marked will make it easy to quickly determine the correct interval. (See Equipment Section.) If a tree's DBH is exactly 5 cm, or exactly 10 cm, this tree is included in size class A. You may encounter a tree with a trunk that is noticeably noncircular in cross-section. In this case, take the average DBH of two measurements - one from the widest angle, one from the narrowest angle.

### DBH - Diameter at Breast Height—

You will measure the diameter of the tree or shrub at a height of exactly 1.3 m above the ground. This measurement is known as “diameter at breast height,” or DBH, and it is a universally accepted method of tree measurement. Measuring the trees at this height standardizes your measurement so that it can be compared to trees measured by others. Before you begin monitoring, measure your own body with a meter stick and carefully note where your own personal 1.3-m mark is. Use this as a reference when measuring trees.

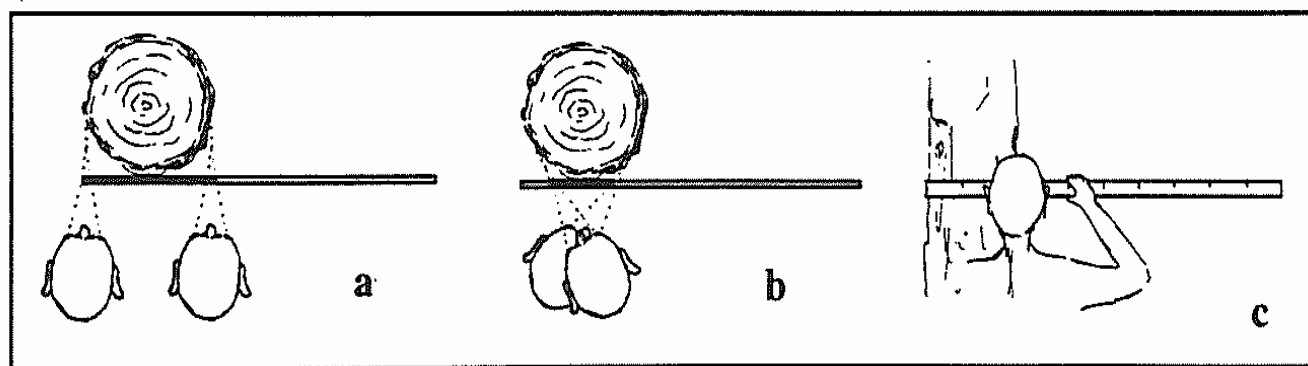


Figure 5. Avoid problems with parallax by making sure that the two lines of sighting are parallel (a). If the lines of view are not parallel, the measurement will not be accurate (b). The shaded areas of the meter sticks (a and b) show the diameters that would be read. With the meter stick held at breast height, lean over to view it at eye level with the line of sight perpendicular to it (c).

Most trees will be easy to measure, but some will be odd- or irregularly shaped. For example, a tree that has a branch coming out 1.3 m above the ground will have a diameter much larger than if the branch wasn't coming out at that height. Also, some trees may have more than one trunk at 1.3 m; count each trunk separately, and record DBH separately for each trunk. Use Figure 6 to guide you on how to adjust for various irregularities.

Large shrub stems should be counted and measured separately at 1.3 m, as should large vine stems, if they are within 5 m of the transect.

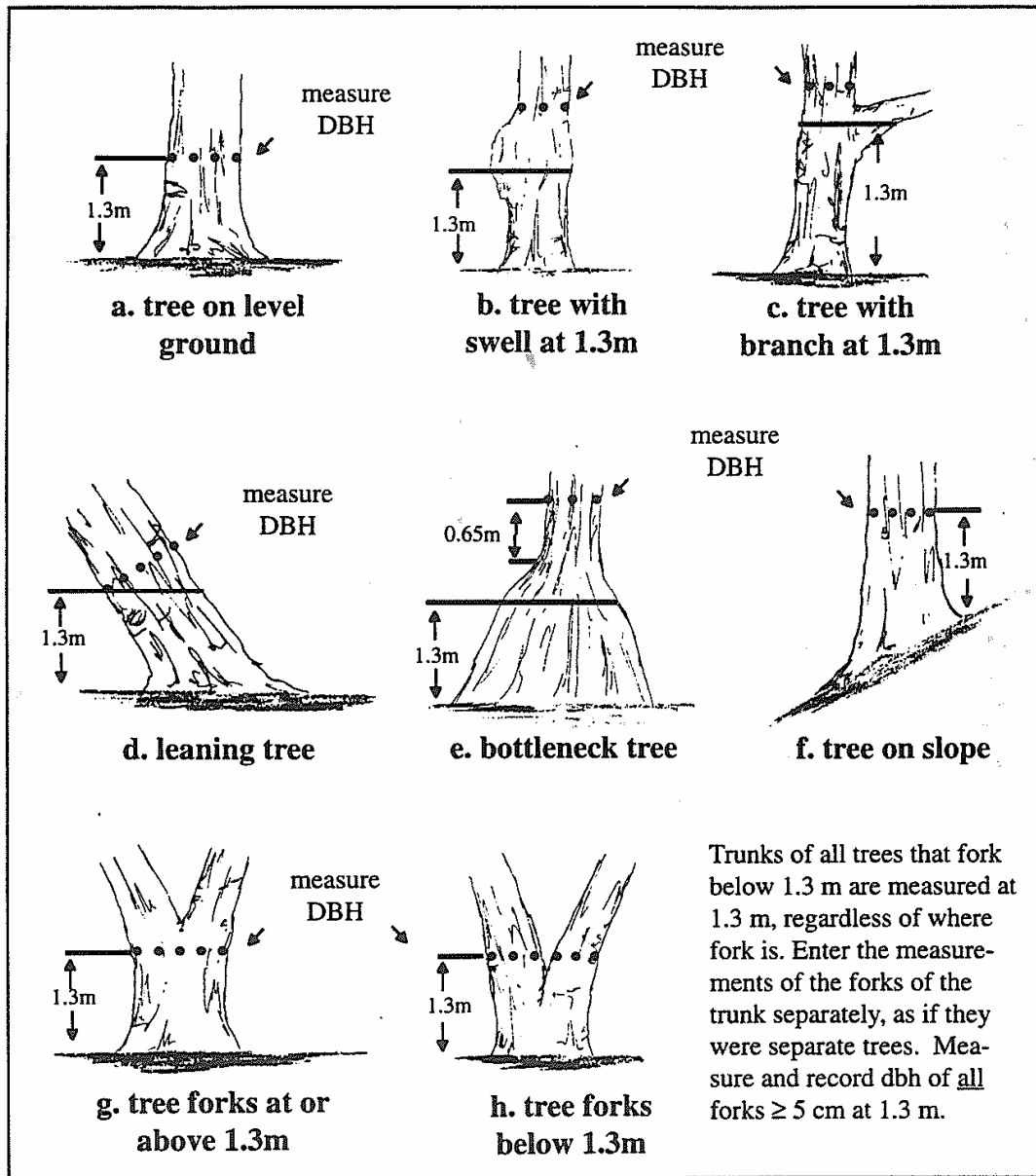


Figure 6. Use this chart to help decide where you should measure the DBH (diameter at breast height) of the tree.

### 3. Count Snags

As you conduct the tree survey, count all standing dead trees and shrubs,  $\geq 5$  cm DBH and within 5 m of the transect. Record as “snags” (do not attempt to identify) and use the data code for snags listed on the Tree List. Also record the DBH using the DBH size classes used for living trees.

#### **4. Record Data**

You will record data on tree, shrub, and vine names and DBHs for each 10-m transect interval between 50 and 100 m. Enter the letter (A through G) which represents the appropriate DBH size class for that tree/shrub/vine, and record the exact DBH in the column “DBH > 60 cm” if the plant is greater than 60 cm DBH.

#### **5. Repeat this procedure for all trees, large shrubs and vines, and snags in each 10-m interval between 50 and 100 m.**

#### **6. Calculate the total number of trees, large shrubs and large vines in each DBH size class.**

#### **7. Repeat steps on the second and third transects.**

### **Procedure Summary: Tree Survey**

**On each of three transects between 50 and 100 m you will:**

1. Identify and measure DBH for all trees, large shrubs and vines, and snags  $\geq 5$  cm DBH and within 5 m of the transect (10-m wide area).
  - Identify each tree, large shrub, or large vine. If a woody plant is not listed, count it as an “Other Shrub” or “Other Vine.”
  - Measure the plant’s “diameter at breast height” (DBH), which is 1.3 m from the ground.
  - For trees with more than one trunk at 1.3 m, and for all large shrubs, count each trunk or stem separately and record DBHs separately for each.
2. Count and record as “snags” all standing dead trees and shrubs  $\geq 5$  cm DBH and within 5 m of the transect. Do not identify. Also record DBH class.
3. Record the data in 10-m transect intervals using the DBH classes (A-G) and also record the exact measurement if  $> 60$  cm DBH.

#### **Shrub Layer Survey - Fall Session**

Purpose:

The data collected in this procedure will be used to examine the structure of the forest shrub layer, and also to monitor the presence and extent of invasive and non-native shrub species. Since the number of shrub, sapling and vine stems is usually much greater than the number of large trees in a given area, a much smaller area is required to obtain a sufficient sample.

The shrub layer is an important component of the forest ecosystem, in part because it provides important habitat for many species of birds and other organisms. In addition, shrubs represent over one-half of the woody plant taxa found in Illinois forests (284 shrub taxa). Thus, shrubs are an important component of the plant diversity of the forest.

The shrub layer consists of several different forms of woody plants. Woody plants are plants whose stems and roots are long-lived and increase in size from year to year.



Shrub layer woody plants include shrubs, vines, and tree saplings. Shrubs are multiple-stemmed at or near the base of the plant. Trees have one main stem (trunk). Vines are plants that wrap around trees or trail along the ground.

The shrub layer is particularly vulnerable to intrusion by non-native, or “exotic,” shrubs and vines. Non-native shrubs pose a serious threat to Illinois forests because they are particularly aggressive and often crowd out a variety of native plants that would otherwise grow in the area. As a consequence, biodiversity is reduced. Species of buckthorn are a major problem in northern Illinois, while multiflora rose and various honeysuckle species are a major problem in forests throughout the state. Even some species of native shrubs, such as gooseberry, can invade or spread throughout the forest after a disturbance, causing many of the same problems as non-native shrubs.

**Materials (for one transect):**

*Forest Watch Monitoring Manual*

2 meter sticks

tree key

pencils

clipboard

Shrub Layer Survey data sheet

**Procedure:**

In this procedure, one person, the “counter,” walks along the transect counting shrub, vine and sapling stems and identifying the plants. The other person, the “recorder,” follows along and records the data on the data sheets, and helps keep track of the number of stems and plant species.

Stem counts are tallied individually for the following invasive shrubs:

- **bush honeysuckle** (*Lonicera spp.*)
- **common and glossy buckthorn** (*Rhamnus cathartica* and *R. frangula*)
- **multiflora rose** (*Rosa multiflora*)
- **European high-bush cranberry** (*Viburnum opulus*)
- **autumn olive** (*Elaeagnus umbellata*)
- **Missouri gooseberry** (*Ribes missouriense*)

All other large shrubs (including *native* buckthorn, if encountered) will be coded as “Other Shrub.” Some species of honeysuckle grow as vines. You will count the stems of **Japanese honeysuckle** (*Lonicera japonica*) under the VINES category on the data sheet. All other vine species encountered during the procedure are identified as “Other Vine.” Tree saplings are identified to the level indicated. Snags are not included in the shrub layer survey.

Note that some shrubs, such as buckthorn, multiflora rose, gooseberry, blackberry and raspberry will grow in both single- and multiple-stem form. All shrub taxa should be counted as shrubs regardless of the number of stems.

**Note:**

There is one native species of buckthorn, the Carolina buckthorn (*Rhamnus caroliniana*) that occurs in southern Illinois. If this plant is encountered, it should be recorded as an “Other Shrub” on the data sheet.

## **1. Determine 1-m height using your body as a reference.**

Take a meter stick, stand it on the ground next to you, and carefully note how high the end of the stick reaches on your body. For some people, this will be approximately waist-height; for others, it may be higher up near the ribs. You will need to remember your own personal “1-meter mark” for the following procedure.

## **2. Count all shrub, woody vine, and tree sapling stems < 5 cm DBH that are at least 1 m tall and within 1 m of the transect line (2 m-wide belt).**

Go to the 50-m point of the first transect. Take two meter sticks, place them together end to end, and hold them perpendicular to the transect line at a height of 1 m.

Now walk right on the transect line toward the 60-m point, and proceed until a woody stem touches the meter sticks. (For “border line” stems that are around 1 m in height, stand the meter stick up next to the stem to determine whether it is  $\geq 1$  m tall.) If the stem is less than 5 cm DBH and is rooted within the 2 m-wide belt, then it is included in this survey. Count the stems as follows:

- Shrub stems are identified as one of the listed shrub taxa or as “Other Shrub.” Count the number of stems rooted in the 2-m area that have branches that are at least 1 m tall. Follow the stem down to the ground level (“basal stems”) and count the stems there, and not at the 1-m level. You will count all basal stems that have branches that touch the meter sticks. See Figure 7.

Some shrub stems will branch right at or near the ground. For these stems you must carefully observe where the stems split--count the stems right **at** the ground level. You may need to wisk away the leaf litter to determine if the stems branch above ground. Use your best judgment to determine if the stems branch above ground; if they do, just count as one stem. If more than one stem is coming out of the ground (and they each hit the meter stick at 1 m), count each stem individually. If a shrub had stems  $\geq 5$  cm DBH that were included in the tree survey, but the shrub also has stems  $< 5$  cm DBH coming out of the ground, count the  $< 5$  cm stems as you would a normal shrub in the shrub procedure, i.e. at ground level.

To touch the meter sticks, stems must be at least 1 m tall and within a 2-m wide belt centered on the transect line. The plants must also be rooted within the 2-m area to be included in the count.

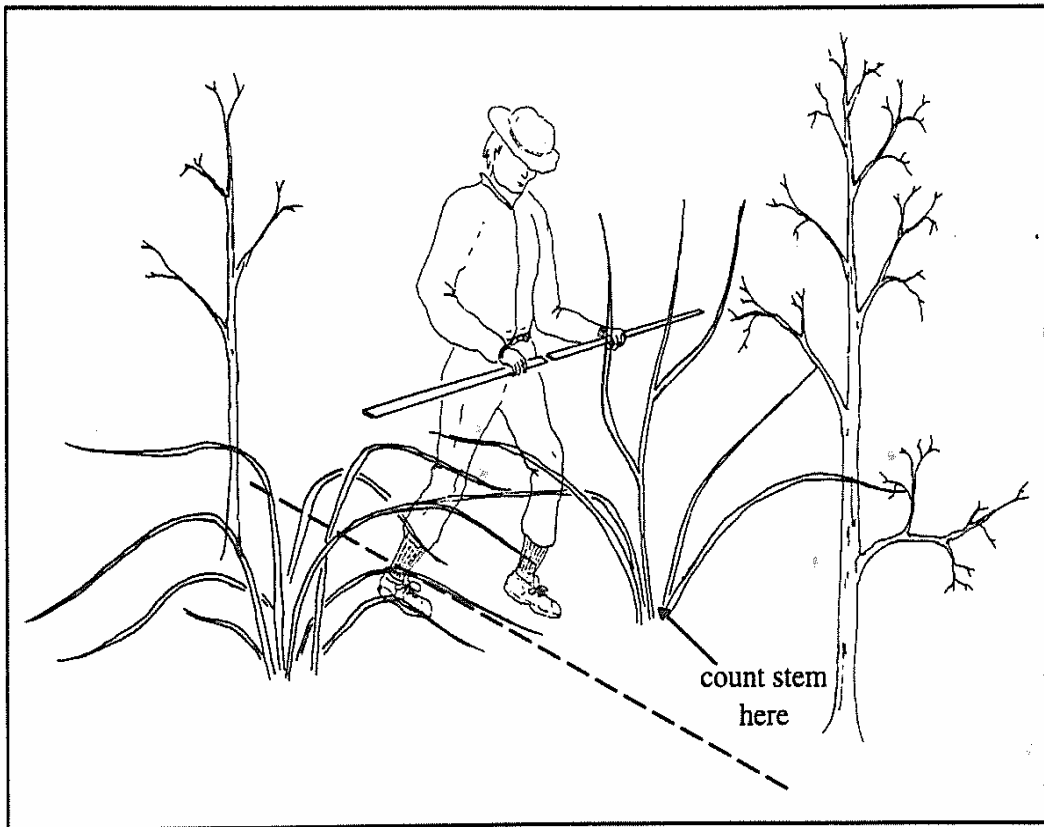


Figure 7. Count the number of basal stems rooted in the two meter-wide area that have branches touched by the meter sticks, at 1 m above the ground. In this figure, two stems hit the meter sticks, but they have only one basal stem.

- Vine stems are identified as Japanese honeysuckle or “Other Vine.” Count the number of vines that are rooted in the 2-m area that have stems touching the meter sticks at the 1-m height. Count vines at ground level as with shrubs. **Avoid touching any vine—it might be poison ivy.**
- Tree saplings that are rooted in the 2-m area and that touch the meter sticks are identified using a tree key, and then counted. DBH is not recorded for saplings < 5 cm. Also, note that if a sapling forks below 1.3 m it is still counted as one sapling.

### Counting Resprouts

In some cases trees and shrubs will send up stem resprouts, or stems that grow out of the base of an old trunk. This may occur naturally, or it may be due to a trunk being cut. If you encounter a stem resprout when monitoring the shrub layer, for trees count each stem coming from the same plant individually, but for shrubs count all stems coming up from the same plant as only one stem.

**3. Repeat the above procedure in the remaining transect intervals until you reach 100 m.**

**4. Calculate TOTAL STEMS for each type of plant identified on the transect, then record.**

**5. Repeat steps two through four on the remaining two transects.**

**NOTE:**

Two non-native woody vines, **kudzu** (*Pueraria lobata*) and **Oriental bittersweet** (*Celastrus orbiculatus*) are spreading rapidly in the state and are becoming a major concern.

Kudzu is a high-climbing twining vine with alternate, compound leaves with three toothless, sometimes palmately lobed leaflets. Kudzu has violet flowers that are borne in clusters in late summer/early fall, and are said to smell like grape Kool-Aid. Oriental bittersweet is also a high-climbing twining vine, with alternate, simple leaves that are very broad and nearly round with small rounded teeth. Its white flowers bloom in May or June, and flower clusters are located in the leaf axils. It can be distinguished from the native climbing bittersweet (*C. scandens*) which has flowers in terminal clusters on branchlets and more elongate, ovate leaves about twice as long as wide.

### Procedure Summary: Shrub Layer Survey

**On each of three transects between 50 and 100 m, you will:**

1. Count all shrub, woody vine, and tree sapling stems < 5 cm DBH that intersect the 2 m-wide belt transect at a height of 1 m. To be counted, all stems must be rooted within the 2-m belt.
  - Walk on the transect line until a stem touches the meter sticks. If the stem is < 5 cm DBH and is rooted within the 2 m-wide area, then it is included in the survey.
  - Shrub stems are identified and then counted at ground level (“basal stems”), not at the 1-m level. Count all basal stems that have branches that touch the meter sticks. If a basal stem branches above ground level, count as one stem.
  - Vine stems are identified as Japanese honeysuckle or “Other Vine,” then counted at ground level.
  - Tree sapling stems are identified then counted. (DBH is not recorded for < 5 cm saplings.)
2. Record stem counts in the correct intervals on the data sheet.
3. Once finished with a transect, calculate/record total stems in the TOTALS box for each type of plant.
4. Note presence of kudzu or Oriental bittersweet.

### Vegetative Shading Survey - Fall Session

**Purpose:**

Light levels on the forest floor have a direct impact on the understory species that grow there. Early-blooming spring ephemeral wildflowers have adapted to low-light conditions in some forests by growing and blooming before the tree canopy, subcanopy, and shrub layers are filled out, although some invasive species green up early and compete for sunlight with the spring

ephemerals. Other herbaceous ground layer species are summer-blooming plants that require some amount of direct sunlight in order to survive. In addition, some species of trees, such as many oaks and hickories, require direct sunlight in order to germinate and grow. Thus, light levels in the understory will directly affect the suitability of a forest or woodland as habitat for many species of plants.

Light levels in the forest understory may be the result of many possible factors. The tree canopy and subcanopy may be thinned due to air pollution, disease, insect outbreaks, storm damage, drought, or old age. The suppression of fire, and the resultant takeover effect of invasive trees and shrubs, can dramatically reduce light levels in the understory, often to the detriment of many native plant species that formerly grew there. Many restoration activities are directed at overcoming the adverse effects of fire suppression and invasive woody plant encroachment, such as prescribed burning and selective tree and shrub removal. The result is a thinning of canopy, subcanopy and shrub vegetation, thereby increasing light levels in the understory. Shading is also a function of forest type. By monitoring canopy, subcanopy and shrub layer vegetation at your forest site, you will be helping scientists to look beyond the normal year-to-year changes that may occur, and to identify long-term changes in forest light levels that may help to explain changes in the plant community and also reveal any signs of stress.

**Materials (for one transect):**

*ForestWatch Monitoring Manual*

ocular tube

meter stick

pencils

clipboard

Vegetative Shading Survey data sheets

**Procedure:**

You will measure vegetative shading along each of three transects using an ocular tube, which is a viewing tube with cross-hairs at one end. (To make an ocular tube, see Appendix E.) You will walk along each transect from 50 to 100 m and note the presence (+) or absence (-) of canopy, subcanopy, and shrub vegetation directly overhead.

It is important that you keep your eyes closed until the tube is pointing straight up, in order to minimize bias. (With your eyes open, you may be tempted to select a spot.) Also, be careful not to move the tube once you have opened your eyes.

## **1. Measure tree and shrub cover along the first transect.**

Go to the 50-m point of the first transect.

Using your meter stick, measure to the 52-m point, then stop.

Close your eyes, and with the tube at your eye, tip your head back until the tube is vertical.

Now open your eyes, and observe whether vegetation (leaves or branches) appears directly in the center of the crosshairs. See Figure 8. Include vegetation associated with mature trees, tree saplings, shrubs, or vines. Do not include any herbaceous (non-woody) vegetation that may be tall enough to obstruct your view upward.

Record presence (+) or absence (-) of vegetation, then move on to 54 m and repeat.

Record measurements every two meters along the transect between 50 and 100 m (25 readings total per transect), beginning at the 52-m mark and ending at 100 m.

## **2. Repeat the same procedure on the second and third transects.**

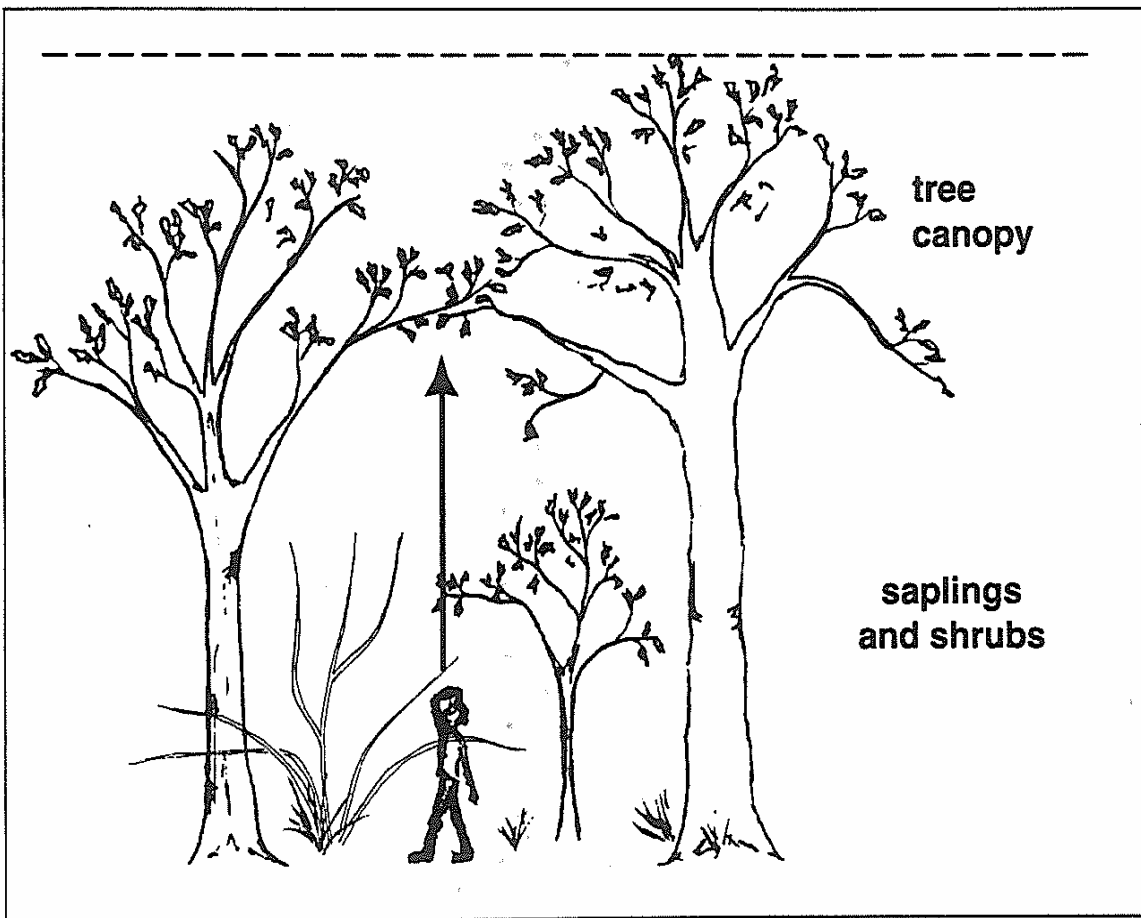


Figure 8. To measure vegetative shading, record all tree, sapling, shrub or vine “hits” when looking straight up. If your view is obstructed by herbaceous (non-woody) vegetation, move slightly to the side and try again.

## Procedure Summary: Vegetative Shading Survey

**On each of three transects between 50 and 100 m, you will:**

1. Walk along each transect and, using an ocular tube, note the presence (+) or absence (-) of vegetation directly overhead. At each observation point:
  - Close your eyes and tip your head back, with the ocular tube at your eye.
  - Open your eyes and observe whether vegetation appears directly in the crosshairs.
  - Record presence or absence as a “+” or “-,” respectively.
  - Be careful not to count herbaceous (non-woody) vegetation.
2. Start at 52 m and record data every 2 m, to and including 100 m (25 readings total per transect).

### **Forest Conditions - Fall Session**

#### **Purpose:**

You will look for signs of two harmful conditions in Illinois forests; dogwood anthracnose and gypsy moths.

#### **Dogwood Anthracnose**

Flowering dogwood (*Cornus florida*) is an understory tree (up to 12 meters, or 40 feet tall) that is widespread in central and southern Illinois woodlands. It is considered by many to be one of Illinois’ most beautiful flowering trees. Its fruit is an important food source for birds, squirrels, and other wildlife.

Flowering dogwoods in Illinois are currently under attack by an exotic disease known as *Discula anthracnose*. It is caused by an Asian fungus (*Discula destructiva*) that was first noticed on the east coast of the United States in the late 1970s. The disease has been spreading across the U.S. and is known to occur in Illinois.

Flowering dogwood saplings less than 4 cm DBH are often killed, leaving no young trees to replace older ones when they die. Dogwood anthracnose spreads quickly during cool, wet weather.

Although little can be done at present to prevent the spread of the disease in a forest, it is important to monitor its presence in forests around the state and document the change in composition of forest trees as the flowering dogwoods become less common.

#### **Gypsy Moth**

The gypsy moth, an insect native to Europe, was accidentally introduced in the U.S. around 1869. It has spread mostly by hitch-hiking on firewood, lawn furniture, and camping and recreational vehicles. It has become widespread in the northeastern U.S. where it is a major defoliator in forests. The gypsy moth is also established in Michigan and Wisconsin, and is present in the northernmost counties in Illinois. Although the Illinois Department of Agriculture

is taking measures to slow the spread of gypsy moths, it is likely to eventually become widespread throughout the state.

Gypsy moth caterpillars feed on many species of trees, but the preferred food plants are oak, apple, alder, aspen, basswood, hawthorn, and birch. It also will feed on beech, cherry, black gum, hemlock, hickory, hornbeam, larch, maple, pine, sassafras, and spruce. Trees not normally fed upon include ash, butternut, black walnut, catalpa, red cedar, dogwood, holly, locust, sycamore and tulip tree.

When present in large numbers, gypsy moth caterpillars defoliate trees. This process will kill evergreens, but deciduous trees usually put out new leaves. Successive years of defoliation will severely weaken the trees and make them susceptible to being killed by other insects and diseases. By establishing a baseline of tree species, size and abundance before the moth becomes established, monitoring when the moth moves into a forest, and then monitoring the forest after establishment, the impact of the gypsy moth on forest composition can be evaluated over time. This procedure also provides the opportunity to find egg masses and have professionals remove them, thereby reducing the risk of colonization.

**Materials (for one transect):**

*ForestWatch Monitoring Manual*

10-m rope marked at 5 m

1 meter stick

pencils

clipboard

Dogwood Anthracnose/Gypsy Moth data sheet

**Procedure:**

The following two procedures can be done on the same trip down the transect line to minimize trampling.

**1. Dogwood Anthracnose**

Damage caused by dogwood anthracnose can be recognized and distinguished from other diseases by the numerous “water sprouts” on the trunk and lower limbs of the tree. Water sprouts are small, abundant, succulent stems, often produced along the main trunk and larger branches of a tree. The tree may have large areas of dead, curled leaves that do not drop from the tree (Figure 9).

Infected branches are likely to appear on the lower parts of the tree first. Leaves develop tan spots with purple borders. On the underside of the infected leaves there are pinhead-sized tan to brown dots which further distinguish this infection from other diseases. Be careful not to report normal fall leaf drop as anthracnose.



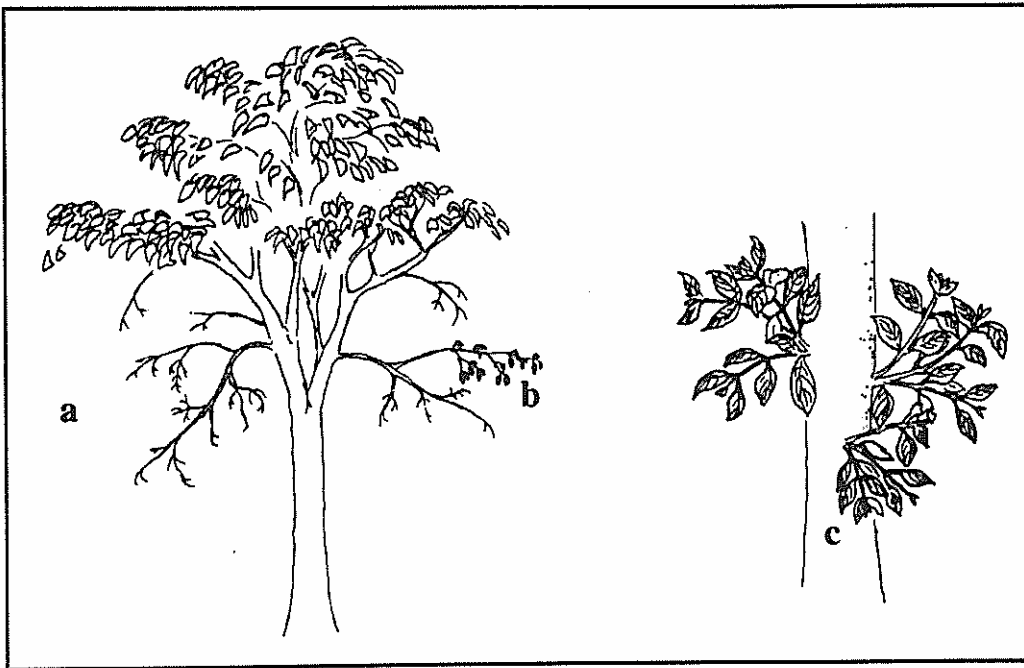


Figure 9. Dogwood anthracnose can be recognized by (a) dead branches on the lower portions of the tree, (b) dead leaves remaining on the branches, and by (c) the presence of water sprouts on the trunk and main branches of the tree.

## **2. Gypsy Moths**

Walk along the transect from 50 to 100 m, and carefully observe the trunks of all trees within 5 m of the transect and with a DBH  $\geq$  5 cm for signs of gypsy moth egg masses.

### Note:

If you find any gypsy moth egg masses, you should place a wire flag next to the tree and call the IDNR and report it. Do not try to remove the egg masses; they will be verified by professional entomologists.

Gypsy moth egg masses contain from 100 to 1000 eggs. The mass is about 1 ½ inches long and about ¾ inches wide. It is covered with buff or yellow hairs from the female moth. If the masses are white or gray instead of yellow, they are not gypsy moth eggs. The egg masses can appear anywhere on the tree. On each tree, search the entire trunk for gypsy moth egg masses.

## **3. Repeat steps one and two on the remaining two transects.**

## **4. Upland/Bottomland**

Based on the topography, tree species composition, and other factors of your site, record whether the site is upland, bottomland, or if you are unsure.



Figure 10. Gypsy moth egg masses are buff or yellow colored and can appear anywhere on the tree.

### **Procedure Summary: Fall Forest Conditions**

- Check each individual dogwood found for evidence of dogwood anthracnose. Record the number of trees with anthracnose by transect interval.
- Walk along the transect from 50 to 100 m, and carefully observe the trunks of all trees within 5 m of the transect and with a DBH  $\geq$  5 cm for signs of gypsy moth egg masses. For each tree on which a gypsy moth egg mass is found:
  - Record tree code, exact DBH in cm, and exact location of the tree on the data sheet.

### **Ground Cover Survey - Spring Session**

#### **Purpose:**

Monitor the presence and percent cover of both native and non-native plant species found in the ground cover of the forest. The measurement of percent cover is a standard method used by botanists and plant ecologists to estimate the abundance of ground layer species. Native plant species are those that were historically present in Illinois prior to European settlement, while non-native species are those that did not originally grow in Illinois and probably dispersed here after Europeans settled the area. “Disturbance-sensitive” native plant species are important indicators of the relative ecological integrity of the forest, as these species are known to be particularly sensitive to human disturbance, and their presence generally indicates that the forest is of high quality. Tracking the presence and coverage of these plants is one good way to monitor changes in the ecological condition of Illinois’ forests.

Monitor presence and percent cover for several additional native ground cover species which are not generally disturbance-sensitive, but which may provide useful information regarding the composition of the ground layer in your forest. Most of these are relatively common wildflowers in Illinois forests. As with the disturbance-sensitive species, the reason that these plants must be monitored in spring is that most of them are “spring ephemerals,” so-called because they are in bloom only for a short period in spring, before the tree canopy fills in and blocks out the sunlight.

A third group of ground layer plants you will look for is non-native, or “exotic,” plant species. At present, over 25 percent of the plant species in Illinois are not native to the state. A small number of exotics are particularly aggressive and often crowd out a variety of native plants that would otherwise grow in the area, reducing biodiversity in the process. For example, garlic mustard (*Alliaria petiolata*), a plant that is originally from Eurasia, now grows in many of Illinois’ forests where it outcompetes native ground cover species. Tracking the presence and coverage of non-native ground cover species will indicate the extent to which Illinois forests are undergoing ecological degradation in the ground layer.

**Materials (for one transect):**

*ForestWatch Monitoring Manual*

two 10-m ropes marked at 5 m

1 meter stick

1 PVC or wood quadrat ( $\frac{1}{2}$  m by  $\frac{1}{2}$  m, or  $\frac{1}{4}$  m<sup>2</sup> in size)

wildflower field guide

pencils

clipboard

Percent Cover data sheet

**Procedure:**

On each transect, you will identify and estimate percent cover for selected species of native and non-native ground cover plants in ten  $\frac{1}{4}$  m<sup>2</sup> quadrats.

You will also determine presence/absence for several disturbance-sensitive and non-native species over a 10-m wide area along each transect. The presence/absence survey is not designed to characterize dominance, but some of these species are rarely encountered in the quadrat sampling, and looking for them over a larger area increases the probability that they will be found if present on your site. The procedure also helps document the spread of invasives. **To minimize the risk of trampling in the quadrats, always complete your quadrat monitoring on a given transect before doing the presence/absence monitoring over the larger area!**

**What is a Quadrat?**

A quadrat is a small square frame used to mark the plot for measuring ground vegetation. The procedures described in this manual use  $\frac{1}{4}$  m<sup>2</sup> quadrats, which measure  $\frac{1}{2}$  m on each side. They can be made of either  $\frac{1}{2}$ -inch PVC or 1- to  $1\frac{1}{2}$ -inch wide pieces of wood.

**Be on the lookout for poison ivy** when conducting the ground cover survey, and try to avoid touching the plant. If you find some where you are placing your quadrat, carefully place the frame around the plants without touching them. Also, if you are monitoring a bottomland forest, learn what **stinging nettle** looks like, so that you will be able to avoid contact with this plant.

### **1. Set up the first $\frac{1}{4} \text{ m}^2$ quadrat.**

Quadrats must be set at precise locations along the transect, 1 m off of the transect and on alternating sides. The first two quadrats are always placed to the left of the transect, the second two quadrats are always placed to the right, the third two to the left again, and so on along the 50- to 100-m section of the transect.

Gather all equipment for this procedure and go to the 50-m point of the first transect. Locate the first quadrat by going to the 55.0-m mark, which should be marked red. Measure out 1 m on the left-hand side of the transect (when facing toward 60 m), and place the quadrat precisely in the area bounded by 55.0 m and 55.5 m along the transect, and bounded by 1 and 1.5 m out from the transect, as show in Figure 11.

If a large tree or shrub is located within the  $\frac{1}{4} \text{ m}^2$  area in which you are to place your quadrat frame, detach one side of the frame and place it around the tree or shrub, but in the specified area. Any tree or shrub which exceeds 1 m in height will not be counted as part of this procedure. If a large tree trunk or shrub stem is in the quadrat area, you will still make your percent cover estimates based on the entire  $\frac{1}{4} \text{ m}^2$  area.

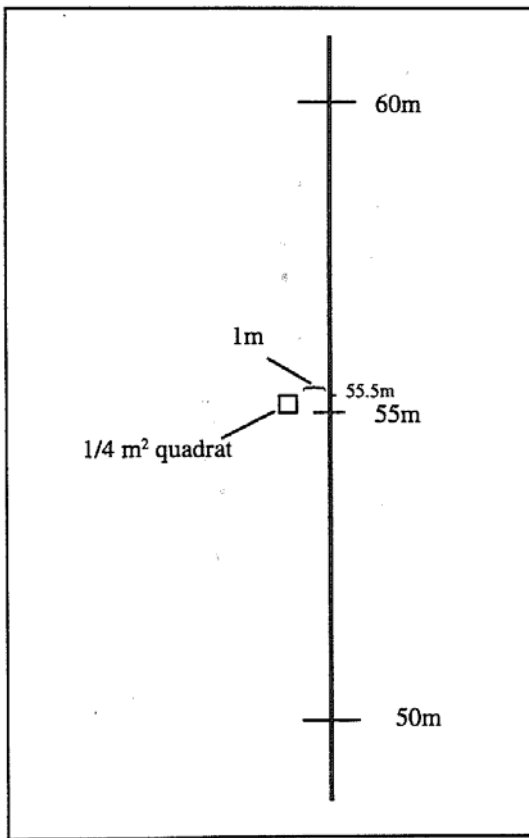


Figure 11. Place the first  $\frac{1}{4} \text{ m}^2$  quadrat at the 55-m point along the transect line. It must be 1 m away from the left side of the transect line and placed precisely between the 55-m and 55.5-m points.

## **2. Identify selected ground cover species and estimate percent cover in first ¼ m<sup>2</sup> quadrat.**

To estimate percent cover for a plant species or category, stand directly over (but not in) the quadrat. Carefully locate all individuals of the plant, then estimate the percentage of the area inside the square that is “covered” by the vegetation (leaves, flowers, or stems) associated with that plant (Figure 12). Record your estimate, and then repeat the procedure for the next species or category. Only consider plants that are rooted in the square. Enter code “A” if none are present.

Percent cover estimates are recorded within the following percent cover classes:

<b>A</b> <b>0%</b>	<b>B</b> <b>&lt;1%</b>	<b>C</b> <b>1-5%</b>	<b>D</b> <b>6-25%</b>
<b>E</b> <b>26-50%</b>	<b>F</b> <b>51-75%</b>	<b>G</b> <b>76-95%</b>	<b>H</b> <b>96-100%</b>

**Herbaceous plants** are those in which the aerial portion is relatively short-lived, and the tissues are relatively soft, i.e. non-woody.

**Woody plants** have bark, stems, and roots which increase in diameter from year-to-year. The tissues that build up tend to be hard, i.e. woody. Examples include trees, shrubs, and most vines.

If your best estimate of percent cover for a species is “borderline” between two cover classes, just use your best judgment as to which cover class best represents that plant’s percent cover.

**First**, record:

- a) total percent cover for all herbaceous (non-woody) plants; and
- b) total percent cover for all woody plants < 1 m tall (tree seedlings, shrubs, and woody vines.)

While a percent cover estimate is somewhat subjective in nature, some amount of subjectivity is unavoidable in any scientific study. Fortunately, you are only estimating what cover class plants fall into, hence the estimate is sufficiently accurate. In addition, you can make reliable estimates by taking your time and by working in small groups to compare estimates, and then average them if they differ. After practice, you will become more confident in your ability to estimate percent cover. One trick that helps is to imagine that all the plants of given species are in one part of the frame, e.g. in one-half or one-fourth of the area; then consider whether the plant coverage would be greater or less than that area.

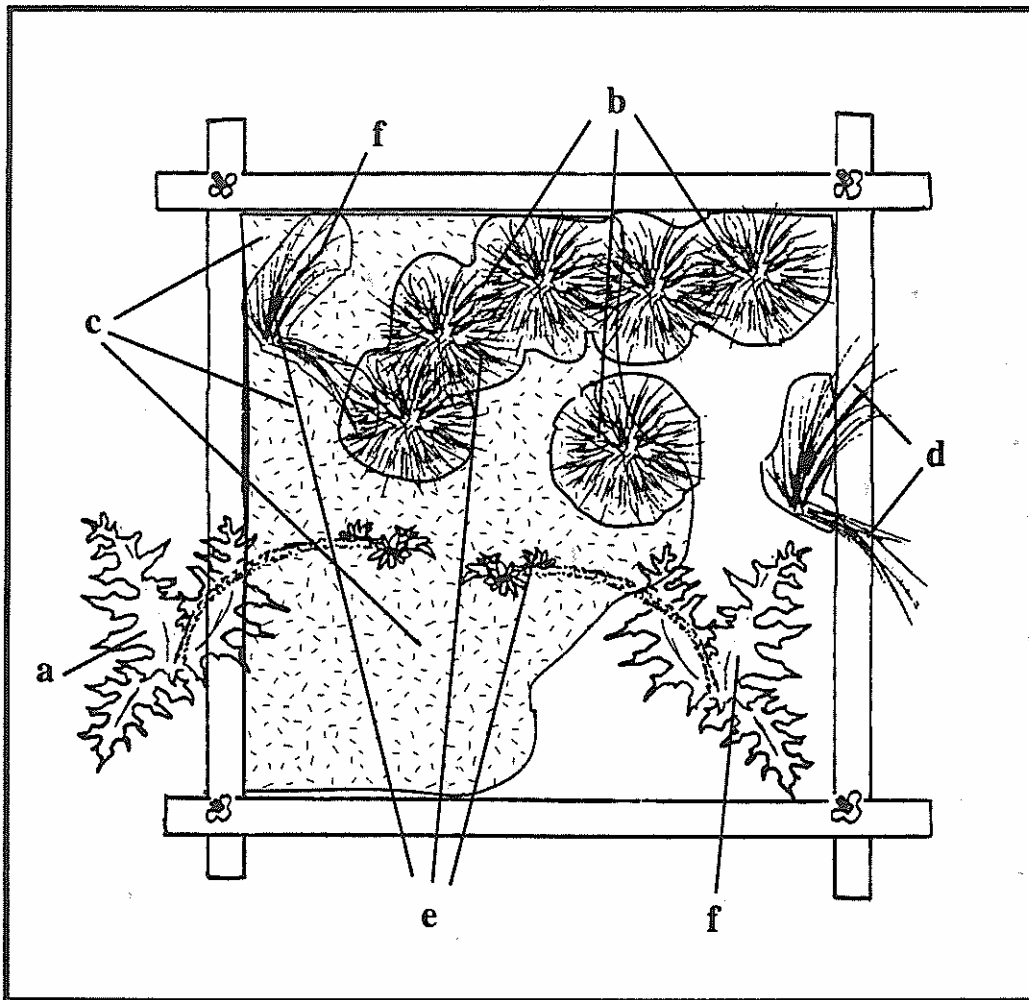


Figure 12. To determine percent cover of a type of plant, look straight down and estimate the percent of the ground within the quadrat that is covered by that plant. Include only plants that are rooted in the quadrat. Do not include dead plants, although brown areas of living plants should be included.

- a)** Plant not rooted in transect. Do not include.
- b)** Plants are all one species. Add percent of area covered by all plants.
- c)** Low-growing plants have other plants towering over them. Include the total area they cover, including areas where other plants are above them.
- d)** Plant hangs out of quadrat but is rooted within it. Include the area that the plant covers within the quadrat only.
- e)** Plants overhang other plants. Include the entire area the plants cover, even where they overhang other plants.
- f)** Irregular-shaped plant. Include only area plant covers, not gaps between plant parts. Exact % cover is not needed—simply determine which cover class interval the plant is in.

**Second**, take a few minutes to carefully scan the quadrat for the presence of any of the following native and non-native ground cover species.

<u>Common Name:</u>	<u>Scientific Name:</u>
<b>Disturbance-Sensitive Species:</b>	
blue cohosh	<i>Caulophyllum thalictroides</i>
white trillium (all white species)	<i>Trillium spp.</i>
doll's eyes	<i>Actaea pachypoda</i> and <i>A. rubra</i>
large-flowered bellwort	<i>Uvularia grandiflora</i>
bleeding hearts (both species)	<i>Dicentra canadensis</i> and <i>Dicentra cucullaria</i>
maidenhair fern	<i>Adiantum pedatum</i>
Virginia spiderwort	<i>Tradescantia virginiana</i>
hepatica (both species) sharp-lobed hepatica round-lobed hepatica	<i>Hepatica nobilis v. acuta (H. acutiloba)</i> <i>H. nobilis v. obtusa (H. americana)</i>
<b>Common Native Species</b>	
Virginia bluebells	<i>Mertensia virginica</i>
wild columbine	<i>Aquilegia canadensis</i>
blue phlox	<i>Phlox divaricata</i>
red trillium	<i>Trillium recurvatum</i>
blue-eyed Mary	<i>Collinsia verna</i>
wild geranium	<i>Geranium maculatum</i>
swamp buttercup	<i>Ranunculus septentrionalis</i>
sensitive fern	<i>Onoclea sensibilis</i>
<b>Non-Native Species:</b>	
garlic mustard	<i>Alliaria petiolata</i>
dame's rocket	<i>Hesperis matronalis</i>
moneywort	<i>Lysimachia nummularia</i>
ground ivy	<i>Glechoma hederacea</i>
gooseberry	<i>Ribes missouriense</i>
Japanese honeysuckle	<i>Lonicera japonica</i>

**Third**, for each of the above species found (i.e., rooted) within the quadrat, estimate and record the percentage of vegetation cover. If a species is not present, enter code “A.”

**Fourth**, for tree seedlings < 1 m tall and rooted inside the quadrat, identify all seedlings present. Seedlings are identified to genus only. Then for each type of tree seedling record the percent cover.

**3. Repeat steps one and two for all remaining quadrats on the transect.**

Go to the 60.0 m point and locate the next quadrat again on the left side of the transect, between 60.0 and 60.5 m, and 1.0 m to the left of the transect line. Collect ground cover data as above, record, then move to the next quadrat location, which is at 65.0 m on the right side, 1.0 m off of the transect. Collect ground cover data, record, then move on to the next quadrat location at 70.0 m, right-hand side again. Quadrat placement always begins at each 5-m point and is always exactly 1 m off of the transect, alternating each pair of quadrat locations to the left and right as shown in Figure 13.

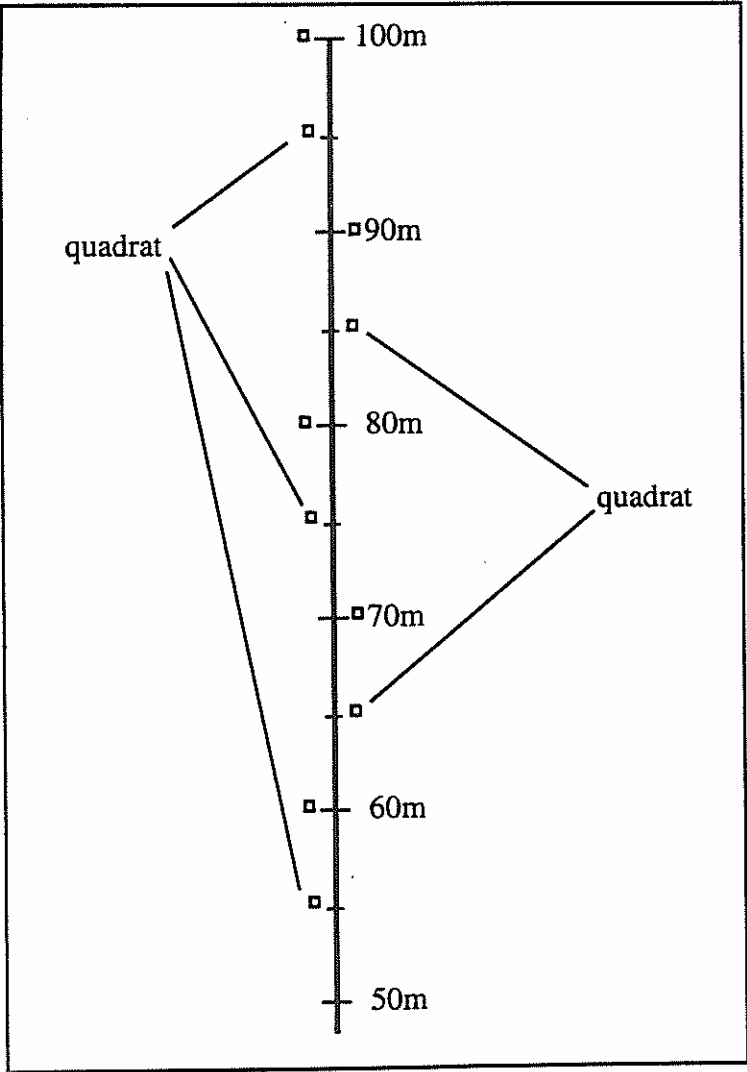


Figure 13. Ten quadrats in total should be set on alternating sides of the transect line.



#### 4. Determine presence (+) or absence (-) of disturbance-sensitive and non-native species.

Now backtrack along the transect and carefully note the presence (+) or absence (-) of each of the above disturbance-sensitive and non-native species in each transect interval, working on one side of the transect at a time. Do not look for the common native species in this procedure.

Note that the left and right sides of each transect are determined when you are standing at 50 m and facing 100 m! So when backtracking from 100 to 50 m, the left side of the transect will be on your right, and the right side will be on your left.

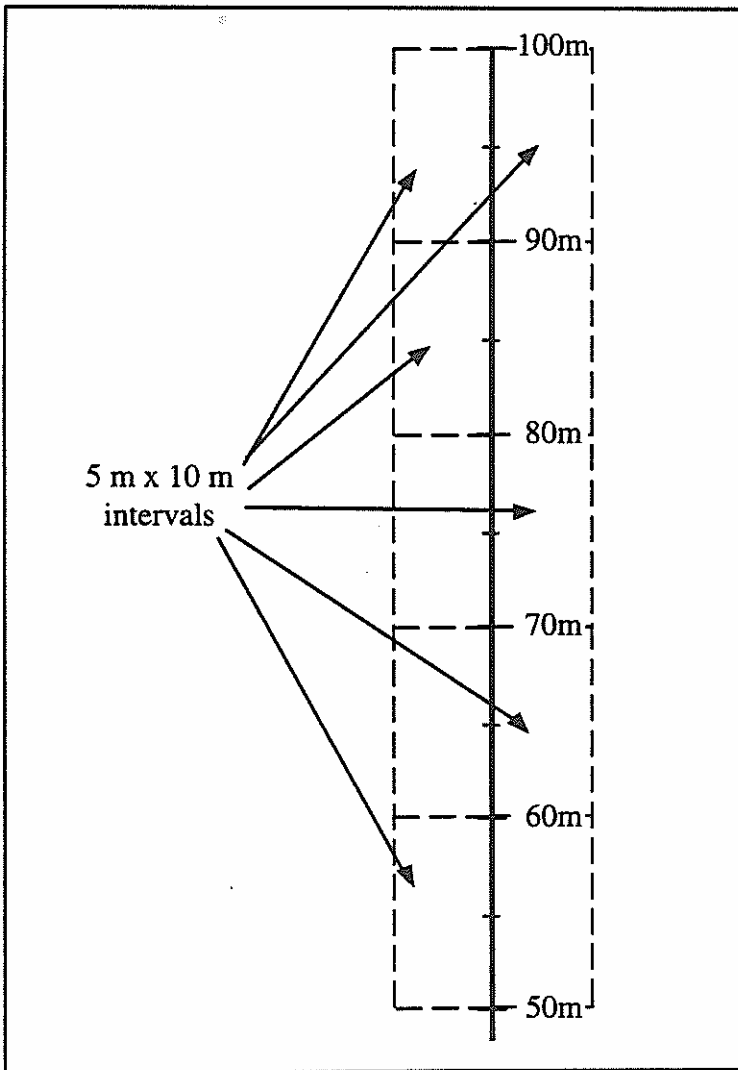


Figure 14. Ten 5 m x 10 m intervals should be surveyed for disturbance-sensitive and non-native species.

To make sure that you are looking only in the area 5 m to both sides of the line, place the 10-m segment ropes perpendicular to the transect line at the start and end of each segment. (See Figure 15.) You will have to move the 10-m ropes from transect interval to transect interval as you proceed back to the 50-m point. To help you keep track of the intervals, it is helpful to place wire flags at the corners of each 5 x 10 plot.

**5. Repeat steps one through four for the remaining two transects at your site.**

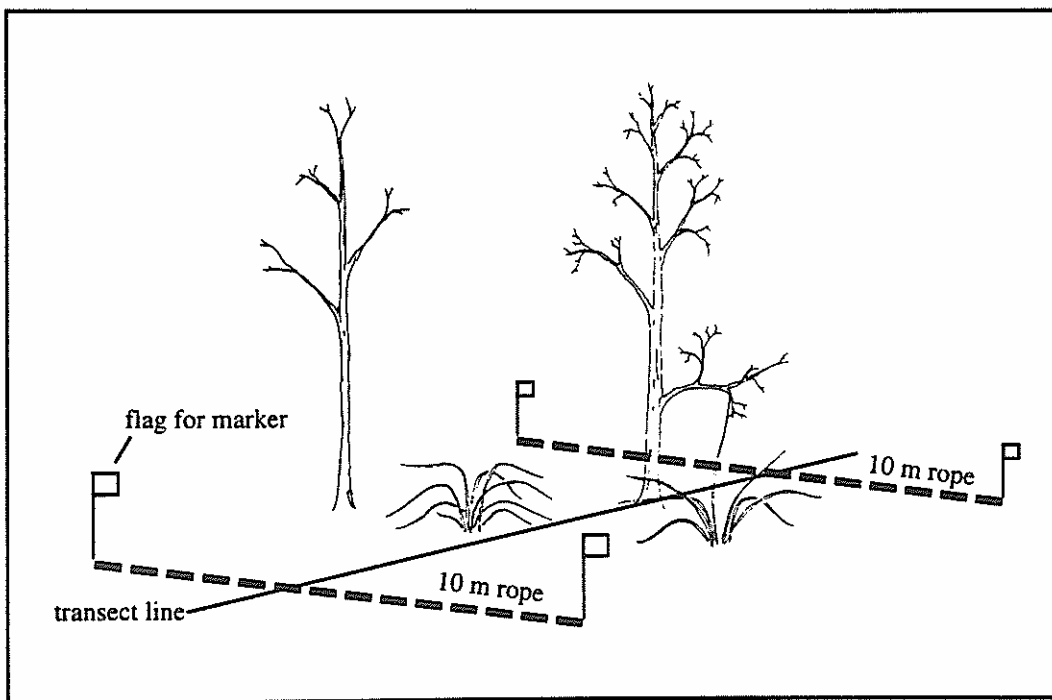


Figure 15. Use the 10-m ropes as guides to mark the sampling area. The ropes can be moved as successive intervals are sampled.

**Procedure Summary: Ground Cover Survey**

**On each of three transects between 50 and 100 m you will:**

1. Set up  $\frac{1}{4}$  m<sup>2</sup> quadrats at 55, 60, 65, 70, 75, 80, 85, 90, 95, and 100 m.
  - Quadrats must be placed at precise locations 1 m off of transect.
  - Place each paired sequence of quadrats on alternate sides: 55 and 60 go on left, 65 and 70 on right, 75 and 80 on left, etc.
  - First quadrat is bounded by 55.0 m, 55.5 m, and by 1.0 and 1.5 m from the transect line (to left of line).
2. Estimate total percent cover in each  $\frac{1}{4}$  m<sup>2</sup> quadrat for:
  - All herbaceous plants; and
  - All woody plants < 1 m tall.

Use percent cover classes listed on data sheet. To be counted, a plant must be rooted in the square.

3. Identify and estimate percent cover for selected disturbance-sensitive, common native, and non-native ground cover species in each  $\frac{1}{4}$  m<sup>2</sup> quadrat. (Use percent cover classes: plants must be rooted in square.)
4. Identify and estimate percent cover for tree seedlings < 1 m tall in each  $\frac{1}{4}$  m<sup>2</sup> quadrat.
5. Record presence (+) or absence (-) of selected disturbance-sensitive and non-native species in each of ten 5- by 10-m areas along transect.

### **Human Use and Topography - Spring Session**

#### **Purpose:**

In this procedure, information is collected on general forest conditions. You will look for **signs of human use** and characterize the **topography** of the site.

#### **Signs of Human Use**

People use forests for a variety of reasons. Many uses of forests by humans have resulted in some type of disturbance, or habitat disruption, to the forest. Looking for signs of how people have used the forest in the past, up through the present, may provide clues which help explain current forest conditions.

One important human use of forests has been that of timber harvesting. At one time or another, almost all of Illinois' forests were logged. Today, many forestry projects are underway in Illinois, including not only harvesting, but tree planting and other activities related to forest resource management.

A large number of forest habitat restoration projects are underway across the state to restore forests to their natural condition. Restoration activities can include the removal of exotic plants, planting native plants, using fire as a management tool, and others.

#### **Topography**

One important factor that has a direct influence on vegetation is that of topography, which is the variation in elevation of the land surface. A hilly area will offer more variable conditions, and thus more variable habitat for plants, than a flat area. In addition, the aspect, or direction of the slope of the land from uphill to downhill, is also important because south- and west-facing exposures result in drier conditions than north- and east-facing exposures. Some species of plants prefer dry, exposed conditions while some prefer more shaded, protected areas.

#### **Materials (for one transect):**

pencils

clipboard

Human Uses/Topography data sheet (one per site)

## **1. Survey for human uses between 50 and 100 m on each transect.**

Carefully look for any signs of human use which you may notice along each transect. Record any human uses as you observe them.

When looking for signs of human uses, you should look in the general vicinity of your forest site (both on, and adjacent to, the 10- by 50-m transect areas). Ignore far away signs like highway noise, an airplane high in the sky, nearby residences, and so on. Do consider things like deer-hunting stands, seeing other people in the forest, clear evidence of logging (e.g. clean-cut tree stumps), restoration activity (cut brush, charred tree trunks, etc.), cattle grazing (e.g. old barbed wire fencing), or previous agricultural activity, and the like.

## **2. Note topography along the transects.**

After you have finished recording your human use information, note whether the topography along the transects is flat, gradually but more or less continually sloping, or hilly. If gradually sloping, indicate the compass bearing of the general direction in which the slope is facing, from uphill to downhill. The direction of the slope is referred to as the “aspect.”

When you contact the landowner or land manager to inform him/her of your monitoring trip, ask him/her whether restoration work is being conducted on the site, and if so, what specifically is being done. Also ask the owner/manager about the general history of the site (e.g. logging, grazing, etc.). This information will supplement your own knowledge or observations made when monitoring.

On each of three transects between 50 and 100 m, you will complete the following steps:

1. Look for any signs of human use which you may notice while walking. Only look in the general vicinity of the site.
2. Note topography along the transects: flat, gradually sloping, or hilly. Record. If sloping, record the compass bearing of the general direction slope is facing.

## Appendix A

### FACTORS THAT AFFECT FOREST ECOLOGICAL INTEGRITY

A forest is a complex, dynamic system of organisms, soil, and a variety of other environmental factors. Given the complexity of forest ecosystems, the introduction of a disturbance into the forest can significantly alter the delicate balance of factors that control the dynamics of the forest. If the disturbance is of a sufficient frequency, duration or intensity, the forest will undergo changes that influence the suitability of the forest as habitat for native organisms.

#### **Illinois Forests**

Forests provide many functions that often are unnoticed. Beyond the more obvious benefits such as recreational uses, wood products, and the unlimited beauty and aesthetic appeal which forests provide, forests are vital to the maintenance of biodiversity in the state. Forests are home to over 60 percent of the state's native plants, and provide 75 percent of the state's wildlife habitat. Healthy forests also help to stabilize soils and reduce erosion, they control stream flow and stabilize water tables, and they reduce global warming.

Illinois has a great diversity of forests, thanks largely to the fact that the state spans approximately 400 miles from north to south and features a wide range of climate, soils, topography, and other factors which affect habitat. Forest types vary from open canopy woodlands to dense forests and from upland to bottomland. Plant species composition will vary significantly depending on soil moisture, light penetration, and other factors. Despite this diversity in the composition and ecological characteristics of the state's forests, all of them are affected in some way by human-induced disturbances or forest management decisions.

#### **Disturbance**

A disturbance is a natural or human-induced event that alters an ecosystem and results in the mortality of organisms. Examples of natural disturbances include fire caused by lightning, wind, natural flooding, and drought. Examples of human disturbances include land clearing, timber harvesting, livestock grazing, prescribed burning, and the introduction of exotic species. An important distinction between natural and human-induced disturbances is that organisms have generally developed tolerances or adaptations to natural disturbances, and are often dependent on them for survival, but are often unable to adapt to the forms or levels of disturbances caused by humans. (It should be noted that prescribed burning is implemented to restore a natural fire regime to an ecosystem.)

Plant species have a range of tolerances to various environmental variables, including disturbance. Many spring wildflowers, or "spring ephemerals," such as species of *Trillium*, Dutchman's-breeches, blue cohosh, and large-flowered bellwort, are intolerant of human-related disturbance. A decline in the presence or abundance of these plants may indicate that some type of habitat degradation is occurring.

#### **Fire**

Fire was once an important part of Midwestern ecosystems, particularly in upland areas. Midwestern prairies, savannas, and open-canopied woodlands were maintained by the combination of fire and relatively low levels of moisture as compared with the forests further east. Fire once swept across the landscape and covered an extensive area. The wind helped guide the flames which stopped at waterways. Today, this phenomenon is greatly reduced. There is a concerted effort to stop fires from burning, and those fires that do occur are limited by fragmentation of forests. This pattern results in a change in composition of the forest as fire-tolerant species (like oaks) are unable to regenerate, while the fire-intolerant species (like sugar maple) now can survive and grow into the canopy. Species that survive fires, like oaks, are still

around but are on the decline as they need higher light levels than maples to grow and usually require some type of disturbance to create light gaps to allow them to grow into the canopy. Thus, oak woodlands are not just fire tolerant, they are actually fire-dependent communities which become degraded in the absence of fire.

Fire was historically responsible for limiting survival of fire-intolerant sugar maples in exposed areas more likely to burn. One result of fire suppression is “maple takeover,” a situation in upland forests where maples begin to dominate the site and replace the oaks, hickories, or other native species that were formerly dominant. While maple trees are native to Illinois and are ecologically valuable in their own right, maple takeover is a concern for three primary reasons:

- Oak-hickory forests were the predominant type of forest in Illinois prior to European settlement.
- Oaks and hickories provide a great deal of food for wildlife. Many animals feed on maple seeds, but acorns and hickory nuts are a staple for many species of wildlife.
- Many native plant species of the forest understory are adapted to the shade levels associated with oak-hickory forests. Some cannot survive under the heavy shade conditions of a maple-dominated forest.

### **Exotic Plants**

Exotics are species not native to this country. Most exotic species come from Europe or Asia. The majority of exotic plants are ornamentals that have been introduced to this country by landowners and government agencies for a variety of reasons, including erosion control, hedgerows, and garden plantings. Once exotics become established in a country or region, they are considered invasive if they begin to replace native vegetation. Such plants generally are not invasive in their own native country because there are natural controls present.

Generally, few exotic plants become problematic, but the few that do often become extreme nuisances. They typically grow quickly and produce many new plants each year. Their spread may be accelerated by grazing or other human-induced activities around the forest. The result is that they take over a site and crowd out many native species. Exotic plants have become established in all vertical layers of the forest; examples include garlic mustard in the ground layer, multiflora rose and species of buckthorn and honeysuckle in the shrub layer, and trees such as white mulberry.

### **Exotic Insects**

Many native insects inhabit the forest ecosystem. These generally cause a cyclical amount of damage each year, which is limited by natural controls. However, some exotic insects, such as gypsy moths, can cause a significant amount of damage because they have few, if any, natural controls to limit their spread.

### **Exotic Diseases**

Diseases are another major problem in forests. Two well-known examples of exotic diseases are chestnut blight, which wiped out the American chestnut, and Dutch elm disease, which has significantly reduced the American elm population in the state. Because of these two diseases, few American chestnut and American elm become large trees. The diseases attack and kill the young trees. Another disease that is relatively new to the U.S. is dogwood anthracnose. This disease attacks flowering dogwood trees. Dogwood anthracnose has spread from the east and occurs in Illinois.

### **Deforestation and Fragmentation**

Much of the pre-settlement forest in Illinois has been cleared for agriculture or urbanization. Most of the land suitable for farming is in use as farmland. In recent decades, there has been a slow increase in total forested area as some farms have been abandoned and replaced with forest. Urban sprawl still threatens forests in certain areas; however slowing urban sprawl may help save some of the remaining forests.

Illinois forests have become highly fragmented as they have been dissected by roads and large areas cleared for agriculture, urbanization, and tree harvesting. The larger forest patches can be found in the southern portion of the state. Most of the forests in Illinois exist as either small patches or as strings of trees along a waterway. Many plants and animals require large patches of forest to survive, whereas small patches tend to be dominated by common species.

As forest fragmentation increases, the amount of edge area also increases, which increases the condition known as the “edge effect.” This change includes physical factors, like increased wind and solar radiation, and changes in biotic factors. Many exotic plants establish themselves at the forest edge and then gradually invade the forest interior, replacing native plants over time. Certain animals are associated with forest edges and can be detrimental to more interior forest animals as patch size decreases. Predators like raccoons and feral cats travel along forest edges and prey on other animals. The brown-headed cowbird is native to Illinois and uses forest edges for reproduction. These birds are brood parasites, meaning they lay their eggs in the nests of other birds (host species) which raise the cowbird chicks as their own. Typically, the host’s young do not survive as the cowbird chick grows quickly and is very aggressive. This situation results in a reduction in the population size of the host species while cowbird numbers increase.

### **Pollution**

Pollution can have a harmful effect on the organisms in the forest. There are various sources of pollution, the most common coming from precipitation and run-off. Much of the atmospheric pollution comes from automobiles and industry. These sources produce greenhouse gases and the compounds that lead to acid rain. The pollutants enter the atmosphere and then travel away from the source of pollution. Because of our weather patterns, most of these pollutants move east and north, resulting in acid rain developing in the New England states and Canada. However, some atmospheric pollution does remain in the state. An additional source of pollution is chemicals applied to the ground or vegetation for insect and weed control.

The effects of pollution often go unnoticed until there is extensive mortality. Pollution by itself, however, rarely kills trees. Pollution stresses a tree, thus making it susceptible to disease and insect pests which may then kill the tree, affecting light levels in the forest understory.

## Appendix B INTERPRETING YOUR DATA

There is much that you can learn about the forest you have monitored by conducting your own informal analysis of the data for your site. This appendix includes some suggestions as to how you can interpret your own data using both qualitative, or observational, techniques, as well as some simple quantitative methods.

Some of the following methods will show you ways in which you can conduct long-term trend analysis for your site. However, even by looking at one year of data, you can start to answer such questions as:

- What type of forest is it?
- How stable is your forest? Are its trees regenerating?
- What does the presence of certain indicator plant species suggest about the ecological integrity of your forest?

The distinction between long-term trend analysis and one-year data analysis is analogous to a movie versus a picture: one tells a story over time, and the other tells you what things look like at a given moment. Both are important, but the point is that you can learn much from the data that you collect in any given year.

### What Type of Forest is It?

A very basic question you should ask about your forest is what type of forest it is. Illinois forests have been classified into seven broad categories based on the dominant tree species present. **Ecological dominance** refers to the extent to which a species or group of species is able to control environmental conditions within a forest through abundance, frequency, and/or coverage, thereby controlling or influencing the rest of the community. **Abundance** is simply the number of individual trees present. (**Density** is the number of trees in a specified area, e.g. trees/hectare). **Frequency** is the percentage of plots in which a tree occurs. **Coverage** is the percentage of ground that is covered by the vegetation associated with a plant; for trees, this is difficult to determine, and it is usually estimated with **basal area**, which is the cross-sectional area of a tree's trunk at breast height. (Basal area is proportional to coverage.)

The seven major forest types in Illinois are:

- |                   |                          |
|-------------------|--------------------------|
| oak-hickory       | oak-pine                 |
| maple-beech       | loblolly, shortleaf pine |
| elm-ash-red maple | white, red, jack pine    |
| oak-gum-cypress   |                          |

The most common type of forest in Illinois is oak-hickory (50.2%), followed by maple-beech (26.0%), elm-ash-red maple (17.9%), and oak-gum-cypress (3.4%). Together, these four forest types comprise over 97% of commercial forestland in Illinois (based on 1985 data). Common associates of oak-hickory forests include tulip tree, elm, maple, black walnut, black locust, and sassafras. Common associates of maple-beech forests include elm and basswood. For elm-ash-red maple forests, common associates are cottonwood, box elder, willow, sycamore, and beech. In oak-gum-cypress forests, dominant species include tupelo gum, sour gum, sweet gum, oak and cypress, and common associates include cottonwood, willow, ash, elm, hackberry and maple.



In some cases, you may be able to tell just by looking at your data which type of forest you have. Make a list of tree species found, organized from most to least numerous. Look at the species on top; if one or more taxa are numerically dominant, and these relate to one of the above forest types, then your forest would probably be classified as that type of forest.

However, often a forest will contain species representing more than one forest type. In addition, as indicated above, abundance is not the only factor which determines species dominance; frequency and coverage (as measured by basal area of trees) also influence the relative dominance of a given species in the community. For this reason, ecologists often calculate an “**importance value**,” which provides an overall estimate of the ecological influence or importance of a species in the community based on abundance, frequency and coverage, or any two of the three. Tree taxa can then be ranked according to their importance values, with the highest-ranked trees representing the dominant species. The importance values for the trees can also be compared from year to year to see how dominance is changing in the forest.

Instructions are provided on how you can calculate a simple importance value for the trees in your forest. This procedure will require the calculation of relative abundance and relative coverage. **Relative abundance** of a species is the total number of individuals of that species divided by the total number of individuals of all species. **Relative coverage** of a species is the proportion of the coverage (for trees, total basal area) for that species divided by the total coverage for all species present.

## How Stable is Your Forest?

The next thing you can look at is forest stability. Look again at your tree data and determine whether the younger trees in the understory (seedlings and saplings) are the same species as the mature canopy trees. If so, this is an indication that the trees in your forest are successfully regenerating, and that the forest is stable. If the seedlings and saplings are different than the canopy trees, this is an indication that the species composition of the trees in your forest is changing.

Sugar maples are slowly replacing oak and hickory trees in Illinois forests. This process is a concern because of the ecological value of oak and hickory trees. You can easily assess the extent of **maple takeover** in your forest by calculating the following ratio separately for seedlings, saplings, and canopy trees.

$$\frac{\# \text{ of sugar maples}}{\# \text{ oaks and hickories}}$$

Seedlings are trees < 1 m tall. Saplings will be defined as all trees > 1 m tall and less than 10 cm DBH. Canopy trees are assumed to be anything larger than 10 cm DBH. You can get a quick idea of the extent of maple takeover in your forest by looking at these ratios for any given year; if the ratios are much greater for seedlings and saplings than for canopy trees, this is an indication that maple takeover is occurring. You can also track these ratios over time to see how they are changing.

You might also conduct a more detailed analysis by comparing the abundance of oaks and maples for each size class. The results can be visually compared using a simple bar chart.

## Interpreting the Presence of Indicator Plant Species

One simple but important qualitative assessment you can conduct is to review your shrub and ground cover data sheets for the presence of disturbance-sensitive and non-native species. These species are **biological indicators**, meaning that their presence tells us something about the condition of the forest.

All of the disturbance-sensitive species included are associated with high-quality forests because they are known to be intolerant of human disturbance. If the disturbance occurs with sufficient frequency, intensity, or duration, these species will disappear. As such, their presence is an important indicator of the ecological integrity of a forest, and if any of these species were present on your site, this is an indication that your site is in a high-quality forest.

Conversely, the non-native, or exotic, species represent a potential problem with the quality of a forest, because they are known to be aggressive invasive plants that can crowd out many native species, and in the process reduce biodiversity of the forest. Unfortunately, most Illinois forests already have several non-native species present; thus it becomes important to monitor not only their presence, but also the extent of their presence, as measured through coverage or density. This information can be used to track the change in non-native species dominance over time at your site. For shrubs, you can calculate the average percent of non-native stems to total stems for your site; for ground cover, you can calculate the total percent cover of all non-native species, averaged across all 30 quadrats on your site.

A simple quantitative assessment that you can conduct for indicator species in the ground layer is to construct a ratio of the total percent cover of all disturbance-sensitive species divided by the total percent cover of all non-native species, averaged across all 30 quadrats on your site. (Use the midpoints of each size class to calculate the ratio.) The result will give an indication as to the relative dominance of the disturbance-sensitive species versus the non-native species in the ground layer, and how the balance may be changing between the two over time.

A more detailed analysis of the percent cover data from the quadrats can also be calculated for individual taxa as follows. You will need to use the midpoint of the cover classes. Look at the following hypothetical data from a site and the results generated.

Number of Quadrats:

Species	Cover Class C	Cover Class D	Cover Class E	Cover Class F
hepatica	2			
bleeding hearts	3	2		
Virginia bluebells	1	3		
garlic mustard	3	5	4	1

Total coverage for each species (numbers in parentheses are midpoints of each cover class):

hepatica -  $2 \times (2.5) = 5$

bleeding hearts -  $[3 \times (2.5)] + [2 \times (15.5)] = 38.5$

Virginia bluebells -  $[1 \times (2.5)] + [3 \times (15.5)] = 49$

garlic mustard -  $[3 \times (2.5)] + [5 \times (15.5)] + [4 \times (38)] + [1 \times (63)] = 300$

Divide the resulting number by the total number of quadrats. In this case, we had 30 (the number for a site), giving the mean cover per quadrat:

Hepatica = 0.17%

bleeding hearts = 1.28%

Virginia bluebells = 1.63%

garlic mustard = 10%

Here are some questions you can answer to help you assess the presence and/or influence of indicator species:

1. Are any disturbance-sensitive species present?
2. Are any non-native species present?
3. If present, how dominant are the non-native species?
4. Calculate the ratio of average cover for all disturbance-sensitive species to average cover for all non-native species, for the ground layer.
5. Track all of the above factors over time at your site.

## How to Calculate an Ecological Importance Value for the Trees on Your Site

The following calculations will be demonstrated using actual data collected from a forest in northern Illinois.

1. Use all of the tree data from all three transects.
2. Make a copy of Table 1- Ecological Importance Value. List the common names of all tree taxa that you recorded on the tree survey data sheets, in the first column. (See Table 2 for example using actual data collected from a northern Illinois forest.)
3. List the number of individual trees for each taxon in the second column.
4. Calculate the relative abundance of each taxon and enter in column 3. Relative abundance ( $RA_i$ ) is calculated as the abundance (# of individuals) of species  $i$  divided by total abundance for all species:

$$RA_i = A_i \div TA$$

Using the data from Table 2 for black walnut:

$$RA_{bw} = 2 \div 29 = .069 = 6.9\%$$

5. Using Table 3, Coverage Chart for Individual Trees, sum up the basal areas for individual trees for each taxon, and enter result in column 4 of Table 1. Table 4 shows how the basal areas of the trees in our example data set were summed to derive coverage totals for each tree taxon.
6. Calculate the relative coverage of each taxon and enter in column 5. Relative coverage ( $RC_i$ ) is calculated as the coverage of species  $i$  divided by total coverage for all species

$$RC_i = C_i \div TC$$

Using the sample data again for black walnut:

$$RC_{bw} = .2552 \div 5.209 = .049 = 4.9\%$$

7. Calculate the importance value for each taxon and enter into the last column (6). Importance value is simply the sum of columns 3 ( $RA_i$ ) and 5 ( $RC_i$ ):

$$IV_i = \text{SUM}(RA_i + RC_i)$$

For our black walnut example:

$$IV_i = 6.9 + 4.9 = 11.8$$

As a check on your math, column 6 should total exactly 200.

8. When you have completed Table 1, you can rank the tree taxa from highest to lowest IV scores and use this information to determine what type of forest you have.

**Table 1. Ecological Importance Value**

1	2	3	4	5	6
Tree Species ( <i>i</i> )	Abundance (A)	% Relative Abundance ( $RA_i$ )	Coverage ( $m^2$ )	% Relative Coverage ( $RC_i$ )	Importance Value (IV)
<b>TOTALS</b>					

**Table 2. Ecological Importance Value  
Northern Illinois Forest Example**

1	2	3	4	5	6
Tree Species ( <i>i</i> )	Abundance (A)	% Relative Abundance ( $RA_i$ )	Coverage ( $m^2$ )	% Relative Coverage ( $RC_i$ )	Importance Value (IV)
black walnut	2	6.9%	.2552	4.9%	11.8
red oak	5	17.2%	.8581	16.5%	33.7
sugar Maple	8	27.6%	.8797	16.9%	44.5
white oak	14	48.3%	3.216	61.7%	110.0
<b>TOTALS</b>	<b>29</b>	<b>100.0%</b>	<b>5.209</b>	<b>100.0%</b>	<b>200</b>

**Table 3. Coverage Chart for Individual Trees**

DBH Interval (cm)	DBH Midpoint (cm)	Basal Area (m <sup>2</sup> )
0-5	2.5	0.0005
5-10	7.5	0.0044
10-20	15	0.0177
20-30	25	0.0491
30-40	35	0.0962
40-50	45	0.159
50-60	55	0.2376

For trees with a DBH > 60 cm, calculate basal area using the following formula and the exact DBH measurement:

Basal Area (Area of a Circle) =  $\pi r^2$ , where

$\pi = 3.14$

r = radius =  $\frac{1}{2}$  DBH

Then divide the result by 10,000 to convert cm<sup>2</sup> to m<sup>2</sup>.

Example for a tree with a DBH of 65 cm:

$$\begin{aligned}\text{Basal Area} &= 3.14 \left(\frac{1}{2} \times 65\right)^2 \\ &= 3.14 (32.5)^2 \\ &= 3.14 (1056.25) \\ &= 3316.625 \text{ cm}^2 \div 10,000 = .3317 \text{ m}^2\end{aligned}$$

**Table 4. Calculation of Coverage by Species  
Northern Illinois Forest Example**

<u>Species:</u>	<u>Tree #:</u>	<u>DBH Midpoint:</u>	<u>Basal Area:</u>
black walnut	1	35	0.0962
	2	45	<u>0.1590</u>
			0.2552
red oak	1	55	0.2376
	2	55	0.2376
	3	25	0.0491
	4	55	0.2376
	5	35	<u>0.0962</u>
		0.8581	
sugar maple	1	75	0.4418
	2	25	0.0491
	3	35	0.0962
	4	25	0.0491
	5	35	0.0962
	6	25	0.0491
	7	25	0.0491
	8	25	<u>0.0491</u>
		0.8797	
white oak	1	45	0.1590
	2	55	0.2376
	3	45	0.1590
	4	65	0.3318
	5	35	0.0962
	6	65	0.3318
	7	35	0.0962
	8	35	0.0962
	9	35	0.0962
	10	65	0.3318
	11	35	0.0962
	12	55	0.2376
	13	55	0.2376
	14	95	<u>0.7088</u>
		3.216	

## Appendix C TREE IDENTIFICATION BASICS

In order to identify trees to species, you will need to use a recognized tree key. *Tree Finder* by May Watts is strongly recommended. Binoculars and a hand lens are also useful for identifying trees. Binoculars are very helpful when all of a tree's leaves are high in the canopy, a common problem in mature forests.

Before you try to “key out” a tree, you should always begin by carefully observing the basic features of the tree, paying particular attention to the leaves and branches. Look at several different leaves and branches, to avoid being misled by atypical leaves or branches where leaves are missing. Once you have a good idea of what the tree looks like, start at the beginning of your key, and proceed step by step. Each step will give you two choices. Based on how well the tree fits one of the choices, you choose that one. When you have worked through the key to your final choice, compare your tree with the description of the tree that you have identified in the key to see if they match. If they do not match, you will have to backtrack in the key and see where you might have gone wrong. If you are unable to identify a tree with confidence, record it as “unidentified sp. #x.”

### Important Tree Features

Some of the tree features that you will need to know include:

**Leaf** - has a bud at its base. Sometimes when you are looking at a “leaf” you may be looking at only a small portion of the leaf. You can tell if you have a whole leaf by looking at where the “leaf” joins the “twig.” If there is a little bud where the two meet, then you have a true leaf. If not, then you are looking at one leaflet of a compound leaf that is made up of many leaflets. Look father down the twig until you find a bud.

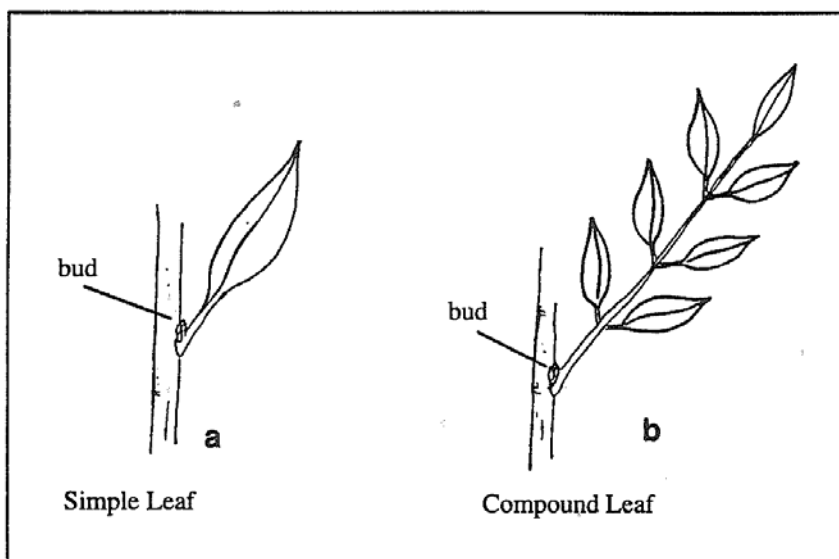
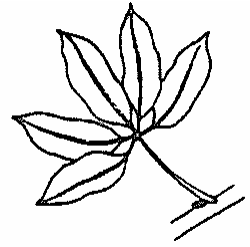


Figure 16. A leaf has a bud at its base where it joins the twig. It may have a single blade (a) or it may be made up of many leaflets (b).

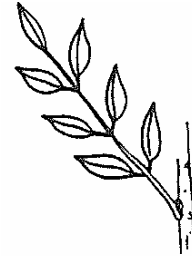


**Compound leaves** - are made up of many leaflets. Leaflets do not have a bud at their base.

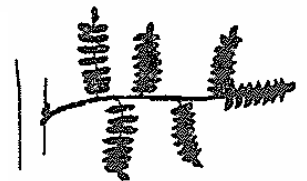
**Palmately compound** - leaflets radiate from one point.



**Pinnately compound** - leaflets are attached to each side of the leaf stem.



**Doubly pinnately compound** - leaflets are attached to lateral stems off of the main stem.



**Simple leaves** - have only one big blade and have a bud at their base. (Figure 16a.)

**Opposite leaves** - grow in pairs opposite one another on the twig. (Figure 17a.)

**Alternate leaves** - grow singly on alternate sides of the twig. (Figure 17b.)

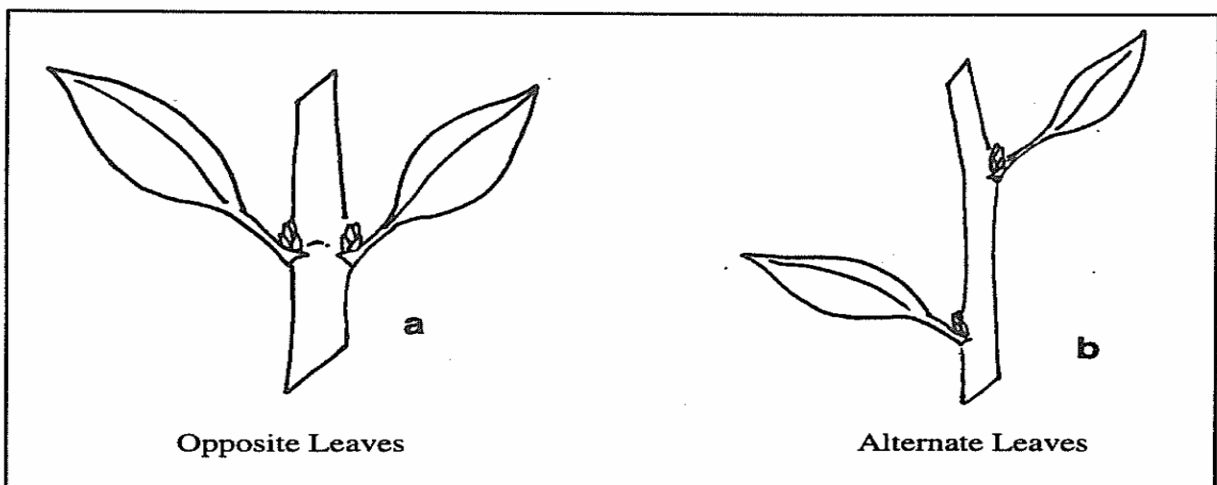
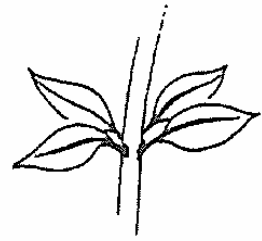
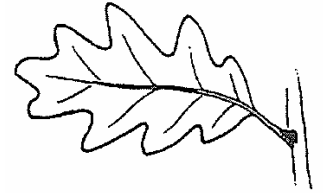


Figure 17. Opposite leaves (a) grow in pairs opposite one another on the twig. Alternate leaves (b) grow singly on alternate sides of the twig.

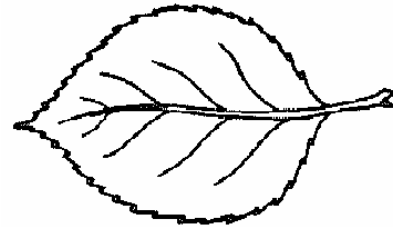
**Whorled leaves** - three or more leaves grow in a circle around the twig.



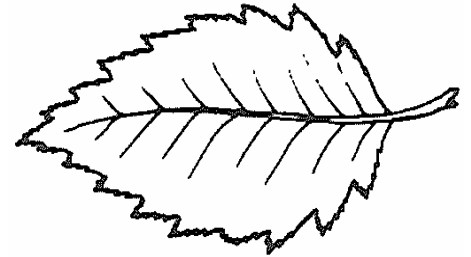
**Lobed leaves** - the leaf has lobes (where the blade sticks out) and sinuses (where the blade curves in).



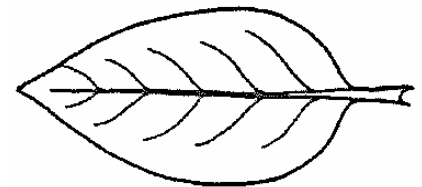
**Toothed leaves** - the leaf has small teeth along its edge.



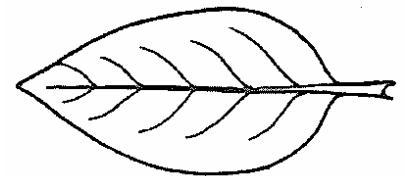
**Doubly toothed leaves** - the leaf has small teeth on larger teeth along its edge.



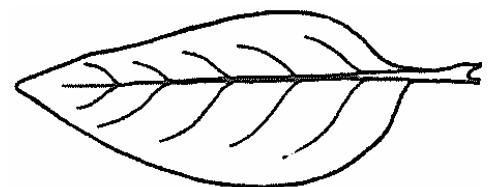
**Entire leaves** - the leaf has a smooth edge, with no lobes or teeth.



**Symmetrical leaf** - the right and left sides are mirror images of one another.



**Asymmetrical leaf** - the right and left sides do not mirror one another.



**Appendix D  
Data Sheets**

DATE: \_\_\_\_\_

MONITORS: \_\_\_\_\_

Sketch the site and exact location of all transect stakes, and at least one reasonably permanent landmark for each stake. Include bearing reading for transect lines and GPS reading if available.



Compass bearing of  
transect \_\_\_\_\_

GPS reading  
Latitude \_\_\_\_\_  
Longitude \_\_\_\_\_

# TREE SURVEY

Date: \_\_\_\_\_

Transect: \_\_\_\_\_

Monitors: \_\_\_\_\_

TRANSECT INTERVALS							SIZE CLASS TOTALS						
Use one line for each species encountered along the transect line. Record the letter representing the size class for each tree in the correct column below. Record the letter G and actual DBH measurements for trees with DBH > 60 cm.							Record the sum of each size class for each tree identified on the transect.						
TREE NAME	50 m - 60 m	60 m - 80 m	70 m - 80 m	80 m - 90 m	90 m -100 m	DBH > 60 cm	A	B	C	D	E	F	G
*EXAMPLE <u>Truffula Tree</u>	A, A, B, C, C, D, G	B		C, C, F, G, A, A	B, B, B, C, C, D	61.72	4	5	6	2	0	1	2

SIZE CLASSES:  
 A= 5 cm - 10 cm      D= 30.1 cm - 40 cm  
 B= 10.1 cm - 20 cm    E= 40.1 cm - 50 cm  
 C= 20.1 cm - 30 cm    F= 50.1 cm - 60 cm  
 G= all trees with DBH > 60 cm  
 For all trees with DBH > 60 cm, enter G in the correct interval and enter the exact measurement in the column titled "DBH > 60 cm."  
**REMEMBER!!! TOTAL THE NUMBER OF TREES IDENTIFIED IN EACH SIZE CLASS AFTER YOU HAVE COMPLETED THE TRANSECT.**

DATE \_\_\_\_\_  
 TRANSECT: \_\_\_\_\_  
 MONITORS: \_\_\_\_\_

**SHRUB LAYER SURVEY**

For each transect interval, tally the number of stems for all shrubs, vines, and tree saplings < 5 cm DBH, at least 1 m tall, and rooted within a 2-m belt centered on the transect. Enter the total number of stems in the TOTAL column. Record 0 for each shrub and vine NOT encountered. Write the actual names of the “other” shrubs at the bottom of the sheet.

YOU DO NOT RECORD SNAGS IN THIS SURVEY.

Shrub/Vine Species	50 m-60 m	60 m-70 m	70 m-80 m	80 m-90 m	90 m-100 m	SUM TOTAL
honeysuckle shrubs						
buckthorn non-native only						
high-bush cranberry						
autumn olive						
multiflora rose						
Missouri gooseberry						
<b>ALL Other Shrubs</b> (e.g.: hazelnut, gray dogwood, sumac, blackberry, raspberry, black haw, etc.)						
Japanese honeysuckle (vine)						
<b>All Other Vines</b>						
<b>TREE SAPLINGS</b>	<b>50 m-60 m</b>	<b>60 m-70 m</b>	<b>70 m-80 m</b>	<b>80 m-90 m</b>	<b>90 m-100 m</b>	<b>TOTAL</b>

Did you notice KUDZU or ORIENTAL BITTERSWEET along the transect? KUDZU <input type="checkbox"/> YES <input type="checkbox"/> NO                      BITTERSWEET <input type="checkbox"/> YES <input type="checkbox"/> NO
--

DATE: \_\_\_\_\_  
 TRANSECT: \_\_\_\_\_  
 MONITORS: \_\_\_\_\_

**VEGETATIVE SHADING SURVEY**

In the boxes below, indicate the presence (+) or absence (-) of vegetation (leaves, twigs, or branches) seen through the ocular tube. Measurements are to be taken at 2-meter intervals within each transect interval. Record the number of + signs for each transect interval in the row marked "HITS." Record the sum of this column in the lower right box ("TOTAL HITS").

50-60 m	+/-	60-70 m	+/-	70-80 m	+/-	80-90 m	+/-	90-100 m	+/-	TOTAL HITS
52 m		62 m		72 m		82 m		92 m		
54 m		64 m		74 m		84 m		94 m		
56 m		66 m		76 m		86 m		96 m		
58 m		68 m		78 m		88 m		98 m		
60 m		70 m		80 m		90 m		100 m		
HITS (+)										

**DOGWOOD ANTHRACNOSE SURVEY**

1. Were flowering dogwoods recorded in any of the surveys? They must be flowering dogwood.  
 \_\_\_\_\_ YES                      \_\_\_\_\_ NO

If yes, check the survey(s) in which they were detected:

\_\_\_\_\_ Tree survey                      \_\_\_\_\_ Shrub/sapling survey

2. Record the number of flowering dogwood trees present in each transect interval and the number of infected trees.

	50 m – 60 m	60 m – 70 m	70 m – 80 m	80 m – 90 m	90 m – 100 m
# trees from Tree Survey					
# infected trees					
# saplings from Shrub Survey					
# infected saplings					

**GYPSY MOTH SURVEY**

Observe all the trees in the tree survey area with a DBH ≥ 5cm for signs of gypsy moth egg masses. If you believe egg masses are present, complete the following information. Otherwise, check "no gypsy moth egg masses detected."

\_\_\_\_\_ NO GYPSY MOTH EGG MASSES DETECTED

TREE NAME	EXACT DBH (cm)	NEAREST 10-m POINT OF TRANSECT	DISTANCE AND BEARING FROM NEAREST 10-m POINT	
			DISTANCE (m)	BEARING
		(50, 60, 70, 80, 90, or 100 m)		

Based on the topography, tree species composition, and other factors of the site, do you consider the site to be:

\_\_\_\_\_ UPLAND                      \_\_\_\_\_ BOTTOMLAND                      \_\_\_\_\_ UNSURE?

DATE: \_\_\_\_\_

TRANSECT: \_\_\_\_\_

MONITORS: \_\_\_\_\_

**PERCENT COVER OF HERBACEOUS PLANTS AND WOODY PLANTS**

Determine the % coverage of herbaceous and woody plants within each of the 10 quadrats. Then determine the % cover for each species listed below. Use the % cover classes provided at the bottom of the page. Be sure to enter "A" for 0% cover for each species not encountered.

PLANT TYPE/ SPECIES	55 m left	60 m left	65 m right	70 m right	75 m left	80 m left	85 m right	90 m right	95 m left	100 m left
<b>HERACEOUS</b>										
<b>WOODY</b>										
<b>DISTURBANCE-SENSITIVE</b>										
BLUE COHOSH										
MAIDENHAIR FERN										
LARGE-FLOWERED BELLWORT										
WHITE TRILLIUM (ALL SPECIES)										
BLEEDING HEARTS (BOTH)										
DOLL'S EYES (BOTH SPECIES)										
VIRGINIA SPIDERWORT										
HEPATIC (BOTH VARIETIES)										
<b>COMMON NATIVE</b>										
VIRGINIA BLUEBELLS										
WILD COLUMBINE										
BLUE PHLOX										
RED TRILLIUM										
BLUE-EYED MARY										
WILD GERANIUM										
SENSITIVE FERN										
SWAMP BUTTERCUP										
<b>NON-NATIVE/NATIVE INVASIVE</b>										
GARLIC MUSTARD										
DAME'S ROCKET										
MONEYWORT										
GROUND IVY										
JAPANESE HONEYSUCKLE										
MISSOURI GOOSEBERRY										

**TREE SEEDLING SURVEY**

Identify tree seedlings < 1 m tall to genus and determine the % cover of each seedling rooted within the quadrat. Use the % cover classes provided.

TREE	55 m left	60 m left	65 m right	70 m right	75 m left	80 m left	85 m right	90 m right	95 m left	100 m left

% COVER CLASSES		
A = 0%	D = 6% - 25%	G = 76% - 95%
B = < 1%	E = 26% - 50%	H = 96% - 100%
C = 1% - 5%	F = 51% - 75%	

DATE: \_\_\_\_\_  
 TRANSECT: \_\_\_\_\_  
 MONITOR: \_\_\_\_\_

**PRESENCE/ABSENCE OF DISTURBANCE-SENSITIVE AND NON-NATIVE SPECIES**

Determine the presence (+) and absence (-) of the following species within 5 meters on the left and right sides of each transect interval. Each box must be filled in with either “+” or “-.”

SPECIES	50 m – 60 m		60 m – 70 m		70 m – 80 m		80 m- 90 m		90 m – 100 m	
	LEFT	RIGHT	LEFT	RIGHT	LEFT	RIGHT	LEFT	RIGHT	LEFT	RIGHT
<b>DISTURBANCE-SENSITIVE</b>										
BLUE COHOSH										
MAIDENHAIR FERN										
LARGE-FLOWERED BELLWORT										
WHITE TRILLIUM (ALL SPECIES)										
DOLL’S EYES (BOTH SPECIES)										
BLEEDING HEARTS (BOTH SPECIES)										
HEPATIC (BOTH VARIETIES)										
VIRGINIA SPIDERWORT										
<b>INVASIVE</b>										
GARLIC MUSTARD										
DAME’S ROCKET										
MONEYWORT										
GROUND IVY										
MISSOURI GOOSEBERRY										
JAPANESE HONEYSUCKLE										

**NOTES:**



DATE: \_\_\_\_\_  
MONITORS: \_\_\_\_\_

**HUMAN USE AND TOPOGRAPHY**  
**COMPLETE ONLY ONE SHEET FOR THIS ENTIRE SITE**

**Part I.**

Check off each human disturbance feature you find along ALL THREE TRANSECTS. Check the box if no features are present.

No features present

\_\_\_\_ A. Cut Tree Stumps      \_\_\_\_ B. Other People      \_\_\_\_ C. Hiking Trail      \_\_\_\_ D. Vehicle Trail  
\_\_\_\_ E. Collected Garbage      \_\_\_\_ F. Strewn Garbage      \_\_\_\_ G. Grazing (evidence of grazing by domestic livestock)  
\_\_\_\_ H. Human Structure(s): List \_\_\_\_\_  
\_\_\_\_ I. OTHER: \_\_\_\_\_

**Part II.**

Did you notice any signs of deer browse in the monitoring area? (Please circle one of the following.)

YES                      NO                      UNSURE

Are there any timber harvest activities presently occurring in the forest? (Please circle one of the following.)

YES                      NO                      UNSURE

Are there any restoration activities presently occurring in the forest? (Please circle one of the following.)

YES                      NO                      UNSURE

- If YES, how long has the restoration been underway? \_\_\_\_\_
- If YES, place an "X" in the blank next to the appropriate restoration activity listed below. If an activity listed below is not occurring in the forest, then leave the line blank. If there is a restoration activity occurring in the forest, and it is not listed below, please provide this activity in the blank titled OTHER.

____ TREE PLANTING	____ OTHER PLANTING
____ LIVE TREE REMOVAL	____ DEAD TREE REMOVAL
____ DISEASED TREE REMOVAL	____ REMOVAL OF EXOTIC PLANTS
____ PRESCRIBED BURNING	____ PRESCRIBED FLOODING
____ HERBICIDE USE	
____ TREE GIRDLING/SNAG CREATION	—
____ OTHER: _____	____ OTHER: _____

**Part III.**

Based on clear signs that you have observed or on information from the landowner or land manager, does the site have a history of:

livestock grazing	YES	NO	UNSURE	(Please circle one.)
crop planting	YES	NO	UNSURE	(Please circle one.)
timber harvesting	YES	NO	UNSURE	(Please circle one.)

**TOPOGRAPHY OF YOUR SITE**

Indicate the general topography of the three transects by checking one selection below. If the site is gradually sloping, indicate the general direction the slope is facing (the ASPECT) in degrees (e.g., a north-facing slope would have 0° for aspect of slope.)

\_\_\_\_ GRADUALLY SLOPING      → \_\_\_\_\_ Aspect of slope (in degrees)  
\_\_\_\_ FLAT  
\_\_\_\_ HILLY

## Appendix E Equipment

### Ocular Tube

The ocular tube can be constructed of PVC pipe with a 1 ½ inch diameter. The tube should be about 18 cm long (approximately seven inches) and have crosshairs at the end. Crosshairs can be made of sewing thread or dental floss taped to the end of the tube. A hand saw can be used to cut the PVC. An ocular tube could be constructed of other materials, for example a toilet paper tube, but sturdier materials are recommended.

