WEEK 3. CLASSIFYING AND MEASURING FORESTS

A few early European settlers described the fauna and flora, and classified and described the vegetation of Illinois as they saw it while crossing or settling in the state. In their diaries and journals these travelers and settlers described, mostly in layman's terms, their thoughts and impressions concerning the vegetation of this new land. These journals are useful in understanding the natural history of a region, as they describe the vegetation as seen by someone who saw Illinois before the landscape was extensively modified by settlement. By using these early journals, along with the Government Land Office (GLO) survey records, it is possible to reconstruct a relatively accurate picture of the vegetation of Illinois close to the time Illinois was being settled.

In the late 1800s and early 1900s more detailed studies of the vegetation were undertaken. Many of these earlier reports were accomplished while some of the original vegetation was still present. By this time, however, many of the prairies had been plowed and much of the forests removed. Nearly all of the forests that remained had been subjected to selective logging and were modified by grazing, exotic species invasion, and fire suppression. Foresters and botanists from the University of Illinois and the Illinois Natural History Survey were involved in many of these early reports. Their results are the basis for much of the information presented in this lesson. Many of the more recent studies on Illinois vegetation build on these early studies, and the use of new information, tools, and techniques have allowed us to expand our knowledge of Illinois vegetation.

Presently, nearly all of Illinois has been extensively modified and very little of the original natural landscape remains. The extensive Illinois prairie is close to death. How this happened is not a dramatic one of war and plunder, but rather one of the relentless and persistent march of civilization. Three forces vanquished our prairies: domestic grazing animals, the drainage ditch, and the steel plow. It started with the arrival of the first settlers and continued mile after mile until no large expanse of prairie remains. It took a little more than a century, and though most people felt that there would always be prairie, it was gone. Presently there is less than one square mile of original, good quality, black soil tallgrass prairie remaining in Illinois.

Our forests have not survived much better than our prairies. Most have been destroyed; the remainder has been cut over and over, has been heavily grazed, and has been extensively modified by human activity. Almost none retain the species composition and stand structure that existed in presettlement time. Besides major changes in the forest overstory, the woody understory and ground layer has been extensively modified by exotic species and fire suppression. All that remains are small remnants of these once extensive biotic communities. Many of these small remnants are our present day natural areas, and many are dedicated nature preserves. These small natural areas of land or water contain relatively undisturbed natural communities, which have fauna and flora that reflect, as nearly as possible, the conditions at the time of settlement. These small remnants give us little more than a glimpse at their past grandeur.

Illinois Natural Areas Preservation Act

A significant accomplishment in the study and preservation of the natural communities of Illinois was the passing of the Illinois Natural Areas Preservation Act (Act 525 ILCS 30/2) in 1963. This act stated "it is public policy of the State of Illinois to secure for the people of present and future generations the benefits of an enduring resource of natural areas, including the elements of natural diversity present in the State, by ensuring a statewide inventory of natural areas that will assist in the preservation of Illinois' significant natural features." The major results of this Act have been the renewed interest in the study of the natural communities and the knowledge that these areas can be preserved for future generations.

Another result of this act was the formation of the Illinois Nature Preserves Commission (INPC). By working with the Illinois Department of Conservation (now the Illinois Department of Natural Resources) the INPC was to create a statewide Nature Preserves System that would be composed of legally protected, high quality natural areas and habitats of endangered and threatened species. The goal of the Nature Preserves System is to preserve Illinois' natural heritage by including representative examples of the numerous natural communities that occurred in Illinois at the time of European settlement. Due in part to this renewed interest in natural community preservation, many biologists have been studying and cataloging the flora and fauna of Illinois.

The INPC promotes the preservation of nature preserves and oversees their stewardship, management, and protection. These significant lands have been permanently protected by state law due to the rare plants, animals, or other natural features present. These preserves range in size from less than half a hectare to more than 800 hectares. They are found in more than 75 of the 102 counties in Illinois. More than 25 percent of the endangered and threatened plants and animals of Illinois occur in these preserves. By 2004 there were nearly 300 dedicated preserves encompassing over 15,800 hectares in the Illinois Nature Preserves System.

The Illinois Natural Areas Inventory

One of the major goals of the INPC was to preserve adequate examples of all significant natural features found in Illinois. This created the need to know exactly what natural features did in fact occur in the state, and to develop a prioritized list of the remaining natural areas that were still present in Illinois. As a result, nearly three decades ago, the INPC embarked on a project that set a national precedent; a statewide inventory of the best remaining examples of natural landscape features remaining in Illinois, or as it is now called, the Illinois Natural Areas Inventory (INAI). This inventory was the first step in creating and coordinating a systematic way to preserve and protect Illinois' natural heritage. The three major accomplishments of the original INAI were: (1) the development of a natural community classification system, (2) developing a rating system to determine the quality of the natural communities encountered, and (3) locating and inventorying the remaining natural areas occurring in the state.

Much of the search methodologies developed by the INAI, and the refinements of these techniques, have become standard procedures for similar surveys across North America. Another major contribution of the INAI was the development of a natural communities classification system. This system allowed for the distinction between different types of forests, prairies, and wetlands that was critical in determining how well our natural heritage has survived, as well as the development of preservation priorities. A major contribution of the INAI was the trained personnel it produced. Many members of the INAI staff have had a major influence on the preservation goals of Illinois and other states.

Not only was the INAI unique, the results of this three-year study were outstanding. More than 5,000 potential natural areas were considered during the inventory. Of this number 1,089 natural areas were listed. Usually about 90 items of information were compiled for each of the natural areas. These included basic information such as the area's name, boundaries, significant features, location, acreage, descriptions of plant communities, degree of disturbance, geology, topography, soil, land use, ownership, management, preservation status, threats, a discussion of preservation values, species lists, vegetation sampling data, and literature about an area.

During the INAI 689 high quality terrestrial and wetlands natural communities were surveyed, the remaining areas being habitats with endangered and threatened species, outstanding geological features, nature preserves or school natural areas, unique natural features, and outstanding lakes and streams. Sites for 269 endangered species were documented. Also, a few natural community types that had previously been unknown in the state were discovered. These included shale glades, salt marshes, and calcareous seeps. The total area of these 1,089 natural areas was 10,410 hectares (25,723 acres or about 40.2 square miles). This represents about seven-hundredths of 1 percent of Illinois' land and water. This means that since settlement, which started about 200 years ago, we have mostly destroyed or extensively modified nearly all of the original natural lands of the state, a total of 56,400 square miles.

Measuring Illinois Forests

Many characteristics of forests, savannas, barrens, and other woodland communities can be determined by using various sampling procedures. These measurements are important since we depend on wood as a raw material for many different products. As a result, many companies and organizations often have large capital investments in land and standing timber. Inventories of these timber reserves are commonly required for tax records, for justifying various forest management expenditures, for determining the amount and quality of wood available for utilization, and for determining the quality, composition, and structure of our natural communities for scientific evaluation. By using various sampling procedures it is possible to determine present stand composition and structure, and to determine by future sampling the changes that are occurring, or to determine if a particular management practice is giving the desired result. Also this vegetation sampling can be used to predict the probable future stand composition and structure of a forest, savanna, barrens, or flatwoods.

Many foresters still survey timber by using the English system of feet and acres. The English system has been traditionally used in the United States and the conversion to the metric system would result in considerable confusion. Most ecologists that study vegetation, however, use the metric system of measurement. The fundamental metric unit, the meter, was originally defined as being equal to one ten-millionth of the meridional distance from the equator to the earth's poles. In terms of English units, a meter is 39.37 inches in length, a little longer than one yard. Some of the common equivalents when converting the English system to the metric system, as well as converting the metric system to the English system are shown below (Table 3.1).

Table 3.1. Converting English units to the metric system and metric units to the English system.

CONVERTING ENGLISH UNITS TO THE METRIC SYSTEM	
1 inch	= 2.5400 centimeters (cm)
1 foot (12 inches)	= 30.4800 centimeters (cm)
1 yard (3 feet)	= 0.9144 meters (m)
1 mile (5,280 feet)	= 1.6093 kilometers (km)
1 acre (43,560 square feet)	= 0.4047 hectares (ha)
CONVERTING METRIC UNITS TO THE ENGLISH SYSTEM	
1 centimeter (cm) (10 millimeters)	= 0.3937 inches
1 decimeter (dm) (10 centimeters)	= 3.9370 inches
1 meter (m) (10 decimeters)	= 39.3700 inches
1 kilometer (km) (1000 meters)	= 0.6214 miles
1 hectare (ha) (10,000 square meters)	= 2.4710 acres

General survey procedures for the forest overstory: No matter which measuring system is used certain characteristics of the woodland community are usually measured. For the overstory, which usually includes trees with a diameter at breast height (d.b.h.) of 10.0 cm or greater, the density (stems per hectare) of each tree species, the basal area (square meters per hectare of stem area) of each tree species, and the average diameter of each tree species are commonly obtained. To obtain this information each tree in the forest being studied is identified and its diameter recorded (measured at 4.5 feet, or 137 cm above the ground). In practice, however, the trees are usually sampled in randomly located plots of known size, and the calculations of density and basal area are determined from this information (Figure 1).

From the number of trees counted the number of stems per hectare (stems/ha) for each species and for the entire forest can be calculated. From the diameter measurements the average diameter of each species is obtained by dividing the number of stems of a species by the total diameter of a species (usually expressed in cm). The diameter measurements are also used to determine the basal area of each species. The basal area is usually expressed as the square meters of trunk area per hectare (m^2/ha) and is calculated for each species and the entire forest. This figure is used to obtain the dominance of each species of tree in the forest as it gives a good indication of the size of the trees present for each species.

Once these calculations are made it is easy to determine the **Importance Value (IV)** of each tree species in a forest. The IV is determined by adding the relative density and relative dominance (relative basal area). The relative density for each species is calculated by dividing the total number of individuals of a species by the total individuals of all species and multiplying that number by 100 (Figure 1). The relative dominance (relative basal area) of each species is calculated by dividing the total basal area of a species by the total basal area of all species and multiplying that number by 100 (Figure 1).

OVERSTYORY CALCULATIONS:

$$\text{Density (stems/hectare)} = \frac{\text{total stems of a species counted}}{\text{total hectares surveyed}}$$

$$\text{Basal Area (m}^2\text{/hectare)} = \frac{\text{total basal area of a species}}{\text{total hectares surveyed}}$$

$$\text{Relative Density} = \frac{\text{total individuals of a species}}{\text{total individuals of all species}} \times 100$$

$$\text{Relative Dominance (basal area)} = \frac{\text{total basal area of a species}}{\text{total basal area of all species}} \times 100$$

Importance Value = relative density + relative dominance

WOODY UNDERSTORY CALCULATIONS:

$$\text{Frequency (\%)} = \frac{\text{total plots of occurrence of a species}}{\text{total plots surveyed}} \times 100$$

$$\text{Density (stems/hectare)} = \frac{\text{total individuals of a species}}{\text{total hectares surveyed}}$$

GROUND LAYER CALCULATIONS:

$$\text{Frequency (\%)} = \frac{\text{total plots of occurrence of a species}}{\text{total plots surveyed}} \times 100$$

$$\text{Relative Frequency} = \frac{\text{total plots of occurrence of a species}}{\text{total plots of occurrence of all species}} \times 100$$

$$\text{Average Cover} = \frac{\text{total cover of a species (using midpoints)}}{\text{total plots surveyed}}$$

$$\text{Relative Cover} = \frac{\text{total cover of a species}}{\text{total cover of all species}} \times 100$$

Importance Value = relative frequency + relative cover

Figure 3.1. Calculations used to determine the various attributes of a forest.

In addition to the above calculations the extent of the canopy cover is usually determined. An estimate of percent cover can be obtained by photographing the canopy from below and calculating the percent of the area covered using a 100 point dot matrix. A more accurate measurement of canopy cover can be determined by using a spherical densiometer. This hand held device has a curved mirror that when held level reflects the forest canopy and allows the observer to calculate the percent of canopy cover.

General survey procedures for the forest woody understory and ground layer: The density (individuals/ha) of the woody seedlings, sapling, and shrub layer are usually determined by using plots scattered randomly throughout the study area. Within each plot the number of woody seedlings (50 cm or less tall), saplings (greater than 50 cm tall and less than 10 cm dbh), and shrubs (multiple branched woody plants that rarely exceed 3 meters in height) are tallied. The number of individuals tallied, when divided by the total number of hectares surveyed, gives the number of individuals of each species per hectare (Figure 3.1). Also, the frequency of each species can be determined by dividing the number of plots of occurrence of a species by the total number of plots surveyed and then multiplying by 100.

The ground layer vegetation is usually determined by using randomly located 1/4 to 1 meter square, rectangular or circular plots. Within each plot the cover of each species present is determined using the modified Daubenmire cover classes system that is used to estimate the cover of each species. Also, litter, rock, and bare ground cover can be determined using these same cover classes (Table 3.2). From these data the frequency (%), relative frequency, average cover, relative cover, and importance value of each species in the ground layer can be determined. The midpoint of each cover class is used to determine the cover of each occurrence (Table 3.2). Formulas used to determine frequency, relative frequency, average cover, relative cover, and importance values are included in Figure 3.1.

Table 3-2. The modified Daubenmire cover classes with their midpoints.

Daubenmire Cover Classes	Cover Class Midpoints
Class 1 = 0-1 percent	0.5
Class 2 = 1-5 percent	3.0
Class 3 = 5-25 percent	15.0
Class 4 = 25-50 percent	37.5
Class 5 = 50-75 percent	62.5
Class 6 = 75-95 percent	85.0
Class 7 = 95-100 percent	97.5

Survey Procedures for the Illinois Natural Areas Inventory in 1975-1978
The vegetation sampling procedure used during the original INAI was a series of relatively rapid techniques that helped to determine the dominant species and assess the natural quality of the community. In herbaceous communities (particularly prairies), species frequency data were gathered from 20 to 30 one-quarter square meter circular plots (1/4 m^2) in each plant community. From this data the frequency of the plant species was determined (Figure 3.1).

In forest communities the basal area (square meters/hectare) determination involved the use of a 3-basal area factor (BAF) metric wedge prism at 20 point in each plant community. The BAF wedge prism is an accurate variable plot gauge that determines which trees are in a plot by which tree trunks are not completely offset when viewed through the wedge prism. In addition, the tree density (stems/hectare) of the overstory was recorded in 10-cm diameter classes in 0.025 hectare circular plots centered at each of the BAF metric wedge prism sampling point. The density (stems/hectare) of woody plants taller than 1 meter but less than 10 cm diameter at 1.2 meters above the ground (d.b.h.) was recorded from a 0.001 hectare circular plot at every other BAF metric wedge prism sampling points. For many communities species lists were prepared which recorded the plant and animal species encountered on the study site. Generally the abundance of the plant species encountered was also listed.

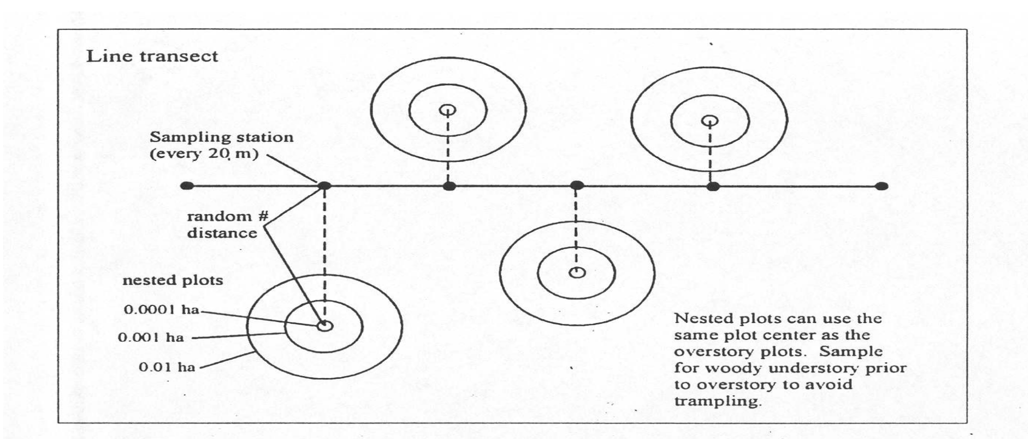
Survey Procedures Now Used by the Illinois Natural Areas Inventory
The INAI is an ongoing process and did not stop when the original study was completed in 1978. Presently the primary guide for determining which areas in the state need to be protected in the Nature Preserves System is the INAI. The INAI is continually being updated and new information concerning all recognized natural areas in the state is continually being added. This database, which is maintained by the Illinois Department of Natural Resources in Springfield, Illinois, has been extremely useful in determining which of the remaining natural should be incorporated into the nature preserves system, which areas should be purchased for protection, and what management practices should be used.

As more preserves are added to the Illinois Nature Preserves System, more information is needed to valuate which new areas should be purchased and included in the Nature Preserves System. This has resulted in a more detailed evaluation system. Presently the survey methods used: (1) produce a representative sample of all vegetation layers within the community, (2) assist in determining community type and quality grade, (3) and provide permanent sampling locations for subsequent monitoring when management practices need to be evaluated.

Overstory sampling: Presently the overstory of a potential natural area is sampled using circular plots located randomly along a line transect. The line transect is located across a homogeneous area of the community type to be sampled. This transect is located so that it follows the longest axis of the vegetation type sampled and is far enough from the edge of the woods to eliminate any edge effect. If a single line transect is too long for the area studied, it may be split into smaller units, but whatever the arrangement the sample plots should not overlap. Along the line transect 20 to 30 sample points are located about 20 meters apart. At these sample points 0.025 hectare circular plots (radius of 8.92 meters) are located using a single digit random numbers table to determine the location of the plot's center point to the right then the left along the line transect (Figure 3.2). In each of the sample plots all trees 10 cm dbh and above are identified and their diameters recorded. From these data the density, basal area, relative density, relative dominance (basal area), and importance value can be calculated (Figure 3.1).

Woody understory sampling: The woody understory is surveyed using the same line transect and plot centers used for the overstory sampling. For this survey nested circular plots 0.0001, 0.001, and 0.01 hectares in size are located at each plot center. These nested circular plots are surveyed by using a rope with all radii marked at the appropriate distances. In the 0.001 hectare plot (radius of 56.42 cm) the woody seedlings (up to 40 cm tall) are identified and recorded. In the 0.001 hectare plots (radius of 1.78 meters) the small saplings (greater than 40 cm tall but less than 2.5 cm dbh), and shrubs (between 40 and 152 cm tall) are identified and recorded. In the 0.01 hectare plots (radius of 5.64 meters) large saplings (2.5 to 9.9 cm dbh) and large shrubs (greater than 1.52 meters tall) are identified and recorded. From this data the frequency and density of woody seedlings, small saplings, and large saplings can be determined (Figure 3.1 and 3.2).

WOODY OVERSTORY



WOODY UNDERSTORY

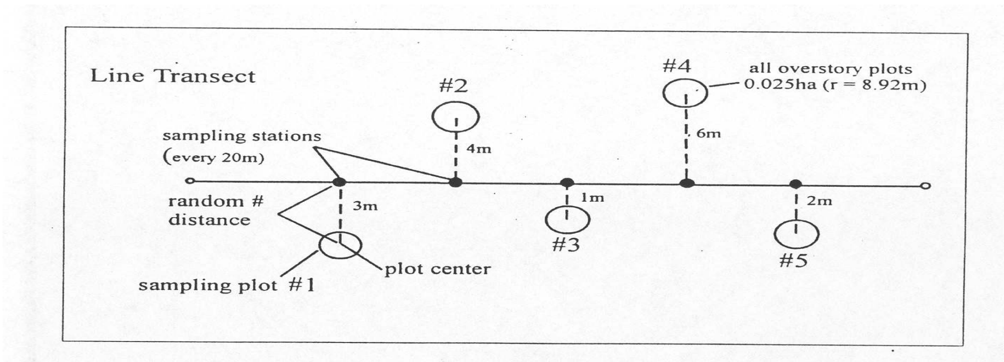


Figure 3.2. Woody overstory and woody understory sampling procedure schematics (not to scale).

Ground layer: The ground layer species (both woody and herbaceous) are analyzed using one-quarter meter-square quadrates (1/4 m^2) randomly located at every fifth meter mark along a line transect. A random numbers table (single digit) is used to determine the number of meters a plot is located to the right or left of the transect. A minimum of 20 to 30 plots should be sampled, but more are recommended. All herbaceous species, and all woody plants less than 50 cm tall are included in the ground layer sampling. From this data the frequency of each species can be determined (Figure 3.2). A supplemental listing of all plant species observed, but not included in the sample plots, should also be completed.

Classifying Illinois Forests

A meaningful landscape inventory classification system is dependent upon our ability to classify natural communities into an organized framework that communicates important information. Probably the most important step in this classification system is to define the fundamental units of this organization system. These discrete and distinct units are then arranged in a hierarchical fashion to describe the way organisms interrelate to each other and to the environment. The goal of the community classification system is to provide the framework necessary to effectively and efficiently inventory and track natural communities in a repeatable and consistent manner.

Numerous systems have been proposed to classify natural communities. The classification system developed by the INAI, however, seems to work well, is used by many botanists, and though modified over time, still is a simple and easily understood system. The natural classification system developed by the INAI has two basic parts. This first part is the landscape scale Natural Divisions of Illinois; the second component is the natural community classes.

In the INAI classification system, the 14 Natural Divisions and their Sections is the framework of the classification system. Several attempts have been made to develop a classification system for the biological landscape in Illinois. The system presently used is modified from these earlier classification systems. This present classification system, the Natural Divisions of Illinois, was published in 1973 by John E. Schwegman, a botanist with the Illinois Department of Natural Resources. This publication recognizes regions of the State based on topography, glacial history, bedrock, soil, and the distribution of nature flora and fauna. Each Natural Division and Section has its own distinct set of natural communities, and the name of the Natural Division and Section is part of the community name. For example, a loess hill prairie of the Northern Section of the Ozark Natural Division is a community distinct from a loess hill prairie of the Glaciated Section of the Middle Mississippi River Border Division.

The second component of the classification system used by the INAI is the natural community classes. A natural community class is a broad group of natural communities that have important natural features in common. A natural community class generally describes the predominant landscape features of a community. Vegetation type and structure are used to separate many of these classes. The natural community classes presently recognized by the INAI are: forest, savanna, prairie, wetland, open water (lakes and ponds), streams, bedrock, shore, cave, and cultural. These natural community classes are ecological assemblages of interacting species that reoccur on the landscape where similar environmental conditions are present.

Each community class (forest, prairie, savanna, etc.) is divided into community subclasses. A community subclass describes in more detail the interactions of features such as topographic position, vegetation growth patterns, species composition, soil moisture, substrate, soil reactions, and hydrology. Each community subclass is then divided into one or more community types (the natural communities of the original INAI). The community type is a group of populations or species that interrelate directly with each other and their specific environment, and whose interactions produce distinct community characteristics. Therefore, the hierarchical system for classifying the community types (natural communities) involves first determining its position within the Natural Divisions System, followed by the community class (forest, prairie, savanna, etc), then the community subclass (upland forest, floodplain forest, etc.), followed by the community type (xeric upland forest, dry upland forest, etc). The Illinois Natural Areas Community Classification list of the forest and savanna community types are discussed below.

In general, many characteristics of the environment and the vegetation are used to distinguish the community types found in Illinois. The structure and composition of the vegetation is most important in separating the community classes (forest, prairie, etc.), but topographic position (upland, slope, floodplain), soil type (loam, gravel, sand), and soil moisture are usually the most important characteristics for distinguishing community types.

In the INAI classification system closely related communities are commonly separated on the basis of soil moisture alone. The following seven soil moisture classes are based on water runoff, soil permeability, and internal drainage characteristics. These moisture classes range from excessively well drained soils due to sloping bedrock or gravel at or near the surface (xeric), to well drained soils that have an intermediate texture (mesic), to very poorly drained soils with the water table remaining at or above the soil surface the greater part of the time (hydric). The entire sequence ranges from: xeric, dry, dry-mesic, mesic, wet-mesic, wet, to hydric.

Classification and Descriptions of Forest and Savanna Community Types Now Used by the INAI

CLASS: FOREST – This class includes natural communities that are dominated by trees which form at least a canopy cover of 80 percent and has a heavy multiple-layered overstory and a thick understory. Three subclasses are recognized with upland and floodplain forest distinguished by their topographic position, and sand forests by their soils.

Subclass: UPLAND FORESTS – The upland forest communities are defined by soil moisture class, which ranges from xeric to wet-mesic. These forests usually do not flood, and therefore include terrace forests along streams and rivers because these terraces do not normally flood.

Community Types:
Xeric upland forests: *Quercus marilandica* (blackjack oak), *Quercus stellata* (post oak) and *Vaccinium arboreum* (farkelberry) are the dominant woody species. The soils are very shallow over bedrock or gravel, and the tree layer is usually stunted.

Dry upland forests: *Quercus ellipsoidalis* (Hill's oak), *Quercus macrocarpa* (bur oak), *Quercus marilandica* (blackjack oak), *Quercus stellata* (post oak), and *Quercus velutina* (black oak) are the dominant tree species. The soils are excessively drained and poorly developed, and the trees grow slowly but are usually not stunted.

Dry-mesic upland forests: *Quercus alba* (white oak), *Quercus rubra* (red oak), and *Quercus velutina* (black oak) are the dominant tree species. The trees grow well, but the canopy is usually more open than in mesic forests.

Mesic upland forests: *Acer saccharum* (sugar maple), *Fagus grandifolia* (American beech), *Quercus rubra* (red oak), and *Tilia americana* (basswood) are the dominant tree species. Ideal soil moisture conditions result in a dense overstory, with shade tolerant species usually common in the understory.

Wet-mesic upland forest: *Ulmus americana* (American elm), *Ulmus rubra* (slippery elm), *Celtis occidentalis* (hackberry) and *Quercus macrocarpa* (bur oak) are the dominant tree species. This community type is usually found on poorly drained soils on level topography, along shallow drainage ways, and in seepage areas.

Subclass: FLOODPLAIN FOREST – The floodplain forest communities are defined by soil moisture class, which ranges from mesic to wet. These forests usually flood, and the frequency and duration of flooding determines the flora and fauna of these communities.

Community Types:
Mesic floodplain forest: *Acer saccharum* (sugar maple), *Quercus alba* (white oak), *Quercus macrocarpa* (bur oak), *Ulmus americana* (American elm), *Quercus rubra* (red oak), and *Tilia americana* (basswood) are the dominant tree species. This community type occurs in the higher elevations of the floodplain, or where the soils are moderately well drained.

Wet-mesic floodplain forest: A large mixture of species occurs in this community type with no clear dominants. The most important tree species are *Acer saccharinum* (silver maple), *Celtis occidentalis* (hackberry), *Liquidambar styraciflua* (sweet gum), *Quercus pagoda* (cherrybark oak), *Quercus macrocarpa* (bur oak), *Quercus palustris* (pin oak), *Ulmus americana* (American elm), *Carya laciniosa* (kingnut hickory), and *Fraxinus lanceolata* (green ash).

Wet floodplain forest: *Acer saccharinum* (silver maple), *Populus deltoids* (cottonwood), *Platanus occidentalis* (sycamore), *Acer rubrum* (red maple), *Betula nigra* (river birch), *Salix nigra* (black willow) and *Acer negundo* (box elder) are the common species encountered in this community type. The tree species of this community vary, but one or more of the species listed above is usually dominant. The wet floodplain forest usually occurs at the river's edge and is commonly flooded for a longer duration than the other floodplain forest community types.

SUBCLASS: SAND FOREST - The sand forest communities are defined by soil moisture class, which ranges from dry to mesic. These communities occur mostly on wind-blown sands of glacial outwash deposits where natural firebreaks greatly reduced burning frequency. Fire suppression after European settlement has increased the area of sand forest at the expense of sand savanna.

Community Types:
Dry sand forest: *Quercus velutina* (black oak) is the dominant tree of this community type, but *Quercus marilandica* (blackjack oak), and *Carya texana* (black hickory) are commonly present. Dry sand forests usually occur on dune ridges and slopes where the soils are very dry.

Dry-mesic sand forest: Both *Quercus alba* (white oak) and *Quercus velutina* (black oak) dominate this community type. Dry-mesic sand forests usually occur on lower dune slopes and the swales between dunes where the soils are fairly well drained.

Mesic sand forest: Many mesic species occur in this community type with the most important being *Quercus rubra* (red oak), *Quercus alba* (white oak), *Acer saccharum* (sugar maple), *Tilia americana* (basswood), *Ulmus rubra* (slippery elm), *Quercus macrocarpa* (bur oak), and *Aesculus glabra* (buckeye). This community type occurs in ravines and along small rivers and streams in sand deposits.

Subclass: FLATWOODS – Flatwoods occur on level or nearly level topography, and are commonly underlain by a clayey subsurface layer that is difficult for water to penetrate (claypan or hardpan). This hardpan layer prevents water movement causing a shallow perched water table and the pooling of water in micro-depressions during wet times of the year. During dry periods the hardpan layer prevents the movement of soil moisture from below, as well as the movements of tree roots.

Community Types:
Southern Flatwoods: *Quercus stellata* (post oak), *Quercus marilandica* (blackjack oak), *Quercus velutina* (black oak), *Quercus alba* (white oak), and *Quercus falcate* (southern red oak) occur on the dryer sites while *Quercus palustris* (pin oak), and *Quercus bicolor* (swamp white oak) are common in the wet micro-depressions of the flatwoods in the Southern Till Plain Natural Division.

Sand Flatwoods: *Quercus palustris* (pin oak) dominates the sand flatwoods of northeastern Illinois. *Quercus alba* (white oak), *Nyssa sylvatica* (black gum), and *Acer rubrum* (red maple) are usually found in low numbers in this community type.

Northern Flatwoods: Restricted to poorly drained uplands on the Valparaiso Moraine of northeastern Illinois this community type is dominated by *Quercus alba* (white oak), *Quercus bicolor* (swamp white oak), *Quercus ellipsoidalis* (Hill's oak), and *Ulmus americana* (American elm).

CLASS: SAVANNA – This community class is characterized by widely spaced trees in which the canopy cover varies from 10 to 80 percent, and there is an understory dominated by native prairie grasses and forbs. Savannas are found on poor to rich soils and generally represent a transition between forest and prairie. Because of fire suppression since the time of settlement savannas are rare communities, and relatively few high quality examples remain. Four subclasses are recognized mostly on the basis of soil characteristics.

Subclass: BLACK SOIL SAVANNA – Black soil savanna communities are extremely rare in Illinois, nearly all having been destroyed. The few remaining have been subjected to fire suppression and except for a few large oaks very little of the original vegetation remains. The community types are determined by soil moisture.

Community Types:
Dry-mesic black soil savanna: *Quercus alba* (white oak) and *Quercus macrocarpa* (bur oak) are the obvious overstory trees, but the dominant vegetation is prairie grasses and forbs. *Schizachyrium scoparium* (little bluestem), *Sorghastrum nutans* (Indian grass), and *Heterostipa spartea* (porcupine grass) are the obvious grass species.

Mesic black soil savanna: *Quercus alba* (white oak) and *Quercus macrocarpa* (bur oak) are the dominant tree species, but the dominant vegetation is prairie grasses and forbs. *Andropogon gerardii* (big bluestem), *Schizachyrium scoparium* (little bluestem), and *Sorghastrum nutans* (Indian grass) are the obvious grass species.

Subclass: SOUTHERN TILL PLAIN SAVANNA – Southern till plain savanna communities are rare, essentially all having been destroyed. This community occurs on Illinoian till soils that are older, poorer, and more leached than the soils of the black soil savanna communities. The southern till plain savanna communities have a wide diversity of both prairie and woodland grasses.

Community Type:
Dry-mesic southern till plain savanna: *Quercus alba* (white oak), *Quercus stellata* (post oak) and *Quercus velutina* (black oak) are the obvious tree species of this savanna community, but *Carya ovata* (shagbark hickory) and *Carya tomentosa* (mockernut hickory) are also encountered. Common grasses include *Schizachyrium scoparium* (little bluestem), *Sorghastrum nutans* (Indian grass), *Agrostis hyemalis* (tickle grass), *Agrostis scabra* (rough bent grass), and *Andropogon gerardii* (big bluestem).

Subclass: SAND SAVANNA – Sand savanna communities are defined by soil moisture classes, which range from dry to dry-mesic. This community occurs mostly on wind-blown sands of glacial outwash deposits where period fires were responsible for the open nature of the vegetation. Fire suppression after European settlement has increased the area of sand forest at the expense of sand savanna.

Community Types:
Dry sand savanna: *Quercus velutina* (black oak) is usually the only tree species encountered. The vegetation is dominated by species of dry sand prairies with *Schizachyrium scoparium* (little bluestem), *Koeleria macrantha* (June grass), and *Heterostipa spartea* (porcupine grass) being the dominant prairie grass species present.

Dry-mesic sand savanna: *Quercus velutina* (black oak) is the dominant tree species, but *Quercus alba* (white oak) is also encountered. The dominant vegetation is dry to dry-mesic sand prairie species with *Schizachyrium scoparium* (little bluestem) *Carex pensylvanica* (Pennsylvania sedge), *Sorghastrum nutans* (Indian grass), and *Heterostipa spartea* (porcupine grass) being the dominants.

Subclass: BARRENS – Barrens communities are defined by soil moisture classes, which range from dry to dry-mesic. Barrens are plant communities in which there is prairie flora mixed with forest. Environmental conditions necessary for barrens include low soil moisture conditions, nutrient poor soils usually with clayey subsoil or hardpan, and occasional catastrophic fires.

Community Types:
Dry barrens: Occurring on thin soils over bedrock or hardpan, dry barrens have thin soil that is usually very dry. *Quercus marilandica* (blackjack oak), *Quercus stellata* (post oak), and *Quercus velutina* (black oak) are the dominant tree species, with *Ulmus alata* (winged elm) a common understory tree. Prairie grasses and forbs are the obvious ground layer with *Schizachyrium scoparium* (little bluestem), *Danthonia spicata* (curly grass), and *Koeleria macrantha* (June grass)
the common species present.

Dry-mesic barrens: The dry-mesic barrens have deeper soils and more moisture than is found in the dry barrens. *Quercus alba* (white oak), *Quercus velutina* (black oak) and *Quercus falcata* (southern red oak) are the important overstory species while *Schizachyrium scoparium* (little bluestem), *Danthonia spicata* (curly grass), and *Sorghastrum nutans* (Indian grass) dominate the ground layer.