W 982

Forest Stand Delineation:

David C. Mercker, UT Extension Forester
Kevin P. Hoyt, Center Director, UT Forest Resources AgResearch and Education Center

University of Tennessee

Real. Life. Solutions.™

UTEXTENSION
INSTITUTE OF AGRICULTURE
THE UNIVERSITY OF TENNESSEE

Introduction

Many landowners understand that responsible forest management doesn't happen by chance. To achieve forestry goals, management must be applied. Activities are implemented that initiate, improve, maintain or regenerate a forest.

When advising private forest landowners, professional foresters often begin with standard inquiries of, "Why do you own your land? What do you wish to achieve? What are your goals?" This motivates landowners to gather their thoughts and sharpen them into specific desired outcomes, or goals. Once goals have been established, a forest stewardship plan can be fashioned, that if followed, achieves the desired goals.

Early in this process, landowners and their forester subdivide larger forests into smaller units called *stands.* This is known as *stand delineation.* Stands are the most basic units of a forest. Stands are recognizable areas of a forest that are relatively uniform in species composition, physical characteristics or condition. Stands are generally managed as a single unit and they exhibit unique features that separate them from adjacent stands. The separation is the stand boundary.

More specifically, a stand is defined as: a contiguous group of trees relatively uniform in age-class distribution, composition and structure, and growing on a site of sufficiently uniform quality, that is a distinguishable unit from adjoining areas or stands (Helms 1989).

Important to this definition is that any treatment or management activity that occurs in a designated stand will have similar results/outcomes across the entire stand because the environment is relatively consistent. If a stand is highly variable, then the results of a treatment will likely also be variable (Clatterbuck 2020).

Stand descriptions on paper should be clear enough that upon field reconnaissance, what's written on paper matches the actual forest condition. A caveat is that forests are not static; forests change. In this sense, stands are temporary, and should be revisited as they are altered through time and with management. Quite often, stands initially may not resemble the desired outcome, so vision and guidance is necessary.

Two distinctly different forest stands that should not be grouped together as one.

Why Delineate Stands?

Stands are delineated to make forest and wildlife management easier, to focus efforts on highest priorities and to establish a time table for future income and expenses (budgeting). Subdividing larger forests into multiple smaller stands also helps achieve non-timber and non-consumptive goals, such as wildlife, recreation or aesthetics. If maintaining early successional habitat for wildlife is important, for example, then a forest shouldn't be harvested in its entirety (regenerated all at once), but rather periodically in smaller stands, thereby providing a continuous mosaic of regenerating patches.

How are Stands Different (and Therefore Delineated)?

Forests stands are often created and re-created through disturbances. Sometimes disturbances originate naturally; sometimes they are human-induced. Natural disturbances might include wind, fire or insect outbreaks. Human disturbances could consist of timber harvesting, livestock grazing or cessation of farming and the resulting forest regeneration. As forests respond to disturbances, a new cohort (or cohorts) of trees invade, creating regrowth that is different from adjacent stands.

Forest stands are not always a result of past disturbances. Stands sometimes are apparent based on characteristics inherent to the site on which the trees grow. For instance, a forest may be broadly divided into *upland* and *bottomland* stands.

The size of individual stands can vary from a few acres to hundreds of acres, depending on the overall property size and the scale of management. Private landowners with less acreage will have smaller stands than would an industrial scale landowner; objectives would be different too. For example, a few acres of high-value black walnut in a creek drainage would be managed quite differently than many acres of upland oak or pine on a dry ridge (Clatterbuck 2020).

The dimension of the property and the complexity of the landowner goals may cause some stands to be grouped (or lumped) together. Some stands may not even represent characteristics "as they are" but rather "what they may become." For instance, a stand may be managed for early successional wildlife nesting habitat, but the present conditions are not representative. That's where professionals are sought to better guide the stand toward the desired goal.

Table 1 provides a summary of how stands might be delineated along with an explanation. Table 1 is not exclusive but does offer examples that make the process clearer.

Table 1: Common Parameters used for Delineating Forest Stands

Possible Stand Delineation Parameters	**Explanation**
Composition	Stand composition is the proportion of tree species and is often described as a pure stand (greater than 80 percent of the trees in the main canopy are the same species) or mixed stand (less than 80 percent of the trees in the main canopy are a single species). An example of a pure stand could be a loblolly pine plantation or sycamore that invaded an abandoned row crop field. Mixed stands contain a distribution of many species that might be collectively delineated as "upland hardwoods."
Age Class	Stand age often can be traced back to a prior disturbance that caused a new cohort of trees to become established. Age classes fall into one of three categories. **Even-aged stands** occur when there is a relatively small age difference between the majority of the trees. For instance, a stand develops into an *even-aged stand* following a clearcut. **Uneven-aged stands** occur when there are at least three distinct age classes present. For instance, a stand that has had repeated intervals of partial harvesting may develop into an *uneven-aged stand.* **Two-aged stands** have two distinct age classes. For instance, an abandoned pastured woodlot might have an overstory of an older age class and an understory of younger regeneration that developed once pasturing ceased. This becomes a *two-aged stand.*

Table 1: Common Parameters used for Delineating Forest Stands, continued

Location	One simple way of delineating stands is based on where they are located in relation to some reference point, for instance, east or west of the farm homestead or of a creek. This method of stand delineation (and naming) has duration. The "East Stand" will generally remain as the East Stand, whereas one named based on age class will eventually change as trees grow. However the titles "east" or "west" indicate nothing descriptive about the stand.
Origin	Stand origin is the means by which the majority of the trees in a stand originated and may vary from one stand to another. Three examples of stand origin are *seedling* (originated naturally from seed), sprouts (originated by regrowth on existing stumps), or plantation (originated by physically planting seedlings). Often regeneration is a composite of these three.
Size Class	Size class is a designation of trees based on their diameter at breast height (dbh = diameter at 4.5 feet above the ground). Although many size classes are identified, four broad size classes include: **Seedling –** A tree, usually less than an inch in diameter and no more than three feet in height. **Sapling –** A small tree, usually between one and three inches in dbh and 15-30 feet in height. **Pole –** A tree generally 3-12 inches in dbh. **Sawtimber –** A tree greater than 12 inches dbh that can be sawn for lumber. Sometimes sawtimber is further broken into small sawtimber (12-18 inches) and large sawtimber (greater than 18 inches). Naming stands based on size class will eventually misrepresent the title because "sapling stands" won't always remain sapling-sized.
Stocking	Stocking is a relative term indicating the amount of growing space occupied by trees. Stocking can't be directly measured. Instead it compares the current condition to what is considered optimal. More commonly, stocking is used to describe stand condition and is not used to name stands. Three levels of stocking are used: *overstocked, fully-stocked* and *understocked.* Tables have been developed to aid foresters in estimating the stocking level and landowners may have difficulty interpreting these tables. Stocking might be combined with other characteristics to name a stand, for instance "Understocked Old Pasture Stand."
Land Features	Land features strongly influence the composition, stocking, growth and quality of forest stands. Land features can include topography, aspect (the compass direction that a slope faces), slope percent and location on the slope. Although most stands found on rolling upland sites have multiple land features, sometimes the features are such that stands can be uniquely delineated. A stand named as the "North Slope Pole Red Oak Stand" is descriptive in aspect, size and species.
Soil Series	The most basic of the U.S. soil taxonomy is the soil series. Soil series has a profound effect on forest composition and timber production. Sometimes forest stands can be delineated based on the soil series, but more often, there are multiple soil series residing within the same stand. However soil series is useful when combined with other characteristics to delineate stands. For instance, a soil composed of coarse textured (rocky) soil often indicates drought is likely and might clearly separate as a unique stand when occurring in combination with a south facing slope.
Past Disturbances	Prior activities and/or disturbances have an impact on the current and future forest composition. Disturbances can be human-induced, such as timber harvesting, fire, livestock pasturing or clearing for row crop agriculture (then abandoned to grow back). Disturbances can also be of natural origin such as wind, tornado, insect outbreaks or drought. These disturbances, particularly when large enough, often result in distinct stands that could be named, for example, "Tornado Stand" or the "Old Pea Patch Stand."

As exhibited in Table 1, users have the freedom of considering many factors that influence how stands are formed and delineated. However, it is usually preferred that species composition, age class and site productivity be relatively uniform at a minimum. Also, consider that the present vegetation (favorable or unfavorable) may be a result of past disturbances and may not reveal the overall site potential.

The first photo is the forest condition as it was prior to management.

The second photo is the same site after active management and shows a small opening that was created to enhance wildlife habitat.

Getting Started in Delineating Stands

As is apparent from the stand delineation examples in Table 1, most of the work needed to accurately delineate forest stands is accomplished in the field. Very little can be accurately observed about stand age and size class, origin, composition or stocking without field reconnaissance. However, preliminary work done in advance will make field observation smoother. This principally includes mapping and assessing forest history.

Maps or aerial photos are readily available in many forms. With the use of web sites, phone apps and GPS, many types of maps and photos can be easily retrieved. Some examples include aerial, soil, topography, LIDAR and watershed. Both recent and dated maps are useful.

The history of a forest is often best captured by talking with the landowner, their representative or neighbors. The present forest condition often is a mosaic of previous land uses. When has harvesting occurred? What were the harvest parameters? Was the forest pastured in prior periods? If so, how heavily and with what animals—cattle, hogs, goats or horses (each impacts forest composition differently)? Are there areas that were once row-cropped and then abandoned that have since reverted back to forest? Has fire occurred? Was it prescribed (intentional) or wild fire? Was the fire hot and destructive to the tree trunks or moderate and without lasting effect? Were trees planted? If so, when, where, how many and what species? Has there been any professional forester or wildlife biologist to assist? Is there a current or an outdated forest stewardship plan with stands already identified?

Together, maps and an assessment of land-use history paint a picture of what may exist on the ground. Although most stands cannot be delineated with only this evidence, having this information will bring clarity once the site is visited.

Field Observation

Upon reaching the forest, stand delineation becomes more visual. Original observations made by reviewing the maps are often confirmed. The boundary of prior land uses and/or disturbances often develop distinct edges. Edges separate dissimilar units into unique stands.

Once stands have been delineated, specific observations as outlined in Table 1 can be made. In addition, other stand features that can be addressed include water bodies, wetlands, roads, basal area, board feet, firebreaks, distinctive plant/animal species, special features (i.e., grave sites), environmentally sensitive areas (i.e., heron rookery), and aesthetic locations (vistas, water falls, etc.). The number of acres within each stand should be determined too.

Estimates are made, or in some cases inventories are conducted, to quantify timber volume, condition, stocking and value within each stand. The strength of such sampling varies according to the accuracy needed. Estimates are often sufficient, whereas other situations require precision. Regardless, stands must be sufficiently evaluated to the level needed. Accurate stand descriptions, once put into text, should allow a reader to visualize the on-the-ground conditions without visiting the site. In other words, what's written should match what's there.

Bringing It All Together

At some point the stands are named. Naming stands with a characteristic unique to the site also helps visualize the stand, e.g., "Pine Plantation Stand," "Tulip Poplar Flats Stand," "Mixed Oak Investment Stand" or "Turkey Roost Stand."

A new, larger map of the entire forest is created that merges the individual stands. Both the property boundary as well as individual stand boundaries must be apparent. The map should identify roads and trails, and any riparian areas. Riparian areas pertain to the zone along the banks of a river, stream or lake. Normally riparian areas offer some protection from forestry activities via the use of buffers.

Once stands have been identified and evaluated (i.e., a diagnosis has been made), treatments, recommendations and/or prescriptions can be drawn. Forest ownership goals cannot be met unless individual stand prescriptions are established and implemented. There are a multitude of prescriptions that can be made to satisfy forest and wildlife management goals, and these are beyond the scope of this publication. For more insight, see UT Extension Publication Forest*A*Syst PB 1679.

Generally, a priority listing of management recommendations is then fashioned against landowner constraints and ranked in order of desired implementation. Often there are financial constraints, such as funding needed to implement some practices. An example might include harvesting Stand A first, to generate funds needed for a wildlife practice in Stand B and a tree planting project in Stand C.

Harvesting valuable timber is the goal of many landowners. Trees such as this are possible through sound forest management, beginning with a forest stewardship plan with stands properly delineated.

Because forests are dynamic systems, stands change. With or without human intervention, trees grow, die and regrow, vegetative succession advances, and disturbances occur—all suggesting that stands must be periodically reassessed. Once the process begins, it is continuous. Likewise, forest stewardship plans must be occasionally altered until such time that they become obsolete, then the process begins again. When this happens, some stands will remain intact and some won't. A time frame for stand revision is not fixed but rather is a function of many factors, including intensity of management and disturbances that might have occurred. For example, if a wind

storm has severely damaged trees in Stand A and an emergency logging of that stand is now necessary, then Stand A may be merged with Stand B and both stands undergo a harvest together. In the end, two stands are harvested simultaneously and then, because they now have uniform features, may become one stand.

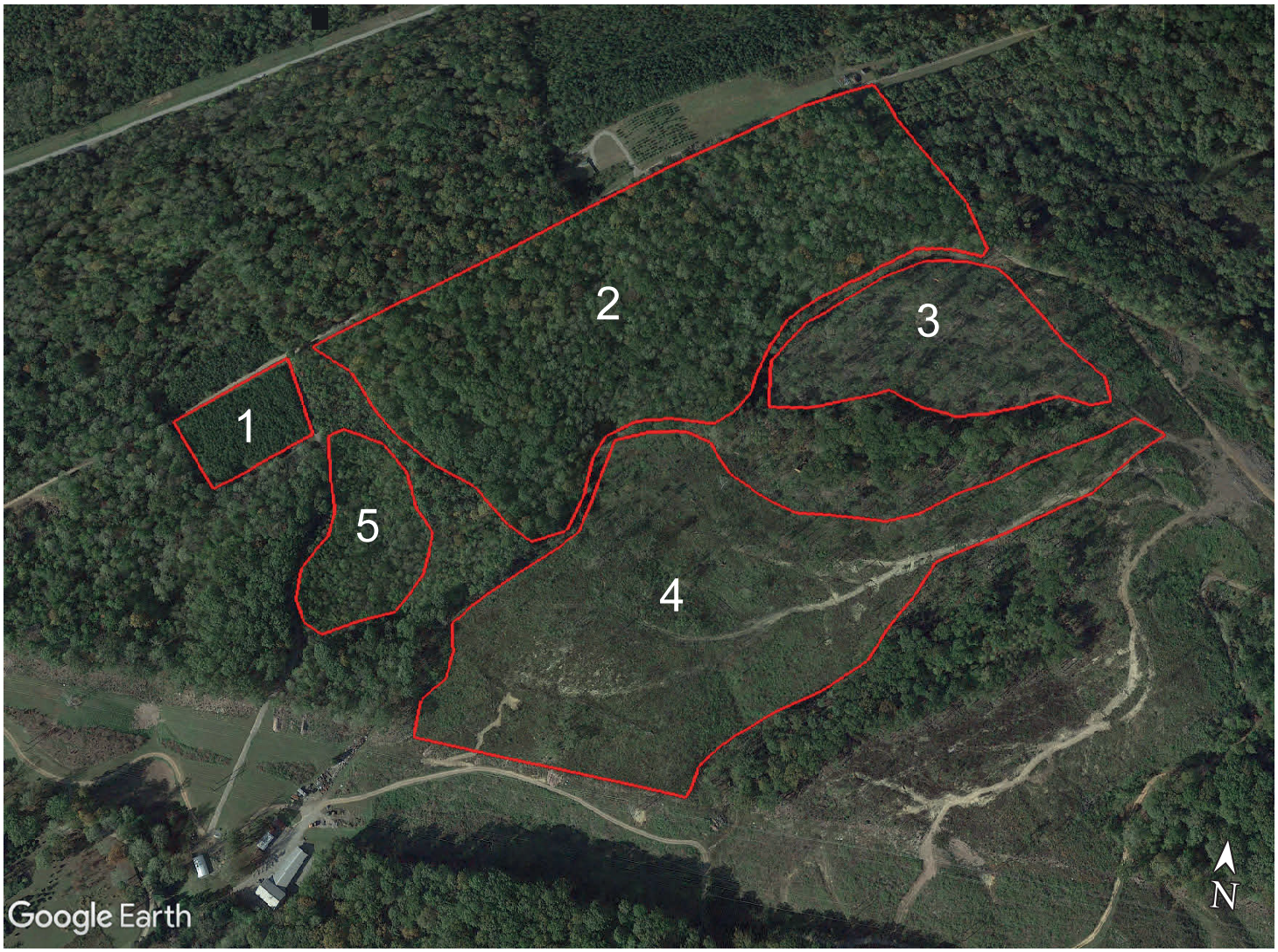
Conclusions

Private forest landowners are encouraged to begin forest activities by first delineating their forest into stands, the smallest and most basic unit of forest areas. Doing so differentiates forests into smaller uniform areas, making forest management recommendations and implementation easier. Professional assistance is available to assist with the process. Other sources include:

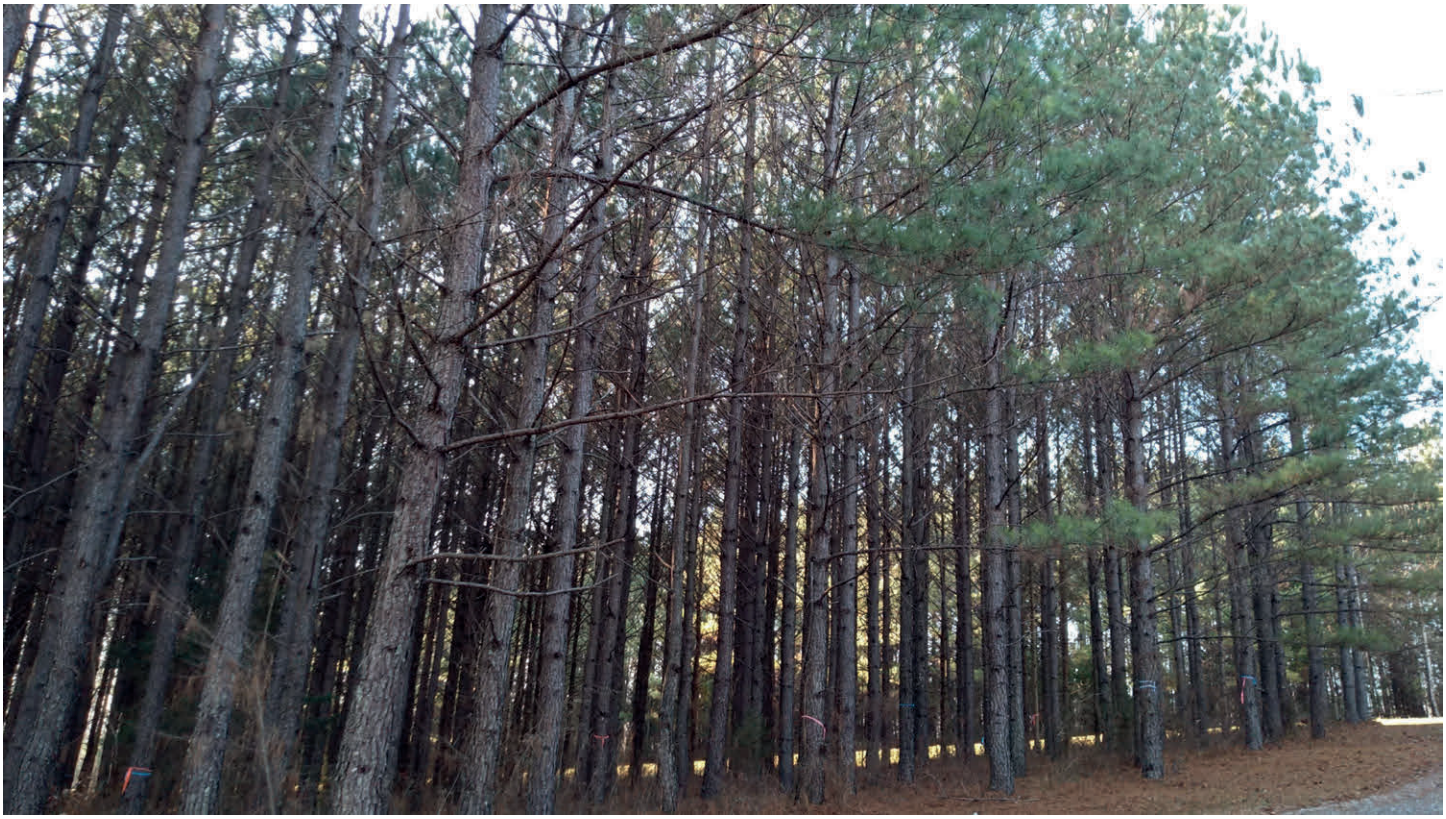
Tennessee Division of Forestry:
https://www.tn.gov/content/dam/tn/agriculture/documents/forestry/AgForAreaForesterMap.pdf

Tennessee Consulting Foresters:
https://www.tn.gov/agriculture/forests/landowners/consulting-foresters.html

Stand Map and Photos



Stand Map – *Example of aerial photos with five unique stands delineated. The corresponding photos that follow show the actual forest conditions on the ground. Notice the differences in the tree crowns and the stocking. Some stands have noticeable gaps in the forest canopy and inconsistent stocking, whereas others have a closed canopy and consistent stocking.*



Stand 1 – *An overstocked 20 year-old planted loblolly pine plantation that is ready for the first thinning. Notice the relatively even spacing, dense canopy and uniform crown texture.*

Stand 2 – *A mature stand of mixed upland hardwoods (75 years old). Notice dense canopy with non-uniform (but large) crowns.*

Stand 3 – *A shelterwood harvest, eight years later. Notice open canopy with scattered trees and dense regrowth.*

Stand 4 – *A clearcut eight years after harvest. Notice no overstory canopy and dense regrowth.*

Stand 5 – *A post-sized stand of mixed hardwoods that naturally regenerated 25 years after a clearcut. Notice dense, uniform canopy with small crowns.*

References

Clatterbuck, W. personal communication, August 31, 2020.

Helms, J. 1998. The Dictionary of Forestry. Society of American Foresters. Bethesda, MD.

Mercker, D. 2016. Forest*A*Syst. University of Tennessee Extension. PB 1679.

Mercker, D. 2018. A Glossary of Common Forestry Terms. University of Tennessee Extension. PB 1867.

Funding for this publication was provided, in part, by the USDA National Institute of Food and Agriculture Renewable Resources Extension Act.

INSTITUTE OF AGRICULTURE
THE UNIVERSITY OF TENNESSEE

UTIA.TENNESSEE.EDU

Real. Life. Solutions.™

W 982 3/21 21-0145 Programs in agriculture and natural resources, 4-H youth development, family and consumer sciences, and resource development. University of Tennessee Institute of Agriculture, U.S. Department of Agriculture and county governments cooperating. UT Extension provides equal opportunities in programs and employment.