Forest Stewardship Plan for the "Bearwallow Bald" Property
[redacted] County, NC

Prepared by EcoForesters:

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Summary

During November and December of 2015 EcoForesters conducted a forest assessment of the approximately 97.3 acre (92.2 of which is currently forested) "Bearwallow Bald" property located in [redacted] County, North Carolina (see Location Map, Appendix A1) for the purpose of creating a forest management plan. The purpose of this management plan is to map and describe the general forest condition and set forth management actions that will improve the forest based on the landowner's objectives. The forest management objectives of the landowner are listed below:

Commercial Timber Management
Forest Ecological Health
High Water Quality
Biodiversity
Wildlife Habitat
Aesthetic Beauty

The property contains 92.2 acres of forestland, consisting of three different forest cover types and one non-forest cover type (see Table 1 and Cover Type Map in Appendix A2). The diversity of cover types is due to variation in management history, topography, soils, and aspect. The property is bordered by other forested private property on all sides. The property is accessed by a rough four-wheel drive, high clearance only accessible road across the neighboring property (see Maps in Appendix A). Once on the property the lower part of this road is in better condition with a more stable and more recently maintained road surface as it switchbacks upwards to the ridge and loops back, with one steep section.

The property is located just south of [redacted] on the [redacted] Mountain ridge. The ridge runs north-south through the western half of the property. Therefore, the parcel consists of mostly east-facing slopes, with a smaller part on the western aspect. [redacted] Branch and a couple of unnamed tributaries drain most of the eastern sides of the property along with [redacted] Branch – which is just off the northern edge of the property and drains the northern quarter of the parcel and then flows into [redacted] Branch off of the property. The western slopes of the property drain into [redacted] Branch which then merges with [redacted] Branch. The property is within the Upper French Broad River watershed. The rugged terrain is extremely varied from fairly gentle near the flat ridge top to moderate and then steep slopes lower down. The land lies between 3100 and 4000 feet in elevation above sea level. The soils resources on the property are rich; they are mostly very productive or at least productive (Appendix B). To classify forest stands, EcoForesters uses an ecological community classification system which is based on the North Carolina Natural Heritage Program's Fourth Approximation of Natural Community Types (http://cvs.bio.unc.edu/pubs/4thApproximationGuideFinalMarch2012.pdf).

There is evidence of at least 4 significant past logging operations on the property. The property was probably clear cut along with the wider area around the turn of the 20th century. There is evidence that the some of the land (probably the upper slopes and flatter ridge top) was then kept clear and probably used as pasture and/or more recently an orchard. However, a few lone "wolf" trees were left to grow after the initial clearing – at the future barn site and a few scattered "boundary" trees along the property's edges. These large "wolf" trees are probably about 100 years old and grew in open conditions without competition and, therefore, put on many stout lower branches. Consequently, although large, these "wolf" trees have

little to no economic value; however, they have great aesthetic value for their character, as well as significant wildlife value. The "wolf" tree at the future barn site is in poor health and large branches are starting to split off due to its dense branches competing with each other, and this is allowing in rot (see picture below to right).

Boundary "wolf" tree.

"Wolf" tree at 19th century home site and future barn site.

The vast majority of the second growth deciduous forests were also heavily cut – as was common – during the era of the chestnut blight in the 1940s and 1950s. More recently, large patches of the slopes were clear cut about 50 and 30 years ago. In addition about 15-20 years ago (probably right before the parcel was sold to the current owner), smaller gaps were also cleared and grazing was stopped on the then larger "grassy bald" which, consequently, was colonized by young sun-loving yellow-poplar and black locust trees from the edges, creating more early successional stands; these 15-20 year old stands have been classified as Early Successional Rich Cove stands (stand #2). This past intensive management has led to the thick re-growth of an overstocked (overly dense) forest over the vast majority of the property. The small remaining, unforested, blackberry-goldenrod "bald" on the ridgetop is currently converting back to forest slowly too, since it hasn't been maintained in quite a few years. This natural succession will continue and the bald will revert back to forest unless an ongoing management intervention happens soon.

If maintaining the "bald" is desired, action is required soon, as it will be much harder to clear it after trees become established.

Wildlife habitat on the property is excellent with a diversity of forest composition and structure. Some small (too small or inaccessible to manage for timber now), but productive, older clusters of trees in the corners of the property and along the streams have not been logged in about 70 years. These areas, along with the few "wolf" trees provide a scattering of hard mast (e.g., acorns and hickory nuts) producing trees. In some of the stands that were harvested about 30 years ago white pines trees (now very poorly formed) were left, which provides evergreen cover for wildlife. The shrinking blackberry-goldenrod "bald" provides a totally different non-forest habitat type including plentiful soft mast (blackberries), as well as fresh grasses and herbs, for bears, deer (observed on property), birds, and everything in between. There are still old apple trees remaining from the historic orchard on the property that probably produce some very alluring fruit for wildlife.

Very poorly formed white pine tree in Early Successional Rich Cove stand.

The early successional forest is another habitat type that can attract grouse (observed on the property), turkeys, and other animals that need dense thickets for cover. Access to water is easy throughout the property and the productive soils form a rich base for plant and animal life. However, over time the current "bald" will transition to an early successional forest and other stands will age. If wildlife diversity is desired, then actions should be taken to keep at least the rare current "bald" open by either mowing, grazing, or burning. While much of the forest is growing well, mast production is probably well below historic levels due to the lack of mature nut-producing oaks and hickories, as well as the loss of the American chestnut in the 1940s. In particular, much of the forests that were cleared have come back dominated by yellow-poplar; and red maple is taking over in the shadier forest understory. Therefore, actions should be taken to encourage declining oaks and hickories. Finally, most of the forest on the property is of a successional stage that does not yet have an abundant amount of over-mature trees, snags, and coarse woody debris, characteristics commonly found in old growth forests which can provide important habitat for some species of birds, small mammals, and amphibians.

Old apple tree from abandoned orchard.

Little opportunity exists for commercial timber management in the next 20-30 years, as the vast majority of the valuable timber has been removed fairly recently. The main challenges to forest management on the property are the steep slopes, many waterways, and sometimes rocky slopes that all make access a concern. Given these conditions and that ground disturbance is the biggest factor for erosion and water quality problems, any future management must be carefully planned. Upon time to conduct management operations in the future, careful consideration must be given to the placement of roads and harvesting systems to minimize impact to the residual forest and prevent erosion. Any future logging operations must rigorously abide by Best Management Practices so that soil resources and water quality are maintained.

Deer antler "rub" on striped maple.

Another significant concern, which should be addressed soon, before it worsens, is non-native invasive species. Patches of the aggressive and undesirable multiflora rose were found all along the road throughout the property. Invasive plants are usually found in these disturbed areas. Invasive plants can also often be a greater problem and more aggressive on moister, more productive sites, which exist over most of the property. Therefore, it is recommended that the significant patches of multiflora rose along all the forest roads be controlled soon before they can spread to prevent further infestation (see Appendix C). EcoForesters can help plan and execute this invasive plant control.

Thicket of dense multiflora rose along road.

In consideration of the forest management history, current conditions for each stand, and the landowner's objectives, EcoForesters, in consultation with the landowner, has set forth management actions that are detailed in Table 2. The remainder of this report contains more detail on stand descriptions and management recommendations.

Summary Tables

Table 1. Area of Each Cover Type	
Type	**Acres**
1. Rich Cove Forest	59.3
2. Early Successional Rich Cove Forest	29.1
3. Chestnut Oak (Mesic) Forest	3.8
4. Non-forest (Blackberry-Goldenrod "Bald")	5.1
Grand Total	**97.3**

Table 2. Management Actions by Stand Type

Stand ID	Suggested Management Action	Target Date	Revenue	Requirement
1.1 Rich Cove Forest	Control numerous patches of invasive multiflora rose and native vines that are covering trees along road.	2016	Cost	Optional+
2. Early Successional Rich Cove Forest	Control numerous patches of invasive multiflora rose and native vines that are covering trees along road.	2016	Cost	Optional+
4. Blackberry-Goldenrod Bald	Expand the bald to its historic size (15 ac.) by clearing and then grazing, mowing, or burning to maintain the bald's open, treeless rare habitat.	2016-2026	Cost	Optional+
1.1 Rich Cove Forest	Conduct Crop Tree Release to increase desired tree growth and promote in stand diversity.	2016-2026	Cost	Optional+
2. Early Successional Rich Cove Forest	Conduct Crop Tree Release to increase desired tree growth and promote in stand diversity.	2020-2030	Cost	Optional+
1.1, 1.2 & 3. Rich Cove & Chestnut Oak Forest	Conduct Crown Thinning and Group Selection Harvests to increase oaks, hickories and other mast producing and valuable species.	2036-2046	Revenue	Required for PUV Program
Entire Property	Reassess forest in updated management plan.	2026	Cost	Required for PUV Program

+These optional treatments may benefit forest health and diversity, but likely may not increase the net return of future harvests and are therefore not required to be conducted to satisfy the requirements of the PUV Taxation Program.

Table 3. Basal Area (square feet per acre) by Community Type and Diameter Class (inches)							
Community Type	**<4"**	**4-8"**	**8-12"**	**12-16"**	**16-20"**	**>20"**	**Total**
1. Rich Cove	7.5	24.2	31.7	27.5	20.8	20.0	131.7
2. Early Successional Rich Cove	48.6	31.4	24.3	20.0	4.3	2.9	131.4
3. Chestnut Oak (Mesic)	10.0	15.0	35.0	40.0	20.0	30.0	150.0

Timber Resources

1. Rich Cove Forest (59.3 acres)

These forests are mesic (see glossary) and are often located near riparian areas. Rich Cove Forests are distinguished from Acidic Cove Forests by the presence of species that prefer richer soils. Rich coves are important to the maintenance of water quality, due to the concave landforms and proximity to the riparian areas where they occur. They are also important to overall plant diversity, especially herbaceous plants, as this community type is one of the most productive forest types. In general, these are the most fertile, high pH soil conditions. Springs often originate in these stands, feeding the larger streams near the bottom of the cove. Stands of this type occur over the vast majority of the forested part of the property. The more recently harvested or established, but very similar, Early Successional Rich Cove (stand #2) has been split off because it should be managed differently.

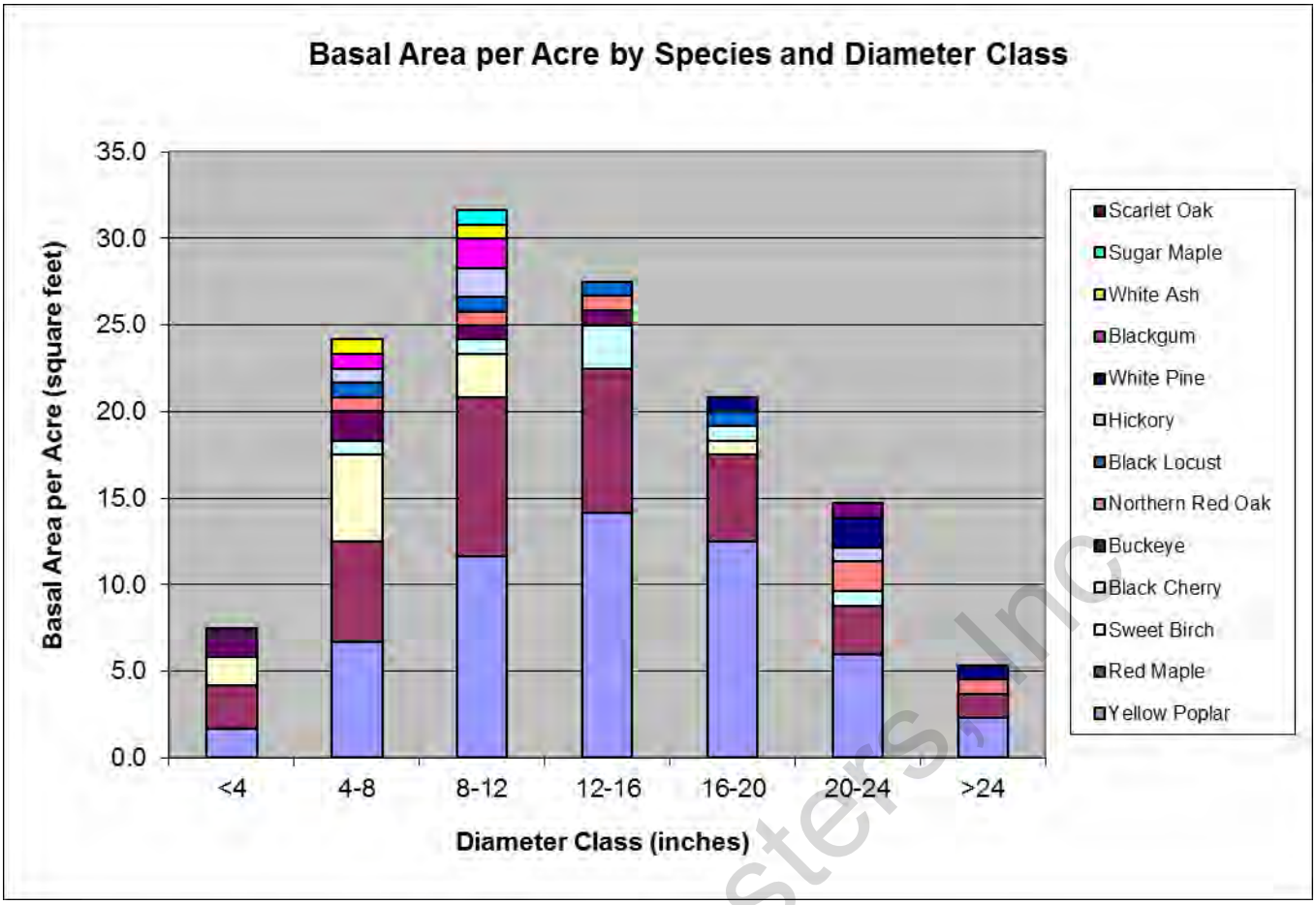
Since this stand is very productive and fairly accessible it has been repeatedly harvested, most recently in large patch clearcuts about 30 years ago. A few much smaller patches inside this stand were also harvested 15-20 years ago but they are not big enough in area to be managed separately. Patches along streams and in the corners of the property were not harvested as recently due to wet conditions and poor access, and are around 70 years old now. However, given that they are in small, disjointed areas and the aforementioned conditions, these small clumps of mature timber would not be profitable to harvest by themselves. Most of the rest of the stand is fairly even aged with most stems between 8 and 12 inches dbh. The basal area of trees in this stands is around 132 square feet per acre reflecting its productivity. However, the trees are fairly tightly spaced.

Due to past heavy harvesting, sun-loving yellow-poplars now dominate areas that were recently harvested. In other areas, more shade-tolerant and less merchantable species like red maple and sweet birch are proliferating. However, especially in less disturbed areas, a rich mix of trees is developing in this stand including black cherry, buckeye, northern red oak, black locust, hickories, some residual white pine, blackgum, ash, sugar maple and scarlet oak. The understory of the forest is fairly open but contains the aforementioned overstory species and midstory species such as striped maple and spicebush. There are some hydrangea shrubs near moister areas, but in general there is enough light on the forest floor to allow a diverse and rich herbaceous layer. Also of note, there are infestations of native grape and dutchman's pipe vines climbing over and damaging trees, especially along the roadside, in stand 1.1 (see pictures above and below).

Native vines growing over the top of trees in Rich Cove Forest.

This stand is currently transitioning from the stem exclusion to the understory re-initiation phase of forest succession (see Glossary). The understory re-initiation stage occurs when trees that have been successful in competition are beginning to have possible health issues. Some of these trees will die in the coming decades opening up some space for the growth of new trees. This process can take several decades. This stand is just beginning to develop the structural and biological diversity that cove forests are known for.

Rich Cove Forest: Basal Area per Acre by Species and DBH (inches)



Management Suggestions:

This forest type occurs on the lower slopes of the property and is the most productive stand type. The stand is currently overstocked. Therefore, some canopy trees are competing heavily and, consequently, growing at a below optimal rate. A crop tree release that targets 30-60 trees per acre to favor would allow for selected desirable trees to grow faster and develop into the future forest. By releasing oaks, hickories, and other desirable trees, they could put on additional growth and mature to mast producing size faster to benefit wildlife. This could also increase the diversity, health, and value of the future stand. See Appendix D for Crop Tree Release directions.

This stand should be reevaluated by a forester in 10 years for a possible harvest in 20 to 30 years when more trees in the stand will be of a size that would make harvest operations more profitable. A crown thinning harvest could be used at that time to increase structural diversity and maintain the vigor of desirable residual canopy trees, while maintaining stand aesthetics. Another approach, group selection harvests, could be done to open up areas of the stand to allow in more sunlight, which would promote the shade-intermediate oaks and hickories. Access to these stands is good, which will make management easier and more profitable.

However, many, large, non-native, invasive multiflora rose bush clumps along the road in Stand 1.1, especially near the stream crossings and other wet areas, as well as the clusters of native vines (both grape and dutchman's pipe), should be controlled as soon as possible – which would be early this growing

season (spring/summer 2016). At the latest, these invasive plants must be controlled before any management takes place, as such disturbance would give them space to invade farther. This invasive can form dense impenetrable tangles of sharp thorns. It is always much easier to control invasive plants early on in an infestation than it is to wait until the problem is so major that it must be addressed. If left unchecked, the non-native multiflora rose will continue to expand its territory and will outcompete desirable native plants from wildflowers and other herbaceous plants to shrubs and even trees. See Appendix C for multiflora rose control. A few non-native invasive royal Paulownia trees were also found near the entrance to the property, which should also be removed before they spread (Appendix E). EcoForesters can help plan and execute this invasive plant control.

Similarly, the native, but aggressive, grape and dutchman's pipe vines should be controlled at the same time as the multiflora rose for economies of scale. In some spots, these vines are already damaging tree crowns, restricting tree growth, and could seriously inhibit future tree regeneration. See Appendix E for vine control instructions. EcoForesters can help plan and execute this vine control as well, which should take place at the same time as the invasive plant control for efficiency.

In order to minimize soil erosion and maintain water quality on the property, a buffer of at least 50 feet on each side of streams in this stand should be included in Streamside Management Zones (SMZs) in which vegetative cover is maintained and management activities should be limited. Canopy cover should be maintained at a minimum of 50% within the SMZ.

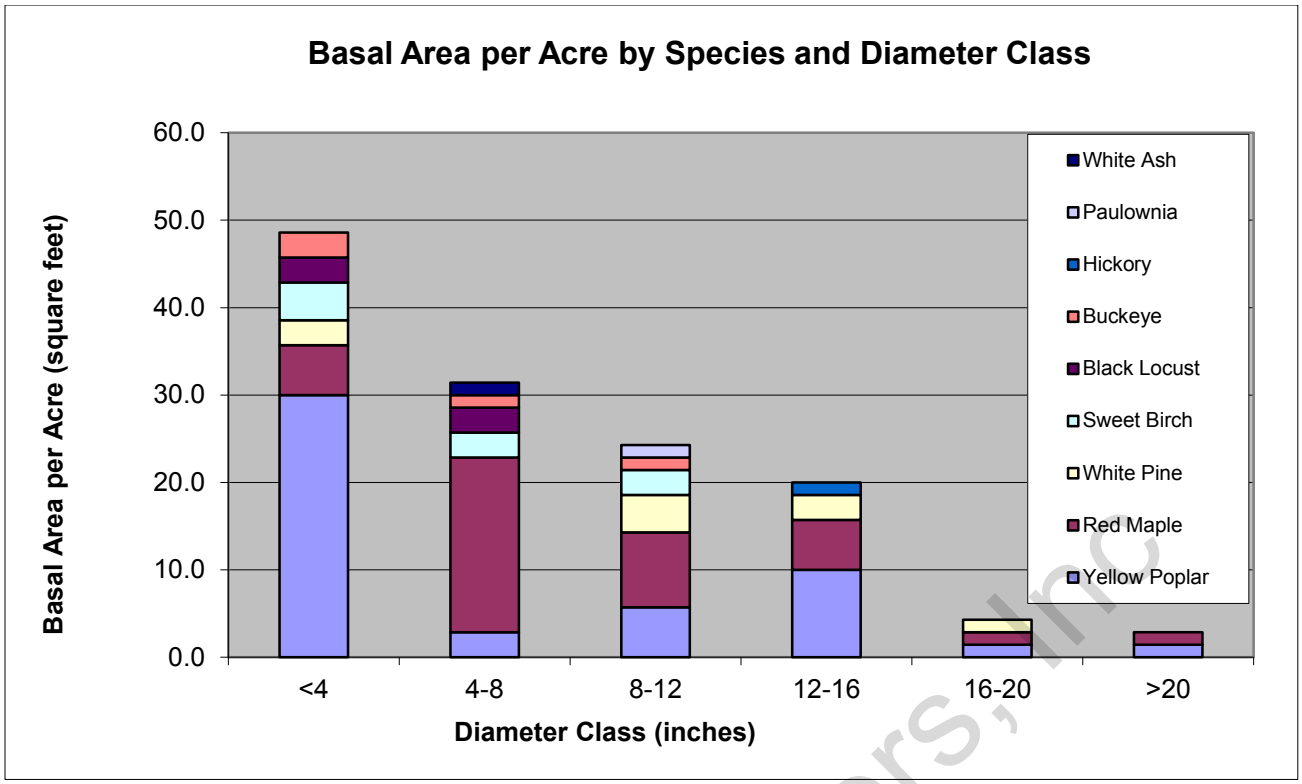
2. Early Successional Rich Cove Forest (29.1 acres)

This stand type is the same general type as Stand 1 only it is significantly younger and slightly higher upslope. Large areas of this stand were clearcut about 25 years ago and smaller pockets were also cleared about 15 years ago. Parts may also have developed from abandoned orchard areas. Furthermore, the no longer maintained – and, therefore, historically larger – grassy bald is shrinking. For the past 15 years or so, along the retreating edges of the bald trees are coming in and encroaching on the bald as part of natural succession. The current young stand around the bald is still expanding into the bald and this will continue to transition to early successional forest. Since all of this stand was cleared recently, the young forest has reverted to mostly sun-loving yellow-poplar. Without past disturbance, and if well managed in the coming decades, the higher and more convex landforms (i.e. drier) would probably be a Montane Oak-Hickory Forest Type. This would be another forest type and add to the diversity on the property.

Currently this stand consists of yellow-poplar, red maple, some bigger residual (but very poorly formed) white pines which were not cut during the last harvest, sweet birch, black locust, buckeye, hickories, and white ash. The quick growing, but shade-intolerant poplars that are currently in the canopy will continue to dominate in these areas. However, as the stand grows and shadier conditions are created, more shade-tolerant species (like the very common, and less valuable for both wildlife and timber, red maple) will eventually increase in the smaller size classes. This stand has the potential to be much more diverse. There also are some clumps of multiflora rose along the roads through this stand as well, which should be controlled soon before they spread.

This stand is still in the stem exclusion phase of stand development. The basal area of the stand is about 130 square feet per acre, with an average diameter of about 7 inches; therefore, it is overstocked (the trees do not have enough growing space). Trees are competing heavily for resources and some will usurp the growing space and others will die. This is a natural process that will set the species composition of the future mature stand.

Early Successional Rich Cove Forest: Basal Area per Acre by Species and DBH (inches)



Management Actions:

Given the very young age of this stand, there is no opportunity for commercial harvest for decades. However, early successional habitat is an important cover type for many different species of wildlife and is under-represented across the landscape. It should be noted that this stand will mature over time and in about 10 years will no longer be early successional habitat. However, if the bald is not maintained it will continue to convert into this young forest type and provide that habitat until it is completely overgrown.

Over the next 10-20 years is a good time to do crop tree release (see Appendix D) in this stand to influence the future stand composition. By selecting which trees to favor – such as better formed and taller poplars, or less common species like hickories and ash – a more valuable and diverse mature stand can be created. While no oaks were recorded in this stand they have the potential to come into the edges from some nearby seed sources lower down. If any oaks are found they should be favored through crop tree selection, as they provide an essential hard mast source for wildlife and are commercially valuable.

3. Chestnut Oak (Mesic) Forest (3.8 acres)

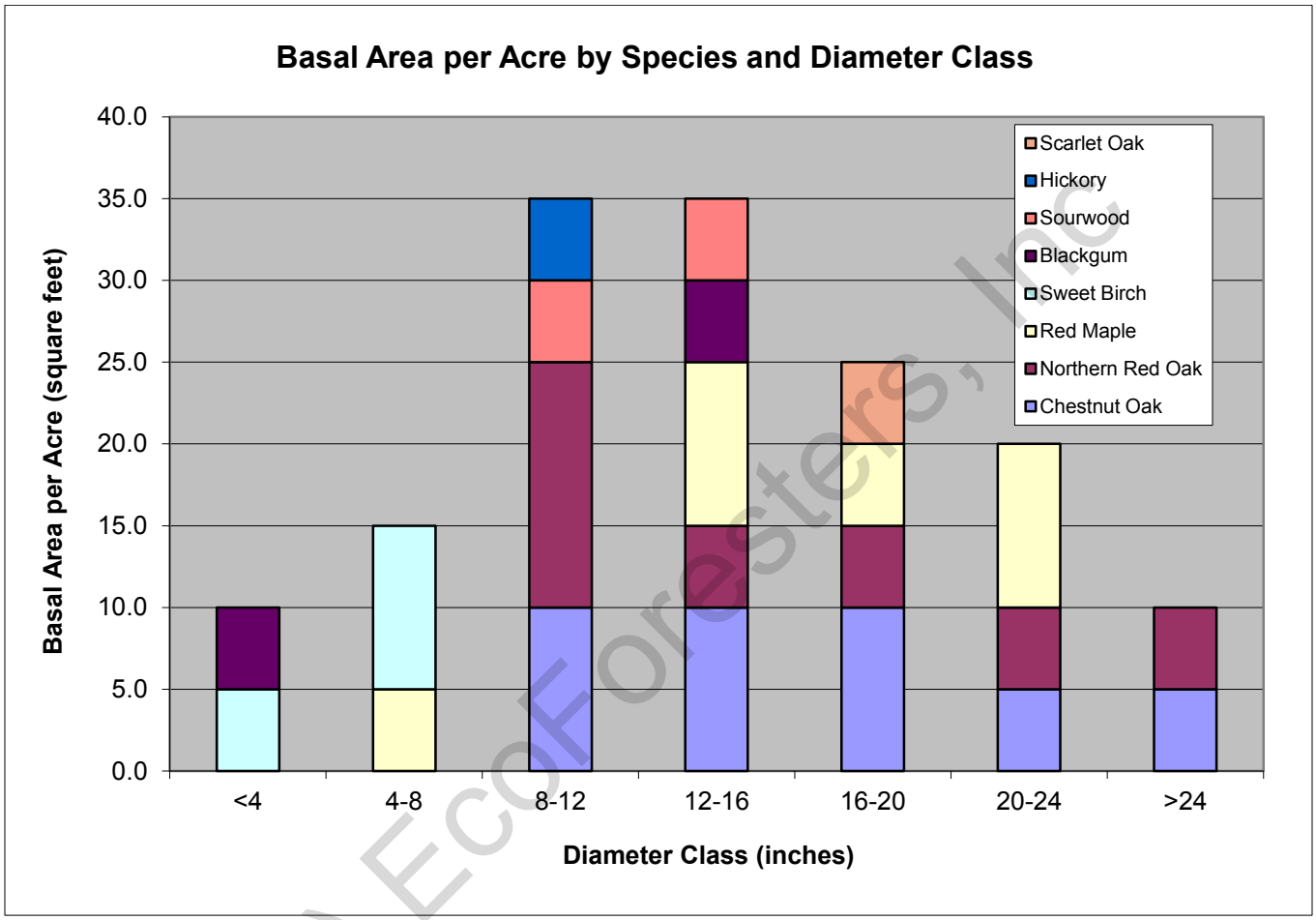
This small stand consists of the Mesic Subtype of Chestnut Oak Forests. This cover type is found on drier sites, predominantly upper slopes, and more exposed or convex landforms. Given their topographical position, soils here tend to be rockier, drier, and lower in nutrients; this subsequently causes slower tree growth. This stand is the Mesic Subtype because it occurs on the lower, slightly moister slopes that adjoin the coves. This stand regenerated approximately 70 years ago after heavy harvests during the era of the chestnut-blight.

Chestnut Oaks tend to dominate on these drier sites, but other species include northern red oak, red maple, sweet birch, blackgum, sourwood, hickories, and scarlet oak. Some large, chestnut oaks, northern red oaks, and red maples make up most of the canopy. In the understory, sourwood, red maple, striped maple, and some white pine are present. The average basal area of the stand is 150 square feet per acre, reflecting the relatively productive nature of this Chestnut Oak Subtype. Much of this basal area is concentrated in stems between 8 and 16 inches in diameter. As is common in these stands, rhododendron and mountain laurel are common in the shrub layer, but are not too dense. The predominant component of oaks in this stand provides a reliable acorn crop, which benefits numerous

wildlife species; this is especially important since few oaks were seen throughout the rest of the property. In addition, evergreen shrubs provide good areas of cover.

The species composition is transitioning to a more shade-tolerant and less diverse and desirable mix. Red maple, sourwood, sweet birch, and blackgum are becoming more common in the smaller size classes while more valuable shade-intermediate species, such as oaks, are becoming less common. This will decrease the diversity and important wildlife value of this stand.

Chestnut Oak Forest (Mesic): Basal Area per Acre by Species and DBH



Management Suggestions:

Given the small area, and steeper, rockier slopes of this stand, as well as the relatively poor form of the trees, commercial management of this stand by itself would not be economically feasible. During future commercial operations in the adjacent cove forest types in about 20 to 30 years, this stand can be harvested as well. At that time, this stand would benefit from group selection or crown thinning harvests then, opening up patches of forest for regeneration of shade-intermediate oaks and hickories. In the meantime, allow the trees in this forest to continue to grow and provide quality wildlife habitat.

4. Blackberry-Goldenrod "Bald" (Non-forest, 5.1 acres)

While this area is non-forest, it is converting through natural succession to more early successional forest and will become dominated by sun-loving species such as yellow-poplar and black locust. Succession has already happened, as this originally grazed, *grassy* bald has converted to mostly goldenrod and black berry shrubs. Without intervention it will soon all be young forest. As this process continues the habitat type and wildlife species it supports will change as well. Losing this fairly rare habitat type will decrease the diversity of cover types and, consequently, wildlife.

Management Suggestions:

According to the 1999 property card there were 12-13 acres of cleared or undeveloped areas, which probably reflect the size of the bald then. The landowner's plan is to expand this bald from its current size (5 acres) to its historic size (15 acres). Therefore, an additional 10 acres will need to be cleared. The area to be cleared should be the flattest surrounding areas. EcoForesters can do a geospatial analysis to help determine the area most suitable to be cleared with minimal risk of erosion. It will be essential that immediately after clearing this area be properly seeded and mulched so it can be revegetated as soon as possible to stabilize the soil. The trees surrounding the bald to be cleared are not merchantable, so this clearing will come at a cost. EcoForesters can also oversee the clearing and revegetation. Once cleared, it is essential that the bald be maintained to keep it in its early successional grassy stage.

There are three options for maintaining the bald in an open state. The most natural way would be to have it grazed by livestock (e.g. cows, horses, sheep, or goats) during the growing season. To do this it would have to be mowed initially and probably treated with a selective herbicide to repress shrubs and trees (though goats will eat anything) and then fenced in – as you do not want livestock roaming through

and damaging the surrounding forest. Once this takes place, livestock can maintain it in a similar manner to the way these grassy balds probably were naturally maintained long ago, by grazing herds of elk or buffalo. Mechanical treatment (mowing) of the area is another option to keep the bald open. Initially, it will probably take a "bush-hog" type tractor-pulled mower to cut through the goldenrod and blackberry. Once this has happened, annual mowing is recommended to keep it in an open and mostly grassy state. The main obstacle to this option is getting the machinery into the top of the property. The final option is to periodically (at least every 3-5 years) burn it. This could be done with the help of the NC Forest Service, but would probably come at a cost to the landowner.

There was clear evidence of ATVs accessing the bald from the neighboring property on its northern end (see photographs to the left and below), where there is an opening in the fence line there. This is despite the fact that the property boundary is well posted and mostly fenced. However, there were no signs of irresponsible ATV use (e.g. rutting or erosion).

Evidence of ATV use to the top of the "bald."

Glossary of Forestry Terms

Advanced Regeneration: regeneration that is already in place in the understory before the canopy is removed. For our studies we classify a tree as advanced regeneration if it is taller than 4.5 feet and has a dbh less than 2 inches.

Age Class: a group of trees which are all roughly the same age and usually belong to a single cohort.

Basal Area: the area of the cross section of a tree bole at 4.5 feet from groundline (DBH). A 12 inch diameter tree for example, has a basal area of 113 square inches or 0.79 square foot. Unless otherwise indicated, basal area units are in square feet.

Basal Area per Acre: the total area of the cross sections of all trees occupying a given acre of land. This measurement is used because it offers the forester the best estimate of how well any given forest site is stocked, and whether or not the site is achieving its optimum growth potential compared to its site quality. Unless otherwise indicated, basal area units are in square feet.

Best Management Practice: forest management practices that reduce erosion and prevent or control water pollution.

Biodiversity: the variety of life forms in a given area; can be categorized in terms of number of species, variety of plant and animal communities, genetic variability or some combination of these categories.

Board Foot: a unit of measure equal to a board that is 1 inch thick, 12 inches long and 12 inches wide, or 144 cubic inches.

Canopy: the general level of the tree crowns in any given forest stand. This zone may be well-defined and unbroken, such as with plantations and classic even-aged forest, or it may be multileveled and weakly defined, such as with multi-stage and uneven aged forests.

Canopy Closure: the canopy is considered to be "closed" if the crowns are touching and the forest floor is fully shaded.

Chestnut Blight: a fungal disease introduced from Asia in the early 1900's that attacks American chestnut trees. The disease eventually killed nearly all mature chestnut trees by 1940. Most of the chestnut trees were harvested before or shortly after the blight killed them. Fortunately, the root system is fairly resistant to the blight and the chestnut persists as shoots from the old root systems. Unfortunately they are only able to grow for several years before the blight attacks them.

Clear-cut: a harvesting and regeneration method that removes all trees within a given area.

Cohort: an aggregation of trees that begins growth as the result of a single disturbance.

Competition: The struggle between trees to obtain sunlight, nutrients, water and growing space. Every part of the tree, from the roots to the crown, competes for space and food.

Coppice: Trees which have regenerated from shoots formed at the stumps of the previously cut trees.

Cover Type: a stand or group of stands which has been designated to one category (i.e. Montane Oak-Hickory) because of similarities such as species composition, age, structure, or site characteristics.

Crop Tree Release: competing trees are removed whose crowns are impeding growth of a crop tree. The crop tree is selected usually based on species, form, superior health, and/or larger size. It is similar to a crown thinning, but usually applied to younger stands of trees still in the Stem Exclusion phase.

Crown: the branches and foliage at the top of a tree.

Crown Class a definition of tree position within the forest canopy. The basic four tree positions are defined as follows:
Dominant Tree- tree is above the general level of the canopy, and receives full sun from above and from one or more sides of the crown.
Co-dominant Tree- tree is level with the general level of the canopy, receiving full sun from above but only partial sun from the sides of the crown.
Intermediate Tree- tree is generally below the general level of the canopy, but occupies the lower canopy levels. Crown receives partial sun from above, but no sun from the sides.
Suppressed Tree- tree is generally below the level of the canopy, does not occupy the canopy layer and is fully shaded from the top and sides.

Crown Thinning: trees are removed from the upper crown classes in order to open up the canopy and favor the development of the most promising trees of the same canopy position.

DBH (diameter at breast height): measured diameter of a tree at 4.5 feet from groundline. In hilly or mountainous terrain 4.5 feet is measured from the highest side of the stump (uphill side on a slope). Certain rules for exceptions are used for trees with forks butt swell or cankers at normal 4.5 feet bole height.

Edge: the transition between two different types or ages of vegetation.

Even-Aged: trees are of that are of the same age or at least the same cohort.

Even-Aged Management: a forest management method used to produce stands that are all the same age or nearly the same age by harvesting all trees in an area at one time or in several cuttings over a short time.

Grade: a system for judging the quality of timber in a tree. In forest service grading rules, grade 1 is greater than 16 inches dbh and with only minor sweep or defects. Grade 2 is greater than 14 inches dbh or greater than 16 inches and with moderate sweep or defects. Grade 3 is greater than 12 inches or greater than 14 inches and with significant sweep or defects. A tree designated as a cull has no timber value due to defects, size, or species.

Group Selection: the removal of small groups of trees to regenerate shade-intolerant trees in the opening (usually at least 1/3 acre).

Growing Space: a reference to the amount of resources (water, sunlight, soil nutrients) available to allow for tree growth. Growing space decreases and becomes very limited as competition between trees increases.

Hemlock Woolly Adelgid: Native to southern Japan, this bug was introduced to the U.S. in the 1920's and has now been established in eleven eastern states, from Georgia to Massachusetts. Appearing as a small cottony pinhead, the insect feeds on the sap of hemlocks, attaching themselves at the base of the needles. After infestation, in the southern Appalachians 90% mortality of all hemlocks can be expected within several years.

High-Grading: a harvesting technique that removes only the biggest and most valuable trees from a stand and provides high returns at the expense of future growth potential. Poor quality, shade-loving trees tend to dominate in continually high-graded sites.

Hydric: a site having or characterized by excessive soil moisture.

Live Crown to Height Ratio: height of the live crown (the part of the tree with live branches) divided by the total height of the tree. It is a useful indicator of a tree's health. Trees with low live crown to height ratios are generally less vigorous and more susceptible to insect attacks and disease.

Low Thinning: trees are removed from only the lower crown classes.

Mast: fruits or nuts used as a food source by wildlife. Soft mast includes most fruits with fleshy coverings, such as persimmon, dogwood seed or black gum seed. Hard mast refers to nuts such as acorns and beech, pecan and hickory nuts.

Mesic: a site that generally has moderate or generally well balanced soil moisture levels.

Natural Regeneration: the growth of new trees in one of the following ways without human assistance: (a) from seeds carried by wind or animals, (b) from seeds stored on the forest floor, or (c) from stumps that sprout.

Prescribed Burning: the practice of using regulated fires to reduce or eliminate material on the forest floor, for seedbed preparation or to control competing vegetation. Prescribed burning simulates one of the most common natural disturbances. Also called controlled burning.

Salvage Cut: the harvesting of dead or damaged trees, or the harvesting of trees in danger of being killed by insects, disease, flooding or other factors in order to save their economic value.

Selective Thinning: dominant trees are removed in order to stimulate the growth of the trees in lower crown classes. This method of timber harvesting is useful in order to favor shade tolerant species. However, in forests, such as most of the southern Appalachian forests, that are dominated by shade intolerant or intermediate species, selective thinning degenerates into the practice of harvesting the best trees and leaving the poorest, also known as high-grading.

Shade Intermediate: trees that can survive in partial shade, but generally do best in full sun.

Shade Intolerant: trees that require full sunlight to thrive and cannot grow in the shade of larger trees.

Shade Tolerant: trees that have the ability to grow in the shade of other trees and in competition with them.

Shelterwood Cut: removing trees in the harvest area in a series of two or more cuttings so that new seedlings can grow from the seeds of older trees. This method produces an even-aged forest.

Site, Site Quality: the inherent productivity of a given piece of forest land. Soil type, soil depth, slope aspect, general terrain, elevation, position on slope, local climate and local precipitation patterns all affect the site quality of a forest stand. Site quality determines the limits of any given piece of land to produce volume and tree growth, and it normally influences the tree species occupying this piece of land.

Site Index: a measurement used to quantify site quality for any given piece of forest land. Site Index is normally expressed, in the southern Appalachian forest types, by the total height of the dominant trees in the stand at 50 years of age. Site Index is always expressed for specific species or species type, as the Site Index value varies between tree species (i.e. White Pine versus Upland Oak).

Silviculture: the art, science and practice of establishing, tending and reproducing forest stands of desired characteristics. It is based on knowledge of species' characteristics and environmental requirements.

Snag: a standing dead or dying tree.

Stand: a delineated portion of forest land that shares similar characteristics in such a way that this portion of the forest can be separated from adjoining forest lands. These shared characteristics can include tree species (conifer, hardwood, mixed oaks, cove hardwoods, etc.), age of the trees, stand structure (even-aged or uneven-aged), site index or site quality, elevation, slope aspect, or special site conditions (swamp, wetlands, rocky, heavy clay soils, special wildlife habitats, etc.). This concept always needs to be used with some care, because natural diversity is such that forest land cannot be completely pigeonholed or defined fully by what is essentially a broad brush approach.

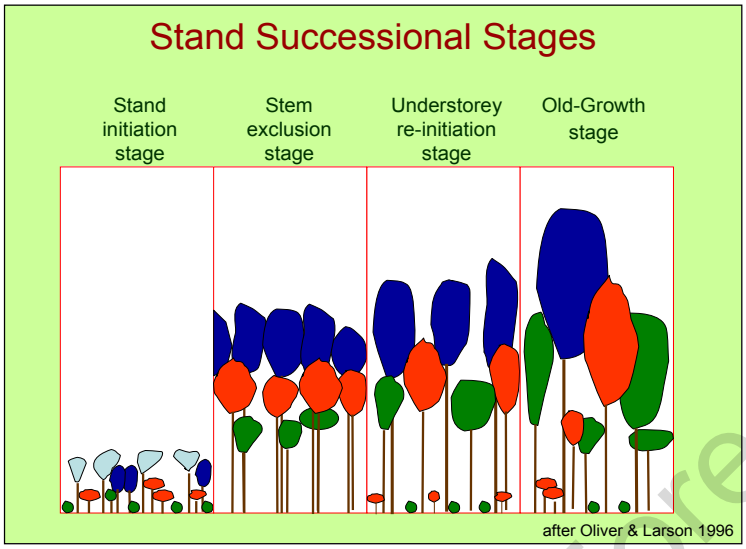
Stem Injection: a method of injecting herbicide directly into the cambium layer of a tree to induce mortality. This method insures the herbicide only impacts the desired tree and does not spread unintentionally. It is commonly used in crop tree release.

Stocking: a measurement or calculated number that expresses the number of trees found on a tract or on a given unit of area (acre, hectare). This is most often expressed by actual number counts of trees (i.e. trees per acre, stems per hectare) or in Basal Area per unit area (i.e. square feet per acre, square meters per hectare). Total number of trees on a tract is meaningful and normally calculated for a timber sale bid offering, but Total Basal Area on a tract is meaningless and is never calculated.

Succession or Stand Development: a given aggregation of trees of a single age class or cohort proceeds from birth to death in a sequence of developmental steps. The steps in the following model were developed by Oliver and Larson, 1996:

Stand Initiation: after a lethal disturbance has created a unit of vacant growing space, the trees that become established in it do not fully occupy the space. Until they do there is opportunity for additional plants to fill the empty spaces such as herbaceous annuals.

Stem Exclusion: when canopy closure is reached and trees begin to compete with each other for limited resources. The more vigorous trees usurp the growing space and weaker ones die. This competition also limits regeneration of a younger cohort of tree species.
Understory Reinitiation: scattered trees that have previously been successful in competition with other trees begin to be lost to pests or other damaging agents. The surrounding tree crowns do not fully close again and the vacancies of growing space thus allow for the growth of new trees. These trees are often advanced regeneration of shade tolerant species.
Old Growth: this occurs when the process of Understory Reinitiation is complete and the initial older cohort has been completely replaced by younger cohorts. Forests in this stage are usually dominated by shade tolerant species. Because there are many age classes of trees, structural and biological diversity is increased. The forest is heavily stratified with foliage extending from tree tops to the forest floor in some places. Biodiversity is also enhanced by a large number of standing and fallen dead trees. Production of wood and organic matter tend to be balanced by loss and decay. (Note this is a unique definition of old growth and there are many others which are based on other factors such as forest structure or tree age.)

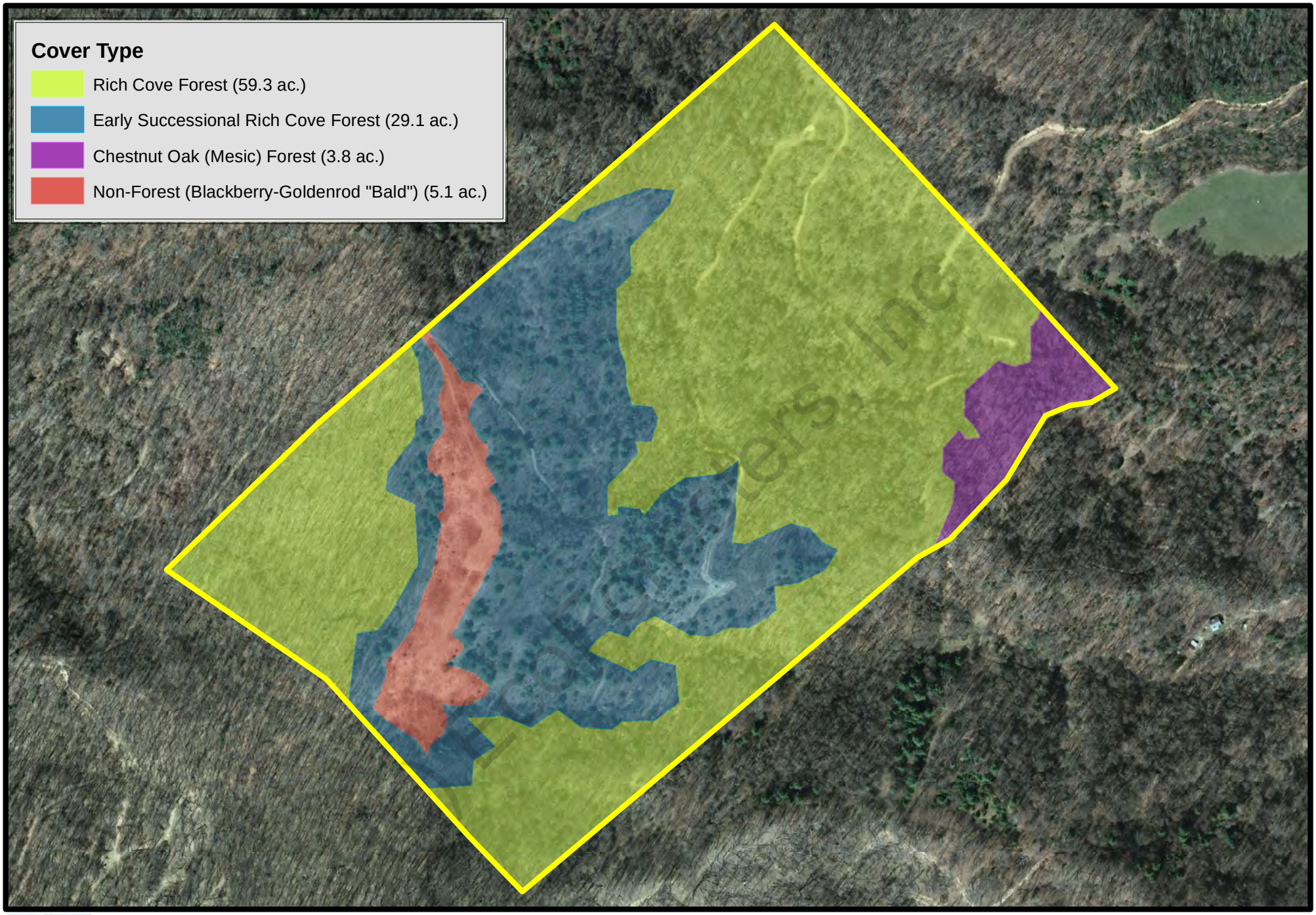


Two-aged: a stand that contains only two cohorts.

Understory: the area below the forest canopy that comprises shrubs, snags and small tree. Because the understory receives little light, many of the plants at this level tolerate shade and will remain part of the understory. Others will grow and replace older trees that fall.

Uneven-aged: a stand that contains three age-classes intermingled intimately on the same area.

Xeric: a site that is regularly deficient in moisture.



EcoForesters

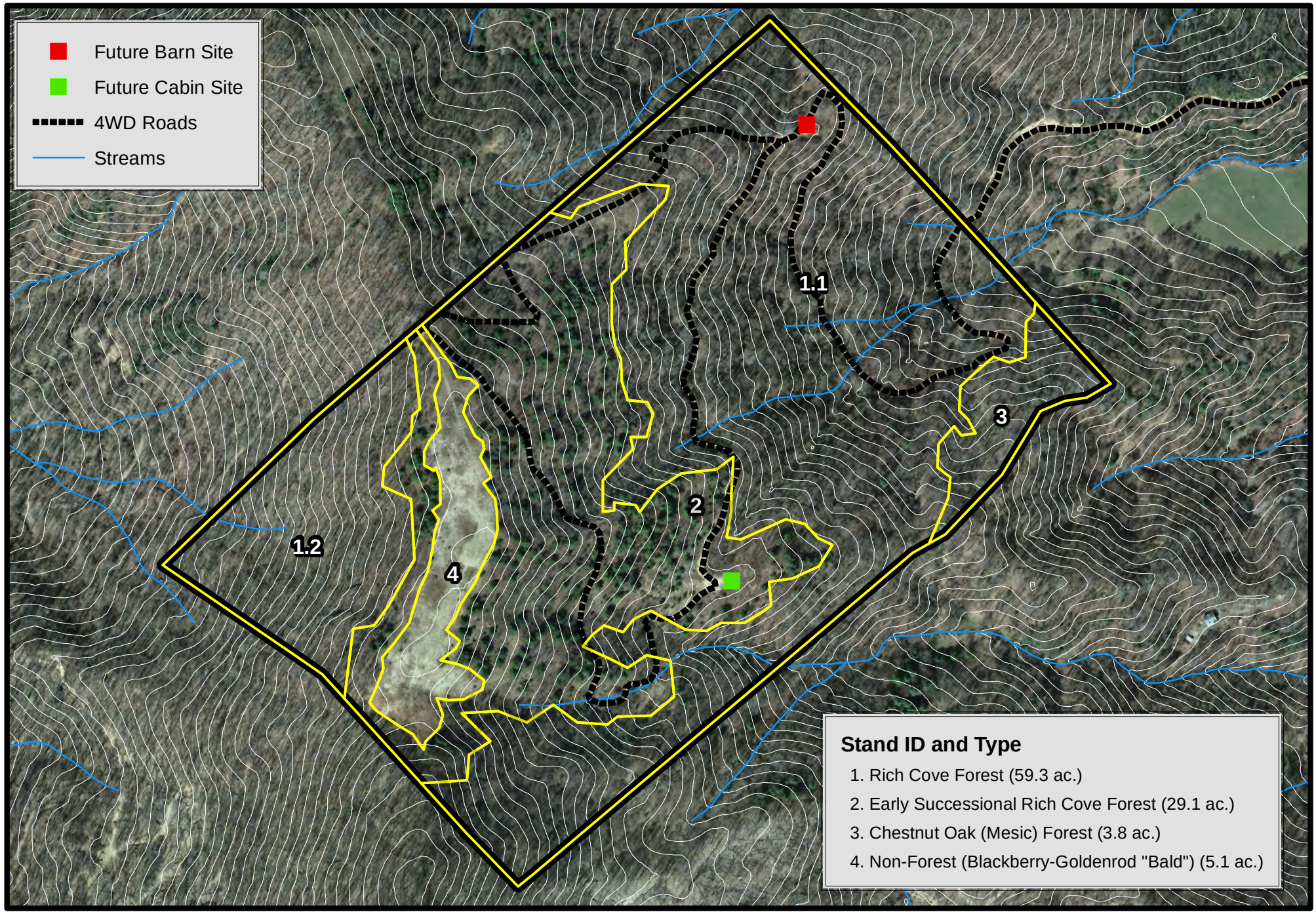
"Bearwallow Bald" Cover Type Map

2010 True Color Aerial Imagery

0 300 600 1,200 Feet

Map Made 12/21/2015

N W E S



EcoForesters

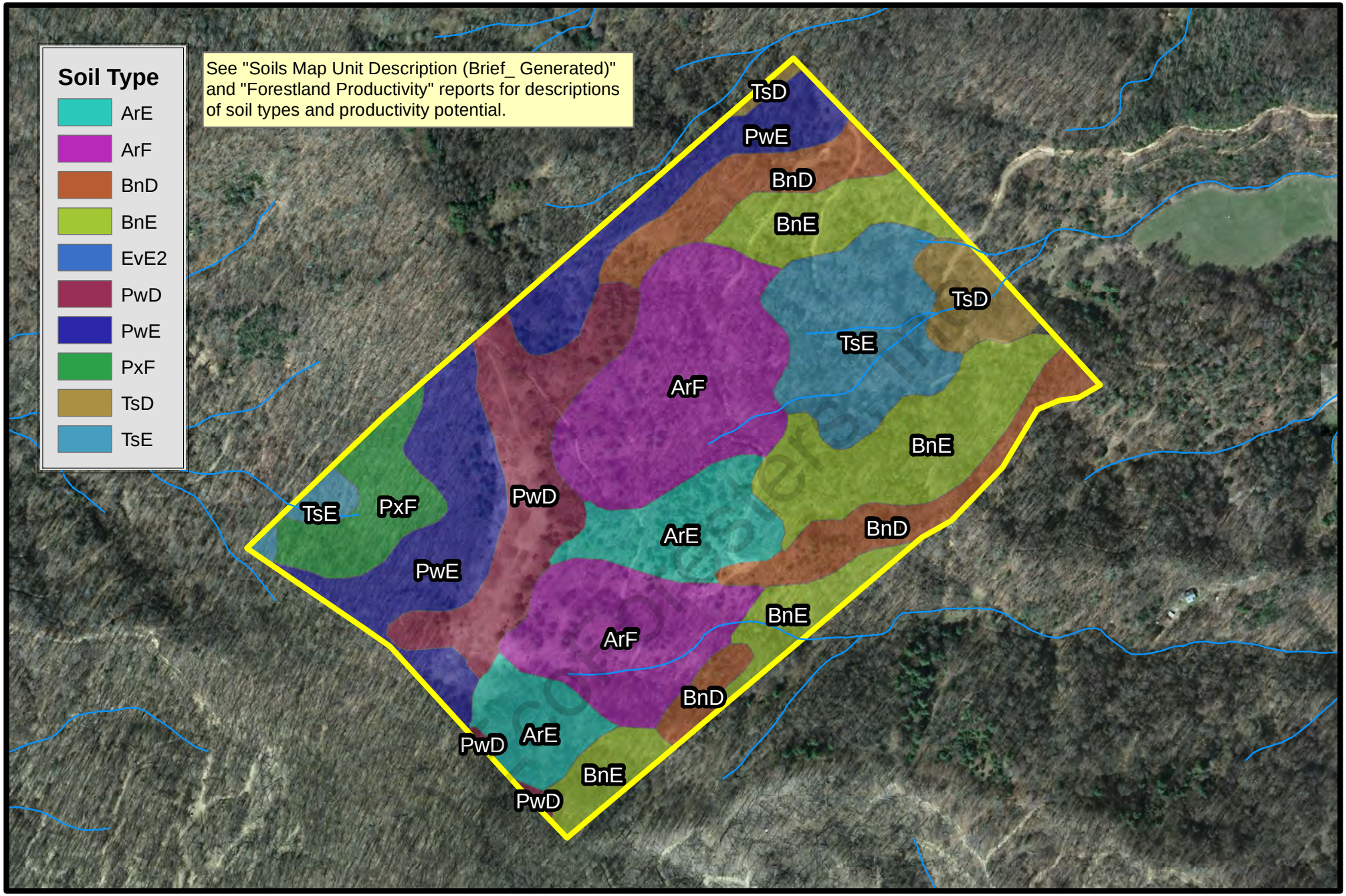
"Bearwallow Bald" Stand ID Map

2010 True Color Aerial Imagery

0 600 1,200 Feet

Map Made 12/21/2015

N W E S



EcoForesters

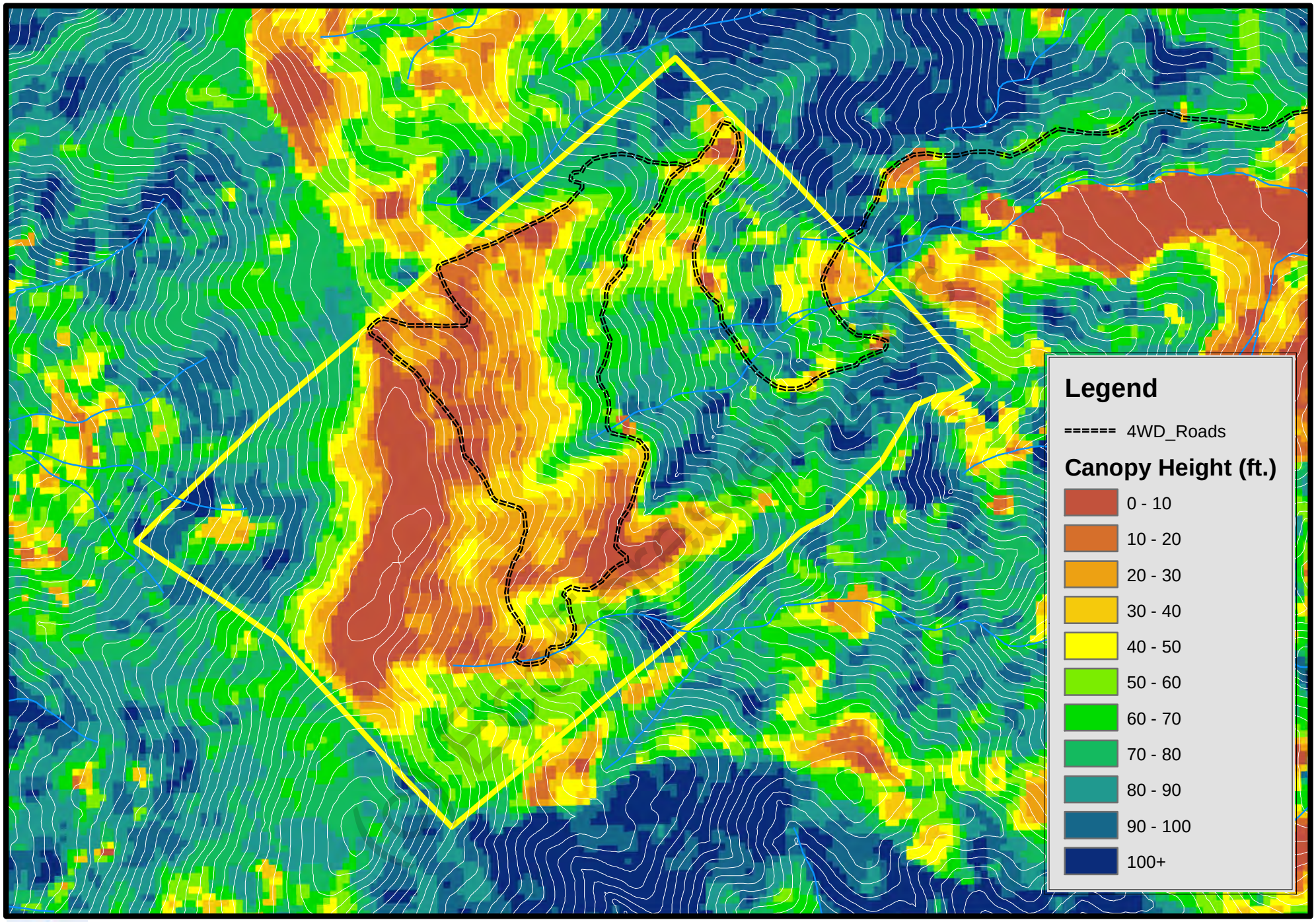
"Bearwallow Bald" Soil Map

2010 True Color Aerial Photo

0 250 500 1,000 1,500 2,000 Feet

N W E S

Created December 10, 2015



"Bearwallow Bald" Tree Canopy Height Map

2005 Lidar Data

EcoForesters

0 250 500 1,000 1,500 2,000 Feet

Map Made 12/21/2015
Contour Interval 20'
Elevation: 3100 to 3980 feet

N W E S

Map Unit Description (Brief, Generated)

Madison County, North Carolina

[Minor map unit components are excluded from this report]

Map unit: ArE - Ashe-Cleveland-Rock outcrop complex, 30 to 50 percent slopes, very bouldery

Component: Ashe, very bouldery (40%)

The Ashe, very bouldery component makes up 40 percent of the map unit. Slopes are 30 to 50 percent. This component is on mountain slopes, ridges, mountains. The parent material consists of affected by soil creep in the upper solum over residuum weathered from biotite granitic gneiss and granodioritic gneiss. Depth to a root restrictive layer, bedrock, lithic, is 20 to 40 inches. The natural drainage class is somewhat excessively drained. Water movement in the most restrictive layer is high. Available water to a depth of 60 inches is low. Shrink-swell potential is low. This soil is not flooded. It is not ponded. There is no zone of water saturation within a depth of 72 inches. Organic matter content in the surface horizon is about 4 percent. Nonirrigated land capability classification is 7s. This soil does not meet hydric criteria.

Component: Cleveland, very bouldery (30%)

The Cleveland, very bouldery component makes up 30 percent of the map unit. Slopes are 30 to 50 percent. This component is on mountain slopes, ridges, mountains. The parent material consists of affected by soil creep in the upper solum over residuum weathered from biotite granitic gneiss and granodioritic gneiss. Depth to a root restrictive layer, bedrock, lithic, is 10 to 20 inches. The natural drainage class is somewhat excessively drained. Water movement in the most restrictive layer is high. Available water to a depth of 60 inches is very low. Shrink-swell potential is low. This soil is not flooded. It is not ponded. There is no zone of water saturation within a depth of 72 inches. Organic matter content in the surface horizon is about 4 percent. Nonirrigated land capability classification is 7s. This soil does not meet hydric criteria.

Component: Rock outcrop (20%)

Generated brief soil descriptions are created for major soil components. The Rock outcrop is a miscellaneous area.

Map unit: ArF - Ashe-Cleveland-Rock outcrop complex, 50 to 95 percent slopes, very bouldery

Component: Ashe, very bouldery (40%)

The Ashe, very bouldery component makes up 40 percent of the map unit. Slopes are 50 to 95 percent. This component is on mountain slopes, mountains. The parent material consists of affected by soil creep in the upper solum over residuum weathered from biotite granitic gneiss and granodioritic gneiss. Depth to a root restrictive layer, bedrock, lithic, is 20 to 40 inches. The natural drainage class is somewhat excessively drained. Water movement in the most restrictive layer is very low. Available water to a depth of 60 inches is low. Shrink-swell potential is low. This soil is not flooded. It is not ponded. There is no zone of water saturation within a depth of 72 inches. Organic matter content in the surface horizon is about 4 percent. Nonirrigated land capability classification is 7s. This soil does not meet hydric criteria.

Map Unit Description (Brief, Generated)

Madison County, North Carolina

Map unit: ArF - Ashe-Cleveland-Rock outcrop complex, 50 to 95 percent slopes, very bouldery

Component: Cleveland, very bouldery (30%)

The Cleveland, very bouldery component makes up 30 percent of the map unit. Slopes are 50 to 95 percent. This component is on mountain slopes, mountains. The parent material consists of affected by soil creep in the upper solum over residuum weathered from biotite granitic gneiss and granodioritic gneiss. Depth to a root restrictive layer, bedrock, lithic, is 10 to 20 inches. The natural drainage class is somewhat excessively drained. Water movement in the most restrictive layer is very low. Available water to a depth of 60 inches is very low. Shrink-swell potential is low. This soil is not flooded. It is not ponded. There is no zone of water saturation within a depth of 72 inches. Organic matter content in the surface horizon is about 4 percent. Nonirrigated land capability classification is 7s. This soil does not meet hydric criteria.

Component: Rock outcrop (20%)

Generated brief soil descriptions are created for major soil components. The Rock outcrop is a miscellaneous area.

Map unit: BnD - Buladean-Chestnut complex, 15 to 30 percent slopes, stony

Component: Buladean, stony (50%)

The Buladean, stony component makes up 50 percent of the map unit. Slopes are 15 to 30 percent. This component is on mountains, ridges. The parent material consists of residuum weathered from biotite granitic gneiss and granodioritic gneiss. Depth to a root restrictive layer, bedrock, paralithic, is 40 to 60 inches. The natural drainage class is well drained. Water movement in the most restrictive layer is high. Available water to a depth of 60 inches is moderate. Shrink-swell potential is low. This soil is not flooded. It is not ponded. There is no zone of water saturation within a depth of 72 inches. Organic matter content in the surface horizon is about 4 percent. Nonirrigated land capability classification is 4e. This soil does not meet hydric criteria.

Component: Chestnut, stony (45%)

The Chestnut, stony component makes up 45 percent of the map unit. Slopes are 15 to 30 percent. This component is on ridges, mountains. The parent material consists of residuum weathered from biotite granitic gneiss and granodioritic gneiss. Depth to a root restrictive layer, bedrock, paralithic, is 20 to 40 inches. The natural drainage class is well drained. Water movement in the most restrictive layer is high. Available water to a depth of 60 inches is very low. Shrink-swell potential is low. This soil is not flooded. It is not ponded. There is no zone of water saturation within a depth of 72 inches. Organic matter content in the surface horizon is about 4 percent. Nonirrigated land capability classification is 4e. This soil does not meet hydric criteria.

Map Unit Description (Brief, Generated)

Madison County, North Carolina

Map unit: BnE - Buladean-Chestnut complex, 30 to 50 percent slopes, stony

Component: Buladean, stony (50%)

The Buladean, stony component makes up 50 percent of the map unit. Slopes are 30 to 50 percent. This component is on mountain slopes, ridges, mountains. The parent material consists of affected by soil creep in the upper solum over residuum weathered from biotite granitic gneiss and granodioritic gneiss. Depth to a root restrictive layer, bedrock, paralithic, is 40 to 60 inches. The natural drainage class is well drained. Water movement in the most restrictive layer is high. Available water to a depth of 60 inches is moderate. Shrink-swell potential is low. This soil is not flooded. It is not ponded. There is no zone of water saturation within a depth of 72 inches. Organic matter content in the surface horizon is about 4 percent. Nonirrigated land capability classification is 6e. This soil does not meet hydric criteria.

Component: Chestnut, stony (40%)

The Chestnut, stony component makes up 40 percent of the map unit. Slopes are 30 to 50 percent. This component is on mountain slopes, ridges, mountains. The parent material consists of affected by soil creep in the upper solum over residuum weathered from biotite granitic gneiss and granodioritic gneiss. Depth to a root restrictive layer, bedrock, paralithic, is 20 to 40 inches. The natural drainage class is well drained. Water movement in the most restrictive layer is high. Available water to a depth of 60 inches is very low. Shrink-swell potential is low. This soil is not flooded. It is not ponded. There is no zone of water saturation within a depth of 72 inches. Organic matter content in the surface horizon is about 4 percent. Nonirrigated land capability classification is 6e. This soil does not meet hydric criteria.

Map unit: EvE2 - Evard-Cowee complex, 30 to 50 percent slopes, moderately eroded

Component: Evard, moderately eroded (55%)

The Evard, moderately eroded component makes up 55 percent of the map unit. Slopes are 30 to 50 percent. This component is on mountains, mountain slopes. The parent material consists of residuum weathered from amphibolite or hornblende gneiss. Depth to a root restrictive layer is greater than 60 inches. The natural drainage class is well drained. Water movement in the most restrictive layer is moderately high. Available water to a depth of 60 inches is moderate. Shrink-swell potential is low. This soil is not flooded. It is not ponded. There is no zone of water saturation within a depth of 72 inches. Organic matter content in the surface horizon is about 1 percent. Nonirrigated land capability classification is 6e. This soil does not meet hydric criteria.

Component: Cowee, moderately eroded (35%)

The Cowee, moderately eroded component makes up 35 percent of the map unit. Slopes are 30 to 50 percent. This component is on mountains, mountain slopes. The parent material consists of residuum weathered from amphibolite or hornblende gneiss. Depth to a root restrictive layer, bedrock, paralithic, is 20 to 40 inches. The natural drainage class is well drained. Water movement in the most restrictive layer is moderately high. Available water to a depth of 60 inches is low. Shrink-swell potential is low. This soil is not flooded. It is not ponded. There is no zone of water saturation within a depth of 72 inches. Organic matter content in the surface horizon is about 1 percent. Nonirrigated land capability classification is 6e. This soil does not meet hydric criteria.

Map Unit Description (Brief, Generated)

Madison County, North Carolina

Map unit: PwD - Porters-Unaka complex, 15 to 30 percent slopes, stony

Component: Porters, stony (60%)

The Porters, stony component makes up 60 percent of the map unit. Slopes are 15 to 30 percent. This component is on ridges on mountains. The parent material consists of residuum weathered from biotite granitic gneiss and granodioritic gneiss. Depth to a root restrictive layer, bedrock, lithic, is 40 to 60 inches. The natural drainage class is well drained. Water movement in the most restrictive layer is high. Available water to a depth of 60 inches is moderate. Shrink-swell potential is low. This soil is not flooded. It is not ponded. There is no zone of water saturation within a depth of 72 inches. Organic matter content in the surface horizon is about 10 percent. Nonirrigated land capability classification is 4e. This soil does not meet hydric criteria.

Component: Unaka, stony (30%)

The Unaka, stony component makes up 30 percent of the map unit. Slopes are 15 to 30 percent. This component is on ridges on mountains. The parent material consists of residuum weathered from biotite granitic gneiss and granodioritic gneiss. Depth to a root restrictive layer, bedrock, lithic, is 20 to 40 inches. The natural drainage class is well drained. Water movement in the most restrictive layer is high. Available water to a depth of 60 inches is low. Shrink-swell potential is low. This soil is not flooded. It is not ponded. There is no zone of water saturation within a depth of 72 inches. Organic matter content in the surface horizon is about 10 percent. Nonirrigated land capability classification is 4e. This soil does not meet hydric criteria.

Map unit: PwE - Porters-Unaka complex, 30 to 50 percent slopes, stony

Component: Porters, stony (50%)

The Porters, stony component makes up 50 percent of the map unit. Slopes are 30 to 50 percent. This component is on mountain slopes on mountains, ridges on mountains. The parent material consists of affected by soil creep in the upper solum over residuum weathered from biotite granitic gneiss and granodioritic gneiss. Depth to a root restrictive layer, bedrock, lithic, is 40 to 60 inches. The natural drainage class is well drained. Water movement in the most restrictive layer is high. Available water to a depth of 60 inches is moderate. Shrink-swell potential is low. This soil is not flooded. It is not ponded. There is no zone of water saturation within a depth of 72 inches. Organic matter content in the surface horizon is about 10 percent. Nonirrigated land capability classification is 6e. This soil does not meet hydric criteria.

Component: Unaka, stony (30%)

The Unaka, stony component makes up 30 percent of the map unit. Slopes are 30 to 50 percent. This component is on ridges on mountains, mountain slopes on mountains. The parent material consists of affected by soil creep in the upper solum over residuum weathered from biotite granitic gneiss and granodioritic gneiss. Depth to a root restrictive layer, bedrock, paralithic, is 20 to 35 inches. The natural drainage class is well drained. Water movement in the most restrictive layer is high. Available water to a depth of 60 inches is low. Shrink-swell potential is low. This soil is not flooded. It is not ponded. There is no zone of water saturation within a depth of 72 inches. Organic matter content in the surface horizon is about 10 percent. Nonirrigated land capability classification is 6e. This soil does not meet hydric criteria.

Map Unit Description (Brief, Generated)

Madison County, North Carolina

Map unit: PxF - Porters-Unaka complex, 50 to 95 percent slopes, rocky

Component: Porters, rocky (40%)

The Porters, rocky component makes up 40 percent of the map unit. Slopes are 50 to 95 percent. This component is on mountain slopes on mountains. The parent material consists of affected by soil creep in the upper solum over residuum weathered from biotite granitic gneiss and granodioritic gneiss. Depth to a root restrictive layer, bedrock, lithic, is 40 to 60 inches. The natural drainage class is well drained. Water movement in the most restrictive layer is high. Available water to a depth of 60 inches is moderate. Shrink-swell potential is low. This soil is not flooded. It is not ponded. There is no zone of water saturation within a depth of 72 inches. Organic matter content in the surface horizon is about 10 percent. Nonirrigated land capability classification is 7s. This soil does not meet hydric criteria.

Component: Unaka, rocky (35%)

The Unaka, rocky component makes up 35 percent of the map unit. Slopes are 50 to 95 percent. This component is on mountain slopes on mountains. The parent material consists of affected by soil creep in the upper solum over residuum weathered from biotite granitic gneiss and granodioritic gneiss. Depth to a root restrictive layer, bedrock, lithic, is 20 to 40 inches. The natural drainage class is well drained. Water movement in the most restrictive layer is high. Available water to a depth of 60 inches is low. Shrink-swell potential is low. This soil is not flooded. It is not ponded. There is no zone of water saturation within a depth of 72 inches. Organic matter content in the surface horizon is about 10 percent. Nonirrigated land capability classification is 7s. This soil does not meet hydric criteria.

Map unit: TsD - Toecane-Tusquitee complex, 15 to 30 percent slopes, very bouldery

Component: Toecane, very bouldery (50%)

The Toecane, very bouldery component makes up 50 percent of the map unit. Slopes are 15 to 30 percent. This component is on fans, mountains, coves, drainageways. The parent material consists of cobbly and stony colluvium derived from igneous and metamorphic rock. Depth to a root restrictive layer is greater than 60 inches. The natural drainage class is well drained. Water movement in the most restrictive layer is high. Available water to a depth of 60 inches is low. Shrink-swell potential is low. This soil is not flooded. It is not ponded. There is no zone of water saturation within a depth of 72 inches. Organic matter content in the surface horizon is about 10 percent. Nonirrigated land capability classification is 6s. This soil does not meet hydric criteria.

Component: Tusquitee, very bouldery (40%)

The Tusquitee, very bouldery component makes up 40 percent of the map unit. Slopes are 15 to 30 percent. This component is on drainageways, fans, mountains, coves. The parent material consists of colluvium derived from igneous and metamorphic rock. Depth to a root restrictive layer is greater than 60 inches. The natural drainage class is well drained. Water movement in the most restrictive layer is high. Available water to a depth of 60 inches is moderate. Shrink-swell potential is low. This soil is not flooded. It is not ponded. There is no zone of water saturation within a depth of 72 inches. Organic matter content in the surface horizon is about 10 percent. Nonirrigated land capability classification is 4s. This soil does not meet hydric criteria.

Forestland Productivity

Madison County, North Carolina

[This report shows only the major soils in each map unit]

Map symbol and soil name	Potential productivity			Trees to manage
	Common trees	Site index	Volume of wood fiber	
			Cu ft/ac	
ArE:				
Ashe, very bouldery	Chestnut oak	70	52	---
	Eastern white pine	81	146	
	Hickory	---	---	
	Pitch pine	---	---	
	Scarlet oak	---	---	
	Virginia pine	---	---	
Cleveland, very bouldery	Black oak	---	---	---
	Chestnut oak	45	30	
	Eastern white pine	70	121	
	Northern red oak	60	43	
	Pitch pine	---	---	
	Scarlet oak	---	---	
	Shortleaf pine	---	---	
	Virginia pine	57	84	
Rock outcrop	---	---	---	---
ArF:				
Ashe, very bouldery	Chestnut oak	70	52	---
	Eastern white pine	81	146	
	Hickory	---	---	
	Pitch pine	---	---	
	Scarlet oak	---	---	
	Virginia pine	---	---	
Cleveland, very bouldery	Black oak	---	---	---
	Chestnut oak	45	30	
	Eastern white pine	70	121	
	Northern red oak	60	43	
	Pitch pine	---	---	
	Scarlet oak	---	---	
	Shortleaf pine	---	---	
	Virginia pine	57	84	
Rock outcrop	---	---	---	---

Forestland Productivity

Madison County, North Carolina

Map symbol and soil name	Potential productivity			Trees to manage
	Common trees	Site index	Volume of wood fiber	
			Cu ft/ac	
BnD:				
Buladean, stony	Black locust	---	---	Chestnut oak, Eastern white pine, Scarlet oak, White oak, Yellow-poplar
	Black oak	---	---	
	Chestnut oak	---	---	
	Eastern white pine	97	180	
	Hickory	---	---	
	Red maple	---	---	
	Scarlet oak	---	---	
	Sourwood	---	---	
	White oak	---	---	
	Yellow-poplar	97	102	
Chestnut, stony	Black oak	71	53	Eastern white pine, Shortleaf pine, Yellow-poplar
	Chestnut oak	69	51	
	Eastern white pine	78	139	
	Scarlet oak	---	---	
	Shortleaf pine	---	---	
	White oak	70	52	
	Yellow-poplar	97	102	
BnE:				
Buladean, stony	Black locust	---	---	Chestnut oak, Eastern white pine, Scarlet oak, White oak, Yellow-poplar
	Black oak	---	---	
	Chestnut oak	---	---	
	Eastern white pine	97	180	
	Hickory	---	---	
	Red maple	---	---	
	Scarlet oak	---	---	
	Sourwood	---	---	
	White oak	---	---	
	Yellow-poplar	97	102	
Chestnut, stony	Black oak	71	53	Eastern white pine, Shortleaf pine, Yellow-poplar
	Chestnut oak	69	51	
	Eastern white pine	78	139	
	Scarlet oak	---	---	
	Shortleaf pine	---	---	
	White oak	70	52	
	Yellow-poplar	97	102	

Forestland Productivity

Madison County, North Carolina

Map symbol and soil name	Potential productivity			Trees to manage
	Common trees	Site index	Volume of wood fiber	
			Cu ft/ac	
EvE2:				
Evard, moderately eroded	Eastern white pine	91	168	Chestnut oak, Eastern white pine, Shortleaf pine, White oak
	Hickory	---	---	
	Northern red oak	---	---	
	Pitch pine	---	---	
	Shortleaf pine	73	116	
	Southern red oak	75	57	
	Virginia pine	70	109	
	White oak	75	57	
	Yellow-poplar	95	98	
Cowee, moderately eroded	Black oak	---	---	Eastern white pine, Shortleaf pine
	Chestnut oak	55	38	
	Eastern white pine	78	139	
	Northern red oak	---	---	
	Pitch pine	52	72	
	Scarlet oak	54	38	
	Shortleaf pine	---	---	
	Virginia pine	63	96	
	White oak	---	---	
	Yellow-poplar	80	71	
PwD:				
Porters, stony	Black cherry	---	---	Black cherry, Northern red oak, White ash, Yellow-poplar
	Eastern white pine	88	162	
	Northern red oak	82	64	
	White ash	---	---	
	Yellow-poplar	97	102	
Unaka, stony	Eastern white pine	80	143	Northern red oak, Yellow-poplar
	Northern red oak	77	57	
	Yellow-poplar	90	86	
PwE:				
Porters, stony	Black cherry	---	---	Black cherry, Northern red oak, White ash, Yellow-poplar
	Eastern white pine	88	162	
	Northern red oak	82	64	
	White ash	---	---	
	Yellow-poplar	97	102	
Unaka, stony	Eastern white pine	80	143	Northern red oak, Yellow-poplar
	Northern red oak	77	57	
	Yellow-poplar	90	86	

Forestland Productivity

Madison County, North Carolina

Map symbol and soil name	Potential productivity			Trees to manage
	Common trees	Site index	Volume of wood fiber	
			Cu ft/ac	
PxF:				
Porters, rocky	Black cherry	---	---	Black cherry, Northern red oak, White ash, Yellow-poplar
	Eastern white pine	88	162	
	Northern red oak	82	64	
	White ash	---	---	
	Yellow-poplar	97	102	
Unaka, rocky	Eastern white pine	---	143	Northern red oak, Yellow-poplar
	Northern red oak	77	57	
	Yellow-poplar	90	86	
TsD:				
Toecane, very bouldery	Black cherry	---	---	Black cherry, Eastern white pine, Northern red oak, White ash, Yellow-poplar
	Eastern hemlock	---	---	
	Northern red oak	---	---	
	Yellow birch	---	---	
	Yellow-poplar	104	114	
Tusquitee, very bouldery	American beech	---	---	Black cherry, Eastern white pine, Northern red oak, White ash, Yellow-poplar
	Black cherry	83	---	
	Black locust	---	---	
	Black walnut	---	---	
	Eastern hemlock	---	---	
	Eastern white pine	100	186	
	Hickory	---	---	
	Northern red oak	---	---	
	White ash	---	---	
	White oak	---	---	
	Yellow birch	---	---	
	Yellow-poplar	103	112	

Fact Sheet: Multiflora Rose

Multiflora Rose

Rosa multiflora Thunb.
Rose family (Rosaceae)

NATIVE RANGE

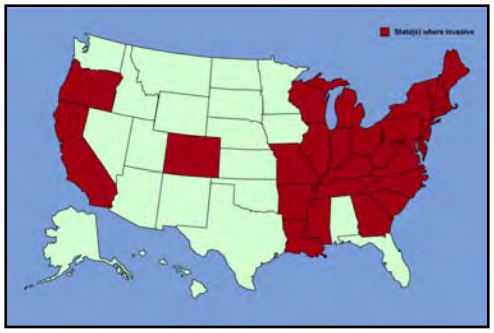
Japan, Korea, and eastern China

DESCRIPTION

Multiflora rose is a thorny, perennial shrub with arching stems (canes), and leaves divided into five to eleven sharply toothed leaflets. The base of each leaf stalk bears a pair of fringed bracts. Beginning in May or June, clusters of showy, fragrant, white to pink flowers appear, each about an inch across. Small bright red fruits, or rose hips, develop during the summer, becoming leathery, and remain on the plant through the winter.

ECOLOGICAL THREAT

Multiflora rose is extremely prolific and can form impenetrable thickets that exclude native plant species. This exotic rose readily invades open woodlands, forest edges, successional fields, savannas and prairies that have been subjected to land disturbance.



DISTRIBUTION IN THE UNITED STATES

Multiflora rose occurs throughout the U.S., with the exception of the Rocky Mountains, the southeastern Coastal Plain and the deserts of California and Nevada.

HABITAT IN THE UNITED STATES

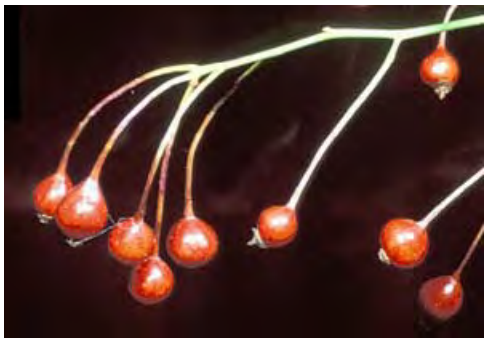
Multiflora rose has a wide tolerance for various soil, moisture, and light conditions. It occurs in dense woods, prairies, along stream banks and roadsides and in open fields and pastures.

BACKGROUND

Multiflora rose was introduced to the East Coast from Japan in 1866 as rootstock for ornamental roses. Beginning in the 1930s, the U.S. Soil Conservation Service promoted it for use in erosion control and as "living fences" to confine livestock. State conservation departments soon discovered value in multiflora rose as wildlife cover for pheasant, bobwhite quail, and cottontail rabbit and as food for songbirds and encouraged its use by distributing rooted cuttings to landowners free of charge. More recently, multiflora rose has been planted in highway median strips to serve as crash barriers and to reduce automobile headlight glare. Its tenacious and unstoppable growth habit was eventually recognized as a problem on pastures and unplowed lands, where it disrupted cattle grazing. For these reasons, multiflora rose is classified as a noxious weed in several states, including Iowa, Ohio, West Virginia, and New Jersey.

BIOLOGY & SPREAD

Multiflora rose reproduces by seed and by forming new plants that root from the tips of arching canes that contact the ground. Fruits are readily sought after by birds which are the primary dispersers of its seed. It has been estimated that an average multiflora rose plant may produce a million seeds per year, which may remain viable in the soil for up to twenty years. Germination of multiflora rose seeds is enhanced by passing through the digestive tract of birds.



Plant Conservation Alliance's Alien Plant Working Group
Weeds Gone Wild: Alien Plant Invaders of Natural Areas
http://www.nps.gov/plants/alien/

MANAGEMENT OPTIONS

Mechanical and chemical methods are currently the most widely used methods for managing multiflora rose. Frequent, repeated cutting or mowing at the rate of three to six times per growing season, for two to four years, has been shown to be effective in achieving high mortality of multiflora rose. In high quality natural communities, cutting of individual plants is preferred to site mowing to minimize habitat disturbance. Various herbicides have been used successfully in controlling multiflora rose but, because of the long-lived stores of seed in the soil, follow-up treatments are likely to be necessary. Application of systemic herbicides (e.g., glyphosate) to freshly cut stumps or to regrowth may be the most effective methods, especially if conducted late in the growing season. Plant growth regulators have been used to control the spread of multiflora rose by preventing fruit set.

Biological

Biological control is not yet available for management of multiflora rose. However, researchers are investigating several options, including a native viral pathogen (rose-rosette disease), which is spread by a tiny native mite, and a seed-infesting wasp, the European rose chalcid. Rose-rosette disease, native to the western U.S., has been spreading easterwardly at a slow pace and is thought to hold the potential for eliminating multiflora rose in areas where it grows in dense patches. An important drawback to both the rose rosette fungus and the European rose chalcid is their potential impact to other rose species and cultivars.

USE PESTICIDES WISELY: Always read the entire pesticide label carefully, follow all mixing and application instructions and wear all recommended personal protective gear and clothing. Contact your state department of agriculture for any additional pesticide use requirements, restrictions or recommendations.

NOTICE: mention of pesticide products on this page does not constitute endorsement of any material.

CONTACTS

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SUGGESTED ALTERNATIVE PLANTS

Using native shrubs and trees for land restoration and landscaping purposes is one way to prevent invasions by multiflora rose.

OTHER LINKS

- http://www.invasive.org/search/action.cfm?q=Rosa%20multiflora
- http://nbii-nin.ciesin.columbia.edu/ipane/icat/browse.do?specieId=29

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Chemical Stem Injection for Crop Tree Release

Crop tree release (CTR) is a forest management technique that can enhance growth and diversity of a forest stand by reducing trees surrounding and competing with pre-selected "crop trees". Crop trees are trees selected for their larger crowns, large diameters, superior form, superior health, preferred aesthetic beauty and/or type of species compared to competing trees. Crop trees are often selected to increase diversity. For example, in a forest that was clearcut and has regenerated as 90% yellow poplar, crop trees may be selected to represent the other 10% of species such that their relative proportion in the stand may increase and thereby increase overall diversity.

Picture 1. Photo shows increased growing space for crop tree after competition is killed by chemical injection.

Crop trees are "released" by reducing the competition from neighboring trees whose crowns are touching that of the crop tree. The degree to which crop tree growth is enhanced depends on the free to grow rating (see figure 1). The rating increases as more competition is removed from the crop tree which thereby increases growth rates of the crop tree (see table 1). For most landowners it may be advisable to spend an afternoon with a forester to discuss how to choose crop trees and subsequently reduce competition. One method is to choose a rough spacing between crop trees, twenty feet is a good one, and select these trees by flagging them. Then come back through to reduce the competition around each selected tree. Crop trees should be selected based on management objectives and forest stand characteristics (see figure 2).

Removing competition can be achieved mechanically, by chainsaw felling, or by chemical stem injection. Chemical stem injection is more efficient in terms of time and energy, and it also is safer than chainsaw work. There are also aesthetic benefits as a dead standing tree appears much more natural to the eye than do numerous trees cut with a saw. One disadvantage of chemical treatment is there is some danger of "flashback", when roots from a chemically treated tree are grafted onto a crop tree and thereby cause unwanted dieback or death to the crop tree. There is little way to predict flashback, though it is more common for the same species to graft roots together, but sometimes grafting can even occur between species. In the southern Appalachians, the only tree that tends to grow as one interconnected root mass is American beech. For this reason, beech should only be killed mechanically unless it is the intention to kill numerous beech trees. However, other than with beech trees flashback seems to occur very infrequently from stem injection treatments.

To treat trees chemically, use a hatchet or ax to frill the bark back around the tree. Frills are approximately 2 inches wide and are spaced at 2 inch intervals around the circumference of the tree. About 1.5 cubic centimeters of the herbicide solution (Roundup Pro© with 41% Active Ingredient) is applied to each frill. This is approximately the same as one squirt from your average spray bottle. While roundup is not very hazardous to humans, precautions should still be taken such as wearing safety glasses, rubber gloves, a long sleeve shirt and pants. Make sure to follow directions and safety precautions carefully as stated on the label.

Figure 1. Crop trees that have a higher free to grow rating grow faster.

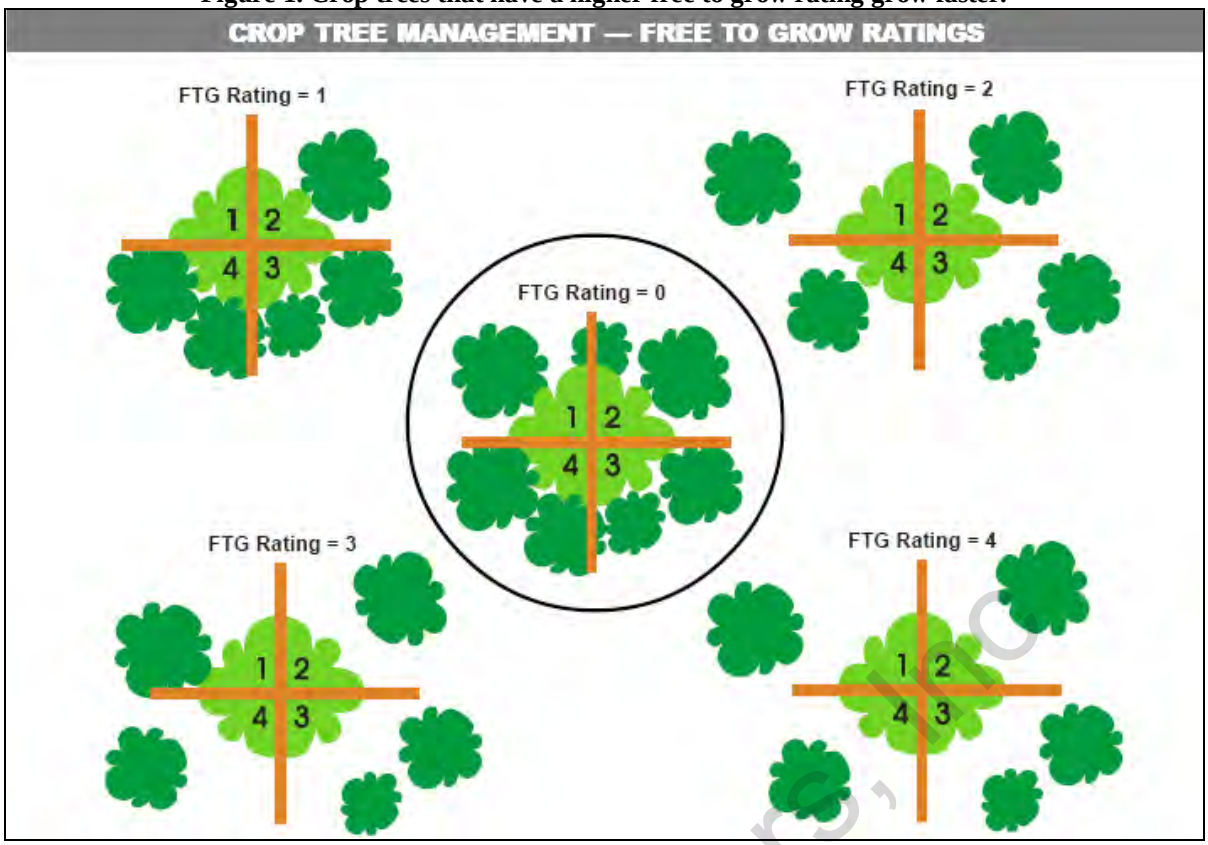


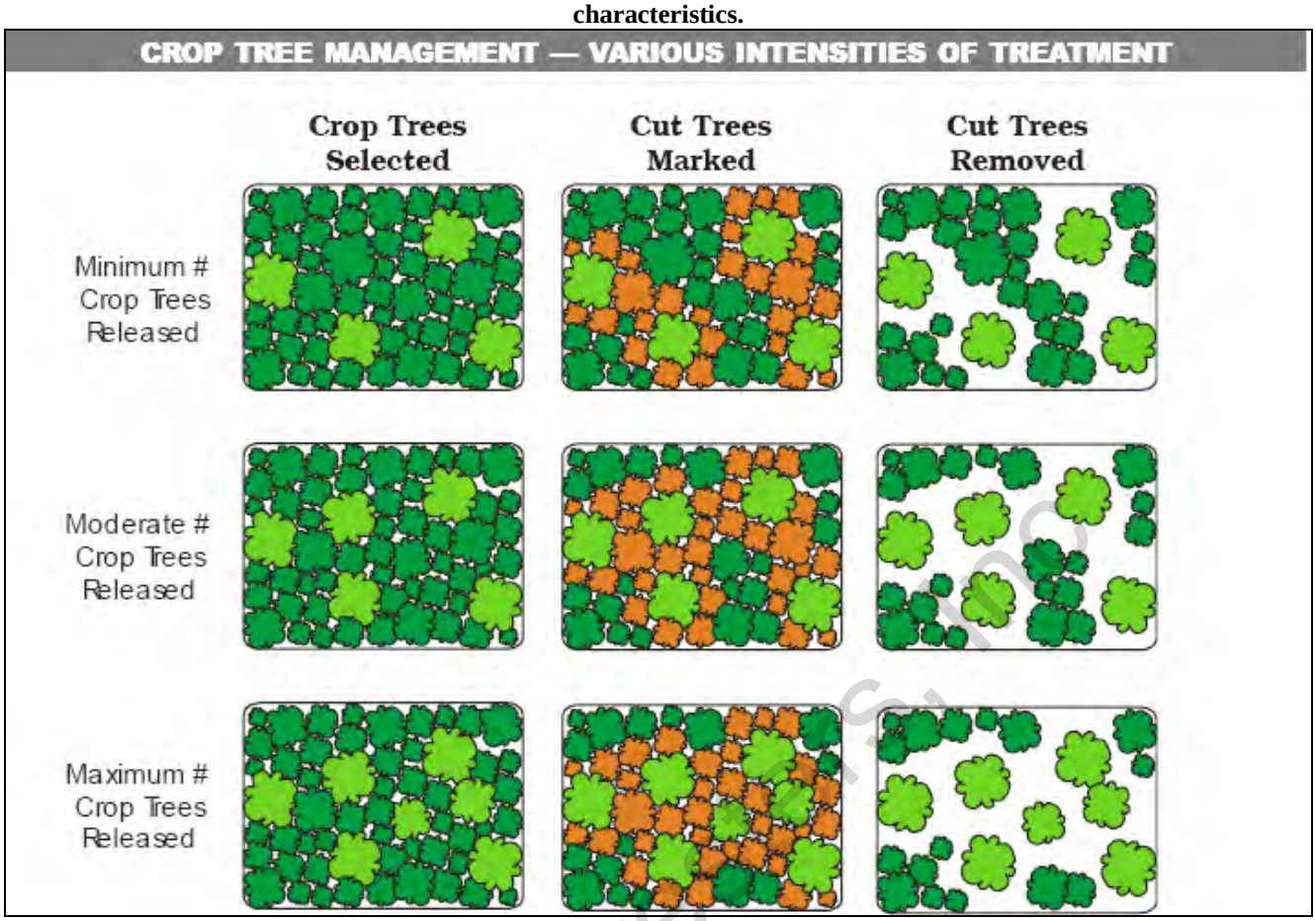
Table 1. Crop trees released from competition can sometimes grow twice as fast as unreleased trees.

Growth Rates on Average Sites for the Species

(Average growth rate, inches per decade)

Species and Site Location*	Age**	Unreleased (FTG 0)	Released (FTG 3 or 4)
Red oak–9	16 to 26	1.8	2.8
Red oak–6	35 to 45	—	4.0
Red oak–2	55 to 65	2.1	3.6
Red oak–5	75+	2.2	3.2
Yellow-poplar–3	12 to 22	2.9	4.0
Yellow-poplar–5	75+	2.0	3.6
Black cherry–3	12 to 22	2.4	3.6
Black cherry–5	75+	2.4	2.4
Sugar maple–6	25 to 35	—	3.5
Sugar maple–5	75+	1.4	2.0
Red maple–5	75+	2.2	2.8
Beech	75+	1.4	3.0
Hickory–10	63 to 70	—	1.5
White oak–10	63 to 70	—	2.5
White oak–1	80+	1.2	2.0
Scarlet oak–1	55+	1.7	2.3
Black oak–7	50	2.0	3.5
Black oak–1	80+	1.5	1.8
Chestnut oak–9	16 to 26	1.7	2.3
Chestnut oak–1	80+	1.5	2.3

Figure 2. The intensity of treatment should be determined based on management objectives and forest stand characteristics.



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Fact Sheet: Princess Tree

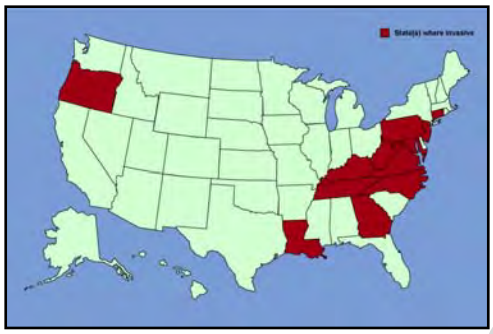
Princess Tree

Paulownia tomentosa (Thunb.) Sieb. & Zucc. ex Steud.
Figwort family (Scrophulariaceae)

NATIVE RANGE
China

DESCRIPTION
Princess tree, also known as royal paulownia or empress tree, is a small to medium sized tree that may reach 30-60 feet in height. The bark is rough, gray-brown, and interlaced with shiny, smooth areas. Stems are olive-brown to dark brown, hairy and markedly flattened at the nodes (where stems and branches meet). Leaves are large, broadly oval to heart-shaped, or sometimes shallowly three-lobed, and noticeably hairy on the lower leaf surfaces. They are arranged in pairs along the stem. Conspicuous upright clusters of showy, pale violet, fragrant flowers open in the spring. The fruit is a dry brown capsule with four compartments that may contain several thousand tiny winged seeds. Capsules mature in autumn when they open to release the seeds and then remain attached all winter, providing a handy identification aid.

ECOLOGICAL THREAT
Princess tree is an aggressive ornamental tree that grows rapidly in disturbed natural areas, including forests, streambanks, and steep rocky slopes.



DISTRIBUTION IN THE UNITED STATES
Princess tree is found in 25 states in the eastern U.S., from Maine to Texas.

HABITAT IN THE UNITED STATES
Princess tree can be found along roadsides, streambanks, and forest edges. It tolerates infertile and acid soils and drought conditions. It easily adapts to disturbed habitats, including previously burned areas, forests defoliated by pests (such as the gypsy moth) and landslides and can colonize rocky cliffs and scoured riparian zones where it may compete with rare plants in these marginal habitats. Its ability to sprout prolifically from adventitious buds on stems and roots allows it to survive fire, cutting, and even bulldozing in construction areas.

BACKGROUND
Princess tree was introduced into the U.S. as an ornamental and landscape tree around 1840. It was first imported to Europe in the 1830's by the Dutch East India Company and brought to North America a few years later. This tree has since become naturalized in the eastern U.S. and is also grown on the west coast. Princess tree is native to western and central China where historical records describe its medicinal, ornamental, and timber uses as early as the third century B.C. It was cultivated centuries ago in Japan where it is valued in many traditions. Recently it has also been grown in plantations and harvested for export to Japan where its wood is highly valued.

BIOLOGY & SPREAD
Princess tree can reproduce from seed or from root sprouts; the latter can grow more than 15 feet in a single season. The root branches are shallow and horizontal without a strong taproot. Seed-forming pollen is fully developed before the onset of winter and the insect-pollinated flowers open in spring. A single tree is capable of producing an estimated twenty million seeds that are easily transported long distances by wind and water and may germinate shortly after reaching suitable soil.

Seedlings grow quickly and flower in 8-10 years. Mature trees are often structurally unsound and rarely live more than 70 years.

MANAGEMENT OPTIONS

Princess tree can be controlled using a variety of mechanical and chemical controls. Hand pulling may be effective for young seedlings. Plants should be pulled as soon as they are large enough to grasp. Seedlings are best pulled after a rain when the soil is loose. The entire root must be removed since broken fragments may resprout. Trees can be cut at ground level with power or manual saws. Cutting is most effective when trees have begun to flower to prevent seed production. Because Princess tree spreads by suckering, resprouts are common after cutting. Cutting should be considered an initial control measure that will require either repeated cutting of resprouts or an herbicidal treatment.

Princess tree seedlings and small trees can be controlled by applying a 2% solution of glyphosate (e.g., Roundup®) or triclopyr (e.g., Garlon®) and water plus a 0.5% non-ionic surfactant to thoroughly wet all leaves. Use a low pressure and coarse spray pattern to reduce damage from spray drift on non-target species. Glyphosate is a non-selective systemic herbicide that may kill non-target plants that are only partially sprayed. Triclopyr is a selective herbicide for broadleaf species. In areas where desirable grasses are growing , triclopyr can be used with minimal non-target damage.

Girdling is effective on large trees where the use of herbicides is impractical. Using a hatchet, make a cut through the bark encircling the base of the tree, approximately six inches above the ground. Be sure that the cut goes well below the bark. This method will kill the top of the tree but resprouts are common and may require a follow-up treatment with a foliar herbicide.

The cut stump method, that is applying herbicide to freshly cut stumps, should be considered for individual trees or when desirable plants are nearby that might be impacted by foliar applications. Stump treatments can be used as long as the ground is not frozen. Begin treatments by horizontally cutting stems at or near ground level. Immediately apply a 50% solution of glyphosate or triclopyr and water to the cut stump making sure to cover the outer 20% of the stump. Basal bark applications are effective throughout the year as long as the ground is not frozen. Apply a mixture of 25% triclopyr and 75% horticultural oil to the base of the tree trunk to a height of 12-15 inches from the ground. Thorough wetting is necessary for good control; spray until run-off is noticeable at the ground line.

USE PESTICIDES WISELY: Always read the entire pesticide label carefully, follow all mixing and application instructions and wear all recommended personal protective gear and clothing. Contact your state department of agriculture for any additional pesticide use requirements, restrictions or recommendations.

NOTICE: mention of pesticide products on this page does not constitute endorsement of any material.

CONTACTS

For more information on the management of Princess Tree, please contact:

- Kris Johnson, Great Smoky Mountains National Park, Gatlinburg, TN

SUGGESTED ALTERNATIVE PLANTS

Many native shrubs and trees make excellent alternatives to Princess tree. Examples include serviceberry (*Amelanchier canadensis* and *A. arborea*), redbud (*Cercis canadensis*), flowering dogwood (*Cornus florida*), American holly (*Ilex opaca*), red mulberry (*Morus rubra*), spicebush (*Lindera benzoin*), and sassafras (*Sassafras albidum*). Contact the native plant society in your state for additional recommendations and for information on local sources of native plants.

OTHER LINKS

- http://www.invasive.org/search/action.cfm?q=Paulownia%20tomentosa
- http://nbii-nin.ciesin.columbia.edu/ipane/icat/browse.do?specieId=83

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Appendix: Grapevine Control

From the December 2007 issue of *The Forestry Source*

Here's How to Manage Grapevines

Wild grapevines are a problem for forest managers in many areas of the central hardwood forests. The vines grow on a wide range of soil and site conditions but usually are more concentrated on good sites (northern red oak site index 70 and above), on the faster growing, more valuable timber. Presently there is more interest and concern in controlling grapevine for the cove hardwood type than the oak–hickory, oak–pine, or bottomland hardwood types.

Grapevines are a problem because they damage trees by breaking tops and limbs, and twisting, bending, and often breaking tree boles. Merchantable volume is lost, and tree growth and quality are reduced. They also can cause trees to be uprooted and killed. On the other hand, grapevines produce food and cover for many species of wildlife, so measures to control grapevines may conflict with wildlife and recreational goals.

Once grapevines get in a tree crown or bole, the vines begin to dominate the tree. When this occurs, the potential use of that tree for future timber products is low. An overabundance of grapevines also can conflict with wildlife management goals for maintaining mast-producing trees. So even where wildlife is the primary concern, vine control is important for mast management in some stands. Wild grapevines need light to grow well. Vines are prolific stump sprouters, and they root easily. Male and female flowers are usually on separate plants, and periodically they produce large quantities of seed that remains viable in the soil for at least 15 years.

Grapevines can be a more serious problem when the stand is cut heavily, as in clearcutting and other even-age-type practices. They are less serious under partial cuts, such as single-tree selection or thinnings. After heavy cuts in areas where grapevines are present, newly germinated grape seed-lings can exceed 100,000 per acre.

Ministry of Agriculture and Regional Development Archive, Ministry of Agriculture and Regional Development, Bugwood.org

Wild grapevines are a problem for forest managers because they damage trees by breaking tops and limbs; twisting, bending, and often breaking tree boles; decreasing the amount of merchantable volume; and reducing tree growth and quality.

Recommendations to Control Growth

The keys to controlling grapevines are in canopy shading or herbicides.

Even-Age Managment

In sapling, poletimber, and immature sawtimber stands, you can control vines by cutting near groundline using tools such as blades, loppers, hatchets, and chain saws. The cut vine stumps will sprout, but the sprouts will die within 3 to 4 years from shade. Do not cut grapevines in sapling stands until the crown canopy provides shade. If a precommercial crop tree release or thinning is planned and grapevines need control, treat the vines first. Wait at least 5 years before doing the release or thinning.

Use herbicides to control grapevines only when mature stands are ready to harvest. If you schedule some even-age practice in a grapevine problem area within the next 4 to 5 years, spray vines at their base with an herbicide–oil mixture. Spray the stems of vines attached to trees and the "layered" vines (ones sprouting roots) at groundline. Vines can be basal sprayed with an herbicide-oil mixture throughout most of the year. Even if you use herbicide before harvest, grape seedlings will germinate prolifically in the new stand, and you will have to control vines when it becomes sapling size.

If the mature stand has a major grapevine problem and is not going to be harvested during the next 5 years using an even-age cutting practice, no herbicides are necessary. Cut the grapevines near groundline. These stumps will sprout, but the dense canopy shade will cause the sprouts to die in 3 to 4 years. Again, you will have to control grapevines in the new sapling stand.

Uneven-Age Management

Normally, partial cuts such as single-tree selection, improvement cuts, and some diameter-limit cuts result in residual stands with understory shading. Grapevines can be controlled in mature stands by severing vines that grow in tree crowns before, during, or after logging. The vine stumps will sprout but will die within a few years. Barring any drastic overstory removal or natural disaster, the vines will not become a major problem for future timber production.

Costs

The costs of cutting vines depend on size and number of vines per acre. In mature stands, it takes one person about 2.2 hours to cut 100 grapevines per acre. And for sapling stands it takes about 1.2 hours to cut 100 grapevines per acre. To basal spray 100 grapevines per acre in mature stands, it takes a person about 1 hour and about 1 gallon of herbicide–oil mixture. You don't need herbicides in immature stands unless a clearcutting-type practice is planned.

When Are Grapevines a Problem?

How many vines per acre should you tolerate? It depends on what percentage of the stand is dominated by grapevines, and, of course, on management objectives. On high-value hardwood sites you may want to eliminate all grapevines. For wildlife managment on the other hand, 1,000 grapevines per acre may be desirable. Where "arbors" are present (vines overtopping vegetation, creating an opening in the stand canopy), few additional grapevines are needed in the remaining stand for wildlife food. For timber production, 50 grapevines per acre (6 percent of the trees in the stand have grapevines in their crowns) are usually tolerable.

Summary

Grapevine management must be consistent with forest management objectives. Controlling the growth and development of wild grape-vines is not difficult in most situations. If your objective is to grow only high-quality timber, you may try to eliminate all grapevines (excluding arbors). If wild-life management is your objective, you may want to create openings to stimulate reproduction and growth of grapevines by felling small groups of trees that have vines in their crowns. However, in most cases, you will probably want to grow quality timber as well as encourage wildlife development. This means that, although there are some grapevines, the stand is not dominated by them. Allowing grape-vines to develop in arbors and applying grapevine control in the remaining stand is a feasible compromise. It provides wildlife food and cover while simultaneously allowing the remaining stand to be managed for quality hardwood timber, mast-producing trees, and other resources as well.

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