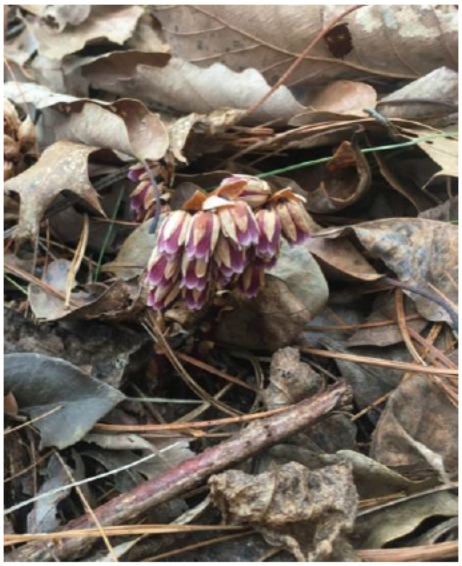
Forest Stewardship Plan for the [redacted] Property

[redacted] NC



April 16th, 2020

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1| INTRODUCTION AND LANDOWNER OBJECTIVES

On March 12th, 2020, EcoForesters conducted a forest assessment of the approximately 39-acre property (Parcel IDs: [redacted]) owned by [redacted] located in [redacted] (see Property Location Map, Appendix A) to create a forest stewardship plan. The purpose of this 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. Any Present Use Valuation Requirements will apply to PIN 9761-50-9454-00000 but not PIN 976160243500000. The forest management objectives of the landowner are listed below:

1. Conduct ecologically-based commercial timber management to improve the health and vitality of the forest ecosystem.
2. Protect high water quality.
3. Maintain and/or increase biodiversity, improve habitat for wildlife, and protect rare & unique species.
4. Maintain and improve the forest's recreation values for hiking and nature observation.
5. Maintain aesthetic appeal.

2| PROPERTY & NATURAL RESOURCE SUMMARY

2.1 Property Description & Summary

Location & Access: The property consists of forested slopes, streams, and a small semi-wooded glade. Structures are located west-centrally and consist of two houses and a shed (see Stand Map, Appendix A). The access from [redacted] is the primary access to the property. Several old logging and other forest roads are still present, and many of them are still used as walking trails. While most of the existing roads would need maintenance/re-establishment to be used for future logging operations, the western steepest portion of the property is too steep and rocky for the building of logging roads. Existing roads should be used as much as possible before establishing new roads. Adjoining Parcels are mostly privately owned in the south, east, and north; towards the west, the property adjoins National Park property that is part of the [redacted]. Some houses are located close to the property on the eastern and southern edge of the property. The property is located on the southeastern slopes of [redacted], which, towards the north, connects to the [redacted] and the [redacted] while towards the south, over [redacted], the mountains fizzle out into the [redacted] periphery and mountain developments.

Terrain, Water & Soils: Situated between 2460 and 3040 feet of elevation, the property itself is located on slopes and ridges with predominantly east to southeast facing slopes. These range from mostly gently and moderately sloped (10-50+ % slope) to rather steep (60-75+ % slope) in the western corner of the property (see Slope Map, Appendix A). The general east to southeast-facing slope is intersected by

several coves and ridges running southeast in the northwestern portion of the property while the southeastern portion of the property is shaped more broadly. The 2-3 unnamed streams are tributaries to [redacted] which flows into the [redacted] which is within the [redacted] watershed.

The soils vary from more productive in coves and bottomlands, to rocky and more nutrient-poor on upper slopes with convex topography (see Soil Reports and Soil Map in Appendix B). The steep western corner of the property is particularly rocky with several places of exposed rock as well as a small semi-wooded glade and associated rock outcrops.

Forest: The forest of the property consists of 3 main forest types: Montane Oak-Hickory Forest, Chestnut Oak Forest, and Rich Cove Forest (see Table 1). The forest types are variable in composition especially for the Chestnut Oak Forest for which a younger portion of the type (Stand 2.1) has been individually assessed. The small semi-wooded glade and small associated rock outcrop are located on the steep western section of the property and represent habitats at risk. Mild to moderate infestations of non-native invasive plants were found throughout the property (but primarily in the forests around the structures) currently posing a threat to these areas. While the diversity of forest types is due to a variation in topography, soils, and aspect, the most recent short-term impact on the forest composition has been the decline of pines primarily in Stand 2.1 due to the southern pine beetle as well as the decades of historic fire regime suppression in the drier forest types.

Table 1: Three main Forest Types were found on the property. Here they are listed with their respective acreage.

Forest Type*	Acres
1. Montane Oak-Hickory Forest	23
2. Chestnut Oak Forest	14
3. Rich Cove Forest	1
4. Non-Forest/House Site	1
TOTAL:	39

* To classify forest types, EcoForesters uses the ecological community classification system based on the North Carolina Natural Heritage Program's Fourth Approximation of Natural Community Types. (http://cvs.bio.unc.edu/pubs/4thApproximationGuideFinalMarch2012.pdf

2.2 Wildlife Habitat

There are four necessities that all wildlife requires for survival: food, water, shelter, and breeding habitat. Our management recommendations, while improving the health of the forest, they simultaneously aim to improve wildlife access to these categories as well. With them we intend to help improve year-round browse from saplings and shrubs, a greater supply of hard mast, seeds, and berries, habitat through standing and downed deadwood, along with maintaining or improving the quality of areas surrounding streams.

The property is connected to a larger section of forested land through the [redacted] and [redacted] ranges, which, primarily towards the west connects to the [redacted] and onwards to the [redacted]. This area towards the northeast provides the necessary wildlife corridor that ensures that a variety of species can more easily travel between the property and the greater habitat hotspot ([redacted]) with ample and suitable habitat

along the way. Such connectivity to larger blocks of conserved land like national or state public lands increases the ecological value of the property, substantiates its importance to the greater area, and may help attract a variety of species.

Riparian areas especially, the land surrounding creeks, streams, ponds, and other surface water occurrences, provide critical habitat for wildlife (see Photo 1). Numerous species are dependent on these buffer zones as the proximity to water creates habitats ideal for many insects, mammals, and birds among others. By creating buffer zones between the surface water and the upland forest types, healthy riparian areas are crucial for maintaining good water quality as they provide a filter for pollutants such as nutrients and sediment.

Photo 1: One of the streams on the property that represents some of the riparian habitats on the property.

A diversity of wildlife habitat on the property is represented by the three forest types, streams, as well as the small glade and associated rock outcrops. While the property is forested, the circumstances of an often thick shrub layer and a shade-tolerant midstory prevent the forest from naturally regenerating with the appropriate species composition. This will degrade the wildlife value of the forest over time as more and more valuable mast trees (such as oaks and hickories that provide acorns and hickory nuts for wildlife) fall out of the canopy. The amount of available year-round browse has also been reduced with the decades of fire-regime suppression that once forced advanced regeneration and shrubs to regularly re-sprout while increasing berry production and the abundance of grass on the forest floor. Management to sustain oaks and hickories in the overstory, establishing structural diversity for a patchwork of light dispersion, and the reintroduction of natural disturbance regimes is, therefore, crucial.

Because the property consists of a more or less continuous canopy, little early successional habitat (i.e. very young forest) was found except for Stand 2.1 where the southern pine beetle has killed the majority of overstory trees and allowed hardwoods to regenerate. As such habitats provide shelter and food sources for wildlife, they also increase wildlife diversity and abundance. Coarse woody material was observed in abundance in Stand 2.1 as a result of fallen trees killed by the southern pine beetle as well as in the form of some uprooted trees on and around the glade that fell likely due to thin soils. However, though some was observed, there is also a lack of over-mature trees and snags which, alike coarse woody material, can provide important habitat for birds, small mammals, and amphibians. With the increased

abundance of small mammals, birds, and insects, their natural predators are also drawn to the area which again increases the species diversity. Additionally, controlled burns of the understory would increase the herbaceous layer offering increased forage for wildlife.

Signs of several species were observed on the property including scat of deer and bears, though countless other species are likely present as well including raccoon, opossum, eastern cottontail, squirrels, and more. It may also be possible that protected timber rattlesnakes are present in and around the rock outcrop in Stand 2.2.

Photo 2: The small semi-wooded glade and associated small rock outcrops that could be home to some uncommon plant and animal species.

At-Risk habitat: The glade and associated rock outcrops (see Photo 2), though small, represent an at-risk habitat that is quickly disappearing around these mountains. While this habitat may shelter several animal species, it also provides space to grow for several uncommon plant species that depend on habitats such as these. Plants observed on the day of the inventory in the off-season include Heuchera sp. and Micranthes sp.. The, in North Carolina, threatened plant, [redacted]) was also observed during the property inventory. Other protected species that have been documented by the North Carolina Natural Heritage Program (NCNHP) to be present within a radius of one-mile around the property include eastern [redacted]) and [redacted]). Under circumstances, these species could also find growing habitat on this property if it is appropriately managed. Other species documented by the NCNHP in this one-mile radius include the [redacted] and [redacted] along with several at-risk natural communities.

2.3 Management History

The forest was heavily cut, probably mostly clear-cut, around the turn of the 20th century, as was much of the Appalachians. Some steep, rocky and hard to access places may have remained undisturbed since then possibly leaving a scattering of older trees of 100+ years old. In the decade of and after the chestnut blight (in the mid-1930s until 1950), another round of pre-emptive or salvage logging may have gone through to harvest the chestnuts while they were still sound, and at the same time harvested other valuable timber as well. These harvests were probably heavy “high-grade” cuts that removed all the biggest, best formed, and most valuable trees. This kind of harvest is usually implemented as a “diameter limit” cut still today (i.e. cut all commercially valuable trees above a certain diameter, usually about 16

inches) and often euphemistically called a “selective” cut. This type of harvest typically reduces the diversity and quality of the forest by removing the fittest trees – and their genetics – from the stand.

The property was likely most recently logged in those aforementioned harvests between the 1930s and the 1950s. Some of the area near and around the house may have gotten harvested more recently.

In about the last 70 years most of these forests have not seen any logging (except for some occasional extraction by the landowners themselves within the last 30 years) and, therefore, for the most part, have had a more or less continuous canopy in place for decades. They exhibit a rather even-aged forest structure. The exception is the area of Stand 2.1 where the southern pine beetle killed much of the pine overstory (recently before 2005) leaving young forest to regenerate and introducing vital structural diversity to the forest. Much of the forest on this property is dominated by Chestnut Oak and Montane Oak-Hickory Forests which historically have benefited from fire. The most ongoing impact on the greater forest composition has, therefore, been a history of fire suppression that has led to an increase in fire-intolerant species and a decrease in fire-tolerant species shifting the forest away from its historic composition. In addition, it has increased the density of the understory and midstory which has increased the fuel accumulation on the forest floor over many decades; this may cause hotter fires if burned at an inappropriate time such as periods of a long drought.

2.4 Invasive Species

Non-Native Invasive Plants:

Non-native invasive plant species are present and include the high priority species Oriental bittersweet, multiflora rose, miscanthus, and Japanese spirea as well as moderate to lower priority species such as periwinkle, Wineberry, and Japanese Knotweed (see **Invasive Species Severity Map and Severity Definitions** in Appendix A for details).

Moderate infestations were observed on the western edge of Stand 4 to Stand 1.2 as well as in Stand 2.2 on its eastern edge to Stand 1.2. Both of these infestations are primarily caused by Oriental bittersweet but also by other species such as multiflora rose and Japanese spirea. The growth and regeneration of the understory, shrub layer, and advanced regeneration has been impacted and larger seed-producing Oriental bittersweet vines are present in the canopy. Japanese spirea has a heavy presence in the shrub layer while multiflora rose is also scattered throughout.

Mild infestations of Oriental bittersweet, Japanese spirea, and multiflora rose were observed around the center of the property that includes recently disturbed areas with higher light levels, as well as moist areas such as along the streams and the wetter forest types. This includes Stands 1.2, 3.1, 3.2, the eastern portion of Stand 2.2, the southern portion of Stand 2.1, and the edges of the Non-Forest Area 4. See Photo 3 for an example.

Occasional infestations will not be described in detail (nor will be included in Table 2). On the Non-Native Invasive Severity Map in Appendix A, these areas are marked as ‘Occasional’ due to the observation of scattered invasive species, their proximity to larger infestations, and/or the potential for scattered invasive plants to be present. At the same time, we do not exclude the possibility of areas marked as not having an infestation to be entirely free of non-native invasive species.

Please review EcoForesters' **Non-native Invasive Species Severity Definitions** on the back of the **Non-native Invasive Species Severity Map** in Appendix A for details on how we determined the appropriate severity for each infestation.

Table 2: The Risk of Individual Invasive Species Spreading & Causing more Ecological Damage by Stand

Species	High	Medium	Low
Oriental Bittersweet	1.2, 2.2, 2.1. 3.1, 3.2	4	
Multiflora Rose	1.2, 2.2, 2.1, 3.1, 3.2,	4	
Miscanthus		4	
Japanese Spirea	1.2, 2.2, 3.1, 3.2,	4	
Periwinkle			4
Wineberry		3.1	
Japanese Knotweed			4

Table 2 lists the non-native invasive species found on the property by stand and categorizes them based on their threat to the surrounding forests. This was also used in determining the management actions in respect to the invasive species.

The invasive species will likely continue to spread to and become more severe in areas where the soil is more productive such as along streams. From these areas, they will spread, though generally somewhat slower, to either side into the drier and less productive forest types. Invasive species will also continue to spread in areas where disturbance has occurred as light conditions there are favorable and the soil often has been more exposed for better germination of seeds.

Because the high priority species Miscanthus is present on the property only at a single very low infested location (Area 4) in low abundance and nowhere else on the property, we, therefore, highly recommend the complete eradication of the species. By eradicating the species early on it may be possible to prevent its establishment in other forest edges and penetrate the forest with future disturbance and potential controlled burns. This could allow the landowner to focus on the control and monitoring of other species present instead.

Oriental bittersweet is one of the greatest threats to southern Appalachian forests as it is shade-tolerant and can climb up, overtop, and eventually kill mature healthy trees. It can, therefore, take over and destroy entire portions of the forest if not actively controlled. This species should be the highest priority species to treat.

It is a high priority to treat these mild to moderate infestations before they spread and become much harder to control. It is always easier, and cheaper, to control non-native plants earlier than to wait to respond to increasingly worse infestations. For sustainable forest management, it is also essential to control these non-native invasive plants well before *and* after any harvesting or other disturbance is planned. The longer ahead of any harvest that invasive plants are controlled, the more it will help reduce invasive species population growth and establishment. Seeds of invasive plants that can germinate several

years later may still be present in the seed bank and will readily germinate should high-light conditions arise and soil disturbance occur.

We, therefore, require that any seed-producing plants along with Oriental bittersweet, multiflora rose, and Miscanthus on the property be controlled within a period of 5 years between 2020-2025 to control these species down to the mild to occasional level. The next 10 years (2025-2035) are then required to be used for follow-up treatments and monitoring to ensure as few invasive species present as possible. At the beginning of these 10 years, the lower priority species (Japanese spirea and wineberry should also be controlled.) We also recommend the control of the Japanese knotweed and periwinkle within this time period. Additional monitoring and follow up treatments should be conducted every few years and especially before any planned disturbance. Otherwise, increased disturbance (such as a harvest or a controlled burn) would create more growing space for the invasive plants while, at the same time, allowing in more sun to stimulate new growth.

Photo 3: A mild infestation of Oriental bittersweet that is common throughout the property. Notice the vine climbing up a young tree, the first step of strangling it and shading out its crown.

If uncontrolled for extended periods, these invasive plants would prevent native trees from regenerating and seriously compromise the future forest ecologically and economically.

General Recommendation: We recommend following EcoForesters' 7 Ps that provide a guideline on how to address invasive problems in an orderly progression to ensure the most effective rate of their control (see **Appendix C for more information on the 7 Ps).** In general, EcoForesters recommends starting invasive control on the outer edges of the infestation, especially the higher elevation areas (or at the upstream parts of the creeks) and working down and inward toward the center of the infestation to control their spread. Also, any seed-producing plants should be targeted first as some invasive seeds are viable for several years. Therefore, ongoing control and monitoring are essential. These treatments would come at a cost to the landowner but would help maintain forest biodiversity and health, as well as increase the future income-potential of the forest. See the forest type-level recommendations for specific treatments. EcoForesters can help plan and execute this work. More information on the species and control methods can be found in the management section of each forest type, in Appendix C, or visit our

website for info on our invasive species control services (https://www.ecoforesters.org/services/invasive-species-control-crew/).

Non-Native Invasive Insects:

A few individual American ash trees were observed on the property. Ash trees are currently under attack from the Emerald Ash Borer (EAB) as the insect has reached our area and already has destroyed large areas of ash trees. Should the owner desire to retain this species of tree, it is recommended to treat trees still in good health for a treatment to be effective. Early treatment is key because it may already be too late to treat trees showing signs of decline from EAB. Because of seasonality, it was difficult to assess the health and therewith the treatability of the trees.

The loss of Ash in this area is the result of the continued introduction of pests and disease into forests around the world. The process of occasional tree death is natural and contributes greatly to the process of stand dynamics. It creates small canopy gaps for advanced regeneration to grow into and provides standing deadwood for wildlife that eventually falls to become coarse woody material. However, the loss of an entire species over the forest landscape is not natural. If untreated, the species will likely be lost from this forest though some seedlings and saplings may persist (as are present on this property). The Emerald Ash Borer generally moves through the landscape killing all ash within 5-6 years when the insect tends to leave the area. It is, therefore, possible to renew the species' presence in the forest by treating still healthy enough ash trees to retain the species in the current canopy that can act as a future seed source. More information on EAB and treatment methods can be found in Appendix D.

3| FOREST RESOURCES & STEWARDSHIP

In consideration of the forest management history, current conditions, and the landowner's objectives, EcoForesters, in consultation with the landowner, suggests the management actions as follows.

Plan Summary

These tables (Tables 3-4) will serve as a summary of the forest conditions and management recommendation which will be put forth and further described, by Forest Type, in the following sections.

Table 3: Management Actions by Forest Type (FT) | Forest Stand Improvement (FSI)

Forest Type / Stands	Suggested Management Action	Target Date	Cost/ Revenue	Requirement
All Forest Types	Control higher risk non-native invasive species down to the occasional level and focus on seed-producing plants.	2025 (5 years)	Cost[1]	Required for PUV
All Forest Types	Continued monitoring for invasive species in particular at high-risk locations and control of lower priority species.	2025-2035	Cost[1]	Required for PUV
Area 4	Eradicate the infestation of Miscanthus	2025	Cost[1]	Highly Recommended[+]
FT 1 & FT 2	Consider implementing controlled burns at about 3 - 10-year intervals once invasive plants have been controlled.	Whenever possible	Cost[1,2]	Recommended[+]
Stand 2.1	Conduct FSI crop-tree release work.	2020-2025	Cost [1]	Recommended[+]
FT 1 & FT 2	Conduct midstory removal FSI work by cut-and-leave/hack-and-squirt treatments in combination with controlled burns.	4-7 years before a harvest	Cost[1]	Recommended[+]
Stand 1.1 (and other Stands if accessible / profitable)	In accessible parts of stands, we recommend crown thinning harvests.	2030 – 2035	Some Revenue	Recommended[+]
FT 1, FT 2 & FT 3	In accessible parts of stands, we recommend group selection, Femelschlag, crown thinning[(FT 1, 3)], & shelterwood[(FT 1, 2)] harvests.	2040 - 2050	Some Revenue	Required for PUV
All Forest Types	Monitor proper stand re-initiation, invasive plant & grapevine problems, as well as erosion issues (immediately) after any harvest or major disturbance.	After 1-2 growing seasons	Cost [1]	Highly Recommended[+]

Table 3 (continued) Management Actions by Forest Type (FT) | Forest Stand Improvement (FSI)				
Forest Type / Stands	**Suggested Management Action**	**Target Date**	**Cost/ Revenue**	**Requirement**
All Forest Types	Conduct crop tree release FSI work after any harvest or major disturbance.	5-15 years after harvest.	Cost [1]	Recommended[+]
FT 3 (& Wherever Found)	Treat healthy ash if desired.	*Before* trees show decline.	Cost	Optional
Non-Forest	(1) Convert edges and powerline ROW to native grassland/wildflower meadow. (2) Feather field-to-forest ecotone with shrubs.	No Target Date	Cost	Optional[+]
Entire Property	Reassess forest in an updated stewardship plan.	2030	Cost	Required for PUV

[1] Cost-share assistance may be available from the NRCS for this pre-commercial treatment through EQIP (see Appendix D).

[2] Controlled burning cost and liability may be fully absorbed through a federal program administered by NCFS.

[3] Cost-share assistance could be available for this action from the NCFS Forest Development Program (FDP) (see Appendix D).

[+]These optional treatments may benefit forest health and diversity but come at a cost to the landowner so are not required.

To protect water quality, extra care must be taken around any surface water or wetland areas in all stewardship actions. Therefore, buffers, called streamside management zones (SMZs), must be established at least 50 feet from any surface water and all forestry best management practices (BMPs, http://ncforestservice.gov/water_quality/bmp_manual.htm) must be rigorously met, or exceeded, to minimize ground disturbance in these areas particularly. Still, there are many other BMP recommendations that must be followed: they are critically important for avoiding liability for impacting water quality, such as stable road and skid trail layout, construction, and the final stabilization at the end of management activities.

Table 4: Basal Area (sqft) per acre by diameter class (DBH) and Forest Type

Forest Type	<4"	4-8"	8-12"	12-16"	16-20"	20-24"	>24"	Total BA	Acres
FT 1: Montane Oak-Hickory Forest	4	30	50	52	20	6	-	162	23
FT 2: Chestnut Oak Forest (except Stand 2.1)	3	33	10	30	30	13	3	120	6
FT 2: Stand 2.1	50	33	27	-	-	-	-	113	8
FT 3: Rich Cove Forest	-	20	55	35	25	10	5	150	1

Forest Type 1: Montane Oak-Hickory Forest (23 acres)

Photo 4: The Montane Oak-Hickory Forest was rich in white oak as well as other oak in the overstory along with a large amount of yellow-poplar in some locations. However, little advanced oak and hickory regeneration was observed.

Description of Typical Forest Type: Montane Oak-Hickory Forests are unique in that white oak, which competes best only in very specific sites, is a significant component, though it is uncommon to see forests with this characteristic today on private land. As white oak is one of the most valuable trees in the mountains, it was often targeted for harvest during logging events over the past century reducing the species' presence in the forest. This forest type is found predominantly on upper to middle slopes and ridges below 4000 feet in elevation. They occur on moderately productive soils on the less steep slopes which can hold some moisture but are also subject to dry periods. These sites are more xeric (dry) and with less productive soils than found in Rich Cove Forests, but more mesic (moist) and more productive than Chestnut Oak Forests. The generally common white oak in the overstory is complemented by a mixture of other oaks, hickories, and pines. The shrub layer may often have components of mountain laurel.

Historically, a fire regime has been an integral part of managing these oak-dominated forest types in the Southern Appalachians by controlling shade-tolerant and fire-intolerant species such as red maple, sourwood, and others for the benefit of oaks, hickories, southern yellow pines, and the herbaceous ground layer.

Forest Type on the Property: On this property, Montane Oak-Hickory Forests occur on the broader slopes of low to medium steepness of the entire southeastern portion of the property (Stand 1.1), some of the areas surrounding the streams in the northwest of the property (Stand 1.2), as well as a small corner in the north of the property. While the slopes are generally mild, the aspect is primarily east to southeast facing.

Table 5: Stand Acreages

Stand 1.1	17 acres
Stand 1.2	5 acres
Stand 1.3	1 acres

Notable parts of the stand include some areas in the center of Stand 1.2 just southwest of where the streams flow together where the slope turns relatively flat and the shrub layer is dominated by spicebush representing a more mesic and alkaline portion of the forest.

As the entire forest was likely clear-cut 70-90 years ago or, at least in part, used as pasture, the generally typical Montane Oak-Hickory Overstory is heavily co-dominated by yellow-poplar.

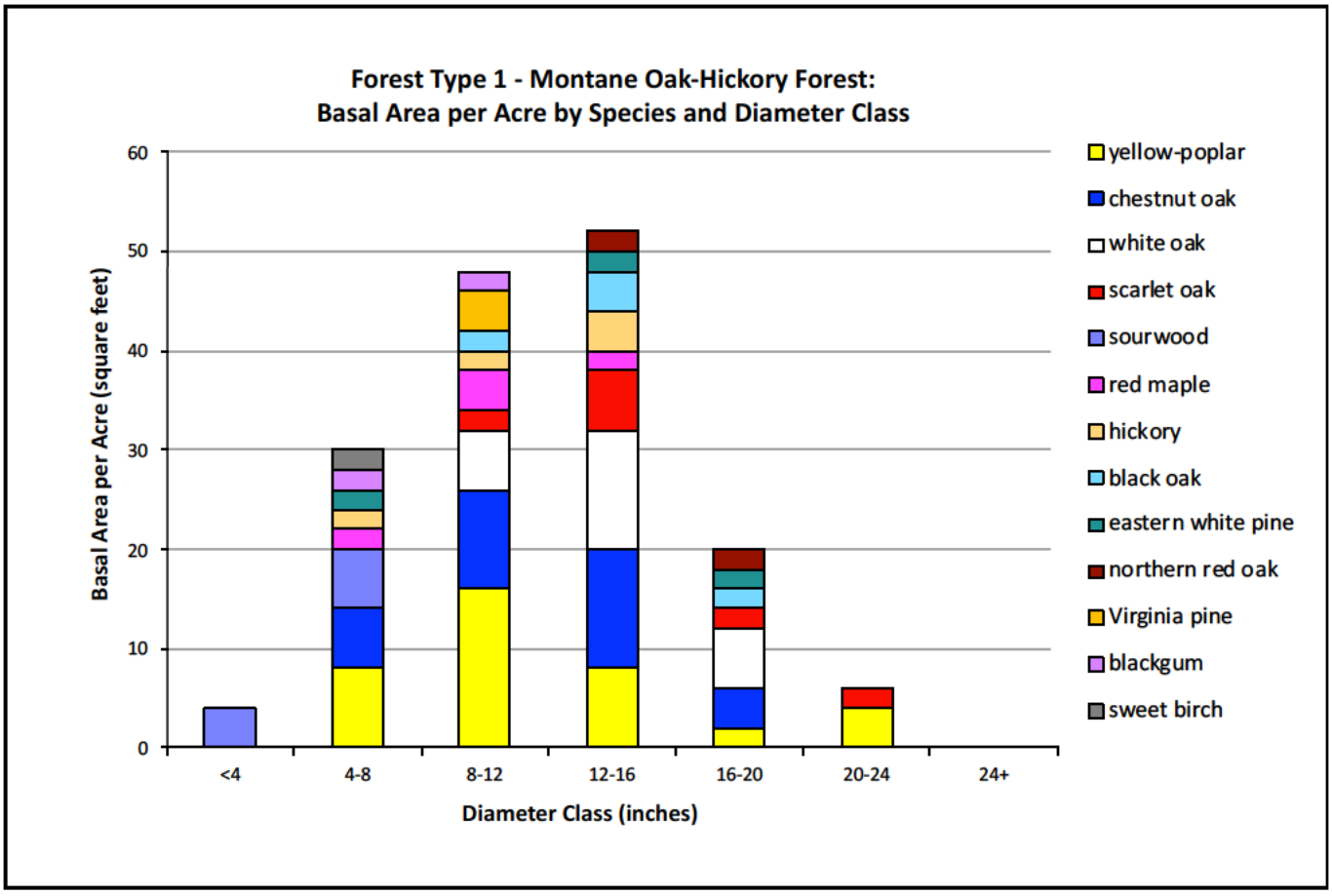


Figure 1: Only a very small amount of the average basal area of 160 square feet per acre is composed of oaks, yellow-poplar, white pine, and hickory with merchantable diameters between 16 and 24 inches at breast height.

Composition & Resources: The overstory is dominated by chestnut oak, white oak, and yellow-poplar. Other species include scarlet oak, black oak, red maple, as well as scattered hickory, eastern white pine, Virginia pine, northern red oak, and blackgum. The midstory is dominated by sourwood, red maple, white pine, American beech but also dogwood, blackgum as well as scattered sweet birch and black cherry. The shrub layer is sparse but, where present, composed of scattered mountain laurel, rosebay rhododendron, and greenbrier. The advanced regeneration is sparse, but where present, is primarily composed of red maple, blackgum, sourwood, white pine, and American beech, as well as more scattered sassafras, eastern red-cedar, hickory, chestnut oak, and American holly. Characteristically, Stand 1.2 is

more variable in composition while having a greater component of spicebush in its southwestern portion. Stand 1.1 is more uniform in composition with a drier shrub and herb layer.

Only a very small amount of the average basal area of 160 square feet per acre is composed of oaks, yellow-poplar, white pine, and hickory with merchantable diameters between 16 and 24 inches at breast height. However, some of the smaller diameter yellow-poplar (down to 14 inches DBH) could also have some economic value if sold to the right mill. Smaller diameter classes have a much larger basal area per acre but, except for the 12-16-inch diameter class, are heavier in yellow-poplar with less chestnut oak, white oak, and scarlet oak. The 12-16-inch diameter class has a significant amount of white oak, chestnut oak, and scarlet oak that could benefit from a crown release. The current overstory, though dominated by valuable species, is not yet stocked with enough volume to justify the removal of merchantable logs. As yellow-poplar on average grow at about 2.5" in diameter per decade (and oaks generally grow slower than that), it will take about 10 years for enough of the trees to reach an appropriate size to be of merchantable value. The smaller diameter classes, as they currently stand, however, are not in a position to replenish a Montane Oak-Hickory Forest composition of the overstory after a future harvest. Similarly, there is not enough oak and hickory advanced regeneration to accomplish this replenishment after a harvest either.

The threat of invasive species is mild in the majority of the area. Stand 1.1 is largely without such infestations so care should be taken to not introduce invasive species into this portion of the property by causing disturbance to the stand before invasive species have been controlled in the stands around it.

Succession & Ecology: The abundance of mature oak is ecologically beneficial for many reasons such as forest health, ample hard mast for wildlife, and a good prospect for regenerating oaks with proper management actions. These stands are currently succeeding from the Stem-exclusion to the Understory Re-Initiation phase of forest succession.

The high component of yellow-poplar in the forest overstory in addition to a continuous canopy suggests that much of the area of these stands likely regenerated from pasture, grazing, or a clear-cut 70-80 years ago. Over time, some of the yellow-poplar, not as well-suited for these somewhat drier conditions will begin to decline allowing for subordinate and intermediate oaks to advance into the upper canopy. However, this process may occur too late for oaks, which may also have begun their decline due to the competition in the canopy. This, in turn, would allow for advanced regeneration in the under and midstory to advance. As the shade-tolerant red maple and sourwood are dominant there, the forest would slowly shift towards a red maple-dominant species composition. Without active management, such as a prescribed fire (or mimicking disturbance), or significant natural disturbance, shade-tolerant red maple, sourwood, white pine, and beech will increase at the expense of shade-intermediate species such as oaks and hickories as well as shade-intolerant species such as yellow pines (most of which are more valuable both economically and ecologically than red maple and sourwood). However, this process could only fuel the establishment of the non-native invasive species already present in some of these or neighboring stands if those are not controlled. The threat of non-native invasive species in many of these stands is posing a significant risk to the future health and resilience of the forest. See Section 2.3 and the Invasive Species Severity Map in Appendix A for details. If left to fend on its own, the natural ecological process described above could affectively halt the natural process of forest regeneration, leaving the forest in an unhealthy state with a transition towards a dominance of invasive shrubs and vines.

Management Recommendations:

The goals for these stands are to actively manage the forest to return it to its historical Montane Oak-Hickory composition. Practically this means to increase the amount of oak, hickory and pitch pine present in the overstory, midstory, and advanced regeneration. While a diversity of oaks, hickories, and pitch pine are important, the focus should be on white, northern red, and black oak. At the same time, red maple, sourwood, white pine, and American beech should be limited from the midstory and advanced regeneration by providing conditions (or mimicking techniques) that allow oak and hickory to compete better. Because a continuous canopy has been in place for decades without the natural process of gap-phase dynamics allowing more light to the forest floor, the forest could be on track of transitioning to more shade-tolerant species that thrive in the current shady conditions. Management should mimic gap-phase dynamics and historic fire disturbance regimes should be reinstalled for the goal to once again re-establish a multi-aged forest dominated by diverse oak and hickory in the overstory.

Recommendation 1: ***Invasive Control*** *[Required for PUV]* Treat all plants (especially those that are seed-producing) of Oriental bittersweet, multiflora rose, Miscanthus, and Japanese spirea on the property within a period of 5 years between 2020-2025 to control these species down to the occasional level. The following 10 years are then required to be used for follow-up treatments and monitoring to ensure as few invasive species present as possible. At the beginning of these 10 years, the lower priority species (periwinkle and Japanese knotweed) should also be controlled. Additional monitoring and follow up treatments should be conducted every few years and especially before any planned disturbance. Before a future harvest, non-native invasive species should only be present at the occasional to mild level (species dependent).

Recommendation 2: ***Prescribed Fire*** *[Recommended⁺]* Consider using controlled burns for stands in this forest type to reduce red maple, sourwood, and white pine regeneration (once invasive species have been controlled). This practice would promote oaks and hickories and prepare the forest floor for their regeneration. With hotter fires, midstory maples and yellow-poplar could also be reduced allowing more light to reach establishing oak regeneration. Growing season fires, especially in early spring and at about 3 to 10-year burn intervals, would be most beneficial for removing competition from oak regeneration.

Periodic burns would also be beneficial *following* a future harvest. Burning to remove the less-desired competition from the desired oak and hickory regeneration after a harvest should be conducted when advanced regeneration has reached about 1-2 inches diameter at the base or when most appropriate after consulting with a forestry or controlled burn professional. Potential damage to timber quality and revenue should be noted if too hot burns are conducted in accessible portions of the forest *before* a harvest.

Though controlled burning could be challenging due to difficulties of fire line establishment access, the landowner could investigate opportunities for prescribed fire with the NC Forest Service if interested (other local burn crews could also be pursued). Should the property be within 10 air-miles of US Forest Service land, the cost and liability of a controlled burn might even be absorbed by the NC Forest Service through the Community Protection Plan (https://www.ncforestservice.gov/fire_control/fc_cpp.htm). Funding for controlled burns is also available through the NRCS Environmental Quality Incentive Program

(EQIP). See Appendix D for more information on the benefits of controlled burning as well as information on EQIP.

Recommendation 3: ***Midstory Removal FSI*** *[Recommended +]* Midstory removal forest stand improvement work through the elimination of the shade-tolerant red maple, sourwood, and white pine would ensure the regeneration of ecologically and economically more valuable tree species (oak & hickory) in the better-suited light-conditions for an impending harvest. This can be achieved through a cut-and-leave or hack- and-squirt treatment of very tall advanced regeneration and up to 8" - 10" DBH suppressed trees of the species mentioned above. Controlled burns may also be used to kill smaller stems or reduce re-sprouts of those already cut (see Recommendation 2). While the hack-and-squirt method will prevent the less-desired stems from re-sprouting through chemical means, the cut-and-leave method, if followed by a controlled burn 1-3 years after completion, could achieve similar results. These treatments should be carried out in locations where oak and hickory seedlings and small saplings are already present but overshadowed by the species to be cut. Such treatments could be conducted before or 2-4 years after a burn and ideally 5-10 years before a harvest. This will increase the regenerative success of oak and hickory as they will be able to establish in the years after a burn (if not already present) and further solidify their presence in the stand.

Recommendation 4: ***Harvest – Crown Thinning*** *[Recommended+]* After one or two returns of prescribed fire (Recommendation 2), some of the trees may have reached a big enough diameter at breast height to make a crown thinning harvest profitable between 2030-2035. During this harvest, target trees that are of poor form and vitality (mostly remove yellow-poplar) while inversely selecting the most vital, healthy, and vigorous trees for release (especially diverse oak and pitch pine, but also hickory). This would speed up the growth of the remaining trees that were selected making them increasingly valuable both ecologically and economically. This could increase the value of the trees for the next harvest (Recommendation 5) while also introducing enough light onto the forest floor to spur the regeneration of oaks and herbaceous species. This harvest could be conducted simultaneously with a Midstory Removal treatment (Recommendation 3) and predominantly applies to Stand 1.1. It should be conducted at least 10 years before the harvest outlined in Recommendation 5.

A prerequisite for this recommendation is to control invasive species as described in Recommendation 1, though it could occur earlier than suggested in this recommendation IF non-native invasive species are controlled at a faster pace than required.

Recommendation 5: ***Harvest*** *[Required for PUV]* In accessible portions of the forest type we recommend shelterwood, Femelschlag (see Glossary for definition), and/or group selection (0.25 to 2 acres) harvests between 2040 and 2050. This would create small canopy gaps promoting early successional habitat and the regeneration of oak species. Oak regeneration would be most successful if the harvests are combined with controlled burning (see next recommendation) to reduce competition from shade-tolerant species within the establishing advanced regeneration. Commercial harvests should be conducted in accessible parts of the stands when adjacent stands are being harvested. During harvests, a variety of healthy oak species and hickory should be left while removing red maple and yellow-poplar

combined with some harvest of the oak and hickory basal area. The residual BA for shelterwood harvests should be between 40 and 60 square feet per acre.

A prerequisite for this recommendation is to control invasive species as described in Recommendation 1, though it could occur earlier than suggested in this recommendation IF non-native invasive species are controlled at a faster pace than required.

Recommendation 6: ***Post-Harvest FSI*** *[Recommended +]* Conduct Forest Stand Improvement work 5-15 years after any harvest favoring species diversity but especially oak (particularly white, northern red, and black oak), hickory, and pitch pine by the removal of competing red maple, yellow-poplar, sourwood, blackgum, white pine, and Virginia pine. This work increases the species diversity and richness across the forest type by reducing the less-desired competition from ecologically and economically desired species. While oak, hickory, and yellow pines should be focused on in these actions, other species of high ecological value may also be favored. Similar outcomes may be achieved by conducting controlled burns with the right conditions (as mentioned in Recommendation 2).

As part of this improvement work, also control invasive plant species that may have come up as part of harvesting operations.

Forest Type 2: Chestnut Oak Forest (14 acres)

Description of Typical Forest Type: Chestnut Oak Forests are found on dry sites, predominantly ridgelines, and exposed convex slopes. Given their topographical position, soils here tend to be drier, rockier, thinner, and lower in nutrients; this subsequently causes slower tree growth. However, these are also the sites where slower-growing, more drought-tolerant trees like oaks and hickories can compete best. Generally, these forests are dominated by chestnut oak with a co-dominance of scarlet oak, black oak or northern red oak and may include just as large components of sourwood, black gum, and several other scattered tree species in the over- and midstory. The understory can be composed of dominating rosebay rhododendron, mountain laurel, or an herb layer instead of shrubs.

Photo 5: An image of the Chestnut Oak Forest in Stand 2.2 above the glade. The forest type in Stand 2.3 is denser with mountain laurel and rhododendron in the shrub layer and Stand 2.1 is composed of smaller diameter trees with a different species composition.

The Chestnut Oak Communities are fire-adapted systems. They were regularly burned for thousands of years by both Native Americans and naturally occurring fires. This process reduced competition for fire-adapted oak and yellow pine species from non-fire-adapted shade-tolerant species such as red maple, sourwood (when young), and white pine that often crowd the understory's advanced regeneration. Some hotter fires also created small canopy gaps (as did storms and ice) by killing fire-intolerant species in the overstory, such as red maple, which in turn allowed the surviving fire-tolerant oak and others to establish into advanced regeneration and thrive in better light conditions.

Forest Type on the Property: On this property, Chestnut Oak Forests occur on the steep east-facing slope in the west of the property (Stand 2.2), the broad north-central ridge facing to the southeast (Stand 2.1), and the northeast-facing slope to the north of it (Stand 2.3). The two latter stands are much more gently sloped than the first.

Table 6: Stand Acreages

Stand 2.1	8 acres
Stand 2.2	3 acres
Stand 2.3	3 acres

The small semi-wooded glade and associated small rock outcrops are notable portions of stands in this forest type.

Though not much management has occurred in Stands 2.2 and 2.3, Stand 2.1 has been heavily impacted by the death of overstory pine species as a result of the southern pine beetle outbreak there about 20 years ago. This has significantly affected the stand's species composition and structure and will, therefore, be treated somewhat separately from the rest of the stands.

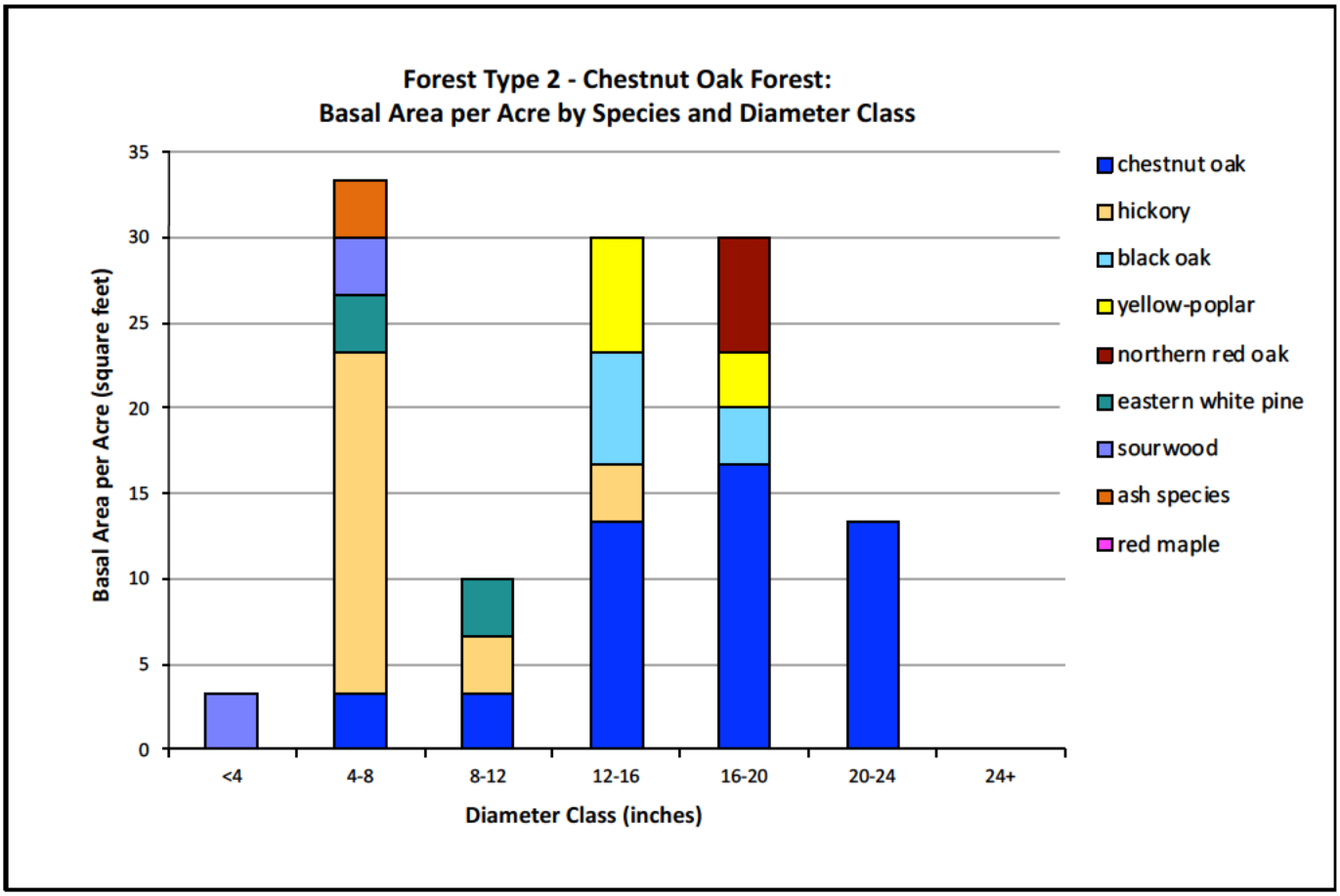


Figure 2: About one-quarter of the average basal area of 120 square feet per acre (for Stands 2.2 & 2.3) is composed of chestnut oak (and some northern red & black oak) with merchantable diameters between 16 and 24 inches at breast height.

Composition & Resources: The overstory is dominated by chestnut oak. Other species include black oak, northern red oak, and yellow-poplar, as well as scattered hickory, scarlet oak, and occasional elm (Stand 2.2) and post oak (Stand 2.3). The midstory is primarily composed of hickory, along with lesser amounts of white pine, sourwood, yellow-poplar, black cherry, sassafras, blackgum, and ash. The Shrub layer in Stand 2.2 is composed of maple-leaf viburnum, serviceberry, greenbrier, Japanese spirea, as well as scattered spicebush and Allegheny chinquapin. In Stand 2.3, the shrub layer is characteristic of more of a Dry Heath Chestnut Oak Forest Subtype with larger amounts of mountain laurel and rosebay rhododendron, but also azaleas. While Stand 2.2 has little advanced regeneration aside from mulberry,

ash, and the occasional oak sapling, Stand 2.3 does not have a large amount of advanced regeneration aside from abundant white pine along with occasional maple and sourwood.

Stand 2.1, on the other hand, is very different from the latter two stands (see Figure 3). It is composed of yellow-poplar, red maple, scarlet oak, chestnut oak, and sourwood in the overstory. Other species there include scattered northern red oak, hickory, pitch pine, Virginia pine, and black cherry. The midstory is composed of a similar composition as the overstory but more white pine, and red maple. Along with some scattered mountain laurel, occasional rhododendron, and blueberry in the shrub layer, the advanced regeneration here is thick with white pine, red maple blackgum, sourwood, and American holly. Lots of dead, fallen, and decomposing pines are on the forest floor as coarse woody material.

About one-quarter of the average basal area of 120 square feet per acre (for Stands 2.2 & 2.3) is composed of chestnut oak (and some northern red & black oak) with merchantable diameters between 16 and 24 inches at breast height. The up-and-coming diameter class of 12”-16” at breast height has similar amounts of chestnut oak but more black oak and yellow poplar. Smaller diameter classes have a lower basal area per acre with significantly more hickory while at the same time significantly less oak in addition to increased white pine (in Stand 2.3). The current overstory is stocked with enough volume to justify the

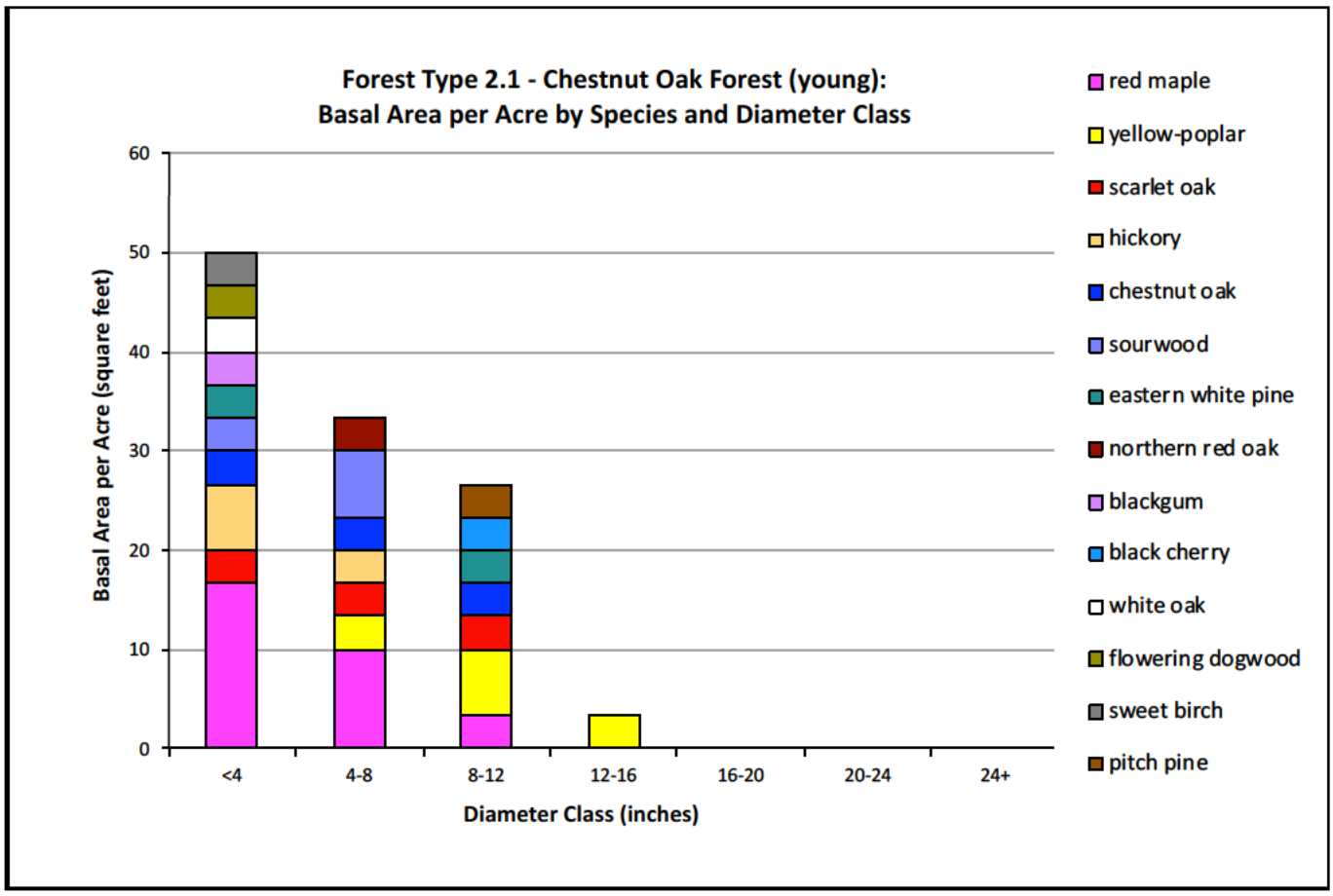


Figure 3: In general Stand 2.1 has trees of significantly smaller diameters with an average basal area of 113 square feet at DBH. The current overstory of this stand is therefore not stocked with enough volume for the removal of merchantable logs in the near future.

removal of merchantable logs in 5-15 years (though a harvest should wait until neighboring stands are being harvested to make the harvest profitable and more ecologically beneficial and to wait until non-native invasive species have been controlled). The smaller diameter classes, as they currently stand, however, are not in a position to replenish a Chestnut Oak Forest composition of the overstory after a future harvest. Similarly, there is not enough oak and hickory advanced regeneration to accomplish this replacement after a harvest either.

Stand 2.1, in general, has trees of significantly smaller diameters with an average basal area of 113 square feet at DBH. The current overstory of this stand is therefore not stocked with enough volume for the removal of merchantable logs in the near future.

Photo 6: Notice the smaller diameter trees in this picture representing the composition of Stand 2.1.

Succession & Ecology: For Stand 2.2 & 2.3, the abundance of mature oak is ecologically beneficial for many reasons such as forest health, ample hard mast for wildlife, and a good prospect for regenerating oaks with proper management actions. These stands are currently succeeding from the Stem Exclusion to the Understory Re-initiation phase of forest succession. This transition is evidenced by occasional canopy gaps and a relatively dense midstory as well as the creation of Stand 2.1 as a larger but natural canopy gap. Over the next several decades, more trees will fall out of canopy due to increased competition, limited resources for growth, and, at times, disease (as was the case for Stand 2.1). This will cause more light to reach the mid- and understory allowing the growth of a younger age class of trees and a densening shrub layer due to the absence of fire. The ingrowth of younger trees creates multiple age-classes which normally increases vital structural diversity and subsequently increases biological diversity. For Stand 2.3 it is of particular concern that the dense rhododendron and mountain laurel cover causes deep-shade and impedes regeneration in the understory while additionally causing the gradual succession of stands to more shade-tolerant species such as red maple, sourwood, blackgum, and white pine. Red maple, sourwood, white pine, and blackgum dominance in the midstory and the smaller diameter classes signifies the species will occupy a significant portion of the future forest should the current ecological processes persist. Without active management or significant natural disturbance, those shade-tolerant species will increase at the expense of shade-intolerant species such as yellow pines as well as shade-intermediate

species such as oaks and hickories (most of which are more valuable both economically and ecologically than red maple and sourwood).

For Stand 2.1, the abundance of oak is ecologically beneficial for many reasons such as forest health, future hard mast for wildlife, and a good prospect for regenerating oaks with proper management actions. This stand is currently succeeding from the Stand Initiation Phase and is within the Stem Exclusion phase of forest succession. Red maple, sourwood, and yellow-poplar's co-dominance in the canopy and in the smaller diameter classes, along with white pine in the midstory, signify that these species will occupy a significant portion of the future forest should the current ecological processes persist. Without active management or significant natural disturbance, red maple, sourwood, yellow poplar, and white pine will outcompete the oaks and hickories that are present.

There is a threat of non-native invasive species in many areas of these stands (Particularly Stands 2.2 & 2.1) posing a significant risk to the future health and resilience of the forest. See Section 2.3 and the Invasive Species Severity Map in Appendix A for details. If left to fend on its own, the natural ecological process described above could eventually halt the natural process of forest regeneration, leaving the forest in an unhealthy state with a transition towards a dominance of invasive shrubs and vines.

Management Recommendations:

The goal for this forest type is to have the advanced regeneration and the midstory be more reflective of the overstory. A variety of oaks (especially chestnut, white, northern red, post, and black oak), hickory, as well as pine (where present in the overstory) should be promoted in the understory. To achieve this, methods mimicking natural disturbance regimes of gap-phase dynamics should be implemented and natural fire regimes of periodic burns re-established. While mimicked gap-phase dynamics will improve the light-conditions for oak regeneration and once again introduce uneven-aged structural diversity to the forest, the burns will improve the forest floor for the establishment of oak (as well as pines where present) and promote their advancement into the mid- and overstory. Shade-tolerant red maple and other fire-intolerant species such as yellow-poplar and young sourwood will be reduced and prevented from chocking the midstory. The shrub layer will also be reduced.

Recommendation 1: ***Invasive Control*** *[Required for PUV]* Treat all plants (especially those that are seed-producing) of Oriental bittersweet, multiflora rose, Miscanthus, and Japanese spirea on the property within a period of 5 years between 2020-2025 to control these species down to the occasional level. The following 10 years are then required to be used for follow-up treatments and monitoring to ensure as few invasive species present as possible. At the beginning of these 10 years, the lower priority species (periwinkle and Japanese Knotweed) should also be controlled. Additional monitoring and follow up treatments should be conducted every few years and especially before any planned disturbance. Before a future harvest, non-native invasive species should only be present at the occasional level (species dependent). For those stands without an invasive infestation, continuously monitor for non-native invasive species. Especially do so at high-risk locations such as disturbed areas and logging roads in particularly during the years preceding a harvest or other planned disturbance.

Recommendation 2: ***Forest Stand Improvement*** *[Recommended +]* Conduct Forest Stand Improvement work in Stand 2.1 within the next 5 years (2020-2025) favoring species diversity but especially oak (particularly white, northern red, black, and post oak), hickory, and yellow pines by the removal of competing red maple, yellow-poplar, sourwood, blackgum, white pine, and Virginia pine. This work increases the species diversity and richness across the forest type by reducing the less-desired competition from ecologically and economically desired species. While oak, hickory, and yellow pines should be focused on in these actions, other species of high ecological value may also be favored. Similar outcomes may be achieved by conducting controlled burns with the right conditions (as mentioned in Recommendation 3) though it may result in the damage of some of the more desired species due to the heavy fuel loading (debris on the forest floor).

Recommendation 3: ***Prescribed Fire*** *[Recommended +]* Consider using controlled burns at about 3 – 7-year intervals for stands in this forest type to reduce red maple, sourwood, blackgum, and white pine regeneration once invasive species have been controlled. This practice would also promote oaks and prepare the forest floor for their regeneration. With hotter fires, midstory maples and yellow-poplars could also be reduced allowing more light to reach establishing oak regeneration. Growing season fires, especially in early spring, are most beneficial for removing competition from oak regeneration. However, potential damage to timber quality and revenue should be noted if too hot burns are conducted in accessible portions of the forest before a harvest.

For the purpose of fuel reduction, the below-mentioned methods for midstory removal treatment could be considered if prescribed burns are impractical. While different in outcome, such treatments will also have a positive ecological impact on these forests. Both such treatments (if combined or otherwise) may serve as an ecologically beneficial fuel reduction treatment that could potentially find support (financial or otherwise) by the neighboring property owners as it would help reduce fuel around their property as well.

Specific to Stand 2.1: Prescribed fire will also beneficial in this stand once the desired trees in the canopy have increased in diameter and therewith in bark thickness which increases their tolerance to fire. An additional 10 years of growth on the trees present (especially with sped up growth as the result from the Crop Tree Release FSI work – Recommendation 2) and the further decomposition of the woody material on the forest floor would help with reducing the damage to the trees significantly.

For more information on controlled burns including potential funding sources, refer to Recommendation 2 in the Montane Oak-Hickory Forest Type 1 on page 14.

Recommendation 4: ***Midstory Removal FSI*** *[Recommended +]* Midstory removal forest stand improvement work through the reduction of the shade-tolerant red maple, sourwood, white pine, and blackgum would ensure the regeneration of economically and ecologically more valuable tree species (oak & hickory) in the better-suited light-conditions for an impending harvest. This can be achieved through a cut-and-leave or hack- and-squirt treatment of very tall advanced regeneration and up to 8” - 10” DBH suppressed trees of the species mentioned above. Controlled burns may also be used to kill smaller stems or reduce re-sprouts of those already cut (see Recommendation 3). While the hack-and-squirt method will prevent the less-desired stems from re-sprouting through chemical means, the cut-and-leave method, if

followed by a controlled burn 1-3 years after completion, could achieve similar results. These treatments should be carried out in locations where oak and hickory seedlings and small saplings are already present but overshadowed by the species to be cut. Such treatments should be conducted before or 2-4 years after a burn and ideally 5-10 years before a harvest. This will increase the regenerative success of oak and hickory as they will be able to establish in the years after a burn (if not already present) and further solidify their presence in the stand.

Specific to Stand 2.3: In addition to the improvement of light conditions, midstory removal techniques (mostly the cut-and-leave treatment for this application), when applied to the thick mountain laurel and rhododendron shrub layer, could also be used for the purpose of fuel reduction as a pre-treatment before a controlled burn. As the shrub layer has been allowed to grow through the decades of fire suppression, it would be beneficial to reduce especially ladder fuels in some areas before a burn or as a preventative to uncontrolled wildfire.

Recommendation 5: ***Harvest*** *[Required for PUV]* To benefit the overall health and resilience of the forest, wildlife, and more valuable timber resources, shelterwood, crown thinning, Femelschlag, and group selection (0.25 to 2 acres) harvests should be conducted between 2040 and 2050. This would create small canopy gaps promoting early successional habitat and the regeneration of oak species. Oak regeneration would be most successful if any of the harvest types are combined with controlled burning (see Recommendation 3) to reduce competition from shade-tolerant species within the establishing advanced regeneration.

Commercial harvests should be conducted in accessible parts of the stand when adjacent stands are being harvested. During harvests, a variety of healthy oak species and hickory should be left while predominantly removing red maple and yellow-poplar combined with some harvest of the oak and hickory basal area. The residual BA for shelterwood harvests should be between 40 and 60 square feet per acre. A prerequisite for this recommendation is to control invasive species as described in Recommendation 1, though it could occur earlier than suggested in this recommendation IF non-native invasive species are controlled at a faster pace than required.

Stand 2.1 will likely not be ready for a harvest at the above specified time, but the stand's merchantability and potential for a harvest to be ecologically beneficial should be re-evaluated at each consecutive Forest Stewardship Plan.

Recommendation 6: ***Post-Harvest FSI*** *[Recommended +]* Conduct Forest Stand Improvement work 5-15 years after the harvest favoring species diversity but especially oak (particularly white and northern red, black, and post oak), hickory, and yellow pines by the removal of competing red maple, yellow-poplar, black gum, white pine, and Virginia pine. This work increases the species diversity and richness across the forest type by reducing the less-desired competition from ecologically and economically more-desired species. While oak, hickory, and yellow pines should be focused on in these actions, other species of high ecological value may also be favored. Similar outcomes may be achieved by conducting controlled burns with the right conditions (as mentioned in Recommendation 3).

As part of this improvement work, also control invasive plant species that may have come up as part of harvesting operations.

Forest Type 3: Rich Cove Forest (1 acre)

Photo 7: Notice the abundance of spicebush in the shrub layer and the presence of Oriental bittersweet on it and advanced regeneration.

Description of Typical Forest Type: Rich Cove Forest generally occurs on mesic sites of low to moderate elevations with more productive soils. Naturally occurring Rich Cove Forests have the highest diversity of tree species of any forest type and include species such as yellow-poplar, sweet birch, ash, red maple, and scattered hickory, black walnut, magnolia, cucumber magnolia, basswood, and buckeye. While this is mostly true for naturally occurring forests of this type, yellow-poplar dominates stands on such productive soils when these forests have been clear-cut. Rich Cove Forests characteristically also have an understory herbaceous layer that is very diverse. The presence of black cohosh in the herbaceous layer and spicebush in the shrub layer are good indicators of this forest type.

Forest Type on the Property: On this property, Rich Cove Forests occur on the very gently sloped area north and south of the house where the soils are moister than in other sections of the forest. Portions of this forest type (at least Stand 3.2) were likely more open or pastured as can be seen from some remnant wolf trees that have open crowns from once being open growing.

Table 7: Stand Acreages

Stand 3.1	0.75 acres
Stand 3.2	0.25 acres

Composition & Resources: The overstory is dominated by yellow-poplar. Other species include scattered black walnut, black locust, and white oak, white pine, Virginia pine, elm, black cherry, and chestnut oak. The midstory is composed of red maple, yellow-poplar, hickory, and American beech. The shrub layer is dominated by spicebush but also hawthorn, American holly, Japanese spirea, Oriental bittersweet, wineberry, and scatted multiflora rose. Advanced regeneration is sparse but where present made up of ash, black cherry, sassafras, and a few scattered others.

About one-quarter of the average basal area of 150 square feet per acre is composed of yellow-poplar with merchantable diameters between 14 and 24 inches at breast height. Smaller diameter classes have a larger basal area per acre and are similarly dominated by yellow-poplar though some other species are present there as well. The current overstory, though dominated by yellow-poplar, is not yet stocked with enough volume to justify the removal of merchantable logs. As yellow-poplars on average grow at about 2.5" in diameter per decade, it will take around 10-20 years for enough of the trees to reach an appropriate size. Also, due to the small size of these stands, a harvest should wait until adjacent stands are being harvested.

There is a threat of non-native invasive species on both of these stands, mostly due to the presence of Oriental bittersweet but also due to the Japanese spirea, wineberry, and multiflora rose. Periwinkle and the Japanese knotweed are also approaching from the border with the Non-forest Area 4.

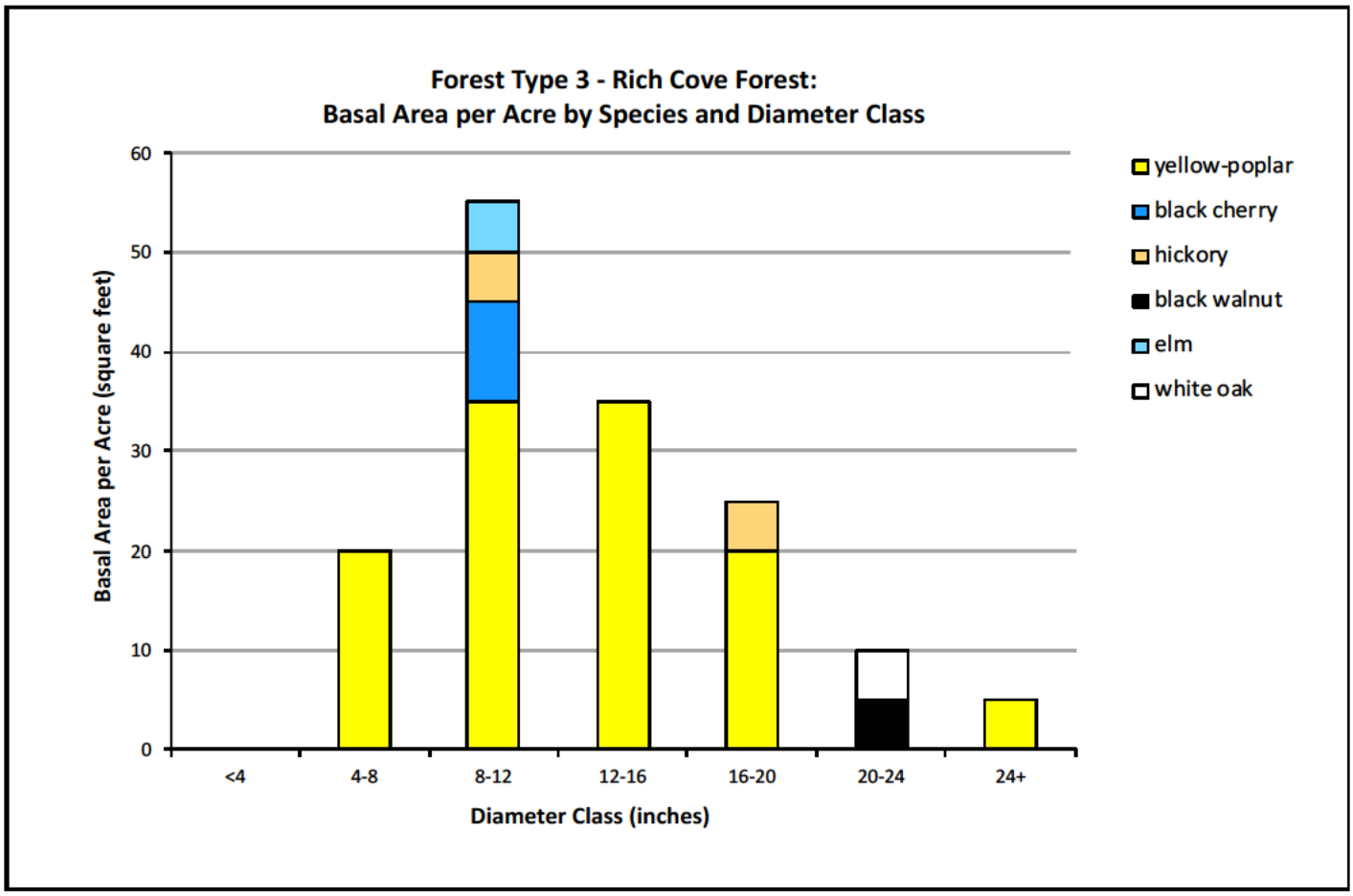


Figure 4: About one-quarter of the average basal area of 150 square feet per acre is composed of yellow-poplar with merchantable diameters between 14 and generally 20 inches at breast height.

Succession & Ecology: These stands are currently succeeding from the Stem Exclusion Phase to the Understory Re-initiation Phase of forest succession. The trees will continue to grow, forcing some individuals out of the canopy through competition. In several decades, some of the largest of the trees will begin to decline in place or by falling which creates small canopy gaps. Light will then reach the advanced regeneration in the understory and midstory allowing them to advance towards the overstory. The partial light conditions will promote shade-intermediate and shade-tolerant trees which, unlike yellow-poplar, can compete well in such conditions. This process, in turn, will create another age class and therewith species and structural diversity.

However, this process will only fuel the continued establishment of the non-native invasive species already present if those are not controlled. The threat of non-native invasive species is real in both of these stands, posing a significant risk to the future health and resilience of the forest. See Section 2.3 and the Invasive Species Severity Map in Appendix A for details. If left to fend on its own, this natural ecological process could affectively halt the natural process of forest regeneration, leaving the forest in an unhealthy state with a transition towards a dominance of invasive shrubs and vines.

Management Recommendations:

The goal for this forest type is to increase/maintain the species diversity and let the herbaceous herb layer, common to these forests, re-establish.

Because yellow-poplar thrives in high-light conditions created by timber harvests (or post pasture conditions), this forest type is dominated by yellow-poplar when it should have higher components of oaks and other typical species. Management actions that create medium light conditions and mimic natural disturbance regimes that allow for oak, basswood, elm, black walnut, and others to compete better would be appropriate. The removal of non-native invasive species will free up advanced regeneration for continued growth and will allow the herb layer to bounce back.

Recommendation 1: ***Invasive Control*** *[Required for PUV]* Treat all seed-producing plants along with Oriental bittersweet, multiflora rose, and Japanese spirea on the property within a period of 5 years between 2020 and 2025 to control these species down to the mild to occasional level. The following 10 years are then required to be used for follow-up treatments and monitoring to ensure as few invasive species present as possible. At the beginning of these 10 years, the lower priority species (Periwinkle, Japanese knotweed, and Wineberry) should also be controlled. Additional monitoring and follow up treatments should be conducted every few years and especially before any planned disturbance. Before a future harvest, non-native invasive species should only be present at the occasional level (species dependent).

Recommendation 2: ***Harvest*** *[Required for PUV]* The stands could benefit from the diversification of the forest structure and the release of ecologically as well as economically more valuable species and their regeneration. In accessible portions of the stand, we recommend crown thinning, group selection (0.25-2 acres), and Femelschlag harvests favoring black walnut, elm, and northern red oak among others along with vital and well-formed yellow-poplar. Poorly formed, less vigorous, and less vital yellow-poplar should be targeted for removal. A combination of these practices would increase both species and structural

diversity by mimicking natural disturbance regimes of gap-phase dynamics. Harvests should be completed between 2040 and 2050 in accessible parts of the stands when adjacent stands are being harvested.

A prerequisite for this recommendation is to control invasive species property-wide for the next 10 years.

Recommendation 3: ***Post-Harvest FSI*** *[Recommended +]* Conduct Forest Stand Improvement work 5-15 years after the harvest favoring species diversity but especially black walnut, northern red oak, elm, white oak, and black cherry by the removal of competing yellow-poplar, red maple, and others. This work increases the species diversity and richness across these stands by reducing the less-desired competition for ecologically and economically desired species. While the above-listed species should be focused on in these actions, other species of high ecological value may also be favored.

As part of this improvement work, also control invasive plant species that may have come up as part of harvesting operations.

Recommendation 4: ***Ash Treatment*** *[Optional]* The emerald ash borer (EAB) has already killed many ash trees in western North Carolina, yet it was difficult to assess signs of EAB on the ash trees on this property due to the seasonality of the cruise. Some of the ash trees could be treated to protect against EAB before they show signs of decline to preserve this species on the property if desired. Early treatment of these trees is key because once damage to the tree has been observed, it may already be too late for treatment. See the section on Non-Native Invasive Insects in Section 2.4 of this plan or Appendix C for details on EAB and its treatment.

Non-Forest (1 acre)

While some portion of this area is developed with structures, landscaping, and pasture, some portion (including the powerline right-of-way) yet remains cleared. We have the following optional recommendations:

Recommendation 1: ***Woody Edge Habitat Improvement*** *[Optional⁺]* The field-to-forest ecotone could be feathered by promoting/planting low growing and increasingly taller growing shrubs along the edge to ease the transition of field-to-forest which would provide different habitats for various species of wildlife and limit the direct infiltration of light into the forest interior (in turn decreasing the establishment of non-native invasive plant species along the forest edge).

Recommendation 2: ***Native Grassland Establishment*** *[Optional⁺]* Open grassland habitats can tremendously contribute to increasing the biodiversity of the ecosystem. While this open area already serves as an important refuge for different wildlife when not regularly mowed, by implementing a plan to convert this area to a native warm-season grassland/wildflower meadow with a focus on native flora, various species of insects, birds, and mammals could be attracted increasing the species diversity for this area. Grassland areas are easy to manage once established by mowing regimes from annually to every few years in the off-season (November – March) for the plants to develop seed and persist. The persistence of native grasses and wildflowers could also be improved by occasional controlled burning of the meadow.

This could be achieved in two ways. The mowing schedule could be reduced to once a year or once every few years in the offseason to promote the already established wildflowers and grasses beneficial for wildlife. (2) The already present species composition could be diversified and improved by supplementary seedings or a complete re-establishment of native wildflowers and grasses.

Native Grasses and Wildflowers for Garden & Lawn: For the option to increase wildlife value immediately around your home and lawn while maintaining or increasing its beauty, the following links may be good resources:

PennState Extension: Meadows and Prairies: Wildlife-Friendly Alternatives to Lawn
https://extension.psu.edu/meadows-and-prairies-wildlife-friendly-alternatives-to-lawn

American Society of Landscape Architects: 2015 Annual Meeting Expo Native Meadows and Grasslands: From Vision to Reality
https://www.asla.org/uploadedFiles/CMS/Meetings_and_Events/2015_Annual_Meeting_Handouts/SUN-B06_Native Meadows and Grasslands.pdf

For General Warm-season Grasses and Meadow Establishment:

Roundstone Seed: Six basic Elements for a Successful Native Grass and Forb Establishment
https://roundstoneseed.com/pdf/SixBasicElements%20-%20including%20coastal%20plains.pdf

UT Extension: A Landowner's Guide to Native Warm-Season Grasses in the Mid South
https://extension.tennessee.edu/publications/Documents/PB1746.pdf

Companies that supply native grass and wildflower seed:
https://www.prairiemoon.com/
https://roundstoneseed.com/

4| HELPFUL LINKS

EcoForesters Website
http://www.ecoforesters.org/
Best Management Practices Manual
http://ncforestservice.gov/water_quality/bmp_manual.htm
Guide to NC's Forestry Present Use Valuation (PUV) Property Tax Program
https://content.ces.ncsu.edu/north-carolinas-forestry-present-use-valuation-puv-property-tax-program
USDA NRCS Funding through the Environmental Quality Incentive Program (EQIP)
https://www.nrcs.usda.gov/wps/portal/nrcs/detail/national/programs/financial/eqip/?cid=nrcseprd1342638
Community Protection Plan
https://www.ncforestservice.gov/fire_control/fc_cpp.htm
Non-Native Invasive Plants of Southern Forests
https://www.srs.fs.usda.gov/pubs/gtr/gtr_srs062/gtr_srs062.pdf
Wildlife and Forest Stewardship
https://content.ces.ncsu.edu/wildlife-and-forest-stewardship
More Wildlife and Forestry Links
https://forestry.ces.ncsu.edu/forestry-wildlife/
FireWise Landscaping
https://content.ces.ncsu.edu/firewise-landscaping-in-north-carolina

5| 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 (BA): 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 (BMPs): 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 Closure: the canopy is considered to be “closed” if the crowns are touching and the forest floor is fully shaded.

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.

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.

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.

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.

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

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

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 Class a definition of tree position within the forest canopy. The basic four tree positions are defined as follows:

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.

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

DBH (diameter at breast height): measured diameter of a tree at 4.5 feet from ground line. 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.

Dominant Tree- A dominant ree is above the general level of the canopy and receives full sun from above and from one or more sides of t

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

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.

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

Femelschlag Harvest: An expanding-group selection harvest for which the edges of a traditional group selection are successional expanded to create a multi-aged forest structure. This silvicultural method was developed in Germany and has shown great promise for fostering oak regeneration.

Forest Stand Improvement (FSI): Also known as Timber Stand Improvement (TSI), includes activities or treatments that improve the composition, structure, condition, health, and growth of forest stands.

Forest 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.

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.

Hack & Squirt / Cut & Leave: A non-commercial forest stand improvement (FSI) method that removes the unwanted trees in the under-, mid-, and overstory. The hack & squirt method uses herbicide to kill the target trees leaving snags and reducing stump sprouts. The cut & leave method reduces the use of herbicide while accomplishing a similar treatment.

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.

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.

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.

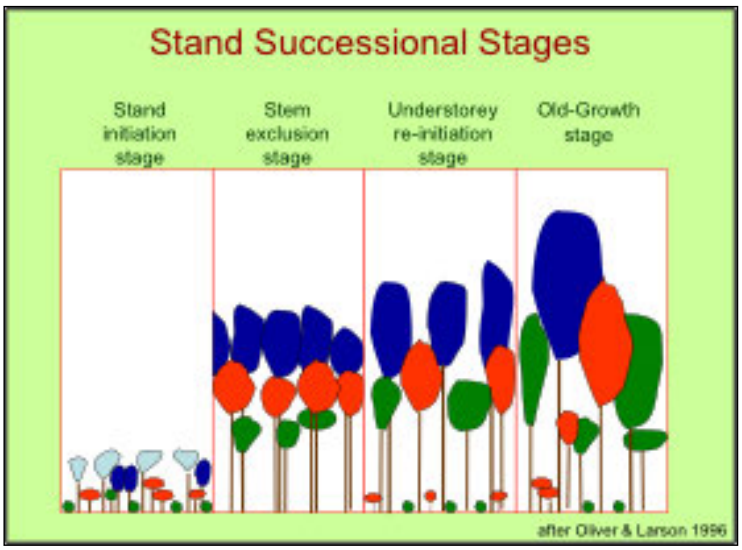
Low Thinning: trees are removed from only the lower crown classes.

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.

Old Growth: this occurs when the process of Understory Re-initiation 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.)



Prescribed Burning: the practice of using regulated fires to reduce or eliminate fuel or 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.

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.

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).

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.

Snag: a standing dead or dying tree.

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.

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 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.

Stem Injection: a method of injecting herbicide directly into the cambium layer of a tree to induce mortality. This method ensures 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:

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.

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

Understory Re-initiation: 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.

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.

Yellow Pines: refers to a group of several pine species that are native to the southeastern United States. In terms of this plan these include shortleaf pine (*Pinus echinate*), pitch pine (*Pinus rigida*) and table mountain pine (*Pinus pungens*). This group does not include white pine (*Pinus strobus*).