RAGGED MOUNTAIN NATURAL AREA 2016 ECOSYSTEM SURVEY

Ragged Mountain Natural Area
Ecosystem Survey

1770 Reservoir Road, Charlottesville, Virginia 22903
Albemarle County Parcel ID 7500-00-00-00100

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A Production of Center for Urban Habitats.
June 1, 2016

Figure 1: *Indian cucumber root finds its home among a lush canopy of marginal wood fern, New York fern, and glade fern in a rich ravine.*

Photograph Credits
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Cover Art
Illustration by Louis Agassiz Fuertes of a Wood Thrush *(Hylocichla mustelina)* and an Ovenbird *(Seiurus aurocapillus)* from a book titled, *"The Burgess Bird Book for Children",* by Thornton W. Burgess.
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Disclaimer
The information provided in this research report is intended to be used as a reference, for planning purposes, for the City of Charlottesville. This baseline ecosystem assessment may be used for land use planning, trail planning, interpretive design plans, conservation planning, habitat-modeled plant designs, education outreach development and serves as a baseline measure of biodiversity at Ragged Mountain Natural Area.

Citations
This report may be cited as follows:
Floyd, Devin. 2016 *Ragged Mountain Natural Area Ecosystem Survey.* Charlottesville, Virginia. Center for Urban Habitats, Survey Department. Published for public use and occasional other use, with permission. 140 pages.

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Acknowledgments

As with all endeavors that involve the study of a complex situation, specialists are needed. Center for Urban Habitats would like to thank its large crew of volunteers, some of which are staff that wished to give time to the project. Many wish to remain anonymous, and thus most will not be mentioned here by name.

Figure 2: *Rachel, CUH project manager, assessing a large rock outcrop for its flora variety.*

I gratefully acknowledge my best friend and Fiancée, Rachel Terese, for her steadfast support during this endeavor. She was willing to go above and beyond that which was required to accomplish a survey with enormous goals and tight time restrictions, including the volunteer accomplishment of weekend survey efforts. Aside from the skills she provided as a naturalist and field tech, the project benefited from her levity and wisdom when things were stressful and challenging.

I thank good friend and colleague, Lonnie Murray, for continuous spirited counsel pertaining to the Natural Resources of the Ragged Mountains. Periodic conversations helped inform my planning, methodology, and the accomplishment of this report. Lonnie also spearheaded a BioBlitz at RMNA in 2015. The data from that effort informed the development of field methodology for this ecosystem survey.

I owe thanks to Drew Chaney, Jessica Schaner, and Owen Luebke for their hard work during volunteer efforts to gather and enter data. Drew and Jessica made side excursions, in addition to regular ecosystem survey efforts, to investigate specific species and habitat variation, and Owen assisted with field work and data entry. Their plant identification skills, abilities to see landscape scale patterns, attention paid to detail, willingness to delve into tedium, and their scientific ethic were valuable additions to the Ecosystem Team's work.

Figure 3: *The Plant Team on an early season expedition.*

I owe much gratitude to a loosely organized group of individuals that wish to remain anonymous. They are known locally as "The Plant Team", and their tireless and impassioned efforts greatly enrich the growing body of knowledge pertaining to natural systems in the Piedmont of Virginia. The group consists of botanists, naturalists, a botanical artist, an historian, and others with the unique expertise necessary for a cohesive and effective Flora assessment team. They performed tedious and thorough plant documentation in nearly all portions of RMNA and their data contributed greatly to the shaping of our survey methodology, plant community classifications, and our understanding of plant distribution across the landscape.

Figure 4: *Owen and Emily Luebke taking a quick break during survey.*

I am grateful to the steady work of the Bird and Dragonfly - Damselfly Team. Jim Childress and Emily Luebke were able to successfully synthesize all historic data (and current observations) to produce the list of birds in this report. This was made possible in part due to existing data created by local experts and a robust community of birders that regularly contribute data to public databases such as eBird (managed by the Cornell Lab of Ornithology). Emily produced dozens of high quality wildlife photographs during the project, a few of which are in this report. They are most fully enjoyed, however, in the on line gallery that is being planned to accompany this report.

I appreciate the efforts of Nancy Weiss and Terri Keffert during the latter portion of the survey. They dedicated a couple of outings to documenting butterfly species. Despite the cool and wet spring that shed very little sun, 14 species we still confirmed. I have no doubt that Nancy, Terri and others will more than double the butterfly list in the coming year.

I am forever grateful to Tom Dierauf, Chip Morgan, Mo Stevens, Dan Bieker, Tim Williams, Ruth Douglas, and David Hirschman for their inspiration and occasional personal counsel. Their intellectual and material contributions have greatly advanced the popular and scientific understanding of local and regional natural history.

I would also like to thank Gary Fleming, a vegetation ecologist with the Natural Heritage Division of the Department of Conservation and Recreation, for sharing the data they have for two areas at RMNA. The DCR's approach to assessing and classifying plant communities also helped to guide the methodology of the survey covered in this report.

I offer a huge thanks to Chris Gensic, park and trail planner for the City of Charlottesville, for his patience, leadership, and support during the process of assessing the vast and varied landscape of RMNA.

Lastly, we all owe a big thanks to the City of Charlottesville for commissioning this work to better understand the natural resources of the Ragged Mountains.

Introduction

Figure 5: *Wood frog, (Lithobates sylvaticus)*

At this point in time, as humans are exploring new ways to live in harmony with their natural environments, we are challenged to rethink and redefine the ways we interact with our landscapes. It has become clear that a balance must be achieved between conserving resources and using them, in order to ensure not only the well-being of our species, but of the countless others that occupy the landscapes we reside upon. It is becoming clearer, as noted recently by E. O. Wilson, that the long term health of our planet's systems probably requires that we set aside great amounts of space that can simply be left alone; that is, no humans allowed. We are indeed an interesting animal, one that has found a million ways to justify using or having access to everything, in one way or another. Achieving a balance between conserving and using is thus a complicated and controversial issue. This balance presents challenges that are particularly potent when landscapes intersect urban areas. We have a dichotomous scenario in which we have the heightened need to provide meaningful access to natural spaces for tens of thousands of city-bound people. Their very health is dependent upon it, and yet that access has the potential to eliminate the natural state of those spaces. It's a pattern in human history, maybe most readily seen in the fact that our east coast shoreline ecosystems have been "loved to death" by millions of beach-goers.

So how does one "use" a natural space without impacting it so much that it loses the very integrity that inspired the use? This is the question that faces us now as we ponder the future of The Ragged Mountains, one of the region's most interesting landscapes.

Without directly addressing that question *(it is not the objective of this report)*, I can say that it is that very question that sparked this Ecosystem Survey and Report. Everyone seems to agree that if one is to make wise decisions pertaining to how to manage, use, or conserve a piece of land, one must first have a basic understanding of the place. With this recognition, Center for Urban Habitats was charged with the task of conducting a baseline assessment of the Ecosystems at Ragged Mountain Natural Area (RMNA). This report summarizes the findings of that effort.

Work Began in early November, 2015 and was completed in late May of 2016. This survey effort augments the findings of other efforts (including a Bioblitz conducted during the summer of 2015) and involved dozens of volunteers. Our work generated new discoveries, but perhaps of equal importance, it provides contextual information for prior findings. This report synthesizes all observations in a way that provides context for each species within a real and varied landscape. Each species is ultimately tied to landscape characteristics, both locally and regionally, and it is the plant community, or ecosystem, that offers the connection between those regional patterns and local distributions. It is the ecosystem that sustains the individual species. Therefore, without an ecosystem-based understanding of plants and animals it's impossible to generate a meaningful approach to conserving those species.

The approach, despite its benefits, does come with challenges. One of those is the need to assess multiple components of the living landscape in order to better understand the systems. To accomplish this, the survey utilized the efforts of several specialized crews, including a volunteer team of prolific botanists (known locally as the "plant team"), a team of paid staff and a volunteer

network focused on birds, a volunteer team dedicated to identifying dragonflies and damselflies, a team focused on butterflies, and a public education program dedicated to getting people involved in documenting exceptionally large trees (Amazing Trees of RMNA). While various teams focused on gathering detail, the ecosystem team focused on conducting natural plant community classification surveys. With this two-pronged approach, we end up with a significant amount of detail without losing landscape-scale contextual information. In this way we were able to identify not only species that may need to be protected, but also the system that sustains them. In most cases, it is the system that must be conserved in order to accomplish species level protection.

But a Glimpse

Though this survey has provided a baseline measure of plant communities and biota at RMNA, time and funding limitations prevented a thorough investigation. Any assessment of biodiversity and natural systems on a landscape of this size would take an organized effort that extends through all seasons of the year, over a period of at least three years. With a November 1, 2015 beginning date and a June 1, 2016 due date for this survey, the dormant season dominates the survey window.

While landscape scale patterns such as ecosystem types may be quantified, the variety and density of life forms within them cannot be fully assessed. Certain species only emerge at certain times of the year. For this reason, rare or sensitive species that should be considered for conservation planning may remain hidden. However, plant community classification does provide us with some estimate for rare species probability. With that in hand we may proceed cautiously and wisely, as many things remain hidden and undiscovered.

Survey Goals

In the wake of the most recent RMNA reservoir expansion, and the transfer of property management and maintenance from the Ivy Creek Foundation to the City of Charlottesville, public access and trail design and use policies are being reconsidered. The City of Charlottesville will be formulating plans about how best to manage and interpret the bounty of natural and cultural resources on the land. Before that can happen the City aims to know what the quality and quantity of those resources are, and how they relate to other ecosystems in the region. To that end, they have asked Center for Urban Habitats to coordinate and execute the Ecosystem Survey that is the subject of this report. The primary goals of the survey were:

1. **Identify, classify and delineate all unique ecosystem types on the property**
2. **Create a species list that details findings within each ecosystem type**
3. **Generate an ecosystem map and a report of findings**

Methodology

Figure 6: *Norah and Eva collecting data on a gigantic chestnut oak on the west slopes of Round Top Mountain.*

The Relevé

The *Relevé* sample method is one of many ways to classify Native Plant Communities. The procedure was developed by plant ecologist, Josias Braun-Blanquet, in the early part of the 20th century, and continues to this day to be one of the more comprehensive approaches recognized in the field. The *Relevé* method is widely employed in the United States by natural heritage programs, as it results in an exhaustive description of a given unique ecological community. It relies upon intense data collection, within a plot of sufficient size, to accurately represent the community being classified. During a *Relevé, w*ithin a landscape being studied, each unique habitat or plant community receives its own plot.

The *Relevé* approach focuses on the habitat's vegetation content and structure, as well as a number of physical factors such as geology, topography, soil drainage, and soil chemistry. The approach operates under the premise that all layers of the forest, from the upper canopy to the forest floor, contribute to describing the plant communities' relationships to the land and to one another. Certain species of flora have unique growing requirements, and thus they serve as "indicator species" for hypothesizing about plant community types. When several of these occur together, the classification confidence level increases. For this reason, indicator species are important for classification and for naming the plant communities. They are among the primary influencing factors when determining where and how many plots should be executed on a given tract of land.

Influenced greatly by the Virginia Natural Heritage Division's natural plant community classification methodology, Center for Urban Habitats has created an adapted form of the *Relevé* for its ecosystem surveys that meets the budget, scope, and goals of this project. We employ *Relevé* methodology for the following reasons:

- We feel that a *Relevé* procedure is the most practical, holistic, and multidisciplinary framework for quantifying a given plant community on the Virginia landscape.

- *Relevé* methodology may be employed on a variety of scales, and with different resolutions, making it ideal for accommodating the various, sometimes differing, needs of projects.
- It covers all important factors that determine where a plant grows and why.
- It allows one to compare across an existing hierarchical classification scheme to see larger landscape patterns and variations.
- It allows us to align our species cover-class data with already classified and named plant communities in order to devise names for those we observe.
- The detailed information that results creates a database that informs Center for Urban Habitat's ecosystem-modeled landscape designs.
- Finally, it allows us to adopt many of the metrics currently used by individuals and institutions in the field of population ecology. In this way our data may be useful beyond the confines of this individual project.

In addition to the intensive plant assessment of the *Relevé*, CUH adds fauna by enlisting specialized teams that visit the site at advantageous times. This approach provides a more complete illustration of the ecosystem and all of its living parts, and occasionally produces animal species that are indicators for ecosystem health and quality. Animals are on the move, and thus they also provide information about relationships between systems across the landscape.

Figure 7: *"Plant Man" Drew filling out a cover class data sheet in an Ash-Hickory Woodland.*

Implementation

Center for Urban Habitats (CUH) conducted several preliminary site visits as an essential first step for beginning survey. CUH performed these preliminary walk-throughs in order to ensure that the majority of the landscape would be seen and taken into consideration during survey. With an objective of identifying and classifying all ecosystems present it would be important to locate test plots in places that captured the unique characteristics of each plant community. Along the way, and at a swift walking pace, the landscape was assessed for large-scale floristic patterns, indicator species, and physiographic characteristics. Areas containing unusually large trees, rock outcrops, wet ground, and increased faunal activity, were noted.

The terrestrial portion of RMNA wraps around the newly full 170-acre reservoir and therefor the survey area is belt-shaped. This belt is just wide enough to prevent a viewer from clearly seeing across it and in two places the land extends broadly, and at great length, into the reservoir. In order to be certain we could make visual contact with all portions of the survey area, we assumed a reconnaissance method that would takes us near the property perimeter when hiking out, and along the interior close to the water on the hike back. From each transect path, whether being on the inner loop or the outer, we could see the other.

Selecting sites for gathering data was a combined objective-subjective effort, by necessity. A subjective approach to choosing plot locations ensures two important things happen. First, small, yet important, plant communities can easily be missed with random sampling. Visual cues make it easy to recognize these areas. Second, it is important to locate test plots firmly within a specific ecosystem type, away from contact points with other ecosystems and away from significant disturbances (if possible). Preliminary assessment of areas that would be mapped as unique units

was done visually using a combination of general physiographic and vegetative characteristics including changes in slope or aspect, soil drainage regimes, forest cover and unique plant communities and indicator species. During the initial assessment, notes were taken pertaining to "notable" or "indicator" species for specific habitat types. Changes or shifts in general forest composition were noted. All of these aided in the creation of a survey plan and the identification of specific sample plot locations.

With an upland survey area of this size (~466 acres of terrestrial landscape), and with such geographic variety, the potential for variation in ecosystems is high. In an effort to identify all of them, we decided to create a map that would show the potential for plant community variation. Using a 2-foot interval contour map we divided the landscape along six terrain shapes pertaining to aspect (the direction the slope of the land faces). We took this approach in order tease out potential variation in seemingly homogenous portions of the forest. North facing slopes tend to hold a different floristic potential than south-facing slopes, even if not initially apparent. The same can be said about westerly and easterly exposures, as well as flat-topped hills or flat-bottomed ravines. Rock outcrop clusters and areas undergoing early-middle woody succession were separated out and seepages, streamlets, and streams were identified. The result was a map that divided Ragged Mountain Natural Area into 112 niches. Starting with this "splitting" method allowed us to consider all possible variation. We would later lump all of them into 8 unique ecotypes.

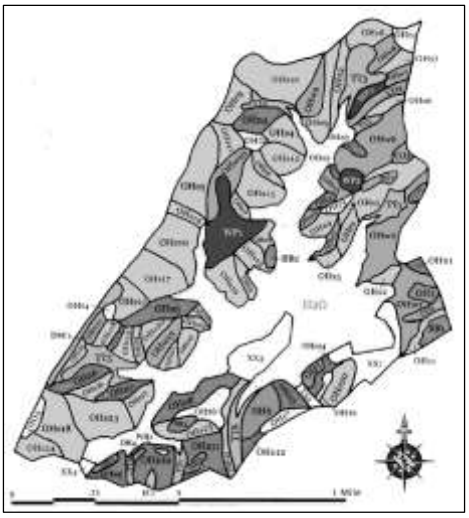


Figure 8: *Aspect-biased field map that aided with plant community variation predictions.*

With the Aspect-biased map in hand, we marched forth with the challenge of locating actual test plots. As new plant communities were encountered, a temporary test plot datum was placed within it. 37 hypothetical datums were placed, each consisting of a trio of pin flags and a label. After all plant communities were recognized, and prior to formal survey, these datums were prioritized and reduced in number to ensure we had the minimum number of test plots that would still allow us to successfully recognize all plant community types at RMNA. After much consideration, we decided 8 new test plots would accomplish the goals of the survey, and a permanent datum was established for each. Data for two additional plots was supplied by the Department of Conservation and Recreation. Gary Fleming, of DCR, accomplished these in 2007. The DCR effort supplied all the information needed to classify the white pine-oak forests at RMNA, and a plot on an east-facing slope in the extensive Basic Oak-Hickory forest provided us with a comparable variant of that ecotype.

RMNA would be surveyed over a period of 6 months, from November 15, 2015 to May 31, 2016. 8 days were identified for survey, allowing for 8-10 hours of work on each day. Each day of survey required on average 19 hours of data entry and research. Special teams of experts, focused on birds, plants, butterflies, dragonflies and damselflies, made additional site visits. New species were added to the lists as they were discovered during proceeding site visits throughout the winter and spring months. Observations are being added even in the last hours of writing this report! Indeed, with subsequent work undertaken throughout multiple seasons, hundreds of species of flora, fauna, and fungi will be added to this baseline measurement.

Because the primary objective of this project was to delineate ecosystem types and boundaries, a 100% woody flora count was executed within test plots representing each hypothesized plant community type. This 100% count, along with topographic features, soil drainage regimes, and herbaceous indicator species, were integral to the process of classifying each ecosystem type.

Prior to counting within the test plots, survey technicians performed an initial visual sweep of each site to assess forest canopy stratification, species variety, and species richness. A strategy was devised to best meet the challenges of quantifying each unique ecosystem. In all plots visual cues were used to employ a segmented approach to counting, particularly in the densest portions of the canopy and in areas of steep slope or abrupt terrain change. In many cases the shrub layer had to be accomplished in small sections, with final numbers being added together to attain shrub layer totals.

All data collected under the 100%-inventory-premise must still be viewed as a snapshot in time. The data collected pertaining to individual species accounts are skewed in favor of those herbaceous plants that were most mature or developed enough to be visually present and identifiable at the time of survey. The observations, coming at only one point during the growing season, did result in a certain number of unidentified species in all survey plots. We estimate that about 60-70% of the flora variety at RMNA was documented during this survey. The species-level determinations were gathered or confirmed using Newcomb's Wildflower Guide (key utilized in the field to accomplish quick Family/Genus level identification hypotheses), the Flora of Virginia (keyed, in the field and lab with photographs, notes and specimens), and the online Atlas of Virginia Flora (utilizing range maps, short descriptors and photographs). Trees and shrubs were surveyed exhaustively. Only one shrub remains unidentified (*Crataegus spp.),* and difficult specimens were identified/verified via key in the Flora of Virginia.

Figure 9: *Rachel preparing clipboards for a day of survey on the south side of Round Top Mountain.*

Animal species were documented in the field when possible. Two CUH field cameras were on site at all times and staff operated under a "capture as you go" policy during the tree-count phases, taking advantage of fleeting moments to document fast moving fauna and unusual flora and fungi. Photographs were used during post-survey analysis to identify animals that could not be identified in the field.

Within each survey plot data collection would take about 4-6 hours. The datum, consisting of a large spike driven through the center of a metal canning jar lid accompanied by a trio of red pin flags, establishes the geometric center of the test plot. The test plots test plot were either a rectangles or a circles, depending on the shape needed to best capture data representative of the ecosystem being assessed. Regardless of the shape, each plot would be ~8,611 sq. ft. in size, in line the Department of Conservation and Recreation's standards for plots.

During the assessment of each plot specific data collection occurred, and the information was recorded on each of three field forms. The first form is the "Ecosystem Classification Data Form" *(See example of form on page*

134) captured general physiographic characteristics, including things like ground cover, slope, aspect, topographic position, soil drainage regime, and evidence of disturbance. This general field form is concluded with a narrative that summarizes those characteristics and conveys the representativeness of the plot when compared to the ecosystem being measured.

The second field form used is a "Cover Class Stratum Form" *(See example of form on page 133)*. One Cover Class Stratum Form is used per vertical layer of the forest. Six potential layers (aligned with the DCR's data collection protocols) are assessed for their species variety, frequency, relative frequency, cover class percentage, and minimum and maximum dbh (diameter at breast height: 4.5' above ground). In order to assign a tree to a specific elevation stratum zone, we estimatee the height of that tree. We employed a digital clinometer and this double tangent formula method to estimate height:

(*Tan* ∠ to tree top *x* distance to tree) + (*Tan* ∠ to tree base *x* distance to tree) = Tree Height

Other information captured on this form includes whether the species is non-native or native, whether a photograph was taken, whether or not the observation was inside or outside the test plot, and whether or not the identification of the species is in question.

The third and final form utilized in the field was a general non-flora species observation form. On this we documented all fungi and fauna that are noted during the survey.

The Study Area:

Regional Context

We live in a temperate part of the world and upon an ancient and complex landscape that offers a great bounty of natural treasures. The Appalachian Mountains have a complex array of powerful and imposing characteristics that shape the culture of Virginia no less than the evolutionary path of the biota that have graced its landscapes. At the root of this phenomenon is the region's geologic past. It influences and shapes all living and nonliving systems that engage its soil and sediment-blanketed surface.

With at least four geologic cycles causing continental plates to crash into what is now Virginia, we are left with linear heaps of remnants that are tilted, overturned, uplifted, and broken, yet organized and translatable. Time, geologic stability, and vegetative growth have softened what would otherwise be a very rugged landscape. Lurking just under that soft verdant blanket we see every day are rocks. These rocks, organized in massive linear strata that trend from southwest to northeast, present powerful selective forces that shape ecological communities through time. Were these strata and the long valleys, ridges, and lines of mountains of Virginia oriented *with* the latitudinal gradient, things would be much simpler from the ecological vantage point. Instead we have complexity that is perfectly reflective of the geographic variety. We have a tapestry of crisscrossing elements that endows the Piedmont, Blue Ridge, and broader Appalachia, with biological variety and density.

To highlight this phenomenon, I offer the following example. The window of opportunity known to farmers and gardeners as the *growing season* narrows as one heads north, upslope, around the slope to a north-facing context. This phenomenon, characterized primarily by the selective forces of light and temperature, creates east-west oriented latitudinal bands of growing season potential that collide with terrain change. The Appalachians run across this east-west gradient, sending each elevation, bedrock type, and soil type through a variety of climatic zones. Because the once-horizontal geologic layers of eastern North America are now resting most frequently on their edge (due to continental plate collisions and tilting), traversing the landscape of Virginia typically means one will encounter a variety of elevations, rock materials, soil types. These different strata have unique characteristics that impact ecosystems. Some are hard and weather-resistant while others are easily carried away by chemical and physical weathering forces. Some have mineral constituents that, once decomposed as part of natural soil building processes, offer a bounty of nutrients so great that biodiversity is higher than average. Others produce nutrient-poor soils and invite only those biota adapted to those harsh conditions. The result is quite complex and interesting, and whether one understands it or not, or sees it, it is ultimately the geologic substrate that elevates the human experience of the wild and varied ecosystems of the Piedmont and Blue Ridge.

All of this variety in geology has created a complex network of Ecoregions upon Virginia's landscape. Within these are ecosystems, habitats, and niches that reflect local variety in climate and physiography. Now is a good time to mention that none of it is static (the geology, the ecosystems). All of it is moving. The edges of one habitat must meet the edges of another, and they push and pull at one another through time. Naturally, this sets the stage for ecological potential and variety in Virginia. The Piedmont is riddled with unique, small and disjunct or relic plant communities (ecosystems separated from others of their kind by some great factor of distance and time). This means that when one looks more closely, when one inquires further, there is always something new to discover. It also means that sometimes, the discovery is significant. In our case, here in the Ragged Mountains, we find a uniquely large, rich, and varied Forest Ecosystem complex.

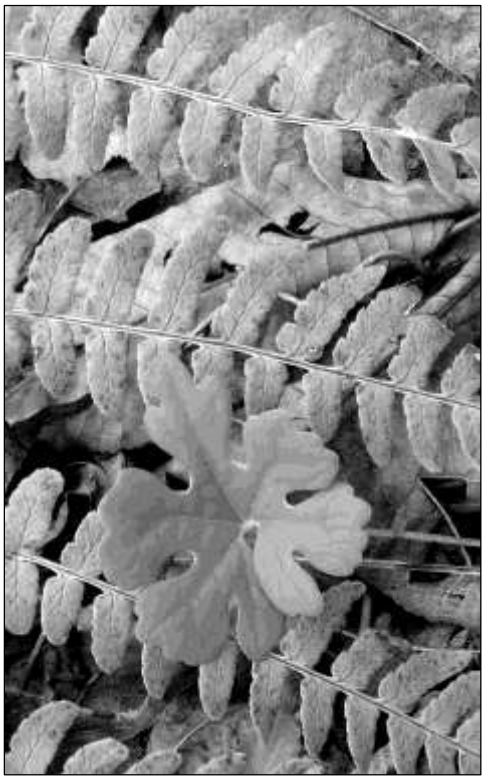


Figure 10*: Bloodroot reaches up between log fern pinnae.*

The Ragged Mountains

With a broad aerial view, Virginia offers a verdant landscape punctuated by lazy mountains and valleys and broad plains reaching to the Atlantic. Most of its rivers are older than the landscape we see, and with time they have worked their magic on an uplifting landscape to give us high areas where rocks are hard, and low areas where they are soft. In the Piedmont we have a phenomenon where, despite the generally low elevations, we find occasional outlier mountains. That is, mountains that are separate from the Blue Ridge to the west, and standing high among the Piedmont landscape around them. These mountain islands in a land of gentle terrain offer sharp contrast to the day-to-day experience for most of us in the Piedmont. The Ragged Mountains, for example, present themselves abruptly whether heading south or west from Charlottesville. Roads such as Route 29 south from Charlottesville, navigate low valleys within them, or as in the case of I-64, they slice right through the heart. In both cases, the navigation creates of sense of passing through a verdant cathedral. Mountains rise on all sides, and they are distinctly forested.

These outlying mountains are indeed "Ragged". They tend to hold rugged terrain, cool sweet air, large forests, whispering streams, and the chatter of birds and frogs. They present a most beautiful scenario for the naturalist, scientist, student and lay person. With the transition from the Piedmont to the Blue Ridge Ecoregion occurring at about 800' elevation, great variety and overlap in ecosystems and species are immediately at hand. In addition to the full array of Piedmont ecosystems and species of plants and animals that we share the landscape with, the Ragged Mountains hold additional species that are more typical of the mountains in the western part of Albemarle County. So inevitably, in these outlying mountains, we have the confluence of high elevation and low elevation systems and an elevated biological richness.

The Ragged Mountains, an area noted as being one of Albemarle County's most important biological sites, cover about 30 square miles immediately west and southwest of Charlottesville. They stretch 6.5 miles (north-to-south) from Route 250 west of Charlottesville to Red Hill and reach 4.8 miles (east to west) from Sherwood Farms to the east flank of Taylor's Mountain. The lowest point falls near the intersection of Interstate 64 and Route 29 at about 450' elevation. The highest spot is on a peak of Dudley Mountain at about 1,690' elevation.

The Ragged Mountains have a base-rich geologic substrate and a good deal of terrain variation over short distance. They also exist in a fairly good state of preservation due to a very long period of stability following 19th subsistence farming (with some notable exceptions of logging and thinning). Under the cloak of this relative stability, plant communities have managed to rejuvenate in a multitude of ways, each occupying the various unique niches available. Current research conducted by the Albemarle County Natural Heritage Committee, as well as the findings that are the subject of this report, are giving us a new perspective of the Biodiversity of the Ragged Mountains. The more inquiry that occurs, the more one realizes the unique nature of these mountains. Globally-rare

flatrock barrens, clean-water seepages and rocky branches, base-rich outcrop woodlands, extensive heaths, and rich basic-mesic ravines combine to create a singular Biome that may be unmatched in all of the Piedmont of Central Virginia.

The "Natural" Area

Figure 11: *Facing East and standing on what's left of a hill that was removed to generate sediment for dam construction, Rachel sizes up the landscape with a 360 degree view of RMNA. In the lower right, round Top Mountain (920' elevation), rises gently from the land to give us 5 unique ecosystem types.*

At the north end of the Ragged Mountains we find *Ragged Mountain Natural Area (RMNA)*. It is divided into North and South portions by Interstate 64. The part of RMNA that is north of I-64 is the subject of this report.

RMNA is about 915 acres in size. The area south of I-64 is about 277 acres. North of I-64, our subject area is divided between water surface and land. Water now covers ~170 acres, leaving ~466 acres of landscape, for a total ~636 acres. The physiography of the 466 acres at RMNA is generally hilly/mountainous. The land wraps all the way around the reservoir, and navigating that land means one will dip in and out of a series of hollows and ridges. The highest location is atop Round Top Mountain at around 920'. The lowest area at RMNA is only ¼ mile southwest at 560' (below the new dam). The subject area may be described as being a large bowl, with an entire watershed being contained by the land and a single exit for the water at the southeast corner. A ridgeline extends north from Round Top Mountain and reaches around the west side of RMNA with elevations ranging from 720'-900'. The ridge line rises and falls in a gentle manner as one circumnavigates the reservoir, reaching 904' elevation in the far southwest corner before dropping to Interstate 64. The trend continues along the south side of the reservoir, with a notable elevation drop occurring at the place where the primary drainage enters the reservoir in the southwest corner. Continuing around the south side, and headed east, one traverses a series of sharp rises and drops. The highest point along the south side is about 916' elevation. A notable feature at RMNA is the deep cut created by Interstate 64. The greatest terrain deviation caused by the cut for I-64 occurs near the south-central area, with the land dropping 166' over only 250' horizontal feet.

Reaching out from the low ridge that circumnavigates the reservoir at RMNA are numerous smaller ridge lines. Some of them reach over 3,500' from the primary ridgeline out toward the heart of the reservoir. This creates 15 unique coves of water that reach back into small hollows. In many areas,

and most notably in the southwest corner, fresh springs erupt from the ground to create small seepages and streamlets in these hollows. These streams are typically in deep ravines, the deepest of which has steep side walls that drop from about 830' to 700' over a very short distance. These deep ravines create a sheltered and cool mountain-like microclimate that is unusual for this area of the Piedmont and they offer us an extremely rich context for upland species of plants, fungi, nesting birds, and woodland amphibians. In some areas the setting is adequate enough to provide refuge for species that are rare in our region (as in the case of the log fern and glade fern).

Figure 12: Stereum ostrea *(false turkeytail)*

RMNA is at the northern tip of a large forest block that is a cornerstone for biodiversity in the Charlottesville area. Many of the species that we are fortunate enough to experience in the urban spaces of Western and Southern Charlottesville are indeed sustained by a food-web that is connected to this forest block. Aside from being a critical foundation for urban biodiversity, RMNA provides a critical escape for humans. It's a place that maximizes the peace and tranquility we may find in the wilds of an urban area. Within only a few miles of the City of Charlottesville, the residents of Central Virginia find vast and wondrous forests that have long inspired naturalists, poets, educators, and artists. Because of its rugged, yet tranquil countenance and extensive network of walking trails, RMNA is a very popular and important destination for people in the region. In addition to being an ideal place to find peace, RMNA is a place where people may learn more about this little known haven for biological richness. It is an ideal outdoor classroom for studying, researching, and interpreting upland ecosystems in the Piedmont. The City of Charlottesville thus has a unique asset to conserve.

Geology

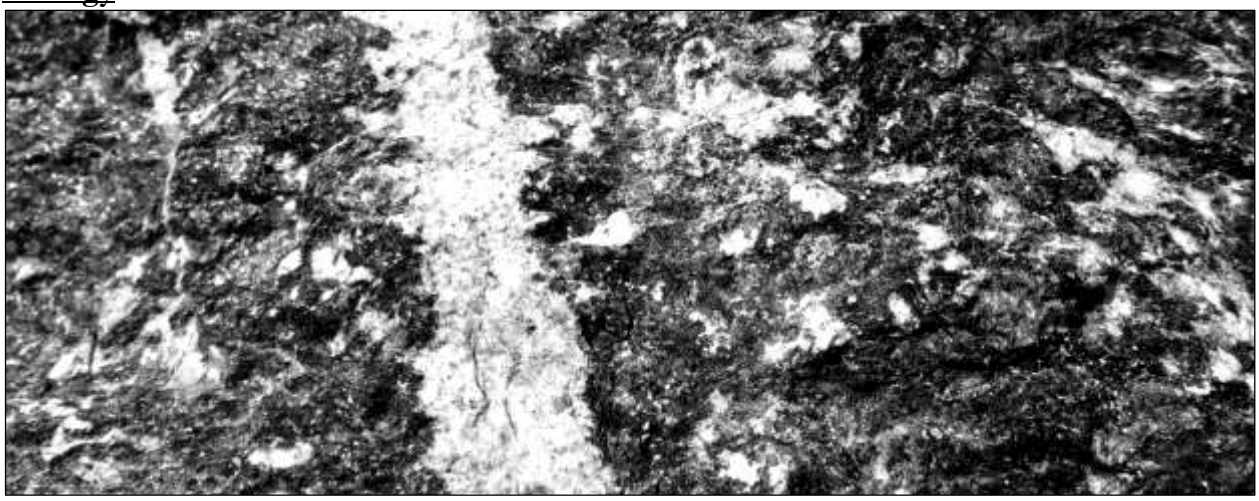


Figure 13: *The dominant rocktype at RMNA, Porphyoblastic Biotite-Plagioclase Augen Gneiss, occurs with great variation. Here we find dark minerals with feldspar and quartz veining and clusters of garnet.*

Formation Description

Trending southwest-to-northeast, in the physiographic region known as the Piedmont Uplands, are hundreds of unique geologic strata. They represent more than 1 billion years and many episodes of continental plate movements, collisions, mountain-building, and subsequent erosion. Upon the complicated landscape and the bedrock substrate known as the Central Blue Ridge Anticlinorium, we find the Ragged Mountains. The rock's origins are from long ago, and have their origins many miles deep within the belly of the ancient Grenville Mountains. About 1 billion years ago massive plutonic swelling and expansion brought magma into the core of this mountain chain. The magma cooled over great expanses of time resulting in the rocks that we find at RMNA. Within them are two distinct formations, the *Two-Mica Granite* and the *Porphyoblastic Biotite-Plagioclase Augen Gneiss*. The *Two-Mica Granite* formation shows evidence of intruding the *Porphyoblastic Biotite-Plagioclase Augen Gneiss*, making it slightly younger. The *Two-Mica Granite* rock type occurs in the very northern end of RMNA, and the *Porphyoblastic Biotite-Plagioclase Augen Gneiss* is the dominant rock type covering the remainder of the land (including all areas of the Ragged Mountains south of I-64) Both of them have experienced significant metamorphism because of the complex geologic history that followed their creation. The boundary between the two is somewhere between the water tower and the north end, and they adjoin one another along a line that trends southwest-to-northeast (similar to most other geologic boundaries associated with Appalachia.

The *Two-Mica Granite* is a coarse-grained granitic-gneiss with two types of mica and two types of feldspar. It typically has fairly large inclusions of biotite and orthopyroxene, making it readily identifiable in the field. Other minerals present include rutile, hornblende, epidote, actinolite, and zircon. The primary rock type is technically classified as orthogneiss. The general mineral makeup of this rock results in both base-rich areas and acidic ridgetops.

The dominant rock type at RMNA is the *Porphyoblastic Biotite-Plagioclase Augen Gneiss*. It is clearly visible in a number of locations, including the road cuts of I-64, the old Quarry area east of the new dam, and upon the newly exposed peninsula that reaches to the center of the reservoir. The augen gneiss is fairly coarse-grained and rich in biotite mica and feldspar. Potassium feldspar is dominant over calcium and sodium feldspars and epidote, apatite, muscovite, ilmenite, and titanite occur throughout. The plagioclase feldspar that is present contains epidote and white mica and in some

areas the minerals hornblende and almandine-grossular garnet occur in great concentrations. Perhaps the easiest place to see the garnet and hornblende are on the north face of the enormous outcrop boulder on the new peninsula (See Figure 13 Above).

Impact of Geology on Soil and Plant Communities

Bedrock plays a dominant and sustaining role in influencing soil chemistry in the Piedmont of Virginia. The bedrock is the stage, if you will, upon which all life unfolds. The soil, sediment, flora and fauna are but a thin and moving blanket draping over a very thick and stable mass. This bedrock not only determines the shape of the land, but it presents minerals during the weathering process. The combined physical and chemical qualities created in part by the bedrock set the stage for what happens upon its surface, including plant community development.

As a result of bedrock, the physical landform characteristics of RMNA differ significantly from those found in the surrounding Piedmont. *Slope* ranges from flat (bottoms of ravines and hilltops) to nearly vertical (rock outcrops in the southwest and southeast corners). The sloping areas face all cardinal directions at RMNA, giving us great variation in *Aspect*. *Elevation* variation is high enough to create an intermingling of Blue Ridge and Piedmont landscape characteristics. *Soils* range from shallow and rocky to deep and rich. The shape of the landforms vary, from convex slopes to concave ravines. Larger patterns influenced by bedrock are visible as well. Segregations of concentrated mafic minerals, erosion-prone feldspars, erosion-resistant quartz veins and other variations in the bedrock create linear landform patterns. A web of stress fractures and dormant faults that are oriented perpendicular to the direction of various continental collisions further exacerbate this phenomenon. As a result there is an overall southwest-to-northeast trend to the ridgelines, ravines, and streamlets. The pattern is visible even in the distribution of ecosystems, and it echoes the greater regional pattern observed in Appalachian landforms.

The high ridges tend to have shallow soils. In these contexts quartz is a prevalent component of the soil. It is more erosion-resistant than the other minerals in the bedrock. While the feldspars and mafic minerals decay and gift their mineral nutrients to the lower slopes and rich-ravines, the quartz remains behind as an ever-present facet of the hilltops. This augments site characteristics that create nutrient-poor, acidic, and well-drained dry soils. Weather-beaten south and south-facing slopes frequently have exposed bedrock and associated talus, offering sharp contrast to the deeper soils of north and east-facing toe slopes.

The chemistry of the soils varies significantly due to the inconstant mineral content of the bedrock. Mafic minerals (typically dark in color) are a dominant facet of the bedrock at RMNA. Epidote, rutile, orthopyroxene, hornblende, and calcium rich feldspars release minerals to developing soils. The two-mica granite, for example, has very high amounts of Potassium, a mineral that is critical for plant growth. In addition to high potassium, the soils have relatively high amounts of calcium, magnesium, iron and other minerals. More important to understand, perhaps, is that the soils of RMNA are what plant ecologists call *Base-rich*. That is, the soil and sediment has moderately high levels of base cations (ions with a net positive charge). The soils have high cation exchange capacity, and the minerals in the soil are thus available for plant uptake. For this reason, the vast majority of the ecosystems at RMNA, and indeed the larger Ragged Mountains, are noted as being "Basic" (Basic Oak-Hickory, Basic-Mesic, Basic-Woodland, or Basic Outcrop Barren).

A few examples of indicator species for base-rich settings include ash, redbud, blackhaw, hackberry, glade fern, hog peanut and richweed. Several dozen calcophile species (plants that prefer calcium-

rich settings) were noted at RMNA. Base-rich soils not only have the indicators species, but also groupings of indicator species. The herbaceous layer can be extremely rich and varied and one will see larger and more robust colonies of plants. The exceptions to "base-rich" circumstance at RMNA exist in small areas of acidic and nutrient poor soils (heath areas and occasional hilltops). For reasons still being investigated, nutrient-poor heaths (dominated by Chestnut Oak, White Pine, and Mountain Laurel) occupy the upper and middle slopes of all areas with a northwest aspect between about 290 and 310 degrees. This may be the result of nutrient leaching, freeze-thaw, and downslope movement only possible within the sheltered contexts of that middle-upper slope and aspect range. This strict plant community-to-aspect correlation seen in the Heath of RMNA would be an interesting topic for research. The indicator species for the heath ecosystems at RMNA include chestnut oak, black gum, mountain laurel, black huckleberry, lowbush blueberry, rattlesnake weed and striped wintergreen.

One of the assets of RMNA is the fact that it contains ecosystems that have classifications across a broad spectrum of nutrient-levels and pH. While most landscapes in the Piedmont are dominated by one end of the spectrum or the other, due to its size and physiographic variation RMNA offers variation ranging from the extreme conditions of the Heath, through the moderate conditions of the Acidic Oak-Hickory systems, and into the Base-rich spectrum. On one end we have extremely acidic conditions, dry and shallow soils, low nutrient levels, and heavy metals. On the other end we have basic-mesic soils, high nutrient levels, and minerals conducive for rich and varied plant assemblages.

Below are soil data collected by the Department of Conservation and Recreation at two test plots at RMNA. They represent the full spectrum of nutrient levels that exist in the soils of RMNA. Note the preponderance of heavy metals, and reduction in calcium and base saturation, in the White Pine-Oak Heath (RMNA-DCR-10). The effect is also evident in the unique assemblage of plants seen in that ecosystem type, and in the dramatically lower species diversity and density (particularly in the herbaceous layer).

	RMNA-DCR-09 (ALBE-008)	**RMNA-DCR-10 (ALBE-009)**
Plant Community Type	*Basic Oak-Hickory forest*	*White Pine - Oak forest (Heath)*
pH (NRCS Classification)	*5.6 (moderately acidic)*	*4.9 (very strongly acidic)*
Cation Exchange Capacity (meq/100g)	*9.71*	***10.28***
Base Saturation (%)	***45.11***	*12.61*
Calcium (ppm)	***611***	*130*
Magnesium (ppm)	*36*	***43***
Calcium:Magnesium Ratio	***6.8***	*3*
Potassium (ppm)	***187***	*84*
Easily Extractable Phosphorous (ppm)	***53***	*8*
Organic Matter (%)	*6.55*	***7.41***

Est. Nitrogen release (lb/acre)	*108*	***112***
Soluble Sulphur (ppm)	*21*	***28***
Sodium (ppm)	***23***	*17*
Iron (ppm)	***138***	*135*
Copper (ppm)	***0.76***	*0.48*
Zinc (ppm)	*1.76*	***1.82***
Alluminum (ppm)	*845*	***927***

The net impact of this soil variation at RMNA is species and plant community variation. Because of the variety we have at least 8 different plant communities at hand, each with unique mixes of flora and specific animal associations. Though it is typical hidden, it is this outcome that makes geology such an important facet of landscape interpretation, conservation planning, and education.

Figure 14: *Quartz flake typical of prehistoric artifact scatters noted during survey.*

Quartz, Prehistoric Sites, and a Note about Cultural Resources

Quartz occurs in veins and vugs in the rock formations of RMNA, and due to its erosion-resistant qualities and low specific gravity, it remains behind as other minerals around it decay to saprolite and soil. As mentioned prior, this is most evident where soils are shallow, such as along ridgetops, on steep slopes, and in areas of erosion. Quartz of varying degree of quality litter the surface in some places. Varieties include clear quartz, milky quartz, and lesser amounts of blue and gray quartz.

One of the fascinating qualities of quartz is that it has what mineralogists, geologists, and archaeologists call *conchoidal fracture*. That is, when struck with another object, the homogenous nature of the atomic matrix within the quartz allows for the even distribution of energy away from the point of contact. This creates a cone of energy that passes through the rock when it is hit. This cone-shaped energy dispersion results in the broken surfaces of quartz being curved. Indeed this results in flakes of quartz that have very thin and sharp edges. Not only can quartz have a sharp edge when it is broken, but it is also a hard mineral, making the sharp edge quite resilient. For these reasons, high-quality quartz was frequently sought after and used by prehistoric peoples in our region.

At RMNA we see prehistoric debitage (flakes and spalls) in nearly every location that has a natural surface scatters of weathered quartz cobbles. Prehistoric peoples were clearly taking advantage of the fact that the quartz was present and easily accessible in the landscape. Most ridgelines and hilltops at RMNA are littered with the artifactual remains of tool-making and resharpening. Surface scatters included flakes, spalls, and cores of all sizes, as well as occasional broken/discarded cutting tools and projectile points. The preferred material seems to have been clear, to mostly-clear, quartz. Some flakes were banded, with alternating stripes of clear and milky quartz (As seen in Figure 15 above).

Of course, all of this was noted only in passing. Projectile points, primarily of Archaic Period age (8000-2000BCE) were noted in several locations. All artifacts noticed were left untouched in the landscape by CUH crew. The same cannot be said for the general public. It is evident that people are

collecting artifacts because we frequently found heaps of less desirable pieces grouped together, or perched atop recently constructed cairns. It is unfortunate, as much can be learned from artifacts in their original context (if investigated by a professional archaeologist). The City of Charlottesville would behoove itself to devise and clearly communicate policy pertaining to the preservation of artifacts and their contexts. The publix should b directly encouraged to leave artificats where they are found. Perhaps a "Leave no Trace" rule can pave the way.

The cultural resources of RMNA are extensive and include both prehistoric and historic sites and artifacts. As with the Ecosystems, Flora, and Fauna, the more we look, the more we find. Formalized research pertaining to cultural resources at RMNA is young, and preservation is critical if future research is to be fruitful. It may be the case that cultural resources are at-risk more so than natural resources for the very fact that when you remove one from the landscape it cannot regenerate. For this reason cultural resource inventory and preservation should be considered top priorities during the planning phases for possible new management and creation/modification of use policies and guidelines.

Preliminary Walk-through Notes, Observations and Hypotheses

Figure 15: *Looking for changes in woody vegetative structure during our preliminary walk-through was critical for identifying proper locations for test plots.*

- ***Day 1. November 7, 2015:***

A day in the field is always preceded by a long period of excited anticipation and obsessive preparation. What could be more enthralling than diving into the unknown with the goal of discovering something? Ha! Nothing! For me and countless others that are enthralled by discovery, this great delving into the unknown is what drives us. It's my compass. It's grounding. It's how I plug in, consciously, to the great eddy of elements that spun off a mammal known as Homo sapiens.

It was with this great anticipation that Rachel and I headed into the forests of Ragged Mountain Natural Area to prepare for survey by approximating ecosystem variety and sizes. Our primary objective was to identify all unique ecosystems and find locations within those to place sample plots.

RMNA wraps around an extensive reservoir and therefor the survey area is best described as being belt-shaped. This belt is just wide enough to prevent a viewer from clearly seeing across it. In order to be certain we could make visual contact with all portions of the survey area, we assumed a method that would takes us near the property perimeter when hiking out, and near the interior water's edge on the hike back.

On our first day in the field we covered the entire east side of RMNA (except for some remote areas on Round Top Mountain). Here are a few of the day's highlights.

- ***Chestnut Oak-Mountain Laurel Heath.*** *We encountered our first example of this plant community type at RMNA. always on northwest facing slopes (at RMNA), the heath is a beautifully simple habitat containing species specially adapted to the dry, acidic, low nutrient and full shade setting. These include chestnut oak, mountain laurel, deerberry, hillside blueberry and striped wintergreen.*
- ***Enormous Trees:*** *The east property lines provide refuge for exceptional specimens of trees, including giant short-leaf pines and towering chestnut, white and red oaks. These trees inspired the creation of our Amazing Trees of RMNA youth program.*
- ***Old Woods:*** *Approximately halfway to the northern tip of RMNA the forest changes in its stature. The trees get bigger, and canopy diversity increases. Some sections*

have many dozens of trees that approach 4 feet in diameter (at chest height). The forest containing this old stature does have a strong tuliptree component in the canopy, likely due to either thinning or American chestnut decline.

- ***White Pine-Oak Heath:*** *A forest type more typical of northern landscapes, we find this one haunting dry microclimate settings on north-to-west facing slopes. Two small patches of this ecosystem type were noted, one of which contains a specimen that is more than 3 feet in diameter. Growing with the white pine are species such as mountain laurel, black oak, chestnut oak, black gum, Christmas fern and slender woodland sedge.*
- ***Pine-Oak Woods:*** *In a southwest facing cove we encountered a bit of an anomaly in the base-rich oak-hickory forest that blankets. Sharing the canopy with large oaks are large-diameter short-leaf pines. This species is known to germinate early in a forest's successional develop and survive well into forest maturity due to its shade-tolerant nature and ability to reach the upper canopy. As a general rule of thumb, a shortleaf pine embedded in an old woods is likely the oldest tree in that woods. With a cluster of them, we have the potential for a unique ecosystem with its own unique assemblage of plants and animals.*
- ***Rich Ravine:*** *Having explored a rich ravine and north-facing slope earlier in the season, we knew in advance we would want to place a sample plot there. Only a small portion of the larger ravine is on RMNA property, but in that corner are at least 8 species of fern. In the gully just to the east is an enormous colony of log fern (a rare plant in the Piedmont). It is critical that we sample the base-rich ravine forests of RMNA, as they contribute significantly to the overall biological richness.*

By the end of the day we had located 7 preliminary sample plots. Exhausted, we packed it in and headed for home to have a look at photographs, maps and notes. The next preliminary walk-through will take us to the south side of RMNA, an area seemingly dominated by north facing basic mesic forests. -D.Floyd

- ***Day 2. November 11, 2015:***

The second day of preliminary walk-through focused on the south side of the reservoir, including the peninsula and all terrain west to the point where the water meets the high embankment for Interstate 64. We passed through multiple steep-sloped forests along the south side, each hill offering a similar pattern of ecosystems. The east sides and ridge tops were healthy dry-mesic oak-hickory forests. The north facing slopes held a bit more moisture and a northerly signature with its preponderance of northern red oak. The northwest slopes were blanketed with mountain laurel, without exception, and the low drainages between these hills had alluvial-species added to the mix, including sycamore, ironwood, and an increase in tuliptree. Leaving the south forest block we crossed the saddle between water and traversed the peninsula landscape. This included an amalgamation of cultural features, north and south facing forests, and a complex of large outcrops and boulders. The east end of the peninsula loop looks like a war zone due to the recent reservoir renovations.
Our primary objective is to identify all unique ecosystems along the south end of the reservoir and find locations within those to place survey plots. In order to be certain we could make visual contact with all portions of the survey area, we maintained the method used during the first walkthrough. On our second day in the field we covered the entire south side of RMNA.

- ***Chestnut Oak Heaths:*** *With a high degree of predictability, we continue to find Chestnut Oak – Mountain Laurel Heaths on northwest facing slopes (between 305-315 degrees), so long as those slopes are relatively steep. Only a few mild exceptions occur, one immediately east of the dam (having a mixed chestnut oak – scarlet oak canopy over mountain laurel) and two in the northern half of RMNA (having white pine-chestnut oak over mountain laurel). Species richness is very low, with only ericaceous species being able to tolerate the dry and rocky slopes and harsh conditions present on northwest aspects. They include colonies of hillside blueberry, black huckleberry, and deerberry.*
- ***Fungi:*** *During our walk, and especially in the Oak-Heath portions of the forest, we happened upon mushrooms on a regular basis. Among those was lion's mane.*
- ***Birds:*** *The first hour was relatively active. We documented yellow-bellied sapsuckers, eastern bluebirds, dark-eyed juncos, and Canada geese.*
- ***Amphibians:*** *Cricket frogs were encountered regularly, particularly in the tuliptree bottoms and slopes leading up from them. The variety in their color patterning was astounding to witness.*
- ***Bryophyte/Lycophyte Clusters:*** *In a small hollow with a trickling streamlet we encountered a dense assemblage of interesting plants. Below the ironwood shrubs were small colonies of shining clubmoss and umbrella liverwort. The slopes east of this streamlet harbor a most interesting assemblage of native woodland sedges.*
- ***Witch-hazel Bluff:*** *Tucked into one north-facing slope is an unusual woodland dominated by an understory of witch-hazel. This steep cove is small, but promises to offer an interesting assemblage of herbaceous plants come spring.*
- ***North Facing Slopes****: The north-facing slopes and the toe-slopes and ravines (when present) below them hold the most promise for the botanist exploring RMNA. With too much complexity for us to engage during these walk-throughs, we continued pace, noting a great deal of fern, graminoid and forb diversity. Of all the ecosystems observed at RMNA, one or two protected north-facing slopes and adjacent ravines will be among the most important from the standpoint of biodiversity conservation.*
- ***Remnant Outcrop Barrens:*** *Along the south slopes of a low ridge large bedrock outcrops breech the surface. Parallel lines of rocky "spines" occupy the slopes below round convex-shaped balds, all under a fairly dense canopy. Several species, including white ash and dwarf hackberry, speak of the unique growing conditions at the site. We hypothesize that this is a "hybrid" plant community that has characteristics of three systems: Basic Outcrop Barrens, Bryophyte Boulders and a base-rich oak-hickory-ash canopy. This combination makes the site an uncommon one. In fact, only two others are noted in the Ragged Mountains north of I-64.*
- ***Old Structure Remnants:*** *Scattered throughout the RMNA forests are the remains of homes, sheds, barns, roads and other ghosts of a long-lost Ragged Mountain Community. On this occasion we encountered a dry-laid stone foundation tucked into the outcrops of a south-facing slope. An old roadbed passes by, making it easier to imagine the historic presence of people on this now-wild landscape. While currently forested, much of the land was clear-cut in the latter part of the 19th century. Deep erosion gullies in the southwest forests of RMNA are direct evidence of past clearcutting.*
- ***Ridge Top Woods:*** *On our walk back we walked hilltops that, on occasions, would flatten out and spread for good distances. The lovely old woods south of the saddle that leads to the peninsula is one such place. The terrain here is unique among RMNA's*

landscapes and we will attempt to quantify any differences that may be seen in the forest as a result of the flat hilltop terrain.

- ***Garnet Rock & Prehistoric Remnants.*** *All that remains of a hill that once stood at the location of the peninsula are artificially tall boulders/outcrops, the top of which is close to the elevation of the pre-existing grade. The land around these is denuded, and the ground is covered with mineral rich soils. Visitors will have the opportunity to witness the dynamics of early forest succession in the coming years. Brownish maroon garnets speckle the boulders and litter the landscape. Scattered among the craggy megalithic meadows are occasional Native American artifacts, having found their new locations following a dramatic reshaping of the land.*

By day's end we had located 7 preliminary sample plots among 24 ecosystem niches! The unpredicted complexity of the RMNA forest is now coming into full view. Balancing the importance of conserving rarities with the importance of providing humans with a deep connection to local biological richness is the challenge that lies ahead. The next preliminary walk-through will take us to the top of Round-Top Mountain and down its south slopes. -D.Floyd

- ***Days 3 and 4. November 15, 17:***

Ecosystem Survey preliminary walk-through came about by needing to just hit the woods. On the evening of November 15, I did so, by myself, with very little light left in the day. Bluebirds greeted me as I entered the late autumn woods on the west slopes of Round Top Mountain. My goal was to identify any unique ecosystems on the top and south slopes of the large hill. The adventure would take me first to the top, and eventually, on a hunch, through the thickets of non-native species to the south. Ultimately I would find myself standing in a unique habitat type, in the dark. Naturally, I would return with Rachel (CUH staff, and naturalist) a couple days later to better assess the situation. This short description summarizes the findings of this two-day jaunt. The effort would result in the placement of two potential test-plots.

- ***Xeric Outcrop Woodlands:*** *Down the west slopes of Round Top Mtn. a xeric to dry-mesic forest assemblage chases a spine of large outcrop boulders of gneiss downslope. Approaching from either the south or the north, one passes through a rich basic oak-hickory forest only to find it quickly reduced to an assemblage that is specially adapted to the bedrock that springs from the ground. Only the species adapted to dry shade lurk here. The basic forest trends suddenly acidic, and the nutrients available to plants drop dramatically. Flora such as upland boneset and chestnut oak are defining characteristics. American senna and rock muhly are present, and the margins are decorated with a diverse array of wildflowers that dare not enter the sub-mesic conditions of the outcrops. The Outcrop Woodlands extend to the hilltop, ending in a Chestnut Oak/Hickory-dominated forest with a ground cover of 40-50% decomposing bedrock. A walking trail cuts across the habitat at least twice, offering the nature enthusiast a great view of a rugged and unique type of piedmont landscape.*
- ***Giants:*** *Large chestnut oak trees lurk in this woods. Some of them are more than 4 feet in diameter and undoubtedly were spared in a late 19th century deforestation. Perhaps they offered shade and mast to pastured swine or sheep. An enormous black gum tree lurks not far from the trail, disguised by its very size. The early successional tuliptree has reclaimed the forest openings on the west and south west slopes of Round Top, offering evidence of clearcutting or thinning. These now race, straight as pencils,*

skyward. They now share the upper canopy with the mighty oaks that were spared. Many of them are enormous, exhibiting the decades that have passed since the pasture was released to natural forest succession. Lastly I will mention a white ash with a diameter of 3 feet, growing on a rock in the south slope barrens mentioned below. It stands alone in its size but shares the sparse upper canopy with other white ash in the barrens.

- ***Remnant Piedmont Mafic Barrens?*** *To ecologists and naturalists, the phrase "mafic barren" ignites the fires of exploration, for this habitat type holds rarities. In fact, when found intact, it is considered to be a globally rare ecosystem that actually only occurs in the Piedmont of Virginia. Extruding from the steep south-facing slopes of Round Top are the possible remnants of a huge mafic barren. I use the word "remnant" because of its current state of impairment. Invasive species blanket the site, particularly Japanese stiltgrass and wineberry. That said, many of the indicator species for this habitat type still remain. They echo healthier times of old. Gnarled and twisted trunks of tiny dwarf hackberry shrubs reach from bedrock cracks. Grimmia dry rock moss is at their feet. Woodsia (cliff-fern) and Corydalis create a strong patchwork of colonies beneath an open canopy of eastern red cedar, white ash, redbud, post oak and devil's walking stick. Interesting grasses and sedges (not identifiable this time of year) are rooted on the rocks and in the organic loam pockets around them. Not yet found, but known from the barrens immediately south, are eastern prickly pear and hairy lipfern. These, as well as fameflower and other rarities, may be present but we will have to wait for the growing season to have the opportunity to find them. For now we will conduct a basic woody flora count. A test plot was placed in the center of this plant community.*

The resounding conclusion from these two outings, and upon reflecting upon the treasures encountered in other parts of the Round Top Forest, is that Round Top Mountain is a unique landform at RMNA having a wide array of unusual, and sometimes rare, Ecosystems. The large hill and its forests are deserving of protection and an equally strong education outreach effort. From the deep north-facing ravine and its rich assemblage of ferns to the basic outcrop barrens that cascade down the south slopes; from the Oak Heath and the rich Basic Oak-Hickory Forest that surrounds it to the Rock-Outcrop Woodlands upon its west slopes, a trip around this little mountain leaves one feeling that there is hope for biodiversity upon our renewing Piedmont landscape.

That said, a history of selective thinning, clear-cutting, pasture use, and more recently, a network of trails across the mountain, have all left the landscape heavily impacted by non-native exotic species. This is particularly the case on the southeast slopes. The rare and unusual plant communities still lurk there, but their heads are barely above water. They are reaching for their final breath. We do have an opportunity to do something about this, however. Time will tell if a unified voice will step forth with a conservation effort at this site. -D.Floyd

Survey Results: Ecosystems of Ragged Mountain Natural Area

Figure 16*: Homalosorus pycnocarpon (glade fern) occurs in giant colonies at RMNA. It is uncommon in the Piedmont because it requires calcium-rich settings… conditions more frequently found on limestone, dolomite, or shell marl substrates.*

All landscapes hold various degrees of potential for biological variety and richness. The nature of the geologic substrate, soils, history of land use, and dozens of various physiographic qualities determine how that plays out. Over periods of time biological systems take root. Given enough time these systems, known as plant communities, ultimately mature to express the full potential of a given landscape's characteristics. The small animals, fungi, and indeed the entire food web, follows suit. A wave of biodiversity growth and diversification runs right up the food chain.

Each of these landscape expressions we call *natural plant communities* is unique, with no two examples being exactly alike. Some are small, and some large. Some are simple, and some complex. Occasionally a landscape presents itself with a certain ability to hold maximum species and ecosystem variation for a given region. The geologic substrate may be rich, but not so rich that it prevents a full spectrum of nutrient-poor and nutrient-rich soils. The landscape may be varied in its elevation, having high-and-dry areas and low-and-wet areas. There may be exposed rock faces, boulders, and talus slopes, or cool and quiet deep-soiled ravines. It is this sort of variation that we see at Ragged Mountain Natural Area. The fact that the upland terrain changes significantly over such a short distance while having a base-rich geologic substrate and soils with a moderately high cation exchange capacity, means that habitat variety is high. Because different species of animals have different habitat requirements, the net result is, inevitably, high diversity potential in the animal assemblage at RMNA.

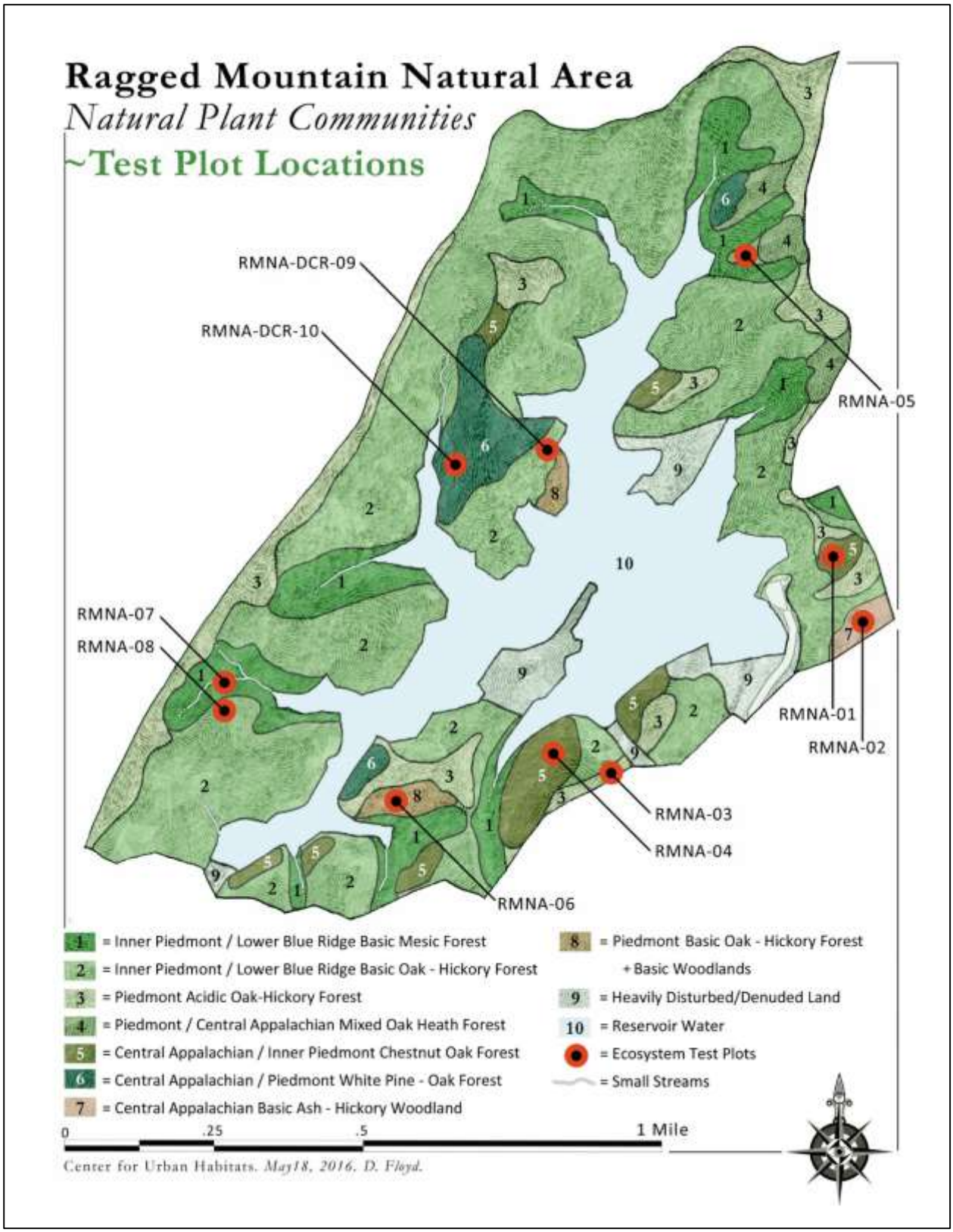
***Figure 17:** RMNA holds exceptional specimens of chestnut oak, northern red oak, eastern white pine, short-leaf pine, black gum, and tuliptree.*

Because of the unique history of the property, we find variation in the ages of the forest, with some areas having a canopy reaching higher than 135' tall with trees having a trunk diameter of more than 4' and approaching 125 years of age. With an old and complex landscape before us, we knew heading into survey that the plant communities would be varied. What we did not expect to see was such great variation, in both the ecosystems and the plant species. RMNA holds some of the most biologically interesting and uncommon deep ravine ecosystems in our region. Species are actively being discovered as this report is being delivered. What is important to understand is that the species that have been noted to date, and their associated ecosystems, indicate that the probability of discovering rare species is very high. Because of the sensitivity of some of the areas, and the rarity of the plant communities within them, land-use and management practices should be sensitively devised.

List of Ecosystems

1. *Rich Ravines:* **Inner Piedmont / Lower Blue Ridge Basic Mesic Forest**
2. *Base-rich side slopes:* **Inner Piedmont / Lower Blue Ridge Basic Oak - Hickory Forest**
3. *Nutrient-poor Hilltops:* **Piedmont Acidic Oak - Hickory Forest**
4. *Oak - Blueberry/Huckleberry Heaths:* **Piedmont / Central Appalachian Mixed Oak / Heath Forest**
5. *Oak - Mountain Laurel Heaths:* **Central Appalachian / Inner Piedmont Chestnut Oak Forest**
6. *White Pine - Mountain Laurel Heaths:* **Central Appalachian / Piedmont White Pine - Oak Forest**
7. *Exposed Outcrop Woodlands:* **Central Appalachian Basic Ash - Hickory Woodland**
8. *Forested Outcrop Woodlands:* **Basic Oak-Hickory + Piedmont Basic Woodland**

Map of Ecosystems



Ecosystem Descriptions

During survey we accomplished test plots (as described in the methodology section beginning on page 10) in each type of ecosystem noted at Ragged Mountain Natural Area. Most of these are comprised of plant communities that are larger than 5 acres. As seen on the map above, the dominant plant community type is Basic Oak-Hickory Forest. Other community types occur in scattered patches ranging from 3-20 acres each. The scope of this project did not permit us to identify and define systems and habitats with finer resolution than that. With that said, the overarching plant community classifications described below provide a thorough baseline framework for further deliations that may result from future inquiries.

In total, 8 unique plant communities were identified at RMNA. This is far greater than what was once assumed to be present. There are several developing plant communities, in the wake of the dam construction. Two worth noting, and studying long-term, are the new long peninsula that extends into the center of the reservoir and a small developing wetland plant community on the truncated base-rich bedrock of the emergency spillway. Furthermore, the entire reservoir margin will be undergoing a vegetative reformulation, as once dry soils are now saturated. To date, no effort has been undertaken to begin assessing these locations, but each affords unique opportunities for study and research pertaining to early successional plant community development.

The plant community descriptions below include combined observations from test plots and from areas outside the test plots that are still part of the ecosystem type. Several community types, such as the basic-mesic forest (rich ravines) and acidic heaths, occur as isolated patches across the landscape. Descriptions for these cover general characteristics that apply to all of them and touch on variation within them.

Due to the rarity, sensitivity, and at-risk nature of some species discovered, they are omitted from this report all-together. Unveiling the locations would pose a significant risk for those species. The location of the species, as well as recommended buffers, long-term management, and poaching prevention may be relayed, in-person, from CUH staff to Charlottesville City Staff.

1. Inner Piedmont / Lower Blue Ridge Basic Mesic Forest *(RMNA-07)*

Figure 18: *Rachel estimates cover class for an extensive colony of Homalosorus pycnocarpon (glade fern) in one of RMNA's rich ravines.*

Representative Community Type: Inner Piedmont / Lower Blue Ridge Basic Mesic Forest
Community Description: *Liriodendron tulipifera / Carya cordiformis - Fraxinus americana – Nyssa sylvatica / Lindera benzoin - Rubus phoenicolasius / Amphicarpaea bracteata - Actaea racemosa - Deparia acrostichoides - Homalosorus pycnocarpon* Forest
USNVC CEGL Code: CEGL006186
Classification Confidence: Moderate
Global/State Conservation Rank: G4?/S4
Albemarle/Charlottesville Conservation Rank: *None Exists (Under Development, ANHC)*

Description: Basic Mesic Forests are among the richest settings in the entirety of the Piedmont (Georgia to New York) and are the low elevation correlate of Rich Cove and Slope Forests. Despite their richness they are scattered broadly and have been reduced in their function and size by a long history of logging, agricultural land-use, and the introduction of non-native invasive species. One may only imagine the density and variety in plants they once held.

Standing in several of the deep ravines at RMNA, this imagining is made easier. A cathedral of old trees shelters a rich layer of herbs, holding rarities in such quantities that baffles even the botanists' mind. Teaming with dusky salamanders, clean and rocky streams cool the air as they meander gently through a glen of ferns and flowering ephemerals. Crevices in stream banks and forks in the lower canopy trees offer nesting sites to the Louisiana Waterthrushes and Woodthrushes. They fill the woods with song, one a maginificent flute-like tune, and the other a series of whistles that decends much like the rocky stream that leaves the hollow. Their song, the whispering waters, the calm cool air, and a 135' canopy over a glen of rare ferns cast all thoughts from the mind that one is near a city. It is within this context that we found ourselves counting trees in Test Plot #RMNA-07.

Basic-mesic forests occur in deep, steep-walled ravines that typically face north, east, or somewhere in-between. This is the case in 7 of the 10 examples we noted at RMNA. 3 of the ravines face either south or west, and the effect of the different aspect appears to shift the classification closer to Basic Oak-Hickory (a slightly less-rich and drier setting). These 3 locations grade somewhere between the

two classes, but in our estimation their flora assemblages and site physiography bring them nearer the classification of "Basic Mesic."

This ecosystem type at RMNA occurs in ravines with sidewalls that reach up, in some cases, nearly 100'. The correlation between depth and richness seems clear, with the richer of the ravines occurring in the deepest ones along the west side. The side wall slopes that reach down from the surrounding base-rich oak-hickory forests vary in their shape from convex to concave, and rocks of various sizes are thinly scattered on the surface. Organic material, including the rotting debris of logs and leaves, slowly creeps downward to eventually find its home in the rich, deep soils of the basic mesic ravine bottoms. At the base of the slopes, and sometimes as far as 50-60 up the slopes, we found springs and seepages. These areas are traced by verdant groves of flora following the moisture. The bottoms of the ravine are generally flat and gently sloping toward the drainages that eventually lead to the reservoir. These flat bottoms are typically dominated by a single permanent or ephemeral (seasonal) streamlet. The deep ravine in the southwest corner is a notable exception, offering two streamlets and a number of springs and seepages, all meeting at a single point that correlates with steepening stream banks. Most of these streams now find themselves ending suddenly at the new reservoir water elevations, where once they continued through forest. The new reservoir brings hydric conditions to a once terrestrial habitat.

One notices they are entering the Basic Mesic Forest first perhaps by a drop in air temperature. This is quickly followed by the recognition that the ground is green with flora. In some places showy orchis colonies stretch out further than the eye can see. In others one finds themselves standing amidst huge colonies of ferns that are rare elsewhere in the Piedmont. Log fern, a plant only noted from one other location in the County, fills an entire ravine on the north side of Round Top Mountain. Silvery spleenwort, broad beech fern, and the county rare Glade fern team up to create a 100% ground cover in the upper reaches of a ravine on the west side of the reservoir. Yet another locality is graced by a preponderance of pennywort and maidenhair fern. The general trend is that nutrient-demanding species appear in great colonies, and large meadows of ferns and overlapping groupings of spring ephemerals cover the ground. It is in this Ecosystem Type that the naturalist's walking pace comes to an abrupt halt due to the overwhelming richness.

All of the examples of this ecosystem type at RMNA are in fairly good condition except for those at the north end. Invasive species and continuous human intrusion, either for reservoir pipelines, forest clearing, or trails, have resulted in a fairly compromised setting. Proximity to current and historic paths and home sites has added to the influx of exotic species. It should be of great concern that the excellently preserved ravines in the southwest corner could end up looking like those at the north end. A primary cause for this potential influx of exotic species could be the movement of humans and other animals along trails that connect areas smothered by invasive species to areas in good states of preservation. Routing trails and roads through a massive colony of invasive species and then sending them into these sensitive areas would literally be an open invitation for the compromise of the Basic-Mesic Rich Ravine Forests at RMNA. This impact would trickle down to reach the rare and uncommon species these plant communities hold.

The forest in these Basic Mesic Ecosystems at RMNA is typically 6-layered. The top layer is most frequently dominated by tuliptree. Some of these trees reach more than 135' above ground and have diameters approaching 4 feet. They spread out to cover about half of the space at the top of the canopy. Some areas do see the upper canopy shared by northern red oak and white ash, but these

are exceptions to the rule. One such area is the southeast facing slopes of the peninsula (in an area with extensive colonies of spicebush, redbud, and non-native shrub species).

A logging operation was conducted in the 1950's, during which 2.5 million board feet of wood was harvested. The effect of that thinning resulted in a spike of species that could grow quickly to fill the new holes in the canopy. The large amounts of moderate to large-sized tuliptrees at RMNA are likely an echo of this harvest. Basic Oak-Hickory and Basic Mesic forests are known to have slightly more tuliptree, but the amount that we see at RMNA is likely exaggerated by 19th and 20th century land clearing and logging operations. Some of the larger specimens are likely a combination of 19th century pasture/field abandonment and later canopy infilling following the decline of the American chestnut.

With some variation seen in each example at RMNA, the following description is most closely aligned with the forest seen at our test plot (RMNA-07).

Below the tuliptree-dominated upper canopy is an upper-middle canopy, typically dominated by bitternut hickory, black gum, and tulip tree with diameters no more than 24". Much of the light that makes it through the upper canopy meets the leaves of this layer and the middle canopy beneath. Several of the trees have chased the light and are stretched into long sinewy poles reaching close to 100 feet tall while maintaining diameters of less than 12 inches.

Stepping down to the middle canopy we noted an absence of tuliptree and an addition of several species. The typical middle canopy species are bitternut hickory and white ash, with occasional black walnut, red maple, and American sycamore. The trees in this layer combine to cover about 50-60% of the space as one looks skyward.

The lower canopy, reaching from about 20-35' above ground, is very similar to the layer above it, with white ash and bitternut hickory being the dominant species. Occasional red maple saplings, sweet birch, and American persimmon find their home in this forest layer as well, and American hornbeam joins the mix in at least two drainages along the south side of the reservoir.

Looking to the shrub layer (2'-20' above ground) in portions of RMNA with good ecosystem system integrity, we find spicebush being dominant, joined mostly by the saplings of white ash, redbud, dogwood, red maple, black gum, and bitternut hickory. Hop-hornbeam, witch-hazel, wild hydrangea, maple-leaved viburnum, and black raspberry make occasional appearances in the shrub layer.

In some examples of the shrub layer of this forest type we observed a host of non-native invasive species (including autumn olive, wineberry, Oriental photinia, coralberry, and Oriental bittersweet) standing strong with spicebush as co-dominant species. This is particularly the case in the tulip-tree ravine at the extreme north end of RMNA and upon the southeast slopes of the base-rich forest on the peninsula. In a couple of instances, large colonies of the deciduous Oriental photinia dominate the shrub layer. This is readily seen late in autumn, as the persistent leaves of this species turn various shades of bold rosy-red and reddish-orange.

Figure 19: *More commonly noted at higher elevations in our region, Osmunda claytoniana (interrupted fern) occurs sparingly at RMNA. Only 3 plants were noted during survey.*

Moving down to the herbaceous layer of the Basic Mesic Forest we find the botanists' dream. Dominant species, and those that also indicate the high base of cations in the soil, are hog peanut, black cohosh, enchanter's nightshade, and silvery spleenwort. Subdominant species, sometimes occurring in dense colonies, include log fern, glade fern, lady fern, broad beech fern, maidenhair fern, richweed, jack-in-the-pulpit, showy orchis, pennywort, and perfoliated bellwort. Species that will not be mentioned in this report (due to their at-risk status) occur in large colonies in this, and other Ecosystem types at RMNA. Maple-leaved viburnum, wild comfrey, bloodroot, forest bedstraw, black snakeroot, and goat's beard also occur with varying degrees of colony size and numbers. An occasional strawberry shrub reaches barely above the ground, having been gnawed nearly flush by browsing deer. In seepage areas wood nettle, impatiens, and drooping sedge make rare appearances, and wet logs are graced by a wide variety of mosses, including fern moss. RMNA's only occurrence of interrupted fern (*Osmunda claytoniana*) is found just outside the plot, but still within the ecosystem. It grows nearly at the reservoir's edge, leaving one to ponder what might have been the full extent of the interrupted fern colony prior to the raising of water levels. Many other species will remain unmentioned here, but nearly all of the 150 flora species are noted in the Basic Mesic Forest in and around Plot #RMNA-07 can be found in the extensive list of flora that follows the ecosystem accounts.

It is perhaps the most unfortunate of circumstances that the same base-rich soils that support the rare and unusual native flora of the Basic Mesic Forests of RMNA also encourage non-native exotic species. This dichotomous dynamic (preponderance of rare and at-risk native species + increased risk of non-native exotics) makes the Basic Mesic Forest ecosystem a top priority for conservation planning at RMNA.

RMNA-07 SITE DESCRIPTION DATA

PLOT#	RMNA-07
PLOT NAME	West Side Rich Ravine
PROJECT	Ragged Mountain Natural Area Ecosystem Survey
DATE	5/15/2016
COUNTY/CITY	Albemarle County / City of Charlottesville
STATE	Virginia
RECORDER (initials)	RTB, DSF
SURVEYORS (initials)	DSF, RTB
ECOREGION (Omernik Level IV)	Piedmont Uplands
ELEVATION RANGE (ft.)	830' - 880'
LATITUDE (Centroid)	38.0277 (+/- 30m)
LONGITUDE (Centroid)	-78.5741 (+/- 30m)
PLOT SIZE (sq. ft.)	8,611
PLOT DIMENSIONS (sq. ft.)	60' x 144'
ESTIMATED ECOSYSTEM SIZE	1-10 acres
PLOT LOCATION DESCRIPTION	Plot Located in the third hollow north of I-64, on the west side of the RMNA reservoir; in the center of a flat-bottomed ravine along the southernmost of 2 streamlets, the northern most corner of the plot is immediately north of the confluence of those streamlets.
GEOLOGIC FORMATION	Central Virginia Blue Ridge Anticlinorium Complex
ROCK TYPES PRESENT	Porphyblastic Biotite-Plagioclase Augen Gneiss
SURFACE COVER (excluding flora, total = 100%)	Organic Matter 89%, Cobbles/Gravel 2%, Decaying Wood 5%, Mineral Soil/Sand 2%, Water 2%
SLOPE rise	2.5'
SLOPE run	30'
100x/y=	8-16% (sloping/rolling)
ANGLE OF INCLINE	4.76°
ASPECT	northeast (65°)
LANDFORM	Cove, Ravine, seep / swale / non-alluvial bottom
TOPOGRAPHIC POSITION	Toe slope, plain/level/bottom, basin/depression
EVIDENCE OF DISTURBANCE	Exotic plants, Clearing, Logging (evident in the even aged tuliptree dominant canopy)

DISTURBANCE COMMENTS	Some storm water run off erosion has generated down-cutting nearest the east end of the plant community, and recent reservoir renovations have brought new water levels into the ecosystem type.
SOIL DRAINAGE CLASS	Moderately well drained
SOIL MOISTURE REGIME	mesic

RMNA-07 TEST PLOT FLORA COUNT COVER CLASS DATA *(Species observed immediately outside of plot, but still in the plant community, are noted in the far left column under "Out")*

Out	*Latin*	common	Cover Class	Frequency	Relative Frequency (%)	DBH range (min-max)
	Upper Canopy (T4)	***(>115')***				
	Liriodendron tulipifera	tulip tree	7	3	100%	25-41"
	Middle-Upper Canopy (T3)	***(67'-115')***				
	Carya cordiformis	bitternut hickory	6	2	40%	11.75-15.25"
	Nyssa sylvatica	black gum	5	2	40%	11.25-14"
	Liriodendron tulipifera	tuliptree	4	1	20%	20"
	Middle Canopy (T2)	***(33'-67')***				
	Fraxinus americana	white ash	6	6	50%	1/4"
	Carya cordiformis	bitternut hickory	6	5	42%	1/2" - 2 1/2"
	Juglans nigra	black walnut	2	1	8%	3/4"
	Lower Canopy (T1)	***(21'-32')***				
	Fraxinus americana	white ash	6	6	50%	2-3"
	Carya cordiformis	bitternut hickory	6	5	42%	2-3"
	Acer rubrum	red maple	1	1	8%	2-3"
	Shrub Layer (S)	***(2'-20')***				
	Lindera benzoin	spicebush	5	16	20.3%	---
	Rubus phoenicolasius	wineberry	5	34	43.%	---

	Fraxinus americana	white ash	3	6	7.6%	---
	Celastrus orbiculatus	Oriental bittersweet	3	10	12.7%	---
	Carya cordiformis	bitternut hickory	2	3	3.8%	---
	Photinia villosa	smooth Oriental photinia	2	5	6.3%	---
	Symphoricarpos orbiculatus	coralberry	2	2	2.5%	---
	Acer rubrum	red maple	1	1	1.3%	---
	Nyssa sylvatica	black gum	1	1	1.3%	---
	Elaeagnus umbellata	autumn olive	1	1	1.3%	---
✓	*Aralia spinosa*	devil's walking stick	---	---	---	---
✓	*Cornus florida*	flowering dogwood	---	---	---	---
✓	*Carpinus caroliniana*	ironwood	---	---	---	---
✓	*Fagus grandifolia*	American beech	---	---	---	---
✓	*Prunus avium*	sweet cherry	---	---	---	---
✓	*Robinia pseudoacacia*	black locust	---	---	---	---
	Herbaceous Layer (H)	***(0'-2')***				
	Amphicarpaea bracteata	hog-peanut	8	---	---	---
	Actaea racemosa	black cohosh	6	---	---	---
	Deparia acrostichoides	silvery gladefern	6	---	---	---
	Circaea canadensis	enchanter's night-shade	5	---	---	---
	Phegopteris hexagonoptera	broad beech fern	5	---	---	---
	Rubus phoenicolasius	wineberry	4	---	---	---
	Adiantum pedatum	northern maidenhair fern	3	---	---	---
	Arisaema triphyllum	common jack-in-the-pulpit	3	---	---	---
	Collinsonia canadensis	richweed	3	---	---	---
	Galearis spectabilis	showy orchis	3	---	---	---
	Homalosorus pycnocarpon	glade fern	3	---	---	---
	Lindera benzoin	spicebush	3	---	---	---

	Microstegium vimineum	Japanese stiltgrass	3	---	---	---
	Parthenocissus quinquefolia	Virginia creeper	3	---	---	---
	Polystichum acrostichoides	christmas fern	3	---	---	---
	Toxicodendron radicans	eastern poison ivy	3	---	---	---
	Undisclosed spp.	at-risk species	3	---	---	---
	Anemone virginiana	thimbleweed	2	---	---	---
	Aruncus dioicus	goat's-beard	2	---	---	---
	Carex prasina	drooping sedge	2	---	---	---
	Celastrus orbiculatus	Oriental bittersweet	2	---	---	---
	Cynoglossum virginianum	wild comfrey	2	---	---	---
	Galium circaezans	forest bedstraw	2	---	---	---
	Obolaria virginica	pennywort	2	---	---	---
	Persicaria virginiana	Virginia knotweed	2	---	---	---
	Rubus occidentalis	black raspberry	2	---	---	---
	Sanicula canadensis	black snakeroot	2	---	---	---
	Uvularia perfoliata	perfoliate bellwort	2	---	---	---
	Vitis spp.	grape unidentified	2	---	---	---
	Botrypus virginianus	rattlesnake fern	1	---	---	---
	Carex rosea	rosy sedge	1	---	---	---
	Cercis canadensis	eastern redbud	1	---	---	---
	Dioscorea villosa	wild yam	1	---	---	---
	Euonymus americanus	strawberry bush	1	---	---	---
	Galium triflorum	sweet-scented bedstraw	1	---	---	---
	Hypericum punctatum	spotted St. John's-wort	1	---	---	---
	Impatiens spp.	jewelweed unidenfied	1	---	---	---
	Maianthemum racemosum	eastern Solomon's-plume	1	---	---	---
	Marchantia spp.	liverwort	1	---	---	---
	Medeola virginiana	Indian cucumber-root	1	---	---	---

	Plagiomnium ciliare	saber-tooth moss	1	---	---	---
	Prenanthes spp.	Lion's paw	1	---	---	---
	Thuidium spp.	fern moss	1	---	---	---
	Viburnum acerifolium	maple leaved viburnum	1	---	---	---
	Viola palmata	wood violet	1	---	---	---
	Viola sororia	common blue violet	1	---	---	---
✓	*Allaria petiolata*	garlic mustard	---	---	---	---
✓	*Aplectrum hyemale*	puttyroot	---	---	---	---
✓	*Asplenium platyneuron*	ebony spleenwort	---	---	---	---
✓	*Carex albicans*	white tinged sedge	---	---	---	---
✓	*Carex laxiflora*	broad loose-flowered sedge	---	---	---	---
✓	*Corallorhiza wisteriana*	spring coralroot	---	---	---	---
✓	*Dennstaedtia punctilobula*	hay-scented fern	---	---	---	---
✓	*Eurybia divaricata*	white wood aster	---	---	---	---
✓	*Geranium maculatum*	wild geranium	---	---	---	---
✓	*Geum canadense*	white avens	---	---	---	---
✓	*Hydrangea arborescens*	wild hydrangea	---	---	---	---
✓	*Laportea canadensis*	wood nettle	---	---	---	---
✓	*Monotropa uniflora*	Indian pipe	---	---	---	---
✓	*Onoclea sensibilis*	sensitive fern	---	---	---	---
✓	*Osmunda claytoniana*	interrupted fern	---	---	---	---
✓	*Polygonatum biflorum*	Solomon's seal	---	---	---	---
✓	*Ranunculus recurvatus*	hooked buttercup	---	---	---	---
✓	*Sanguinaria canadensis*	bloodroot	---	---	---	---
✓	*Smilax rotundifolia*	common greenbrier	---	---	---	---
✓	*Stellaria pubera*	star chickweed	---	---	---	---
✓	*Thalictrum thalictroides*	rue-anemone	---	---	---	---
✓	*Tipularia discolor*	cranesfly orchid	---	---	---	---

2.Inner Piedmont / Lower Blue Ridge Basic Oak-Hickory Forest *(RMNA-05, 08, DCR-09)*

Figure 20: *A view southwest through a mature basic oak-hickory forest at RMNA.*

Representative Community Type: Inner Piedmont/Lower Blue Ridge Basic Oak-Hickory Forest
Community Description: *Quercus rubra - Quercus montana - Carya ovalis / Cercis canadensis / Solidago caesia* Forest
USNVC CEGL Code: CEGL008514
Classification Confidence: High
Global/State Conservation Rank: G3G4/S3S4
Albemarle/Charlottesville Conservation Rank: ***None Exists (Under Development, ANHC)***

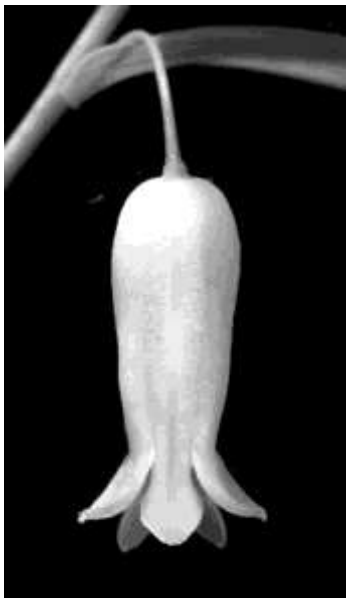


Figure 21: *The flower of Solomon's seal.*

Description: Basic Oak-Hickory forests have long been bastions of biodiversity in the Piedmont of Eastern North America. Their rich soils and varied landscapes allow for the low and hilly Piedmont to fully express its floristic potential. Walking from an Acidic Oak-Hickory forest to a Basic Oak-Hickory forest type will present distinct changes in the plants around you. In some areas, the change is so abrupt that the species richness nearly doubles. In other places the differences are more subtle. Richness is seen not only in the variety in species present, but also in the tendency to harbor both rare and disjunct species (species separated from others of its kind, outside of its typical range). The northernmost accounts (as well as outliers) of many documented species occur in the Basic Oak-Hickory forests of central Virginia.

As one may observe through history, on a global scale, most terrain that harbors rich and fertile soils is the target of exploitation for agricultural operations. As described in the section covering Basic Mesic Forests, the Basic Oak-Hickory Forests have a similar history of heavy land use, except on steep, rocky, or water-saturated landscapes. The very places that hold our biological treasures have long been at risk. Today we see different risks. While agriculture and logging remain threats, new challenges present themselves. The rich soils attract numerous aggressive non-native species that, once colonized, result in a dramatic compromise of biological richness. Yet another risk remains development. Another new threat is at hand; one that is becoming more common in our eastern

temperate forests. That is, the places that are the richest and the most beautiful are the same places that humans demand access to. It just so happens that base-rich substrates and landscapes produce qualities across the board that make them highly desirable places, for plants and animals (humans included). For this reason the Basic Oak-Hickory Forests of the Piedmont must be treated with care if the region's biodiversity is to be restored and preserved. The property of RMNA is, therefore, an ideal place for encouraging conservation practices and behavior, and for facilitating gentle and nurturing biodiversity research, observation, and education.

One may view the modern landscape with aerial photography and predict base rich substrates. In many cases one my find the exact points in the landscape where a poor soil ends and a rich one begins by looking at landcover patterns. Most frequently one finds a great line of old agricultural fields that meet a forest along an edge that coincides with a change in geologic substrate. Many of our region's base-rich substrates were clearcut early on and have been in agricultural use ever since due to their productivity. However, some areas were allowed to regenerate, gifting us forests. The base-rich rocks of Albemarle and Charlottesville are typically erosion resistant. Steep slopes, hills, and deep valleys often host Basic Oak-Hickory Forests and create large semi-mountainous forest blocks. Among these are the area's most significant upland landscapes: the Southwest Mountains, the Southern Albemarle Mountains, and the Ragged Mountains.

This plant community type occupies broadly scattered, but sometimes extensive, Piedmont landscapes as well as low elevation portions of the Blue Ridge. The largest patches of this habitat type in Albemarle County probably occur on the metabasalts of the Catoctin Formation (lower Blue Ridge and Southwest Mountains).

At RMNA the Basic Oak-Hickory Forest is the dominant ecotype, covering about 70% of the landscape. It covers all upland and lowland areas except where landscape or soil anomalies exist. In the deep ravines the conditions allow for a transition to Basic Mesic Forest development (a distinction made evident by greater species richness and preponderance of nutrient-demanding plants). Often times this transition is intermediate, landing somewhere between the two degrees of richness. In other areas, and especially on ridge tops and northwest facing slopes, soil conditions deviate to dry and nutrient poor. In these areas the Basic Oak-Hickory Forest is supplanted by Acidic Oak-Hickory Forests and Heaths. In areas where levels of base cations are still high, but the landscape is dominated by bedrock boulders or outcrops, the Basic Oak-Hickory forest grades toward Basic Woodland plant communities with increased amounts of species such as Hickory, Ash, Redbud, Hackberry, and Cedar. In the areas noted at RMNA as Ecosystem #'s 7 and 8, Ash or Hickory trees are the dominant canopy species, with the oaks playing a co-dominant or secondary role.

The rich woods of the Basic Oak-Hickory would naturally hold significant amounts of tuliptree as well. However, we have an inordinate amount of them at RMNA, and an historic record that sheds light on why. In the 1950's 2.5 million board feet were harvested from Ragged Mountain Natural Area. When one does the math, it becomes apparent that this may have left significant forest gaps. We can assume that, after 70 years of forest succession (following the abandonment of the agricultural/pasture land use of this portion of RMNA beginning in the 1880's), the trees would have reached a relatively mature size. The oldest of the trees observed today at RMNA date to the 1880's (with a few possible exceptions that warrant investigation). The largest trees approach 4' in diameter and reach to nearly 140' tall. If we presume that the harvest took trees of this size from some forgotten older portions of the landscape, it would take about 530 trees to produce 2.5 million

board feet. However, it is most likely the case that trees of more modest size were being harvested. Let's assume that the average tree diameter was closer to 24 inches. In this scenario it would take about 1,660 trees to produce the resulting board feet. The reality is probably that the harvest took a variety of species and sizes, possibly including some old giant snags and erosion resistant logs of American chestnut. With this moderate perspective we may conjecture that the operation harvested around 1,000 trees. What does this look? Our tree counts during survey can shed some light on this. During surveys the average number of trees occupying the upper canopy (and also averaging 25 inches in diameter) was 12. That's 12 large and valuable timber trees per test plot with a size of 8,611 square feet. This translates to about 61 large trees per acre at RMNA today. In the 1950's the terrestrial forested acreage of RMNA was about 635 acres. It is tempting to assume, therefore, that 1-2 trees per acre were harvested. This is likely not an accurate perspective because of a variety of factors. First, the logging operation may have been concentrated in more easily accessible areas. There is some evidence that the forest on the west side of the Reservoir, from about the water tower south beyond Round Top Mountain, is younger than other areas. Occasional old field trees are present (with evidence of low-growing limbs) and trees in some areas can't be more than 60 years old. Further complicating any assumption is the fact that the forest structure may have been completely different in the 1950s. With fewer tulip trees in the upper canopy (which was most likely the case), oaks would have had broader spreading crowns, and the number of large trees per acre would have been far less. Logging would have resulted in significant openings in the forest with the removal of a single tree. It is a likely hypothesis that the stands of tuliptree on the upland terrain represent the rapid filling of these canopy openings. Further research into the historic record may shed some light on these ideas.

Regardless of the nature of the logging operation, it is significant that the 1950's logging operation was the only substantial land disturbance in the upland swales, slopes, ravines, and ridgelines of RMNA during the 20th century. The land was left alone for most of that time and therefore we find robust herbaceous layer regeneration throughout the Basic Oak-Hickory setting. The most significant disturbances in modern times are the influx of non-native invasive species, browsing by deer, and an increase in human presence (including toys, machines, and pets). Seeds are being moved around the landscape more frequently and those species that are more aggressive are responding in kind. Pathways, flyways, and trails are now vectors for invasive species movement, and as these lifeways navigate upper slopes, rainwater and gravity distribute seeds downslope. This could potentially be a disaster for specific areas at RMNA (most notably the rich ravines on the west side, under threat of a new trail that will navigate the ridgeline above it).

The variation observed from one area to another in the Basic Oak – Hickory Forest ecosystem is moderate. Northern red oak and sweet birch increase in numbers on north aspects. South aspects see more tuliptree. Richer areas see a spike in hickory and ash as they approach having Basic-Mesic characteristics. Chestnut oak is slightly more dominant than white oak, black oak, and red oak in areas approaching heath conditions. White pine, shortleaf pine, and Virginia pine exist as scattered specimens. The white pine becomes gradually more prevalent nearing the pine-oak heath areas, with occasional singular specimens lurking on north slopes. Occasional large shortleaf pine stand tall in the upper canopy. These may be the oldest trees at RMNA, despite the smaller diameter, as they are noted regionally as being shade tolerant early successional species. Being among the first trees to germinate after field abandonment, the dozens of enormous specimens in the Basic Oak-Hickory Forests of the Northwest portions of RMNA may produce some very old dates indeed (perhaps reaching 200 years back or more). The last bit of variation in this forest type that I will mention is that associated with old homesites, farm buildings, roads, and fencelines. These old remnants create

as much variation as there are historic sites at RMNA. But most areas have a significant amount of non-native invasive species, including some garden-variety cultivars. The roads approaching these sites are equally invaded by invasives, with density and variety typically correlating with proximity to the site. In fact, were one to perform a Phase 1 survey of existing historic resources (including foundations, chimneys, barn and shed sites, and surface mining areas), the flora would light the way.

Figure 22: *Uvularia perfoliata (perfoliated bellwort) flower.*

To gather data that would best represent the extensive Basic Oak-Hickory forests at RMNA while capturing some variation, three test plots were employed. The first (noted in this report as RMNA-DCR-09) was undertaken by the DCR in 2007 on the east slopes of the large chunk of land that extends south into the reservoir. That plot was likely executed in an area that is now at least partially under water. CUH accomplished two additional plots for this ecotype. RMNA-05 was located on a west facing aspect along the east side of the reservoir and RMNA-08 was placed on a north aspect above a deep ravine along the west side of RMNA. Between the three of them we do see trends.

In the upper canopy find the dominant species to be northern red oak, chestnut oak, and tuliptree. In the upper portions of the middle canopy we find the same trees dominating, but a bit more variety, with black gum, red hickory, red maple, and white oak being regular occurrences. All of the above occur again in the middle canopy, with notable additions of mockernut and pignut hickories, and occasional stands of scattered sweet birch. Shagbark hickory is noted from the DCR plot, and likely occupied the middle canopy in numbers similar to red hickory. Tuliptree is all but absent in most of the forest below 66' height. The lower canopy is dominated by red maple, with pignut hickory, mockernut hickory, black gum and red hickory being sub-dominant. Witch-hazel reaches into the lower canopy, especially on northwest facing slopes. In at least three areas witch-hazel is the dominant shrub and small tree in the lower canopy. One is a sheltered northwest facing steep slope south of the new bridge. Another is on the northwest slopes of a ravine on the west side, and the third notable colony occurs east of the pine-oak heath that occurs on the east side of the reservoir. There are several others, but I will risk redundancy by mentioning them here.

Only two specimens of eastern hemlock were noted in the entirety of RMNA, at least one of which has evidence of decline due to the hemlock wooly adelgid.

The shrub layer is dominated by red maple, but sees regular witch-hazel, flowering dogwood, and saplings of white ash, hickory species (including occasional bitternut hickory). Seedlings of the middle-to-upper canopy species are common in the shrub layer. Downy serviceberry, sassafras, redbud, sweetbirch, ironwood, slippery elm, hackberry, deerberry and spicebush occur on occasions in varying degrees. The uncommon species, dwarf hackberry, occurs in association with large rock outcrops, typically growing in cracks in the rock.

To further convey the slight variations within this forest type at RMNA, I include the following excerpt from the 2007 DCR survey field form describing the east facing plot, RMNA-DCR-09:

"Plot was positioned in one of the most mature parts of an upland hardwood forest that extensively covers the Ragged Mountain Natural Area. Most other portions of this forest have higher concentrations of invasive exotics, along with overstory dominance or co-dominance by Liriodendron tulipifera, indicative of extensive past logging and clearing disturbances. Large Quercus rubra are prevalent in the overstory of the plot; large Q. montana and Q. alba are present in nearby parts of the stand. Shrubs and woody saplings are sparse to absent both within the plot and the adjacent parts of the stand, possibly as a result of past livestock grazing or other disturbances. The herb layer is well developed and consists largely of native species. However, the presence of shrub-sized Elaeagnus umbellata and several invasive exotic herbs at low cover does not bode well for the compositional integrity of the stand." (DCR 2007)

Perhaps more than any other ecosystem type at RMNA the Basic Oak-Hickory Forests were impacted most by the raising of the water levels. There is no wet-mesic or hydric transition zone where it meets the water. With time aquatic vegetation will replace the submesic flora of the forest where it meets the water, but likely not before some erosion creates a softer transition. The forest composition within 25 feet of the water will change significantly over time, with new species arriving to all portions of the canopy. Many dry-soil species will die and drop into the water, creating organic material and habitat for aquatic species of plants and animals.

The richness and variety of flora in the Basic Oak-Hickory Forests of RMNA is evident in the lists below, and additional species noted in the full species list later in the document show the full spectrum. The animals, and particularly the birds, are equally robust in this ecosystem. The test plots and hikes through this ecosystem type produced more animal observations than any other.

Non-Native Invasive Species and Trails in the Basic Oak-Hickory Forests of RMNA

Figure 23: *A song sparrow (Melospiza melodia) perches on the branch of wineberry (Rubus phoenicolasius).*

While the tree canopy delivered only an occasional non-native species (including *Ailanthus*), the shrub layer had non-native exotics as a significant cover class. Leading the way is wineberry. Autumn olive and Chinese photinia are next in line. An occasional Oriental bittersweet colony stands strong enough to reach into the shrub layer as well. Thankfully, Japanese stiltgrass and Japanese honeysuckle are nearly absent from the vast majority of RMNA's basic oak-hickory forests.

Three areas of RMNA's Basic Oak-Hickory Forest are heavily impacted by over a dozen species of non-native invasives. Beginning in the southeast corner, on the southwest slopes of Round Top Mountain, we see enormous variety and density in scattered patches of a number of non-natives. The spur trail leading from the old parking lot affords one an excellent view of this phenomenon, and the colonies spread upslope and east of the trail as one climbs higher. The invasives continue into the outcrop woodlands of ecosystem #7, with wineberry and sliltgrass presenting a real problem. The invasives decline sharply near the top of the mountain, and nearly disappear from the landscape down the north and west slopes of Round Top.

The second large concentration of non-native invasive species probably impacts more than 30 acres of Basic Mesic and Basic Oak-Hickory Forest at the north end of Ragged Mountain Area. 17 invasive species occur here and collaborate to create a thicket that is nearly an impasse in places. The new Albemarle Co. species (and indeed a new species for the region), *Photinia villosa*, was first noticed in this area. As one rounds the reservoir to the west, the photinia may be observed in substantial colonies, making it apparent that it has been here, unnoticed, for some time.

As noted in several other portions of this report, the massive assemblage of non-native invasive species at the north end is, in effect, a seed bank that could compromise nearly every ecosystem at RMNA within 25 years (if not sooner). This risk is particularly high because of plans to have more than one trail navigate the area. Currently it seems there may be a desire for up to three trails in this area. That would be a very risky.

> ***The most risky of them all is the upper road, as it navigates the upper slopes and ridgelines above important ecosystems all the way around the reservoir. Its position in the landscape, in combination with its proposed use, endows that path with the wicked ability to transport exotic seeds to a multitude of points around the reservoir where gravity and water will carry them down and into the very systems that need protection.***

Another planned trail navigates the north end at the middle of the slope, and yet another traces the water's edge. Asserting more than one path through any portion of the narrow landscape that wraps the reservoir at RMNA is not conducive to ecosystem conservation, regardless of the use permitted. To reiterate, the path that puts the most ecosystems at risk is the old forestry/fire road, as it acts as the most effective vector for spreading nonnative species. The most attractive location, from the standpoint of conserving the Basic Oak-Hickory Forest at RMNA (as well as other systems) is a path that is as near the water's edge as possible.

The third area of the Basic Oak-Hickory Forest that is most impacted by invasive species is the very remotely located southwest corner. Enormous outcrops and boulders stand against the back side of a shallow cove that appears to be somewhat artificial in its shape. Evidence of land disturbance can be seen in the entire area, and there is an enormous influx of invasive species to go with it. Time did not permit a thorough survey of this area, but it is clear that perhaps construction of I-64 and/or some type of old quarry/mining operation impacted this area. The unnatural landforms seem to trend in the direction of an old access road departing to the north.

RMNA-05 SITE DESCRIPTION DATA

PLOT#	RMNA-05
PLOT NAME	Basic Oak Hickory East Side
PROJECT	Ragged Mountain Natural Area Ecosystem Survey
DATE	4/15/2016
COUNTY/CITY	Albemarle County / City of Charlottesville
STATE	Virginia
RECORDER (initials)	DSF
SURVEYORS (initials)	DSF, DMC, OSL
ECOREGION (Omernik Level IV)	Piedmont Uplands
ELEVATION RANGE (ft.)	820' - 840'
LATITUDE (Centroid)	38.0378 (+/- 30m)
LONGITUDE (Centroid)	-78.5586 (+/- 30m)
PLOT SIZE (sq. ft.)	8,611
PLOT DIMENSIONS (sq. ft.)	52.4’ radius
ESTIMATED ECOSYSTEM SIZE	1-10 acres
PLOT LOCATION DESCRIPTION	Plot Located ½ mile north of the upper parking lot, and about 500’ northwest of the water tower. Plot centered on a gentle ridgeline, mid-slope, with a trail intersecting its west margin.
GEOLOGIC FORMATION	Central Virginia Blue Ridge Anticlinorium Complex
ROCK TYPES PRESENT	Porphyblastic Biotite-Plagioclase Augen Gneiss
SURFACE COVER (excluding flora, total = 100%)	Organic Matter 84%, Boulders 2%, Cobbles/Gravel 4%, Decaying Wood 5%, Mineral Soil/Sand 5%
SLOPE rise	3'
SLOPE run	20'
100x/y=	8-16% (sloping/rolling) (15%)
ANGLE OF INCLINE	8.5°
ASPECT	Northwest (300°)
LANDFORM	Side slope, hill
TOPOGRAPHIC POSITION	Middle slope
EVIDENCE OF DISTURBANCE	Trails/roads, clearing, logging (thinning)
DISTURBANCE COMMENTS	Forest is of mixed age with clear evidence of selective clearcut, including occasional large oak and prevalent tuliptree
SOIL DRAINAGE CLASS	Moderately well drained

SOIL MOISTURE REGIME	Dry-mesic

RMNA-05 TEST PLOT FLORA COUNT COVER CLASS DATA*(Species observed immediately outside of plot, but still in the plant community, are noted in the far left column under "Out")*

Out	*Latin*	common	Cover Class	Frequency	Relative Frequency (%)	DBH range (min-max)
	Upper Canopy (T4)	***(>115')***				
	Quercus rubra	northern red oak	7	2	33.30%	40-45"
	Liriodendron tulipifera	tulip tree	6	2	33.30%	30-31"
	Quercus montana	chestnut oak	4	1	16.70%	29"
	Quercus alba	white oak	4	1	16.70%	24"
	Upper Canopy (T3)	***(67'-115')***				
	Liriodendron tulipifera	tulip tree	6	3	30.00%	16-19"
	Quercus rubra	northern red oak	5	2	20.00%	22-23"
	Quercus alba	white oak	5	2	20.00%	16-19"
	Quercus montana	chestnut oak	4	1	10.00%	12"
	Carya ovalis	red hickory	3	1	10.00%	12"
	Acer rubrum	red maple	3	1	10.00%	16"
	Middle Canopy (T2)	***(33'-67')***				
	Acer rubrum	red maple	6	10	52.60%	3-4"
	Carya tomentosa	mockernut hickory	4	4	21.10%	4-6"
	Carya glabra	pignut hickory	3	2	10.50%	4"
	Carya ovalis	red hickory	2	2	10.50%	7"
	Nyssa sylvatica	blackgum	1	1	5.30%	6"
	Lower Canopy (T1)	***(21'-32')***				
	Hamamelis virginiana	witch-hazel	2	1	44.00%	3"
	Carya glabra	pignut hickory	4	3	11.00%	3.25-4.5"
	Acer rubrum	red maple	6	4	70.00%	2-"
	Carya tomentosa	mockernut hickory	3	1	15.00%	4.85"

	Shrub Layer (S)	***(2'-20')***				
	Acer rubrum	red maple	6	10	38.00%	1.25-2.5"
	Carya glabra	pignut hickory	2	1	3.00%	2.75"
	Nyssa sylvatica	blackgum	2	1	3.00%	2.75"
	Hamamelis virginiana	witch-hazel	5	11	42.00%	1-2.25"
	Cornus florida	flowering dogwood	3	2	8.00%	2-3"
	Carya tomentosa	mockernut hickory	2	1	3.00%	2"
	Herbaceous Layer (H)	***(0'-2')***				
	Polystichum acrostichoides	Christmas fern	4	---	---	---
	Vaccinium pallidum	hillside blueberry	4	---	---	---
	Celastrus orbiculatus	Oriental bittersweet	3	---	---	---
	Hamamelis virginiana	witch-hazel	3	---	---	---
	Parthenocissus quinquefolia	Virginia creeper	3	---	---	---
	Rubus phoenicolasius	wineberry	3	---	---	---
	Smilax rotundifolia	common greenbrier	3	---	---	---
	Symphoricarpos orbiculatus	coralberry	3	---	---	---
	Uvularia perfoliata	perfoliate bellwort	3	---	---	---
	Viburnum acerifolium	maple leaved viburnum	3	---	---	---
	Viola palmata	wood violet	3	---	---	---
	Acer rubrum	red maple	2	---	---	---
	Carex nigromarginata	black edge sedge	2	---	---	---
	Carex pensylvanica	Pennsylvania sedge	2	---	---	---
	Chimaphila maculata	striped wintergreen	2	---	---	---
	Cynoglossum virginianum	wild comfrey	2	---	---	---
	Dichanthelium spp.	panic grass unidentified	2	---	---	---
	Elaeagnus umbellata	autumn olive	2	---	---	---
	Erigeron pulchellus	Robin's plantain	2	---	---	---
	Galearis spectabilis	showy orchis	2	---	---	---

	Galium circaezans	forest bedstraw	2	---	---	---
	Juniperus virginiana	eastern red cedar	2	---	---	---
	Maianthemum racemosum	eastern Solomon's-plume	2	---	---	---
	Obolaria virginica	pennywort	2	---	---	---
	Poa sylvestris	woodland bluegrass	2	---	---	---
	Potentilla canadensis	Canada cinquefoil	2	---	---	---
	Quercus alba	white oak	2	---	---	---
	Quercus montana	chestnut oak	2	---	---	---
	Robinia pseudoacacia	black locust	2	---	---	---
	Scutellaria spp.	scullcap unidentified	2	---	---	---
	Silene virginica	fire pink	2	---	---	---
	Smilax glauca	white-leaf greenbrier	2	---	---	---
	Solidago caesia var. caesia	bluestem goldenrod	2	---	---	---
	Stellaria pubera	star chickweed	2	---	---	---
	Tipularia discolor	cranesfly orchid	2	---	---	---
	Carex striatula	lined sedge	1	---	---	---
	Chrysogonum virginianum	green and gold	1	---	---	---
	Grimmia spp.	grimmia dry-rock moss	1	---	---	---
	Uvularia sessilifolia	sessile bellwort	1	---	---	---
✓	*Actaea racemosa*	black cohosh	---	---	---	---
✓	*Antennaria plantaginifolia*	plantain-leaved pussytoes	---	---	---	---
✓	*Sanguinaria canadensis*	bloodroot	---	---	---	---
✓	*Sceptridium biternatum*	grape fern	---	---	---	---
✓	*Symphyotichum undulatum*	wavy-leaved aster	---	---	---	---

RMNA-08 SITE DESCRIPTION DATA

PLOT#	RMNA-08
PLOT NAME	Basic Oak Hickory East Side
PROJECT	Ragged Mountain Natural Area Ecosystem Survey
DATE	4/15/2016
COUNTY/CITY	Albemarle County / City of Charlottesville
STATE	Virginia
RECORDER (initials)	DSF
SURVEYORS (initials)	DSF, DMC, OSL
ECOREGION (Omernik Level IV)	Piedmont Uplands
ELEVATION RANGE (ft.)	820' - 840'
LATITUDE (Centroid)	38.0378 (+/- 30m)
LONGITUDE (Centroid)	-78.5586 (+/- 30m)
PLOT SIZE (sq. ft.)	8,611
PLOT DIMENSIONS (sq. ft.)	52.4’ radius
ESTIMATED ECOSYSTEM SIZE	1-10 acres
PLOT LOCATION DESCRIPTION	Plot Located ½ mile north of the upper parking lot, and about 500’ northwest of the water tower. Plot centered on a gentle ridgeline, mid-slope, with a trail intersecting its west margin.
GEOLOGIC FORMATION	Central Virginia Blue Ridge Anticlinorium Complex
ROCK TYPES PRESENT	Porphyblastic Biotite-Plagioclase Augen Gneiss
SURFACE COVER (excluding flora, total = 100%)	Organic Matter 84%, Boulders 2%, Cobbles/Gravel 4%, Decaying Wood 5%, Mineral Soil/Sand 5%
SLOPE rise	3'
SLOPE run	20'
100x/y=	8-16% (sloping/rolling) (15%)
ANGLE OF INCLINE	8.5°
ASPECT	Northwest (300°)
LANDFORM	Side slope, hill
TOPOGRAPHIC POSITION	Middle slope
EVIDENCE OF DISTURBANCE	Trails/roads, clearing, logging (thinning)
DISTURBANCE COMMENTS	Forest is of mixed age with clear evidence of selective clearcut, including occasional large oak and prevalent tuliptree
SOIL DRAINAGE CLASS	Moderately well drained

SOIL MOISTURE REGIME	Dry-mesic

RMNA-08 TEST PLOT FLORA COUNT COVER CLASS DATA*(Species observed immediately outside of plot, but still in the plant community, are noted in the far left column under "Out")*

Out	*Latin*	common	Cover Class	Frequency	Relative Frequency (%)	DBH range (min-max)
	Upper Canopy (T4)	***(>115')***				
	Quercus rubra	northern red oak	7	4	50.00%	27-38"
	Quercus montana	chestnut oak	7	3	37.50%	23"-33"
	Liriodendron tulipifera	tulip tree	5	1	12.50%	32"
	Upper Canopy (T3)	***(67'-115')***				
	Quercus rubra	northern red oak	6	2	50.00%	16"
	Quercus montana	chestnut oak	5	1	25.00%	22.5"
	Nyssa sylvatica	blackgum	5	1	25.00%	15"
✓	*Quercus alba*	white oak	---	---	---	---
✓	*Liriodendron tulipifera*	tulip tree	---	---	---	---
	Middle Canopy (T2)	***(33'-67')***				
	Carya glabra	pignut hickory	6	6	46.00%	4.5-5.25"
	Acer rubrum	red maple	6	3	23.10%	5-6"
	Carya ovalis	red hickory	5	3	23.10%	4-5"
	Carya tomentosa	mockernut hickory	4	1	7.80%	7"
	Lower Canopy (T1)	***(21'-32')***				
	Acer rubrum	red maple	4	3	60.00%	4-6"
	Carya glabra	pignut hickory	3	1	20.00%	5"
	Nyssa sylvatica	blackgum	3	1	20.00%	3"
	Shrub Layer (S)	***(2'-20')***				
	Acer rubrum	red maple	7	3	17.10%	1.5-3"
	Rubus phoenicolasius	wineberry	5	10	28.60%	<1"
	Celastrus orbiculatus	Oriental bittersweet	3	4	11.40%	<1"
	Carya cordiformis	bitternut hickory	3	2	5.70%	2-3"

	Cornus florida	flowering dogwood	3	3	8.60%	1-3"
	Carya glabra	pignut hickory	3	3	8.60%	2-3"
	Carya ovalis	red hickory	3	3	8.60%	2-3"
	Fraxinus americana	white ash	2	1	2.90%	2"
	Nyssa sylvatica	blackgum	2	2	5.70%	1.5-2"
	Elaeangus umbellata	autumn olive	1	1	2.90%	.5"
✓	*Photinia villosa*	smooth Oriental photinia	---	--	---	---
	Herbaceous Layer (H)	***(0'-2')***				
	Parthenocissus quinquefolia	Virginia creeper	5	---	---	---
	Polystichum acrostichoides	christmas fern	5	---	---	---
	Acer rubrum	red maple	3	---	---	---
	Amphicarpaea bracteata	hog-peanut	3	---	---	---
	Arisaema triphyllum	common jack-in-the-pulpit	3	---	---	---
	Celastrus orbiculatus	Oriental bittersweet	3	---	---	---
	Circaea canadensis	enchanter's night-shade	3	---	---	---
	Galium circaezans	forest bedstraw	3	---	---	---
	Galium spp.	bedstraw unidentified 2	3	---	---	---
	Lindera benzoin	spicebush	3	---	---	---
	Rubus phoenicolasius	wineberry	3	---	---	---
	Viburnum acerifolium	maple leaved viburnum	3	---	---	---
	Desmodium spp.	unidentified trefoil	2	---	---	---
	Dioscorea villosa	wild yam	2	---	---	---
	Endodeca serpentaria	Virginia snakeroot	2	---	---	---
	Galearis spectabilis	showy orchis	2	---	---	---
	Galium triflorum	sweet-scented bedstraw	2	---	---	---
	Phegopteris hexagonoptera	broad beech fern	2	---	---	---
	Sanguinaria canadensis	bloodroot	2	---	---	---
	Toxicodendron radicans	eastern poison ivy	2	---	---	---

	Undisclosed spp.	at-risk species	2	---	---	---
	Vitis spp.	grape unidentified	2	---	---	---
	Asplenium platyneuron	ebony spleenwort	1	---	---	---
	Botrypus virginianus	rattlesnake fern	1	---	---	---
	Eurybia divaricata	white wood aster	1	---	---	---
	Maianthemum racemosum	eastern Solomon's-plume	1	---	---	---
	Photinia villosa	smooth Oriental photinia	1	---	---	---
	Prunus serotina	wild black cherry	1	---	---	---
	Quercus montana	chestnut oak	1	---	---	---
	Uvularia perfoliata	perfoliate bellwort	1	---	---	---

RMNA-DCR-09 SITE DESCRIPTION DATA

PLOT#	RMNA-DCR-09
PLOT NAME	Basic Oak-Hickory, East Facing (2007 DCR Plot #ALBE-008)
PROJECT	Ragged Mountain Natural Area Ecosystem Survey
DATE	7/27/2007
COUNTY/CITY	Albemarle County / City of Charlottesville
STATE	Virginia
RECORDER (initials)	GF
SURVEYORS (initials)	GF
ECOREGION (Omernik Level IV)	Piedmont Uplands
ELEVATION RANGE (ft.)	660'
LATITUDE (Centroid)	38.032774 (+/- 25m)
LONGITUDE (Centroid)	-78.5644 (+/- 25m)
PLOT SIZE (sq. ft.)	4,306
PLOT DIMENSIONS (sq. ft.)	52.5' x 82'
ESTIMATED ECOSYSTEM SIZE	Extensive
PLOT LOCATION DESCRIPTION	Plot was positioned in one of the most mature parts of an upland hardwood forest that extensively covers the Ragged Mountain Natural Area.
GEOLOGIC FORMATION	Central Virginia Blue Ridge Anticlinorium Complex
ROCK TYPES PRESENT	Porphyblastic Biotite-Plagioclase Augen Gneiss

SURFACE COVER (excluding flora, total = 100%)	Organic Matter 88%, Mineral Soil/Sand 10%, Boulders 1, Decaying Wood 1%
SLOPE rise	--
SLOPE run	--
100x/y=	--
ANGLE OF INCLINE	18º
ASPECT	East (100º)
LANDFORM	Side slope
TOPOGRAPHIC POSITION	Middle slope
EVIDENCE OF DISTURBANCE	exotic plants, chestnut blight
DISTURBANCE COMMENTS	Old chestnut log in the plot
SOIL DRAINAGE CLASS	Well drained
SOIL MOISTURE REGIME	submesic

RMNA-DCR-09 TEST PLOT FLORA COUNT COVER CLASS DATA *Survey method omitted strata delineation, and focused on cover class. Therefore the chart below looks a bit different from others in this document.*

Latin	**common**	**Cover Code**	**Cover (%)**
Quercus rubra	northern red oak	8	62.50%
Actaea racemosa	black cohosh	6	17.5 %
Amphicarpaea bracteata	hog-peanut	6	17.5 %
Carya tomentosa	mockernut hickory	6	17.5 %
Dichanthelium boscii	Bosc's panic grass	6	17.5 %
Carya ovalis	red hickory	5	7.5 %
Liriodendron tulipifera	tuliptree	5	7.5 %
Nyssa sylvatica	black gum	5	7.5 %
Quercus montana	chestnut oak	5	7.5 %
Carya ovata	shagbark hickory	4	3.5 %
Hylodesmum nudiflorum	naked-flowered tick-trefoil	4	3.5 %
Carex albicans	white tinged sedge	3	1.5 %
Elaeagnus umbellata	autumn olive	3	1.5 %
Festuca subverticillata	nodding fescue	3	1.5 %
Polystichum acrostichoides	christmas fern	3	1.5 %

Quercus alba	white oak	3	1.5 %
Asplenium platyneuron	ebony spleenwort	2	0.505 %
Carex nigromarginata	black edge sedge	2	0.505 %
Carex rosea	rosy sedge	2	0.505 %
Cercis canadensis var. canadensis	eastern redbud	2	0.505 %
Chimaphila maculata	striped wintergreen	2	0.505 %
Clitoria mariana var. mariana	butterfly pea	2	0.505 %
Cornus florida	flowering dogwood	2	0.505 %
Desmodium rotundifolium	round-leaf tick-trefoil	2	0.505 %
Dichanthelium commutatum	variable panic grass	2	0.505 %
Dioscorea villosa	wild yam	2	0.505 %
Diospyros virginiana	common persimmon	2	0.505 %
Eupatorium godfreyanum	Godfrey's thoroughwort	2	0.505 %
Galium circaezans	forest bedstraw	2	0.505 %
Galium pilosum	hairy bedstraw	2	0.505 %
Galium triflorum	sweet-scented bedstraw	2	0.505 %
Houstonia purpurea var. purpurea	summer bluets	2	0.505 %
Juniperus virginiana var. virginiana	eastern red cedar	2	0.505 %
Lespedeza repens	creeping lespedeza	2	0.505 %
Lespedeza violacea	wand lespedeza	2	0.505 %
Lindera benzoin	spicebush	2	0.505 %
Lonicera japonica	Japanese honeysuckle	2	0.505 %
Lysimachia quadrifolia	whorled loosestrife	2	0.505 %
Maianthemum racemosum ssp. racemosum	eastern Solomon’s-plume	2	0.505 %
Muhlenbergia sobolifera	rock muhly	2	0.505 %
Parthenocissus quinquefolia	Virginia creeper	2	0.505 %
Passiflora lutea	yellow passionvine	2	0.505 %
Phaseolus polystachios	wild bean	2	0.505 %
Rubus phoenicolasius	wineberry	2	0.505 %
Sanguinaria canadensis	bloodroot	2	0.505 %
Scutellaria elliptica	hairy skullcap	2	0.505 %
Toxicodendron radicans	eastern poison ivy	2	0.505 %

Uvularia perfoliata	perfoliate bellwort	2	0.505 %
Viburnum acerifolium	maple leaved viburnum	2	0.505 %
Viola palmata var. triloba	wood violet	2	0.505 %
Vitis vulpina	winter grape	2	0.505 %
Acalypha virginica	Virginia copperleaf	1	0.05 %
Acer rubrum	red maple	1	0.05 %
Ailanthus altissima	tree-of-heaven	1	0.05 %
Albizia julibrissin	mimosa	1	0.05 %
Carex digitalis	slender woodland sedge	1	0.05 %
Carex laxiflora	broad loose-flowered sedge	1	0.05 %
Celastrus orbiculatus	Oriental bittersweet	1	0.05 %
Celtis occidentalis	common hackberry	1	0.05 %
Chamaecrista nictitans var. nictitans	wild sensitive plant	1	0.05 %
Microstegium vimineum	Japanese stiltgrass	1	0.05 %
Prunus serotina var. serotina	wild black cherry	1	0.05 %
Quercus velutina	black oak	1	0.05 %
Rubus occidentalis	black raspberry	1	0.05 %
Sanicula canadensis	black snakeroot	1	0.05 %
Silene caroliniana var. pensylvanica	wild pink	1	0.05 %
Tipularia discolor	cranesfly orchid	1	0.05 %
Verbascum thapsus	common mullein	1	0.05 %

3.Piedmont Acidic Oak-Hickory Forest *(Test Plot RMNA-03*)

Figure 24: *The CUH Ecosystem Survey Crew standing among the giants of a small patch of Acidic Oak-Hickory Forest at RMNA.*

Representative Community Type: Piedmont Acidic Oak - Hickory Forest
Community Description: *Quercus rubra - Quercus montana - Carya glabra / Acer rubrum – Carya tomentosa / Polystichum acrostichoides - Chimaphila maculata - Tipularia discolor* Forest
USNVC CEGL Code: CEGL008475
Classification Confidence: Moderately High
Global/State Conservation Rank: G4G5/S4S5
Albemarle/Charlottesville Conservation Rank: *None Exists (Under Development, ANHC)*

Description: Acidic Oak-Hickory Forests are dominant in Virginia. Not only are the required acidic bedrock substrates very widespread and common but most Piedmont landscapes have been further depleted of their nutrients by a couple hundred years of agriculture. Acidic Oak-Hickory forests are similar to Basic Oak-Hickory Forests, but they differ in a number of important ways. Acidic Oak-Hickory forests tend to occur primarily on silica-rich sub-acidic rocks like shale, quartz sandstones, siltstones, and granites with high amounts of quartz and low amounts of mafic minerals. When these coincide with weathered and shallow-soiled hilltops, the effect is doubled, and the soil drainage class meanders to the extreme edge of well-drained. Calcium levels are very low, and nutrients aren't as available for plant uptake as they are in the Basic Oak-Hickory Forest (due to differences in base-levels of cations and cation exchange capacity). The Acidic Oak-Hickory Forests at Ragged Mountain are not, however, in the extreme. They are marginally close to being Basic, and limited in their size and distribution due to the base-rich bedrock. In fact, they transition smoothly and seamlessly to the Basic Oak-Hickory Forests that dominate RMNA. They change more abruptly when Heath-producing characteristics are present, frequently along a clear and sudden line. Generally speaking, Acidic Oak-Hickory Forests are ecologically in-between the species-rich basic forest settings and the species-poor heath forest settings. However, the examples at RMNA lean in the basic direction and are limited to only the most extreme and exposed areas along hilltops and ridgelines.

Walking through the forests at RMNA an easy way to distinguish the Acidic Oak-Hickory Forest from the Base-rich Forest (aside from noting landform shape and position) is by noting the presence of either acidophiles or calcophiles. Basic settings will typically have a greater number of species like

hickory (*Carya)*, ash (*Fraxinus)*, redbud (*Cercis canadensis)*, black cohosh (*Actaea racemosa)*, and hog peanut (*Amphicarpaea bracteata)*. The Acidic oak-hickory forest setting will have lower diversity in all layers, a canopy dominated by 1-2 oak species, and a more robust assemblage of ericaceous shrubs such as hillside blueberry (*Vaccinium pallidum*), deerberry (*Vaccinium stamineum)*, and black huckleberry (*Gaylussacia baccata*).

This plot is representative of a patchwork of hilltop flat woods at RMNA, the total of which approaches 50 acres. The habitat type varies from place to place only slightly, with some stands being predominantly tuliptree (due to logging and old field abandonment) and some predominantly chestnut oak (due to subxeric soil conditions). A notable variation occurs along the ridge in the west side of RMNA. A shrub layer dominated by devil's walking stick (*Aralia spinosa)* stretches out to cover nearly 10 acres. This shrub layer in this area appears to be relatively fixed and stable, as the *Aralia* has had the opportunity to spread along the ridge. It may be the largest colony of this interesting native species in the region. Known for its powerful pollinator attracting abilities, the site is nearly blanketed every summer with swallowtail butterflies, bees, wasps, and the predatory food chain that comes with it. Gratefully, this swath of land is part of a larger forest on the west side that will undoubtedly be treated with a strong conservation ethic.

The plot was placed in a mesic mixed flora area that best represents the average for this ecotype at RMNA. The herbaceous layer is depauperate, with only 18 species being present at the time of survey. Dry-mesic acidophiles are present only as a trace, including American holly (*Ilex opaca),* striped wintergreen (*Chimaphila maculate),* white-leaved greenbrier (*Smilax glauca),* putty-root orchid (*Aplectrum hyemale)*, and Christmas fern (*Polystichum acrostichoides)*. Non-natives are nearly absent. Chestnut oak (*Quercus montana),* northern red oak *(Quercus rubra),* hickories *(Carya spp.),* Red maple *(Acer rubrum)* and tuliptree (*Liriodendron tulipifera)* dominate the woody strata. The upper canopy reaches to about 110' high with northern oak (*Quercus rubra*) being the largest specimens. Short-leaf pine (*Pinus echinata*) and black gum (*Nyssa sylvatica*) were noted outside of the plot (single specimens). The stand is roughly 100 - 105 years old (estimated using tree rings from similar forests on the property). The lack of density and variety lends credence to the diagnosis of "low-nutrient". The low numbers in the herbaceous and shrub layers, as well as the lower half of the canopy, may correlate with gradual increases in deer populations through the 20th century.

Red maple *(Acer rubrum)* is the dominant cover class in all woody strata lower than 66' tall. Fire exclusion is likely to the culprit here, as this shade-tolerant but fire-intolerant species will fill the canopy of nearly any nutrient poor setting in the Piedmont.

RMNA-03 SITE DESCRIPTION DATA

PLOT#	RMNA-03
PLOT NAME	Hilltop Oak Hickory (OHt7)
PROJECT	Ragged Mountain Natural Area Ecosystem Survey
DATE	12/18/2015
COUNTY/CITY	Albemarle County / City of Charlottesville
STATE	Virginia
RECORDER (initials)	DSF
SURVEYORS (initials)	DSF, DMC, TRS, RTB
ECOREGION (Omernik Level IV)	Piedmont Uplands
ELEVATION RANGE (ft.)	900'
LATITUDE (Centroid)	38.025682
LONGITUDE (Centroid)	-78.56276
PLOT SIZE (sq. ft.)	8,611
PLOT DIMENSIONS (sq. ft.)	115' x 75'
ESTIMATED ECOSYSTEM SIZE	50-100 acres
PLOT LOCATION DESCRIPTION	Southwest of the south spillway, and upon the flat ridge top, the plot was located 100' east of the gentle saddle, away from a grove of tuliptree that must have been disturbed heavily sometime in the first half of the 20th century. Plot restricted to hilltop.
GEOLOGIC FORMATION	Central Virginia Blue Ridge Anticlinorium Complex
ROCK TYPES PRESENT	Porphyblastic Biotite-Plagioclase Augen Gneiss
SURFACE COVER (excluding flora, total = 100%)	Organic matter 84%, Cobbles/gravel 1%, Decaying wood 15%
SLOPE rise	1'
SLOPE run	50'
100x/y=	0-3% (level or nearly so)
ANGLE OF INCLINE	average of 1.2° (Range: 0° to 2°)
ASPECT	flat
LANDFORM	ridge/interfluve, hill/knob/monadnock
TOPOGRAPHIC POSITION	crest/interfluve
EVIDENCE OF DISTURBANCE	trails/roads, grazing/browsing, logging

DISTURBANCE COMMENTS	Forest is of mixed age with clear evidence of selective clearcut, including occasional large oak and prevalent tuliptree
SOIL DRAINAGE CLASS	well drained
SOIL MOISTURE REGIME	Dry-mesic

RMNA-03 TEST PLOT FLORA COUNT COVER CLASS DATA*(Species observed immediately outside of plot, but still in the plant community, are noted in the far left column under "Out")*

Out	*Latin*	common	Cover Class	Frequency	Relative Frequency (%)	DBH range (min-max)
	Upper Canopy (T3)	***(67'-115')***				
	Quercus rubra	northern red oak	7	3	27.20%	30" - 40"
	Quercus montana	chestnut oak	7	5	45.50%	15" - 32"
	Liriodendron tulipifera	tulip tree	3	2	18.20%	25.5 - 28.3"
	Quercus velutina	black oak	2	1	9.10%	30"
✓	*Quercus alba*	white oak	---	---	---	---
✓	*Pinus echinata*	short leaf pine	---	---	---	---
✓	*Nyssa sylvatica*	black gum	---	---	---	---
	Middle Canopy (T2)	***(33'-67')***				
	Acer rubrum	red maple	5	6	42.90%	4 - 10"
	Carya spp.	red/pignut hickory	5	4	28.50%	3.5 - 10"
	Carya tomentosa	mockernut hickory	4	2	14.30%	5 - 7"
	Liriodendron tulipifera	tulip tree	3	1	7.10%	7"
	Quercus alba	white oak	2	1	7.10%	7"
	Lower Canopy (T1)	***(21'-32')***				
	Acer rubrum	red maple	4	14	70.00%	2" - 4"
	Carya tomentosa	mockernut hickory	2	3	15.00%	2.5"
	Carya ovalis	red hickory	1	2	10.00%	4"
	Fraxinus americana	white ash	1	1	5.00%	2"
	Shrub Layer (S)	***(2'-20')***				
	Acer rubrum	red maple	5	23	76.00%	1.5" - 2"
	Carya ovalis	red hickory	2	4	13.00%	1.5" - 2"

	Carya tomentosa	mockernut hickory	1	2	6.00%	2"
	Quercus montana	chestnut oak	1	1	3.00%	2"
	Herbaceous Layer (H)	***(0'-2')***				
	Pinus strobus	white pine	1	---	---	---
	Ilex opaca	American holly	1	---	---	---
	Carex albicans	white tinged sedge	1	---	---	---
	Chimaphila maculata	striped wintergreen	1	---	---	---
	Polystichum acrostichoides	christmas fern	1	---	---	---
	Tipularia discolor	cranefly orchid	1	---	---	---
	Smilax glauca	white-leaf greenbrier	1	---	---	---
	Elaeagnus umbellata	autumn olive	1	---	---	---
	Carex nigromarginata	black-edged sedge	1	---	---	---
	Aplectrum hyemale	putty-root orchid	1	---	---	---
	Celastrus orbiculatas	Oriental bittersweet	1	---	---	---
	Carex communis	fibrous-rooted sedge	1	---	---	---
	Smilax rotundifolia	common greenbrier	1	---	---	---
✓	*Ligustrum sinense*	Chinese privet	---	---	---	---
✓	*Microstegium vimineum*	Japanese stiltgrass	---	---	---	---
✓	*Lonicera japonica*	Japanese honeysuckle	---	---	---	---
✓	*Juniperus virginiana*	eastern red cedar	---	---	---	---

4.Piedmont / Central Appalachian Mixed Oak / Heath Forest

Figure 25: *The unmistakable open understory and bright light of the chestnut oak – blueberry – hackberry heaths of RMNA.*

Representative Community Type: Piedmont / Central Appalachian Mixed Oak / Heath Forest
Community Description: *Quercus montana / Gaylussacia baccata – Vaccinium pallidum* Forest
USNVC CEGL Code: CEGL008521
Classification Confidence: High
Global/State Conservation Rank: G5/S5
Albemarle/Charlottesville Conservation Rank: *None Exists (Under Development, ANHC)*

Figure 26: *Hillside blueberry (Vaccinium pallidum) flowers.*

Description: This interesting Oak heath occurs only at three sites, all within close proximity to one another. This plant community type occupies flat to gently sloping and southwest facing ridgetops at RMNA. It has a general bright appearance due to the sparse canopy trees and one can see for great distances through the understory. The land is relatively flat with occasional rock outcroppings and scatterings of weathered boulders and cobbles. A significant amount of mineral soil is present at the surface, and the ground is visible in most places. CUH did not perform test plot samples in this ecotype due to time restrictions and priorities. Furthermore, this ecotype is nearly identical to the Oak-Kalmia heaths sampled in several other locations at RMNA. The site characteristics make it a very easy and high confidence classification.

The old forestry/fire access road that navigates the perimeter of RMNA slices though each of the three occurrences of this ecotype. The landscape characteristics differ slightly between them, with some areas not having enough soil to support flora. Where soil and mineral sediment are present, acidophiles and ericaceous species are scattered.

The most significant floristic difference between this oak heath plant community and the others at RMNA is the complete absence of mountain laurel. This thicket-forming shrub occurs in Ecosystem #'s 5 and 6, reaching up to 20 feet in some places. Because of its absence, the bottom 20' of the canopy are essentially empty. This evergreen shrub is replaced by black huckleberry and hillside

blueberry colonies, interspersed with robust groupings of deerberry. The ground is depauperate, supporting occasional rattlesnakeweed, striped wintergreen, and other acidophiles.

The upper canopy is comprised solely of chestnut oak, with possible scarlet oak and northern red oak occurring at the margins. The remainder of the overstory is sparsely populated with black gum, red maple, and an occasional sassafras. The shrub and herbaceous layers are a simple and classic blueberry-huckleberry thicket not standing more than 3 feet tall. Blooming nearly all at once in April, it's an extraordinary display of heath ecosystem pollinators. This is an excellent place to go for birds, reptiles, and butterflies. Of particular interest to me are the early season elfin and hairstreak butterflies that occur here (I chased a couple, but could not get an identification for this report). Also present are many species of woodland butterflies that are otherwise difficult to see. Unusual occurrences of smaller butterflies such as skippers are probable as well, as made evident by the salt-and-pepper skipper observed alighting on a huckleberry leaf between sips.

The Oak Heath transitions quickly through Acidic Oak-Hickory conditions on its way to the Basic Oak-Hickory Forests to the west. It occurs with some considerable overlap and intergrading with the Acidic Oak-Hickory ecosystems that trace along the long ridgline on the east edge of the property. All-in-all, this remarkable forest type leaves the naturalist wanting to revisit. Perhaps a pink lady's slipper or small stand of eastern bracken fern finds its home here. When grouped with the many different plant communities nearby, we observe extraordinary variation and diversity over a very short distance. This variety has earned the area the casual designation of Biological Hotspot (the others being the west side of the property, a cluster of ecosystems in the south central area, and Round Top Mountain).

5.Central Appalachian / Inner Piedmont Chestnut Oak Forest *(RMNA-01, 04)*

Figure 27: *View upslope into an extensive mountain laurel grove with a canopy dominated by chestnut oak.*

Representative Community Type: Inner Piedmont Chestnut Oak Forest
Community Description: *Quercus montana / Kalmia latifolia / Vaccinium pallidum* Forest
USNVC CEGL Code: CEGL006299
Classification Confidence: High
Global/State Conservation Rank: G5/S5
Albemarle/Charlottesville Conservation Rank: *None Exists (Under Development, ANHC)*

Figure 28: *American chestnut (Castanea dentata) sapling in the Heath.*

Description: The plot RMNA-01 was positioned in the easternmost of seven oak heaths at RMNA. Non-native species were entirely absent and the plot is easily accessed from the dam parking lot. The overstory is dominated by chestnut oak (*Quercus montana)*, some of which reach more than 100' in height. The plot is nearly free of the tuliptree *(liriodendron tulipifera)* that is prevalent in surrounding forests. The middle and lower canopies are quite sparse, with only sixteen individuals reaching to the height range of 20-60'. In those strata *Quercus montana* remains dominant, followed by a light scattering of red maple (*Acer rubrum)* and black gum (*Nyssa sylvatica)*. The shrub layer is dominated by mountain laurel (*Kalmia latifolia)*. Red maple (*Acer rubrum)* and witch-hazel (*Hamamelis virginiana*) occur with regularity and the deciduous heath species pinxter azalea (*Rhododendron periclymenoides),* deerberry *(Vaccinium stamineum),* and black huckleberry *(Gaylussacia baccata*) reach up above the herbaceous layer. White pine *(Pinus strobus)* and American chestnut *(Castanea dentata*) occur only a few feet outside the plot. The herbaceous layer is dominated by hillside blueberry (*Vaccinium pallidum),* deerberry *(Vaccinium stamineum),* and black huckleberry *(Gaylussacia baccata*). Small colonies of *Polytrichum juniperum* play host to various acidophiles, including striped wintergreen *(Chimaphila maculata)* and ground-pine *(Dendrolycopodium obscurum)*. This habitat type, due to unique site conditions, is depauperate at best. The nutrient-poor soils at this plot and the one described below support only around 30 species of flora. This is second

lowest at RMNA, after the white pine-oak heath (with only 23 species). The estimated age of the forest at this test plot is 90-110 years.

One of the most interesting discoveries during survey was the fact that this plant community occurs consistently on northwest slopes with aspects between 290 and 320 degrees northwest. During preliminary walk-throughs, we noticed this trend. It became quite predictable. In fact, this plant community drapes itself over every single portion of the landscape at RMNA that has a specific set of site conditions, without exception. In addition to the 290-320 degree aspect, slope and soil drainage/moisture classes play an important role in the creation of 8 examples of this community type at RMNA. Very little variation exists between these 8 examples, and most of the variation that does exist is the result of ecosystem size. For example, the largest of the chestnut oak- mountain laurel heaths (RMNA-04) has a slightly higher number of species. Scarlet oak (*Quercus coccinea)* is an important associate in the heath immediately west of the new dam and in several other situations species richness spikes at the transition zone with nearby basic oak-hickory forests.

To shed some light on the slight variation we observed, I offer the following description from test plot RMNA-04. This plot [RMNA-04] was positioned in the east half of an extensive heath located near the center of the south portion of RMNA. This forest is nearly identical to other Oak Heaths on the property, but has slightly more variety in biota (largely due to its size). The lay of the land has become a notable trademark for Kalmia-dominated heaths at RMNA, with aspects always being northwest and slopes being steep. The habitat stops abruptly along the new water's edge at its north side and meets an acidic oak-hickory assemblage to the south. The west margins transition abruptly to a basic mesic forest with tuliptree dominance. In the heath still, and along its west margins, are the anomalous Lion's paw *(Prenanthes serpentaria),* lady fern (*Athyrium asplenoides*) and singular occurrence of eastern bracken fern *(Pteridium aquilinum)*. Red maple *(Acer rubrum)* has become a dominant tree present in all subcanopy layers documented and American beech *(Fagus grandifolia),* another fire-intolerant species, lurks here and there. This habitat type relies historically on fire. Mountain laurel and chestnut oak recruitment are high with fire, but in its absence we may expect an encroachment of red maple, American beech, and other shade-tolerant and fire-intolerant species. Witch-hazel (*Hamamelis virginiana)* occurs occasionally throughout the ecosystem. This forest is likely to be between 75-100 years old and is showing evidence of fire exclusion in *Acer* and *Fagus*. Downed trees, organic material pockets, and outcropping boulders and cobbles offer niches for interesting mosses and fungi.

The mountain laurel thickets at RMNA provide extraordinary shelter and protection for a great variety of species. One of those, the black-throated blue warbler, places its nests in the forks of the laurel shrubs. This species is at risk of disturbance at RMNA, and is noted as being in decline in the region. It is sensitive to all large terrestrial animals, including humans and dogs.

RMNA-01 SITE DESCRIPTION DATA

PLOT#	RMNA-01
PLOT NAME	Oak Heath (OH1)
PROJECT	Ragged Mountain Natural Area Ecosystem Survey
DATE	12/11/2015
COUNTY/CITY	Albemarle County / City of Charlottesville
STATE	Virginia
RECORDER (initials)	DSF
SURVEYORS (initials)	DSF, DMC, RTB
ECOREGION (Omernik Level IV)	Piedmont Uplands
ELEVATION RANGE (ft.)	860' - 890'
LATITUDE (Centroid)	38.0312 (+/- 30m)
LONGITUDE (Centroid)	-78.5564 (+/- 30m)
PLOT SIZE (sq. ft.)	8,611
PLOT DIMENSIONS (sq. ft.)	75' x 115'
ESTIMATED ECOSYSTEM SIZE	1-10 acres
PLOT LOCATION DESCRIPTION	Leaving the upper parking lot, northbound, the plot is immediately east of the RMNA access road. Plot was positioned in the easternmost of 7 oak heaths at RMNA. Non-native species are absent and the plot is easily accessed from the dam parking lot.
GEOLOGIC FORMATION	Central Virginia Blue Ridge Anticlinorium Complex
ROCK TYPES PRESENT	Porphyblastic Biotite-Plagioclase Augen Gneiss
SURFACE COVER (excluding flora, total = 100%)	Bedrock 2%, Organic Matter 86%, Boulders 6%, Cobbles/Gravel 2%, Decaying Wood 4%
SLOPE rise	3.9'
SLOPE run	10.8'
100x/y=	30-65% (Steep) (36.1%)
ANGLE OF INCLINE	19.85°
ASPECT	northwest (307°)
LANDFORM	side slope
TOPOGRAPHIC POSITION	middle slope
EVIDENCE OF DISTURBANCE	dogwood anthracnose (1 specimen, dead), trails/roads (intersects west margin of habitat)

DISTURBANCE COMMENTS	Trail/Road below and above the habitat appear to have had little impact. American chestnut sapling is present.
SOIL DRAINAGE CLASS	well drained
SOIL MOISTURE REGIME	dry-mesic

RMNA-01 TEST PLOT FLORA COUNT COVER CLASS DATA

Latin	**common**	**Cover Class**	**Frequency**	**Relative Frequency (%)**	**DBH range (min-max)**
Upper Canopy (T3)	***(67'-115')***				
Quercus montana	Chestnut Oak	9	18	94.70%	11 - 25"
Liriodendron tulipifera	tulip tree	1	1	5.30%	9"
Middle Canopy (T2)	***(33'-67')***				
Quercus montana	chestnut oak	6	5	62.50%	6"-8"
Acer rubrum	red maple	2	2	25.00%	4"-6"
Nyssa sylvatica	black gum	1	1	12.50%	8"
Lower Canopy (T1)	***(21'-32')***				
Acer rubrum	red maple	4	6	85.70%	3"-4"
Nyssa sylvatica	black gum	1	1	14.30%	3"
Pinus strobus	eastern ash pine	---	---	---	7.5"
Shrub Layer (S)	***(2'-20')***				
Kalmia latifolia	mountain laurel	7	59	61.00%	1/2" - 2 1/2"
Acer rubrum	red maple	5	16	16.50%	1/2" - 2 1/2"
Hamamelis virginiana	witch-hazel	5	10	10.30%	1/2" - 1 3/4"
Vaccinium stamineum	deerberry	4	6	6.20%	1/8" - 1 3/4"
Nyssa sylvatica	black gum	2	2	2.00%	1"-2"
Cornus florida	dogwood	1	1	1.00%	1"
Gaylussacia baccata	black huckleberry	1	1	1.00%	1/4"
Quercus montana	chestnut oak	1	1	1.00%	2 1/2"
Rhododendron periclymenoides	pinxter azalea	1	1	1.00%	3/4"
Castanea dentata	American chestnut	---	---	---	---

Pinus strobus	white pine	---	---	---	3" - 7 1/2"
Herbaceous Layer (H)	***(0'-2')***				
Vaccinium pallidum	early lowbush blueberry	6	---	---	---
Polytrichum juniperinum	juniper haircap moss	5	---	---	---
Vaccinium stamineum	deerberry	4	---	---	---
Gaylussacia baccata	black huckleberry	4	---	---	---
Carex albicans	white-tinged sedge	3	---	---	---
Chimaphila maculata	striped wintergreen	2	---	---	---
Polystichum acrostichoides	Christmas fern	2	---	---	---
Smilax glauca	white-leaf greenbrier	2	---	---	---
Dendrolycopodium obscurum	ground-pine	1	---	---	---
Pinus virginiana	Virginia pine	1	---	---	---
Juniperus virginiana	eastern red cedar	1	---	---	---
Dichanthelium spp.	panic grass spp.	1	---	---	---
Hieracium venosum	rattlesnake weed	1	---	---	---
Comandra umbellata	eastern bastard toadflax	1	---	---	---

RMNA-04 SITE DESCRIPTION DATA

PLOT#	RMNA-04
PLOT NAME	Oak heath(OH6)
PROJECT	Ragged Mountain Natural Area Ecosystem Survey
DATE	12/18/2015
COUNTY/CITY	Albemarle County / City of Charlottesville
STATE	Virginia
RECORDER (initials)	DSF
SURVEYORS (initials)	DSF, RTB, DMC, JRS
ECOREGION (Omernik Level IV)	Piedmont Uplands
ELEVATION RANGE (ft.)	830'-820'
LATITUDE (Centroid)	38.0262

LONGITUDE (Centroid)	-78.5644
PLOT SIZE (sq. ft.)	8,611
PLOT DIMENSIONS (sq. ft.)	52.4' radius
ESTIMATED ECOSYSTEM SIZE	10-12 acres
PLOT LOCATION DESCRIPTION	Plot located in the east half of the largest Oak Heath at RMNA & Approx. 300' south of the water's edge.
GEOLOGIC FORMATION	Central Virginia Blue Ridge Anticlinorium Complex
ROCK TYPES PRESENT	Porphyblastic Biotite-Plagioclase Augen Gneiss
SURFACE COVER (excluding flora, total = 100%)	Organic matter 85%, Boulders 2%, Cobbles/Gravel 3%, Decaying wood 7%, Mineral Soil/Sand 3%
SLOPE rise	6'
SLOPE run	20'
100x/y=	30-65% (steep)
ANGLE OF INCLINE	Single measure 16.7°
ASPECT	northwest
LANDFORM	side slope
TOPOGRAPHIC POSITION	middle slope
EVIDENCE OF DISTURBANCE	grazing/browsing, logging
DISTURBANCE COMMENTS	Deer browsing on Vaccinium pallidum and Kalmia latifolia. Fire dependent habitat type has the fire-intolerant species Acer rubrum extending into the middle canopy.
SOIL DRAINAGE CLASS	well drained
SOIL MOISTURE REGIME	Dry-mesic

RMNA-04 TEST PLOT FLORA COUNT COVER CLASS DATA

Out	*Latin*	common	Cover Class	Frequency	Relative Frequency (%)	DBH range (min-max)
	Upper Canopy (T3)	***(67'-115')***				
	Quercus montana	Chestnut Oak	9	11	76.70%	10-46"
	Liriodendron tulipifera	tulip tree	3	2	14.20%	15-18"
	Acer rubrum	red maple	1	1	7.10%	10.5"
✓	*Quercus coccinea*	scarlet oak	---	---	---	---
	Middle Canopy (T2)	***(33'-67')***				
	Acer rubrum	red maple	4	6	54.50%	4-6.6"

	Nyssa sylvatica	black gum	4	5	45.50%	5-5.7"
✓	*Fagus grandifolia*	American beech	---	---	---	---
	Lower Canopy (T1)	***(21'-32')***				
	Nyssa sylvatica	black gum	5	19	82.60%	2-4.5"
	Acer rubrum	red maple	1	3	13.10%	2-3"
	Hamamelis virginiana	witch-hazel	1	1	4.30%	2"
	Shrub Layer (S)	***(2'-20')***				
	Kalmia latifolia	mountain laurel	8	197	92.10%	.25-2.5"
	Nyssa sylvatica	black gum	4	14	6.50%	1-2.5"
	Sassafras albidum	sassafras	1	2	<1%	1.5"
	Acer rubrum	red maple	1	1	<1%	1.5"
	Herbaceous Layer (H)	***(0'-2')***				
	Kalmia latifolia	mountain laurel	5	---	---	---
	Chimaphila maculata	striped wintergreen	2	---	---	---
	Leucobryum glaucum	cushion moss	2	---	---	---
	Polytrichum juniperinum	juniper haircap moss	2	---	---	---
	Carex spp.	sedge unidentified	1	---	---	---
	Goodyera pubescens	downy rattlesnake plantain	1	---	---	---
	Rhododendron periclymenoides	pinxter azalea	1	---	---	---
	Smilax glauca	white-leaved greenbrier	1	---	---	---
	Thuidium delicatulum	delicate fern moss	1	---	---	---
	Vaccinium pallidum	hillside blueberry	1	---	---	---
✓	*Prenanthes serpentaria*	lion's paw	---	---	---	---
✓	*Athyrium asplenioides*	southern lady fern	---	---	---	---
✓	*Vaccinium stamineum*	deerberry	---	---	---	---
✓	*Gaylussacia baccata*	black huckleberry	---	---	---	---
✓	*Pteridium aquilinum*	eastern bracken fern	---	---	---	---

6.Central Appalachian / Piedmont White Pine-Oak Forest *(RMNA-DCR-10)*

Figure 29: *The white pine heaths at RMNA hold the only true "evergreen" forests on the property.*

Representative Community Type: Central Appalachian / Piedmont White Pine - Oak Forest
Community Description: *Pinus strobus - Quercus alba - Quercus* (*coccinea, montana*) / *Vaccinium stamineum* Forest
USNVC CEGL Code: CEGL008539
Classification Confidence: High
Global/State Conservation Rank: Global/State Ranks: G4/S4
Albemarle/Charlottesville Conservation Rank: *None Exists (Under Development, ANHC)*

Description: The evergreen forests at RMNA are a pleasant deviation from the dominant deciduous forests. With a canopy co-dominated by eastern white pine *(Pinus strobus)* and chestnut oak *(Quercus montana)*, and a shrub layer that presents a thicket of mountain laurel *(Kalmia latifolia)* this ecosystem is reminiscent of Appalachian or northeast forests. The west to northwest aspect of the slopes that this plant community grows on offers a microclimate setting that results in this northern signature. Typically in the Piedmont, when we speak of pine forests, we do so in reference to early to middle successional forests that eventually make way for oak-hickory. In rare cases we have pine-heaths as the mature forest expression, and the most notable of these typically occurs either on ridges and steep upland slopes with a southerly exposure (as in the case of mixed pine, pitch pine, table mountain pine - chestnut oak and/or scarlet oak heaths) or in association with groves of hemlock on steep river bluffs with a westerly or northerly exposure. The white pine finds itself in those ecosystems occurring only sparingly. Our other pines not yet mentioned, the shortleaf *(Pinus echinata)* and Virginia pine (*Pinus virginiana)* will co-occur at these pine and hemlock heaths, but they are more typically associated with young forest succession. Loblolly pine gets in on the action as well, with the greater Albemarle/Charlottesville area being the northern and western-most extent of its natural range (only one hypothesized native specimen has been documented in the area). With the white pine being rather uncommon in the Piedmont, it always catches my attention when present. It reminds me of my Appalachian roots. I can smell this heath forest type before I see it, as the organic duff covering the forest floor has a distinct tannin-citrus odor (to my nose). But what intrigues me most about this ecosystem type is the romantic idea that it is a relic ecosystem that was more common thousands of years ago when our climate was cooler. It's a northern system that marched north long ago as we departed the last ice age. As the climate warmed, our Piedmont landscape held fewer and fewer examples of northern species. They crept upslope and around to the cooler north and northwest side of hills. Today they find refuge in our area in rare and isolated patches. The white pine-oak heath is now contained on west-to-north facing slopes in our area, separated by great

distances from forests of their kind. At RMNA we have conditions in a few areas that allow this already diverse forest biome to host yet another plant community type.

This is a simple forest type, from the standpoint of species variety. The soil conditions are sharply acidic, nutrient-poor, and well-drained, and a bounty of heavy metals further impede plant growth. This has the effect of carefully selecting only the species that can handle these conditions. There aren't many in our area, and in fact survey results only produced 23 species! This may seem low, but this low number is part of what characterizes this unique ecosystem type. A benefit of the harsh soil conditions is the fact that non-native invasive species will not grow here. This heath, as well as the oak-blueberry-mountain laurel heaths at RMNA, have the least invasive species when compared to other ecosystem types. In fact, only one specimen of one species was noted in all the heaths combined… Oriental bittersweet. That said, it is likely that occasional Japanese honeysuckle finds its way into the margins of the heath, despite the not-so-friendly welcome.

The upper canopy of this forest type is dominated by a mix of white pine and chestnut oak, with occasional white oak and black oak getting in on the action. A few giant specimens of white pine lurk here and there. Filling the middle canopy strata are scattered occurrences of black gum, sassafras, dogwood, with-hazel and red maple. At the margins of the habitat tuliptree and oaks become more prevalent as the soil moisture picks up a bit. The lower canopy and shrub layers are dominated by heath, including mountain laurel, hillside blueberry *(Vaccinium pallidum)*, deerberry *(Vaccinium stamineum)*, and an occasional maleberry (*Lyonia ligustrina).* The extremely sparse herb layer has only a hand full of species. Slender woodland sedge (*Carex digitalis*) and ribbed sedge *(Carex virescens)* occur sparingly, as do christmas fern *(Polystichum acrostichoides)* and hay-scented fern *(Dennstaedtia punctilobula)*. Striped wintergreen *(Chimaphila maculata),* Indian cucumber-root *(*Medeola virginiana), Virginia creeper *(Parthenocissus quinquefolia),* winter grape *(Vitis vulpina)*, and naked-flowered tick-trefoil *(Hylodesmum nudiflorum)* round off the list.

Three separate examples of this ecotype reside at RMNA. They differ from one another only slightly, and mostly by scales of size and ecosystem type purity. The smallest and most fragmented of these is the mixed white pine-oak heath in the southwest corner, immediately east of the new bridge. While conditions here may have once been optimal for the white pine it appears that it is declining here. Perhaps the largest specimens were harvested during the 1950's logging operation, and maybe a significant portion was lost the recent dam renovation. It presents itself somewhere between the classifications of pine-oak heath and oak-heath, with a strong enough signature of eastern white pine to cause us to maintain the eastern white pine – oak forest classification. Another difference observed at this particular site are the sunny margins at the west end. This may be a new condition, but it appears to encourage large numbers of flowering acidophiles, including one of the most magnificent colonies of the yellow-flowering rattlesnake week I've encountered anywhere. Another occurrence is along a northwest facing ridge line in the northeast portion of RMNA. This one contains an enormous white pine specimen and varies from the other occurrences only slightly. It transitions to a pure chestnut oak heath to the east, and significant amounts of witch-hazel occupy the eastern portions of the habitat.

The largest of the three occurrences is in the north-central area of RMNA. The Department of Conservation and Recreation conducted a survey here in 2007, providing us with detailed soil and vegetative information. This white pine-oak forest is extensive and offers the best example of the forest type at RMNA. It is worth noting that the extensive thickets of mountain laurel in this heath and others provide ideal nesting habitat for the black-throated blue warbler (an at risk species that is

in decline). It nests close to the ground, and minimal human presence would best preserve this species, as well as the overall northern wilderness feel of the habitat type.

The following excerpt from the 2007 DCR survey plot describes the largest of the white pine-oak forests at RMNA:

> *"This plot is located in a 4 hectare stand of white pine and hardwoods on a west-facing slope and ridge. This is the most mature and least disturbed of several similar stands occurring in the Ragged Mountain Natural Area. Most of the patch is quite dry and Quercus montana, Quercus alba, and Quercus velutina, some of which are quite old, are the principal hardwoods. On the lower slope at the western edge of the stand, Quercus rubra and Liriodendron become important as soil moisture ostensibly increases. The plot is positioned near the transition zone between these variants. The overall vegetation of this area is much less species-rich than most other parts of the Natural Area, and Kalmia latifolia forms dense thickets. There is little or no recruitment of oaks in this stand, and only moderate recruitment of Pinus strobus; Liriodendron tulipifera, Nyssa sylvatica, and Acer rubrum are the principal understory trees. It appears that Pinus strobus initially increased in this area following logging many decades ago, but has been overtaken by the mesophytic hardwoods in recent decades".* (DCR 2007)

RMNA-DCR-10 SITE DESCRIPTION DATA

PLOT#	RMNA-DCR-10
PLOT NAME	Basic Oak-Hickory, East Facing (2007 DCR Plot #ALBE-009)
PROJECT	Ragged Mountain Natural Area Ecosystem Survey
DATE	7/27/2007
COUNTY/CITY	Albemarle County / City of Charlottesville
STATE	Virginia
RECORDER (initials)	GF
SURVEYORS (initials)	GF
ECOREGION (Omernik Level IV)	Piedmont Uplands
ELEVATION RANGE (ft.)	692'
LATITUDE (Centroid)	Latitude 38 01 58.6 (+/- 25m)
LONGITUDE (Centroid)	Longitude 78 34 03.8 (+/- 25m)
PLOT SIZE (sq. ft.)	4,306
PLOT DIMENSIONS (sq. ft.)	43.7' x 98.4'
ESTIMATED ECOSYSTEM SIZE	Large
PLOT LOCATION DESCRIPTION	Plot was located on a west facing slope and ridge in the west portion of RMNA.
GEOLOGIC FORMATION	Central Virginia Blue Ridge Anticlinorium Complex

ROCK TYPES PRESENT	Porphyblastic Biotite-Plagioclase Augen Gneiss
SURFACE COVER (excluding flora, total = 100%)	Organic Matter 97%, Decaying Wood 3%
SLOPE rise	--
SLOPE run	--
100x/y=	--
ANGLE OF INCLINE	12º
ASPECT	East (280º)
LANDFORM	Side slope
TOPOGRAPHIC POSITION	Middle slope
EVIDENCE OF DISTURBANCE	exotic plants, logging
DISTURBANCE COMMENTS	Old chestnut log in the plot
SOIL DRAINAGE CLASS	Well drained
SOIL MOISTURE REGIME	submesic

RMNA-DCR-10 TEST PLOT FLORA COUNT COVER CLASS DATA *Survey method omitted strata delineation, and focused on cover class. Therefore the chart below looks a bit different from others in this document.*

Latin	**common**	**Cover Code**	**Cover (%)**
Kalmia latifolia	mountain laurel	8	62.5 %
Pinus strobus	eastern white pine	7	37.5 %
Quercus alba	white oak	6	17.5 %
Acer rubrum	red maple	5	7.5 %
Liriodendron tulipifera	tuliptree	5	7.5 %
Nyssa sylvatica	black gum	5	7.5 %
Quercus montana	chestnut oak	5	7.5 %
Quercus velutina	black oak	5	7.5 %
Sassafras albidum	sassafras	3	1.5 %
Carex digitalis	slender woodland sedge	2	0.505 %
Carex virescens	ribbed sedge	2	0.505 %
Chimaphila maculata	striped wintergreen	2	0.505 %
Cornus florida	flowering dogwood	2	0.505 %
Dennstaedtia punctilobula	hay-scented fern	2	0.505 %
Lyonia ligustrina var. ligustrina	maleberry	2	0.505 %

Medeola virginiana	Indian cucumber-root	2	0.505 %
Parthenocissus quinquefolia	Virginia creeper	2	0.505 %
Polystichum acrostichoides	christmas fern	2	0.505 %
Vaccinium pallidum	hillside blueberry	2	0.505 %
Vaccinium stamineum	deerberry	2	0.505 %
Vitis vulpina	winter grape	2	0.505 %
Celastrus orbiculatus	Oriental bittersweet	1	0.05 %
Hylodesmum nudiflorum	naked-flowered tick-trefoil	1	0.05 %

7.Central Appalachian Basic Ash-Hickory Woodland *(RMNA-02)*

Figure 30: *The bright atmosphere of the ash-hickory rock outcrop woodlands on the south side of Round Top Mountain is speckled with the blossoms of redbud in spring.*

Representative Community Type: Central Appalachian Basic Ash-Hickory Woodland
Community Description: *Fraxinus americana / Carya glabra – Juniperus virginiana - (Ailanthus altissima) / Aralia spinosa – Cercis Canadensis - (Rubus phoenicolasius) / Corydalis flavula – Woodsia obtusa - (Microstegium vamineum)* Woodland
USNVC CEGL Code: CEGL003683
Classification Confidence: Moderate. No exact match.
Global/State Conservation Rank: G2/S2
Albemarle/Charlottesville Conservation Rank: *None Exists (Under Development, ANHC)*

Description: This reare plant community occurs on the exposed and weathered south-facing slopes of Round Top Mountain. The rather open terrain is completely exposed to the elements and shallow soils drape over and in between huge flat and convex rock outcroppings. Variation, dictated by the islands of convex-sloped bedrock, results in a patchwork of full sun and partial shade conditions. Pockets of soil accumulate to great depths in places, allowing for larger trees to grow. However, due to the lack of root grip, trees can only grow to moderate heights before winds topple them over. Therefore the site is littered with the decomposing logs of a wide variety of sizes and species of shrubs and trees.

More than a dozen extensive rock faces press up from the land. They are spread across the south slopes for a significant distance and cascade downward until the terrain begins to flatten again. The steep rock faces alternate with relatively flat areas of rock soil, creating a terraced effect. Centuries of tree falls have cracked, removed and dispersed large boulders and spalls of bedrock. These have toppled down slope over time, creating fields of talus at the base of the hill. The sheer quantity of the talus may also indicate that significant freeze-thaw and storm events played a role during the distant past. No evidence of quarry activity is readily visible, so for now we hypothesize that the landform and rocky surface patterns are natural.

In aerial imagery for this habitat one finds the classic brown and gray color patterning typical of southeast facing Basic Woodlands and Outcrop Barrens in the region. The woodland differs significantly from the other plant communities on Round Top and is unique to RMNA north of I-64. There are a few examples of the community type south of I-64, and even a couple immediately east of the old RMNA parking lot (one can see the same vegetative patterns in aerial imagery). All of

those examples are known to be in a better state of preservation than our example on the south side of Round Top.

Despite the shallow rocky soils, the substrate is quite fertile. The high levels of calcium and magnesium have resulted in a unique plant community. Calcophiles dominate the assemblage, including ash, hickory, redbud, eastern red cedar, and hackberry. Due to this richness these habitat types tend to have issues with non-native species. This is certainly the case with our 3 acre outcrop woodland. It is significantly impacted by *Microstegium vamineum, Lonicera japonica and Rubus phoenicolasius*, making it a reduced version of the intact and remarkable outcrop barrens that occur 500' south (and off of current RMNA property). Despite the influx of non-natives species, indicator species remain present. The upper canopy, being about 50% open, consists entirely of white ash (*Fraxinus americana)*. One large specimen has a dbh of 36", despite being perched upon the face of a rock. Somehow it has managed to grasp the bedrock adequately so as to avoid the fate that has met other large trees on site.

The middle canopy remains mostly open and is occupied by scattered white ash (*Fraxinus americana*), eastern red cedar (*Juniperus virginiana),* pignut hickory (*Carya glabra*), and post oak (*Quercus stellata*). The lower canopy is nearly empty, containing scattered specimens of pignut hickory (*Carya glabra),* Ailanthus *(Ailanthus altissima),* and redbud *(Cercis Canadensis*). The shrub layer is highly compromised by wineberry *(Rubus phoenicoloasius)* and 3 other non-native shrubs. Remnants of a once healthy ecosystem are seen in devil's walking stick (*Aralia spinosa)* colonies, dwarf hackberry (*Celtis tenuifolia*) and blackhaw (*Viburnum prunifolium)*. The herbaceous layer is greatly impacted by (*Microstegium vamineum)*. Blunt-lobed woodsia (*Woodsia obtusa)* occurs in patches among extensive colonies of yellow fumewort *(Corydalis flavula*). A *Grimmia* species of dry rock moss graces the rock faces. Occasional seepages provide rare, but consistent moisture. Some bedrock faces are large, and a few vertical drops occur.

RMNA-02 SITE DESCRIPTION DATA

PLOT#	RMNA-02
PLOT NAME	Basic Outcrop Woodland (BB-1)
PROJECT	Ragged Mountain Natural Area Ecosystem Survey
DATE	12/11/2015
COUNTY/CITY	Albemarle County / City of Charlottesville
STATE	Virginia
RECORDER (initials)	DSF
SURVEYORS (initials)	DMC, DSF, RTB
ECOREGION (Omernik Level IV)	Piedmont Uplands
ELEVATION RANGE (ft.)	720'-875'
LATITUDE (Centroid)	38.0292 (+/- 30m)
LONGITUDE (Centroid)	-78.5553 (+/- 30m)

PLOT SIZE (sq. ft.)	8,611
PLOT DIMENSIONS (sq. ft.)	52.4' radius
ESTIMATED ECOSYSTEM SIZE	1 - 10 acres
PLOT LOCATION DESCRIPTION	Located on the south upper slopes of Round Top Mountain, extending down to a drainage that leads southwest to the lower (older) parking lot area.
GEOLOGIC FORMATION	Central Virginia Blue Ridge Anticlinorium Complex
ROCK TYPES PRESENT	Porphyblastic Biotite-Plagioclase Augen Gneiss
SURFACE COVER (excluding flora, total = 100%)	Bedrock 50%, Organic Matter 25%, Boulders 10%, Cobbles/Gravel 5%, Decaying Wood 10%
SLOPE rise	6.2'
SLOPE run	13.6'
100x/y=	30-65% (steep) (46% - 57%)
ANGLE OF INCLINE	27.1º
ASPECT	South (160º)
LANDFORM	Side slope, cliff / escarpment / face, bedrock outcrop, boulderfield / talus / debris slide
TOPOGRAPHIC POSITION	Middle slope
EVIDENCE OF DISTURBANCE	exotic plants, wind / ice damage, erosion
DISTURBANCE COMMENTS	This site, while retaining most of its woody strata integrity, has a greatly compromised herbaceous layer. Despite the prevalence of exotics, interesting indicator species still grow beneath them.
SOIL DRAINAGE CLASS	Rapidly drained
SOIL MOISTURE REGIME	Predominantly xeric, but with wet-mesic pockets/seepages

RMNA-02 TEST PLOT FLORA COUNT COVER CLASS DATA

Latin	**common**	**Cover Class**	**Frequency**	**Relative Frequency (%)**	**DBH range (min-max)**
Upper Canopy (T3)	***(67'-115')***				
Fraxinus americana	white ash	7	7	100%	11" - 36"
Middle Canopy (T2)	***(33'-67')***				
Carya glabra	pignut hickory	7	8	61.50%	5" - 9.5"
Juniperus virginiana	eastern red cedar	5	2	15.40%	14" - 17"
Quercus stellata	post oak	1	1	7.70%	16"

Carya ovalis	red hickory	---	---	--%	---
Lower Canopy (T1)	***(21'-32')***				
Carya glabra	pignut hickory	4	3	50%	2.5in-3.5"
Ailanthus altissima	tree-of-heaven	2	2	33%	2"-5"
Cercis canadensis	redbud	1	1	16.70%	15 7/8"
Shrub Layer (S)	***(2'-20')***				
Rubus phoenicolasius	wineberry	7	89	48.10%	1/8" - 1/2"
Aralia spinosa	Devil's walking stick	5	31	16.80%	1/2" - 1 3/4"
Ailanthus altissima	tree-of-heaven	5	19	10.30%	1/2" - 1 1/2"
Symphoricarpos orbiculatus	coralberry	4	21	11.40%	1/8" - 1/2"
Carya glabra	pignut hickory	4	8	4.30%	1/2" - 3 1/2"
Cercis canadensis	redbud	2	4	2.20%	1 1/2" - 4 1/2"
Elaeagnus umbellata	autumn olive	2	3	1.60%	1/2" - 1 3/4"
Quercus stellata	post oak	1	2	1.10%	4"
Celtis tenuifolia	dwarf hackberry	1	1	<1%	1/2"
Rubus pensylvanicus	Pennsylvania blackberry	1	3	1.60%	1/4"
Parthenocissus quinquefolia	Virginia creeper	1	1	<1%	1/8"
Juniperus virginiana	eastern redcedar	1	1	<1%	5"
Viburnum prunifolium	black haw	1	2	1.10%	1/4" - 2 1/2"
Herbaceous Layer (H)	***(0'-2')***				
Microstegium vimineum	Japanese stiltgrass	7	---	---	---
Corydalis flavula	yellow fumewort	5	---	---	---
Alliaria petiolata	garlic mustard	3	---	---	---
Cardamine hirsuta	hairy bittercress	3	---	---	---
Symphoricarpos orbiculatus	coralberry	3	---	---	---
Aralia spinosa	devil's walking-stick	3	---	---	---
Stellaria media	common chickweed	2	---	---	---
Galium triflorum	sweet-scented bedstraw	2	---	---	---

Lonicera japonica	Japanese honeysuckle	2	---	---	---
Asplenium platyneuron	ebony spleenwort	2	---	---	---
Woodsia obtusa	blunt-lobed woodsia	2	---	---	---
Bidens bipinnata	Spanish needles	2	---	---	---
Grimmia spp.	grimmia dry rock moss	2	---	---	---
Ailanthus altissima	tree-of-heaven	2	---	---	---
Muhlenbergia sobolifera	rock muhly	2	---	---	---
Acalypha virginica	Virginia copperleaf	1	---	---	---
Allium spp.	unidentified onion	1	---	---	---
Carex albicans	white-tinged sedge	1	---	---	---
Carex spp. 1	sedge unid. 1	1	---	---	---
Carex spp. 2	sedge unid. 2	1	---	---	---
Cercis canadensis	redbud	1	---	---	---
Parthenocissus quinquefolia	Virginia creeper	1	---	---	---
Perilla frutescens	perilla	1	---	---	---
Persicaria longiseta	longbristled smartweed	1	---	---	---
Solanum ptycanthum	black nightshade	1	---	---	---
Gleditsia triacanthos	honey locust	1	---	---	---
Parietaria pensylvanica	Pennsylvania pellitory	1	---	---	---

8.Basic Oak-Hickory + Piedmont Basic Woodlands *(RMNA-06)*

Figure 31: *A view into the hickory-dominated rock outcrop woodlands of RMNA.*

Representative Community Type: Inner Piedmont/Lower Blue Ridge Basic Oak-Hickory Forest with Piedmont Basic Woodland characteristics
Community Description: *Quercus rubra – Carya tomentosa / Carya tomentosa (Carya ovalis - Carya glabra) / Bidens bipinnata - Carex pensylvanica - Eupatorium sessilifolium - Vaccinium stamineum* Woodland
USNVC CEGL Code: CEGL008514
Classification Confidence: Moderately Low. No good matches. Likely a subset of the Basic Oak-Hickory Forest.
Global/State Conservation Rank: G3G4/S3S4
Albemarle/Charlottesville Conservation Rank: *None Exists (Under Development, ANHC)*

Description: This basic oak-hickory woodland is located on a south-facing slope west of the newly shaped peninsula and immediately south of the new bridge. These boulder and outcrop-strewn woodlands span from the ridge top to about half way down the slope, transitioning to a mesic ravine setting with preponderance of tuliptree near the base of the slope. The plant community type is present so long as the slope is facing due south (+/- 10 degrees). Great variation is present due to scattered but extensive flat, convex, and round outcrops. The spaces in between contain more tree and herbaceous growth variety, and the woodlands are dominated by hickory species closer to, and upon, the rocks. Classification of this ecosystem type was difficult, as the forest mix is ambiguous and inconsistent. We hypothesize that this portion of the property was under heavy pasture use during the early part of the 20th century. Evidence of early succession is present in the seedlings and downed logs of black locust, and shrub layer density is low with Autumn olive being a co-dominant species.

Dominating the ceiling of this vibrant habitat are the upper canopy species, mockernut hickory *(Carya tomentosa),* northern red oak (*Quercus rubra),* and white oak (*Quercus alba).* The middle canopy is sparse, containing only six trees. Interestingly, there are 1 each of 6 species, with mockernut hickory *(Carya tomentosa)* having the most robust canopy. The other five species were common persimmon, pignut hickory, tuliptree, northern red oak, and chestnut oak. A sparse lower canopy is again dominated by mockernut hickory *(Carya tomentosa),* with secondary species being red hickory (*Carya ovalis)* and white oak *(Quercus alba).* Pignut hickory, northern red oak, and red maple complete the list.

The shrub layer is a little more complex than that seen in other ecosystems at RMNA. 13 species are present. Despite this variety, the density in native species is quite low. Wineberry *(Rubus phoenocolasius)* is the dominant cover class, with an estimated 40 shrubs being present. Mockernut hickory and Ailanthus seedlings come in a distant second. Though low in numbers, flowering dogwood does generate a significant significant coverage.

Despite the apparent site disturbance, the soil seed bank remains intact. Herbaceous flora variety at this site is extremely high, with base-loving species being ever-present, including yellow passionvine (*Passiflora lutea),* enchanter's nightshade *(Circaea Canadensis),* and Virginia snakeroot (*Endodeca serpentaria).* Many species found here occur nowhere else at RMNA, including the woody species gooseberry *(Ribes spp.)* and a hawthorn *(Crataegus spp.).* Old field and cultural species remain include dandelion, Siberian crabapple, pokeweed, and Chinese holly. Many interesting natives lurk here and give us a Basic Woodland classification bent, including Spanish needles (*Bidens bipinnata),* blunt-lobed woodsia (*Woodsia obtusa),* woodland sunflower (*Helianthus divaricatus)*, dwarf hackberry *(Celtis tenuifolia)*, eastern red cedar (*Juniperus virginiana),* upland boneset (*Eupatorium sessilifolia)*, rock muhly *(Muhlenbergia sobolifera),* Pennsylvania sedge (*Carex pensylvanica),* Carolina rose *(Rosa Carolina)*, and a suspected fringetree *(Chionanthus virginicus)* seedling. At the margins of the test plot, and filling deeper base-rich soil pockets, are extensive colonies of black cohosh *(Actaea racemosa).* A large grouping of false Solomon's plume *(Maianthemum racemosum)* cascades down a rock at the west end. Many unidentified species that occur nowhere else at RMNA warrant further research, including a woodland goldenrod and milkweed. Southern wood violet (*Viola hirsutula)* and wood violet (*Viola palmate)* form lovely colonies nearer the ridgeline. Moss and fungi variety are very high in this ecosystem and animal activity appeared to exceed that of all the other ecosystem types we samples.

Dragonflies and damselflies were very active, as were woodland butterfly species. Insects of great variety were spread throughout and gray tree frogs, yellow-rumped warblers, and wood thrushes provided song for the day. A giant black rat snake visited our datum on its way through the site and a large northern watersnake was observed at the far west margin. Five-lined skinks and six-spotted tiger beetles were activity darting about in search of prey. A lone coyote found its final resting place on an outcrop ledge in this ecosystem, possibly after being struck by a vehicle on I-64 (its jaw was crushed). Within the span of the survey it was reduced to a pile of scattered bones by various scavengers that remain undocumented.

RMNA-06 SITE DESCRIPTION DATA

PLOT#	RMNA-06
PLOT NAME	Hickory Outcrop Woodland (BB3 + OHs25)
PROJECT	Ragged Mountain Natural Area Ecosystem Survey
DATE	4/25/2016
COUNTY/CITY	Albemarle County / City of Charlottesville
STATE	Virginia
RECORDER (initials)	DSF
SURVEYORS (initials)	DMC, DSF, RTB, JRS

ECOREGION (Omernik Level IV)	Piedmont Uplands
ELEVATION RANGE (ft.)	825'-860'
LATITUDE (Centroid)	38.0254 (+/- 30m)
LONGITUDE (Centroid)	-78.5690 (+/- 30m)
PLOT SIZE (sq. ft.)	8,611
PLOT DIMENSIONS (sq. ft.)	52.4' radius
ESTIMATED ECOSYSTEM SIZE	1 - 10 acres
PLOT LOCATION DESCRIPTION	Located on a south facing rocky slope, west of the new peninsula and south of the trail leading to the bridge.
GEOLOGIC FORMATION	Central Virginia Blue Ridge Anticlinorium Complex
ROCK TYPES PRESENT	Porphyblastic Biotite-Plagioclase Augen Gneiss
SURFACE COVER (excluding flora, total = 100%)	Bedrock 35%, Organic Matter 35%, Boulders 10%, Cobbles/Gravel 5%, Decaying Wood 15%, Mineral Soil/Sand 5%
SLOPE rise	4.8'
SLOPE run	20'
100x/y=	16-30% (moderate/hilly)
ANGLE OF INCLINE	13.5º
ASPECT	South (200º)
LANDFORM	Side slope, bedrock outcrop
TOPOGRAPHIC POSITION	Upper - Middle slope
EVIDENCE OF DISTURBANCE	exotic plants, trails and roads, clearing
DISTURBANCE COMMENTS	Historic clearing is visible in the age of the trees, likely abandoned pasture from early 20th century
SOIL DRAINAGE CLASS	Well-drained
SOIL MOISTURE REGIME	Dry-mesic

RMNA-06 TEST PLOT FLORA COUNT COVER CLASS DATA *(Species observed immediately outside of plot, but still in the plant community, are noted in the far left column under "Out")*

Out	*Latin*	common	Cover Class	Frequency	Relative Frequency (%)	DBH range (min-max)
	Upper Canopy (T3)	***(67'-115')***				
	Quercus rubra	northern red oak	6	4	40%	6.9-22.9"
	Carya tomentosa	mockernut hickory	6	3	30%	9-14"
	Quercus alba	white oak	4	1	10%	22.8"
	Liriodendron tulipifera	tuliptree	3	1	10%	7.1"

	Quercus montana	chestnut oak	3	1	10%	14.9"
✓	*Quercus velutina*	black oak	3	---	---	---
	Middle Canopy (T2)	***(33'-67')***				
	Carya tomentosa	mockernut hickory	4	1	16.6%	6.4"
	Quercus montana	chestnut oak	3	1	16.6%	8.4"
	Liriodendron tulipifera	tuliptree	3	1	16.6%	5.8"
	Quercus rubra	northern red oak	3	1	16.6%	6.3"
	Carya glabra	pignut hickory	3	1	16.6%	4"
	Diospyros virginiana	common persimmon	3	1	16.6%	7.3"
	Lower Canopy (T1)	***(21'-32')***				
	Carya tomentosa	mockernut hickory	6	4	33%	2.3-4.3"
	Carya ovalis	red hickory	4	2	16.6%	2.6-3"
	Acer rubrum	red maple	3	1	8.3%	3.2"
	Quercus alba	white oak	4	3	25%	2.4-4.6"
	Quercus rubra	northern red oak	3	1	8.3%	3.6"
	Carya glabra	pignut hickory	3	1	8.3%	3.2"
	Shrub Layer (S)	***(2'-20')***				
	Carya tomentosa	mockernut hickory	5	8	10%	1.1-2.4"
	Rubus phoenicolasius	wineberry	5	40	51%	>1"
	Cornus florida	flowering dogwood	4	2	2.5%	2-3.15"
	Celastrus orbiculatus	coralberry	3	3	3.8%	>.5
	Ailanthus altissima	tree-of-heaven	2	7	8.9%	>1"
	Aralia spinosa	devil's walking stick	2	5	6.4%	>1"
	Carya glabra	pignut hickory	2	2	2.5%	3-3.4"
	Carya ovalis	red hickory	2	2	2.5%	>1-2.3
	Elaeagnus umbellata	autumn olive	2	5	6.4%	>1"
	Acer rubrum	red maple	1	1	1.2%	2.25"
	Celtis tenuifolia	dwarf hackberry	1	1	1.2%	>1"
	Ilex opaca	American holly	1	1	1.2%	>.5

	Juniperus virginiana	eastern red cedar	1	1	1.2%	>.5
✓	*Fagus grandifolia*	American beech	---	---	---	---
✓	*Hamamelis virginiana*	witch-hazel	---	---	---	---
✓	*Malus baccata*	Siberian crabapple	---	---	---	---
	Herbaceous Layer (H)	***(0'-2')***				
	Bidens bipinnata	Spanish needles	4	---	---	---
	Carex pensylvanica	Pennsylvania sedge	4	---	---	---
	Eupatorium sessilifolium	upland boneset	4	---	---	---
	Rubus phoenicolasius	wineberry	4	---	---	---
	Vaccinium stamineum	deerberry	4	---	---	---
	Amphicarpaea bracteata	hog-peanut	3	---	---	---
	Carya spp.	hickory	3	---	---	---
	Celtis tenuifolia	dwarf hackberry	3	---	---	---
	Physalis spp.	ground cherry unidentified	3	---	---	---
	Acer rubrum	red maple	2	---	---	---
	Ailanthus altissima	tree-of-heaven	2	---	---	---
	Aralia spinosa	devil's walking stick	2	---	---	---
	Asclepias spp.	milkweed unidentified	2	---	---	---
	Boehmeria cylindrica	false nettle	2	---	---	---
	Carex communis	fibrous-rooted sedge	2	---	---	---
	Carex striatula	lined sedge	2	---	---	---
	Celastrus orbiculatus	Oriental bittersweet	2	---	---	---
	Cercis canadensis var. canadensis	eastern redbud	2	---	---	---
	Chimaphila maculata	striped wintergreen	2	---	---	---
	Circaea canadensis	enchanter's night-shade	2	---	---	---
	Cornus florida	flowering dogwood	2	---	---	---
	Eupatorium godfreyanum	Godfrey's thoroughwort	2	---	---	---
	Euphorbia corrolata	flowering spurge	2	---	---	---
	Galium aparine	cleavers	2	---	---	---

	Galium circaezans	forest bedstraw	2	---	---	---
	Galium triflorum	sweet-scented bedstraw	2	---	---	---
	Grimmia spp.	grimmia dry-rock moss	2	---	---	---
	Juniperus virginiana	eastern red cedar	2	---	---	---
	Liriodendron tulipifera	tuliptree	2	---	---	---
	Microstegium vimineum	Japanese stiltgrass	2	---	---	---
	Muhlenbergia sobolifera	rock muhly	2	---	---	---
	Parthenocissus quinquefolia	Virginia creeper	2	---	---	---
	Polygonatum biflorum	Solomon's seal	2	---	---	---
	Prunus serotina	wild black cherry	2	---	---	---
	Quercus falcata	southern red oak	2	---	---	---
	Quercus rubra	northern red oak	2	---	---	---
	Rubus flagellaris	common dewberry	2	---	---	---
	Sassafras albidum	sassafras	2	---	---	---
	Silene virginica	fire pink	2	---	---	---
	Symphoricarpos orbiculatus	coralberry	2	---	---	---
	Triodanis perfoliata	Venus' looking-glass	2	---	---	---
	Uvularia sessilifolia	sessile bellwort	2	---	---	---
	Viola palmata	wood violet	2	---	---	---
	Anomodon rostratus	yellow yarn moss	1	---	---	---
	Asplenium platyneuron	ebony spleenwort	1	---	---	---
	Cardamine hirsuta	hairy bittercress	1	---	---	---
	Carex blanda	eastern woodland sedge	1	---	---	---
	Carex virescens	ribbed sedge	1	---	---	---
	Endodeca serpentaria	Virginia snakeroot	1	---	---	---
	Geum canadense	white avens	1	---	---	---
	Helianthus divaricatus	woodland sunflower	1	---	---	---
	Hypericum spp.	St. John'swort unidentified	1	---	---	---
	Ilex cornuta	Chinese holly	1	---	---	---
	Passiflora lutea	yellow passionvine	1	---	---	---

	Phytolacca americana	pokeweed	1	---	---	---
	Poa cuspidata	early bluegrass	1	---	---	---
	Potentilla indica	Indian strawberry	1	---	---	---
	Prenanthes spp.	prenanthes unidentified	1	---	---	---
	Quercus montana	chestnut oak	1	---	---	---
	Ribes rotundifolium	Appalachian gooseberry	1	---	---	---
	Robinia pseudoacacia	black locust	1	---	---	---
	Smilax glauca	white-leaf greenbrier	1	---	---	---
	Taraxum officinale	common dandelion	1	---	---	---
	Toxicodendron radicans	eastern poison ivy	1	---	---	---
	Vitis aestivalis	summer grape	1	---	---	---
	Woodsia obtusa	blunt-lobed woodsia	1	---	---	---
	Youngia japonica	Japanese hawkweed	1	---	---	---
✓	*Actaea racemosa*	black cohosh	---	---	---	---
✓	*Adiantum pedatum*	northern maidenhair fern	---	---	---	---
✓	*Antennaria plantaginifolia*	plantain-leaved pussytoes	---	---	---	---
✓	*Aplectrum hyemale*	puttyroot	---	---	---	---
✓	*Asclepias variegata*	white milkweed	---	---	---	---
✓	*Botrypus virginianus*	rattlesnake fern	---	---	---	---
✓	*Carex albicans*	white tinged sedge	---	---	---	---
✓	*Carex swanii*	Swan's sedge	---	---	---	---
✓	*Corallorhiza odontorhiza*	autumn coralroot	---	---	---	---
✓	*Crataegus spp.*	hawthorn species unid.	---	---	---	---
✓	*Desmodium paniculatum*	narrow-leaf tick-trefoil	---	---	---	---
✓	*Desmodium spp.*	desmodium unidentified	---	---	---	---
✓	*Dioscorea villosa*	wild yam	---	---	---	---
✓	*Dryopteris marginalis*	marginal wood fern	---	---	---	---
✓	*Maianthemum racemosum*	eastern Solomon’s-plume	---	---	---	---
✓	*Obolaria virginica*	pennywort	---	---	---	---
✓	*Ophioglossum pycnostichum*	southern adder's tonque	---	---	---	---

✓	*Phegopteris hexagonoptera*	broad beech fern	---	---	---	---
✓	*Polystichum acrostichoides*	christmas fern	---	---	---	---
✓	*Rosa caroliniensis*	Carolina rose	---	---	---	---
✓	*Scutellaria elliptica*	hairy skullcap	---	---	---	---
✓	*Tipularia discolor*	cranesfly orchid	---	---	---	---
✓	*Ulmus rubra*	slippery elm	---	---	---	---
✓	*Verbena urticifolia*	white vervain	---	---	---	---
✓	*Viola hirsutula*	southern wood violet	---	---	---	---

Flora and Fungi of Ragged Mountain Natural Area *Associated Ecosystem Type(s) are noted with numbers, keyed to the Ecosystem map on page 31. Specific locations are omitted intentionally. Species growing on new terrain such as the parking lot, the new dam, and south spillway, and the peninsula, were not inventoried and thus are omitted from this report. Of the 280 flora species observed, 76 species of trees and shrubs, 21 fern species, and 7 orchid varieties were documented.*

Pteridophytes and Lycophytes (Ferns and Fern Allies). 24 species.

Adiantum pedatum (northern maidenhair fern) 1, 2, 8
Asplenium platyneuron (ebony spleenwort) 1, 2, 4, 7, 8
Athyrium asplenioides (southern lady fern) 1, 5
Botrypus virginianus (rattlesnake fern) 1, 2, 8
Dendrolycopodium obscurum (ground-pine) 5
Dennstaedtia punctilobula (hay-scented fern) 1, 2, 6
Deparia acrostichoides (silvery spleenwort) 1, 2
Dryopteris celsa (log fern) 1
Dryopteris cristata (crested wood fern) 1
Dryopteris intermedia (intermediate wood fern) 1
Dryopteris marginalis (marginal wood fern) 1, 8
Homalosorus pycnocarpon (glade fern) 1
Huperzia lucidula (shining clubmoss) 1
Ophioglossum pycnostichum (southern adder's tonque) 2, 8
Osmunda claytoniana (interrupted fern) 1
Parathelypteris noveboracensis (New York fern) 1
Phegopteris hexagonoptera (broad beech fern) 1, 2, 8
Polypodium virginianum (common rock polypody) 1
Polystichum acrostichoides (christmas fern) 1, 2, 3, 4, 5, 6, 8
Pteridium aquilinum (bracken fern) 5
Sceptridium biternatum (grape fern) 1, 2
Sceptridium spp. (grape fern unidentified) 1
Thelypteris noveboracensis (New York fern) 1
Woodsia obtusa (blunt-lobed woodsia) 7, 8

Bryophytes (Mosses, Hornworts, and Liverworts). 6 species

Anomodon rostratus (yellow yarn moss) 8
Grimmia spp. grimmia (dry-rock moss) 2, 7, 8
Leucobryum glaucum (cushion moss) 5
Marchantia polymorpha (liverwort) 1
Polytrichum juniperinum (juniper haircap moss) 5
Thuidium delicatum (delicate fernmoss) 5

Fungi (mushrooms). 10 species.

Auricularia auricula (brown wood ear) 5
Daedaleopsis sp. (maze polypore) 8
Phellinus robiniae (cracked-cap polypore) 8

Pleurotus ostreatus (oyster mushroom) 8
Pycnoporus cinnabarinus (cinnabar-red polypore) 8
Schizophyllum commune (split-gill fungus) 8
Stereum ostrea (false turkeytail) 5
Stropharia rugoso-annulata (wine-cap) 8
Tremella mesenterica (witch's butter) 3
Trichaptum biforme (violet-toothed polypore) 8

Dicots, Monocots, Gymnosperms. 250 species. (Flowering Plants, Rushes, Sedges, Grasses, and Cone-producing Plants)
Acalypha virginica (Virginia copperleaf) *2, 7*
Acer rubrum (red maple) *1, 2, 3, 4, 5, 6, 8*
Actaea racemosa (black cohosh) 1, 2, 8
Agrimonia spp. (agrimony unidentified) 1, 3
Ailanthus altissima (tree-of-heaven) 1, 2, 7, 8
Albizia julibrissin (mimosa) 2
Allaria petiolata (garlic mustard) 1, 2, 7
Allium spp. (allium unidentified) 7
Amelanchier arborea (downy serviceberry) 2
Amphicarpaea bracteata (hog-peanut) 1, 2, 8
Anemone virginiana (thimbleweed) 1
Antennaria plantaginifolia (plantain-leaved pussytoes) 2, 8
Aplectrum hyemale (puttyroot) 1, 2, 3, 8
Apocynum cannabinum (Indian hemp) 2
Aquilegia canadensis (wild columbine) 1
Arabidopsis lyrata (lyre-leaf rock cress) 1
Aralia spinosa (devil's walking stick) 1, 2, 7, 8
Arisaema triphyllum (common jack-in-the-pulpit) 1, 2
Aruncus dioicus (goat's-beard) 1, 2
Asarum canadense (common wild ginger) 2
Asclepias quadrifolia (four-leaf milkweed) 2
Asclepias variegata (white milkweed) 2, 8
Asclepias spp. (milkweed unidentified) 8
Aureolaria virginica (downy yellow galse foxglove) 3
Berberis bealei (Chinese mahonia) 1
Berberis thunbergii (Japanese barberry) 1
Betula lenta (sweet birch) 1, 2
Bidens bipinnata (Spanish needles) 7, 8
Bidens cernua (nodding beggar-ticks) 1
Boechera laevigata (smooth rock cress) 3
Boehmeria cylindrica (false nettle) 1, 8
Brachyelytrum erectum (bearded shorthusk) 2, 7
Cardamine hirsuta (hairy bittercress) 2, 7, 8
Carex albicans (white tinged sedge) 1, 2, 3, 7, 8
Carex amphibola (eastern narrow-leaf sedge) 3
Carex blanda (eastern woodland sedge) 1, 8
Carex communis (fibrous-rooted sedge) 8

Carex digitalis (slender woodland sedge) 2, 6
Carex laxiculmis (spreading sedge) 1, 7
Carex laxiflora (broad loose-flowered sedge) 1, 2
Carex nigromarginata (black edge sedge) 2, 3
Carex pensylvanica (Pennsylvania sedge) 2, 8
Carex platyphylla broad-leaved sedge 1
Carex prasina drooping sedge 1
Carex rosea rosy sedge 1, 2
Carex striatula lined sedge 2, 8
Carex swanii Swan's sedge 8
Carex virescens ribbed sedge 6, 7, 8
Carex spp. (sedge unidentified) 3
Carex spp. (sedge unidentified) 7
Carpinus caroliniana (ironwood) 1, 2
Carya cordiformis (bitternut hickory) 1, 2
Carya glabra (pignut hickory) 1, 2, 3, 7, 8
Carya ovalis (red hickory) 2, 3, 8
Carya ovate (shagbark hickory) 2
Carya tomentosa (mockernut hickory) 1, 2, 3, 7, 8
Carya spp. (hickory unidentified) 1, 8
Castanea dentata (American chestnut) 2, 5
Celastrus orbiculatus (Oriental bittersweet) 1, 2, 3, 6, 7, 8
Celtis occidentalis (common hackberry) 2, 7
Celtis tenuifolia (dwarf hackberry) 7, 8
Cercis canadensis var. canadensis (eastern redbud) 1, 2, 7, 8
Chamaecrista nictitans var. nictitans (wild sensitive plant) 2
Chimaphila maculata (striped wintergreen) 1, 2, 3, 4, 5, 6, 8
Chrysogonum virginianum (green and gold) 2
Circaea canadensis (enchanter's night-shade) 1, 2, 8
Clitoria mariana var. mariana (butterfly pea) 2
Collinsonia canadensis (richweed) 1, 2
Corallorhiza odontorhiza (autumn coralroot) 1, 8
Corallorhiza wisteriana (spring coralroot) 1
Cornus florida (flowering dogwood) 1, 2, 4, 5, 6, 8
Corydalis flavula (yellow fumewort) 7
Cunila origanoides (common dittany) 2, 5
Cynoglossum virginianum (wild comfrey) 1, 2, 7
Danthonia spicata (poverty oatgrass) 1
Desmodium paniculatum (narrow-leaf tick-trefoil) 1, 8
Desmodium rotundifolium (round-leaf tick-trefoil) 2
Desmodium spp. desmodium (unidentified) 8
Dichanthelium boscii (Bosc's panic grass) 2, 5
Dichanthelium commutatum (variable panic grass) 2
Dichanthelium spp. (panic grass unidentified) 2
Dioscorea villosa (wild yam) 1, 2, 8
Diospyros virginiana (common persimmon) 1, 2
Elaeagnus umbellata (autumn olive) 1, 2, 3, 7, 8
Endodeca serpentaria (Virginia snakeroot) 2, 8

Epilobium coloratum (purple-leaved willow-herb) 1
Erigeron pulchellus (Robin's plantain) 2
Euonymus alatus (burning bush) 2, 7
Euonymus americanus (strawberry bush) 1
Eupatorium godfreyanum (Godfrey's thoroughwort) 2, 8
Eupatorium sessilifolium (upland boneset) 2, 4, 8
Euphorbia corrolata (flowering spurge) 8
Eurybia divaricata (white wood aster) 1, 2
Fagus grandifolia (American beech) 1, 2, 5, 8
Festuca subverticillata (nodding fescue) 2
Fraxinus americana (white ash) 1, 2, 3, 4, 7
Galearis spectabilis (showy orchis) 1, 2
Galium aparine (cleavers) 8
Galium circaezans (forest bedstraw) 1, 2, 8
Galium pilosum (hairy bedstraw) 2
Galium spp. 5 (bedstraw unidentified) 2
Galium spp. 6 (bedstraw unidentified) 1, 2
Galium triflorum (sweet-scented bedstraw) 1, 2, 4, 7, 8
Gaylussacia baccata (black huckleberry) 1, 4, 5
Geranium maculatum (wild geranium) 1, 2
Geum canadense (white avens) 1, 2, 3, 8
Gleditsia triacanthos (honey-locust) 7
Goodyera pubescens (downy rattlesnake-plantain) 1, 5
Gymnocladus dioica (Kentucky coffee-tree) 2
Hamamelis virginiana (witch-hazel) 1,2,5,8
Helianthus divaricatus (woodland sunflower) 8
Hepatica americana (round-lobed hepatica) 1
Heuchera americana (American alumroot) 1, 7
Hieracium venosum (rattlesnake weed) 1, 2, 4, 5
Hosta ventricosa (blue plantain-lily) 2
Houstonia purpurea var. purpurea (summer bluets) 2, 5
Hydrangea arborescens (wild hydrangea) 1
Hylodesmum nudiflorum (naked-flowered tick-trefoil) 2, 6
Hypericum punctatum (spotted St. John's-wort) 1
Hypericum spp. (St. John'swort unidentified) 8
Hypopytis monotropa (pinesap) 1
Hypoxis hirsuta (eastern yellow stargrass) 2
Ilex cornuta (Chinese holly) 8
Ilex opaca (American holly) 1, 3, 8
Impatiens spp. (jewelweed unidentified) 1
Juglans nigra (black walnut) 1
Juniperus virginiana var. virginiana (eastern red cedar) 1, 2, 3, 5, 7, 8
Kalmia latifolia (mountain laurel) 1,2,5,6
Laportea canadensis (wood nettle) 1
Lespedeza repens (creeping lespedeza) 2
Lespedeza violacea (wand lespedeza) 2
Ligustrum sinense (Chinese privet) 2, 3, 7
Lindera benzoin (spicebush) 1, 2

Liparis liliifolia (large twayblade) 2
Liriodendron tulipifera (tuliptree) 1, 2, 3, 5, 6, 8
Lonicera japonica (Japanese honeysuckle) 1, 2, 3, 7
Lyonia ligustrina var. ligustrina (maleberry) 6
Lysimachia quadrifolia (whorled loosestrife) 1, 2
Maianthemum racemosum ssp. racemosum (eastern Solomon's-plume) 1, 2, 8
Malus baccata (Siberian crabapple) 8
Medeola virginiana (Indian cucumber-root) 1, 2, 6
Menispermum canadense (Canada moonseed) 2
Microstegium vimineum (Japanese stiltgrass) 1, 2, 3, 7, 8
Mimulus ringens (square-stemmed monkeyflower) 1
Monotropa uniflora (Indian pipe) 1
Morus rubra (red mulberry) 2
Muhlenbergia sobolifera (rock muhly) 1, 2, 7, 8
Nuttalanthus canadensis (blue toadflax) 2
Nyssa sylvatica (black gum) 1, 2, 3, 4, 5, 6
Obolaria virginica (pennywort) 1, 2, 8
Oenothera fruticosa (evening-primrose) 2
Onoclea sensibilis (sensitive fern) 1, 2
Ostrya virginiana (hop-hornbeam) 1
Oxalis violacea (violet wood-sorrel) 2
Packera aurea (golden ragwort) 1
Packera obovata (roundleaved ragwort) 2
Panicum spp. (panicum unidentified) 1
Parietaria pensylvanica (Pennsylvania pellitory) 7
Paronychia spp. (nailwort species) 2
Parthenocissus quinquefolia (Virginia creeper) 1, 2, 6, 7, 8
Passiflora lutea (yellow passionvine) 2, 8
Paulownia tomentosa (royal paulownia) 1
Perilla frutescens (perilla) 7
Persicaria longiseta (long-bristled smartweed) 7
Persicaria virginiana (Virginia knotweed) 1
Prunus subhirtella (spring cherry) 2
Phaseolus polystachios (wild bean) 2
Philadelphus inodorus (mock orange) 2, 8
Photinia villosa (smooth Oriental photinia) 1, 2
Physalis spp. (ground cherry unidentified) 8
Phytolacca americana (pokeweed) 8
Pilea pumila (clearweed) 1
Pinus echinata (shortleaf pine) 1, 2, 3, 4
Pinus strobus (eastern white pine) 1, 2, 3, 5, 6
Pinus virginiana (Virginia pine) 1, 5
Poa cuspidata (early bluegrass) 1, 3, 8
Poa sylvestris (woodland bluegrass) 2
Podophyllum peltatum (mayapple) 2
Polygonatum biflorum (Solomon's seal) 1, 2, 8
Potentilla canadensis (Canada cinquefoil) 2
Potentilla indica (Indian strawberry) 1, 8

Prenanthes serpentaria (lion's foot) 2, 5
Prenanthes spp. (prenanthes unidentified) 1, 8
Prunus avium (sweet cherry) 1, 2, 7
Prunus serotina (wild black cherry) 1, 2, 8
Quercus alba (white oak) 1, 2, 3, 6, 8
Quercus coccinea (scarlet oak) 1, 5
Quercus falcata (southern red oak) 8
Quercus montana (chestnut oak) 1, 2, 3, 4, 5, 6, 7, 8
Quercus rubra (northern red oak) 1, 2, 3, 5, 7, 8
Quercus stellata (post oak) 7
Quercus velutina (black oak) 1, 2, 3, 6, 8
Ranunculus abortivus (kidneyleaf buttercup) 1
Ranunculus recurvatus (hooked buttercup) 1, 2
Rhododendron periclymenoides (wild azalea) 1, 2, 5
Ribes rotundifolium, Appalachian gooseberry 8
Robinia pseudoacacia (black locust) 1, 2, 8
Rosa caroliniensis (Carolina rose) 8
Rubus flagellaris (common dewberry) 8
Rubus occidentalis (black raspberry) 1, 2, 7
Rubus pensylvanicus (Pennsylvania blackberry) 7
Rubus phoenicolasius (wineberry) 1, 2, 7, 8
Ruellia caroliniensis (Carolina wild-petunia) 2
Salvia lyrata (lyre-leaf sage) 2
Sanguinaria canadensis (bloodroot) 1, 2
Sanicula canadensis (black snakeroot) 1, 2
Sassafras albidum (sassafras) 1, 2, 5, 6, 8
Scirpus cyperinus (woolgrass) 1
Scutellaria elliptica (hairy skullcap) 2, 8
Scutellaria spp. (scullcap unidentified) 1, 2
Senna hebecarpa (American senna) 4
Silene caroliniana var. pensylvanica (wild pink) 2
Silene virginica (fire pink) 2, 8
Sisyrinchium angustifolium (narrow-leaved blue-eyed grass) 2
Smilax bona-nox (catbrier) 2
Smilax glauca (white-leaf greenbrier) 1, 2, 3, 4, 5, 8
Smilax rotundifolia (common greenbrier) 1, 2, 3
Solanum ptycanthum (eastern black nightshade) 7
Solidago bicolor (silverrod) 2, 5
Solidago caesia var. caesia (bluestem goldenrod) 2
Stellaria media (common chickweed) 7
Stellaria pubera (star chickweed) 1, 2
Symphoricarpos orbiculatus (coralberry) 1, 2, 7, 8
Symphyotichum undulatum (wavy-leaved aster) 2
Taraxum officinale (common dandelion) 8
Thalictrum thalictroides (rue-anemone) 1, 2
Tilia americana (basswood) 2
Tipularia discolor (cranesfly orchid) 1, 2, 3, 8
Toxicodendron radicans (eastern poison ivy) 1, 2, 8

Triodanis perfoliata (Venus' looking-glass) 8
Tsuga canadensis (eastern hemlock) 2
Typha latifolia (common cattail) 1
Ulmus rubra (slippery elm) 2, 8
Uvularia perfoliata (perfoliate bellwort) 1, 2
Uvularia sessilifolia (sessile bellwort) 2, 8
Vaccinium pallidum (hillside blueberry) 1, 2, 4, 5, 6
Vaccinium stamineum (deerberry) 2, 4, 5, 6, 8
Verbascum thapsus (common mullein) 2, 7
Verbena urticifolia (white vervain) 8
Viburnum acerifolium (maple-leaved viburnum) 1, 2
Viburnum prunifolium (blackhaw) 7
Viola hirsutula (southern wood violet) 1, 3, 8
Viola palmata var. palmata (wood violet) 1, 2, 8
Viola palmata var. triloba (wood violet) 2
Viola sororia (common blue violet) 1
Viola spp. (violet unidentified) 1
Vitis aestivalis (summer grape) 8
Vitis spp. (grape unidentified) 2, 7
Vitis vulpina (winter grape) 2, 6
Youngia japonica Japanese hawkweed 1, 8
*Undisclosed (*At-Risk Protected Species) 1, 2

Lists of Fauna

Birds of RMNA

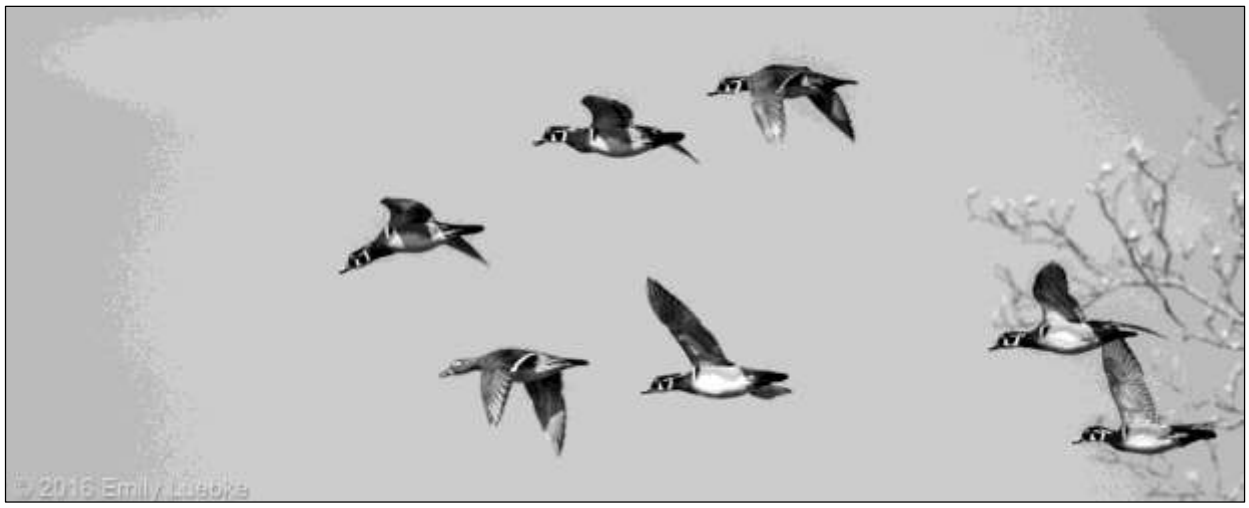


Figure 32: *Wood ducks (Aix sponsa) are one of the many colorful species that may be observed at RMNA. These prepare to land in the newly elevated waters of RMNA.*

Data on the birds that have been identified at the Ragged Mountain Natural Area *was compiled by Jim Childress and Emily Luebke and comes from personal observations, online postings by observers who are considered reliable, published records of Charles E. (Mo) Stevens, Jr. and John H. Gray, Jr (The Birds of Albemarle County, Virginia, The Raven, Vol. XX, Nov. – Dec. 1949), the Monticello Bird Club's updating of that article (The Birds of Albemarle County and Charlottesville, Virginia, An Annotated Checklist, Sept., 2010), along with personal historical records provided by Dan Bieker. This data comprises both recent records and records that date back to the earlier part of the Twentieth Century. Because of the relatively large body of water, the natural setting, the proximity to the population of Charlottesville, the length of time the reservoir has been in existence, and the open access for the public, this may be the single best documented site for birds in our area. Reliable records have been found for 147 species of birds at what is now called the* Ragged Mountain Natural Area. *As well as many species of waterfowl, the site has also been rich in raptors, woodland songbirds, and seasonal migrants.*
–Jim Childress, Bird Survey Coordinator

The RMNA Bird List (147 species):

ANSERIFORMES: Anatidae	
Branta canadensis	Canada Goose
Cygnus columbianus	Tundra Swan
Cygnus olor	Mute Swan
Bucephala albeola	Bufflehead
Bucephala clangula	Common Goldeneye
Lophodytes cucullatus	Hooded Merganser
Clangula hyemalis	Long-tailed Duck
Aythya collaris	Ring-necked Duck
Aythya marila	Greater Scaup
Aythya affinis	Lesser Scaup
Spatula clypeata	Northern Shoveler
Spatula discors	Blue-winged Teal
Mareca strepera	Gadwall
Anas platyrhynchos	Mallard
Anas rubripes	American Black Duck
Anas crecca	Green-winged Teal
Aix sponsa	Wood Duck
Oxyura jamaicensis	Ruddy Duck
Melanitta americana	Black Scoter
GALLIFORMES: Phasianidae	
Meleagris gallopavo	Wild Turkey
PHOENICOPTERIFORMES: Podicipedidae	
Podiceps auritus	Horned Grebe
Podilceps grisegena	Red-necked Grebe
Podilymbus podiceps	Pied-billed Grebe
COLUMBIFORMES: Columbidae	
Columba livia	Rock Dove

Zenaida macroura	Mourning Dove
CAPRIMULGIFORMES: Apodidae	
Chaetura pelagica	Chimney Swift
CAPRIMULGIFORMES: Trochilidae	
Archilochus colubris	Ruby-throated Hummingbird
CUCULIFORMES: Cuculidae	
Coccyzus americanus	Yellow-billed Cuckoo
GRUIFORMES: Rallidae	
Fulica americana	American Coot
GAVIIFORMES: Gaviidae	
Gavia immer	Common Loon
PELECANIFORMES: Ardeidae	
Butorides virescens	Green Heron
Ardea herodias	Great Blue Heron
Ardea alba	Great Egret
PELECANIFORMES: Phalacrocoracidae	
Eudocimus albus	White Ibis
Pelecanus occidentalis	Brown Pelican
Phalacrocorax auritus	Double-crested Cormorant
CHARADRIIFORMES: Charadriidae	
Charadrius vociferus	Killdeer

CHARADRIIFORMES: Scolopacidae	
Actitis macularius	Spotted Sandpiper
Tringa solitaria	Solitary Sandpiper
CHARADRIIFORMES: Laridae	
Chroicocephalus philadelphia	Bonaparte's Gull
Larus delawarensis	Ring-billed Gull
ACCIPITRIFORMES: Cathartidae	
Cathartes aura	Turkey Vulture
Coragyps atratus	Black Vulture
ACCIPITRIFORMES: Pandionidae	
Pandion haliaetus	Osprey
ACCIPITRIFORMES: Accipitridae	
Accipiter striatus	Sharp-shinned Hawk
Accipiter cooperii	Cooper's Hawk
Haliaeetus leucocephalus	Bald Eagle
Buteo lineatus	Red-shouldered Hawk
Buteo platypterus	Broad-winged Hawk
Buteo jamaicensis	Red-tailed Hawk
STRIGIFORMES: Strigidae	
Megascops asio	Eastern Screech Owl
Strix varia	Barred Owl
Bubo virginianus	Great Horned Owl

PICIFORMES: Picidae	
Dryocopus pileatus	Pileated Woodpecker
Colaptes auratus	Northern Flicker
Sphyrapicus varius	Yellow-bellied Sapsucker
Melanerpes erythrocephalus	Red-headed Woodpecker
Melanerpes carolinus	Red-bellied Woodpecker
Picoides pubescens	Downy Woodpecker
Picoides villosus	Hairy Woodpecker
CORACIIFORMES: Alcedinidae	
Megaceryle alcyon	Belted Kingfisher
FALCONIFORMES: Falconidae	
Falco sparverius	American Kestrel
PASSERIFORMES: Tyrannidae	
Tyrannus tyrannus	Eastern Kingbird
Myiarchus crinitus	Great Crested Flycatcher
Sayornis phoebe	Eastern Phoebe
Empidonax virescens	Acadian Flycatcher
Contopus virens	Eastern Wood Pewee
PASSERIFORMES: Vireonidae	
Vireo griseus	White-eyed Vireo
Vireo flavifrons	Yellow-throated Vireo
Vireo solitarius	Blue-headed Vireo
Vireo olivaceus	Red-eyed Vireo
PASSERIFORMES: Corvidae	
Corvus ossifragus	Fish Crow
Corvus corax	Common Raven
Corvus brachyrhynchos	American Crow
Cyanocitta cristata	Blue Jay

PASSERIFORMES: Fringillidae	
Haemorhous mexicanus	House Finch
Haemorhous purpureus	Purple Finch
Spinus tristis	American Goldfinch
PASSERIFORMES: Passerellidae	
Peucaea aestivalis	Bachman's Sparrow
Spizella passerina	Chipping Sparrow
Spizella pusilla	Field Sparrow
Pipilo erythrophthalmus	Eastern Towhee
Junco hyemalis	Dark-eyed Junco
Zonotrichia albicollis	White-throated Sparrow
Passerculus sandwichensis	Savannah Sparrow
Melospiza melodia	Song Sparrow
Melospiza georgiana	Swamp Sparrow
PASSERIFORMES: Parulidae	
Seiurus aurocapilla	Ovenbird
Helmitheros vermivorum	Worm-eating Warbler
Parkesia motacilla	Louisiana Waterthrush
Vermivora cyanoptera	Blue-winged Warbler
Mniotilta varia	Black-and-white Warbler
Protonotaria citrea	Prothonotary Warbler
Geothlypis trichas	Common Yellowthroat
Setophaga ruticilla	American Redstart
Setophaga tigrina	Cape May Warbler
Setophaga cerulea	Cerulean Warbler
Setophaga americana	Northern Parula
Setophaga castanea	Bay-breasted Warbler
Setophaga fusca	Blackburnian Warbler
Setophaga petechia	Yellow Warbler
Setophaga pensylvanica	Chestnut-sided Warbler

Setophaga striata	Blackpoll Warbler
Setophaga caerulescens	Black-throated Blue Warbler
Setophaga palmarum	Palm Warbler
Setophaga pinus	Pine Warbler
Setophaga coronata	Yellow-rumped Warbler
Setophaga dominica	Yellow-throated Warbler
Setophaga virens	Black-throated Green Warbler
Cardellina canadensis	Canada Warbler
PASSERIFORMES: Icteridae	
Sturnella magna	Eastern Meadowlark
Icterus galbula	Baltimore Oriole
Icterus spurius	Orchard Oriole
Agelaius phoeniceus	Red-winged Blackbird
Molothrus ater	Brown-headed Cowbird
Quiscalus quiscula	Common Grackle
PASSERIFORMES: Cardinalidae	
Pheucticus ludovicianus	Rose-breasted Grosbeak
Passerina cyanea	Indigo Bunting
Passerina caerulea	Blue Grosbeak
Piranga olivacea	Scarlet Tanager
Piranga rubra	Summer Tanager
Cardinalis cardinalis	Northern Cardinal
PASSERIFORMES: Paridae	
Baeolophus bicolor	Tufted Titmouse
Poecile carolinensis	Carolina Chickadee
PASSERIFORMES: Hirundinidae	
Hirundo rustica	Barn Swallow
Tachycineta bicolor	Tree Swallow
Progne subis	Purple Martin

Stelgidopteryx serripennis	Northern Rough-winged Swallow
PASSERIFORMES: Regulidae	
Regulus calendula	Ruby-crowned Kinglet
Regulus satrapa	Golden-crowned Kinglet
PASSERIFORMES: Bombycillidae	
Bombycilla cedrorum	Cedar Waxwing
PASSERIFORMES: Certhiidae	
Certhia americana	Brown Creeper
PASSERIFORMES: Sittidae	
Sitta carolinensis	White-breasted Nuthatch
PASSERIFORMES: Troglodytidae	
Troglodytes hiemalis	Winter Wren
Troglodytes aedon	House Wren
Thryothorus ludovicianus	Carolina Wren
PASSERIFORMES: Polioptilidae	
Polioptila caerulea	Blue-gray Gnatcatcher
PASSERIFORMES: Mimidae	
Dumetella carolinensis	Gray Catbird
Mimus polyglottos	Northern Mockingbird
PASSERIFORMES: Sturnidae	
Sturnus vulgaris	Common Starling
PASSERIFORMES: Turdidae	
Sialia sialis	Eastern Bluebird
Hylocichla mustelina	Wood Thrush

Catharus ustulatus	Swainson's Thrush
Catharus fuscescens	Veery
Catharus minimus	Gray-cheeked Thrush
Catharus guttatus	Hermit Thrush
Turdus migratorius	American Robin

Figure 33: *Birds nest in branches of tall flowering perennial plants, quite close to the ground, at RMNA.*

RMNA Ground Nesting Species Sensitive to Trail Activity

The mature Basic Mesic Forests, Heaths, and Basic Oak-Hickory Forests of RMNA stand like cathedrals with enormous limbs arching out 100 feet overhead. There's a whole world of faunal activity up there in the canopy that is out of sight. A good portion of that is undoubtedly represented by *Coleoptera* and *Lepidoptera* species (beetles, moths, and butterflies). Feeding in this swarm of millions are the birds. Due to the extensive reach of the forests and the development of their structure, the birds are afforded comfort and safety enough to begin filling all various layers of the forest. With the abundance of insect food available an increasing number of bird species will nest at RMNA. Indeed, we see a long history of observations from local Avian specialists that confirms this richness. As a paramount example, a study of woodthrush nests by Matthew Etterson (EPA/Smithsonian, results published in 2014) at RMNA identified more nests (64) than any other site studied in Central Virginia except for the Blue Ridge Parkway corridor (86). With that said, the 64 nests at RMNA occurred on nearly 1/10 of the land area when compared to the Parkway. Though the survey was not focused on inventorying numbers, the tally is significant. The list of study sites also included Fernbrook Natural Area, Fortune's Cove Preserve, Paul State Forest, Betsy Bell Wilderness Park, Grand Caverns, and Natural Chimneys Regional Park. The Ragged Mountains offer arguably the best nesting habitat for thrush species in Central Virginia. This is but one example of the density that occurs at RMNA.

Figure 34: *Many bird species nest in the shrub layer not far above the ground.*

While there are birds nesting and feeding in all layers of the forest at RMNA, many of the Neotropical migratory songbirds nest on, or close to, the ground. These birds, which also happen to be at-risk species, are most vulnerable to change. They choose adequate habitat and safe shelter for nesting, and they will avoid areas that present potential dangers or unfamiliar patterns of movement or sound. With the help of local birding experts, I list below the ground-nesting birds of RMNA that will be most affected by increased human and/or pet presence.

Figure 35: *Louisiana waterthrush nests on the banks of small streams at RMNA.*

There are nesting Louisiana waterthrushes in probably every streamlet at RMNA. A local birder has been tracking this species for about a decade and can confirm consistent and long-term nesting activity. This species builds its nest directly in the banks of the small branches that exit the ravines. They utilize these small stream habitats to gather food when fledglings are in the nest, and the sheer amount of food they must gather for the young most certainly takes them up and down the streamlets, from the spring heads to the reservoir's edge, in search of food. Bike traffic across the streams, dogs running in the streams, or humans playing in the streams could be a catastrophe for this species at RMNA. The most sensitive time of the year is the breeding-nesting-fledgling period from early March to the end of July.

Figure 36: *Vireos construct their intricate nests in the lower canopy and shrub layer at RMNA.*

A number of breeding and feeding habitats are in the path of proposed trails and bridges. Of particular concern are those that intrude upon the middle and upper reaches of the Basic Mesic plant community type. Ground-nesting birds were very active during our test plot surveys, and we were left wondering if the Louisiana waterthrush and others will be forced to relocate if trails are too close. This could be an issue at RMNA, because there's just nowhere left to go. With narrowed forest corridors and reduced stream habitat (following the increase in reservoir water levels), they may just get pushed out. How close we are to that tipping point is a matter of conjecture and debate.

There are many ground-nesting birds at RMNA aside from the Louisiana waterthrush, and many more ground-foraging birds. One thing that may get lost in this conversation is that it is not just the interruption of breeding/nesting behavior that should be of concern. Birds use these forests for many reasons other than nesting. RMNA is an important stop-over for migrating birds as well. Where a

migrant lands, and why, is certainly influenced by human and pet presence. It does not take much of a cranial reach to deduce that if human and pet activity increases at RMNA, one would see a deviation from normal behavior in all animals at RMNA, not just birds.

Many of the thrushes, and especially the Veery, Gray-cheeked, Swainson's, and Hermit don't breed at RMNA. But, they do actively feed in the ground and shrub layers of the forest during spring migration (April and May). As mentioned earlier, woodthrushes breed in good numbers at RMNA and nest fairly close to the ground. These and other species are fairly skittish and flush easily if approached.

The ground-nesting species of most concern (all of which are in decline) are:

- **Black-throated Blue Warbler:** tend to nest in shrub layer thickets, especially in mountain laurel. The white pine and oak heaths may be ideal nesting habitat for this species (Ecosystems 5 and 6 on map).
- **Black and White Warbler:** in leaves, usually at base of trees.
- **Worm-eating Warbler:** in leaves, usually under overhanging vegetation on wooded hillsides.
- **Ovenbird:** wide-ranging throughout woodland habitat.
- **Hooded Warbler:** Nests at or near ground, usually on higher ground throughout woodland habitat.
- **Louisiana Waterthrush:** Nests in root crevices along the stream banks at RMNA (confirmed in 2016)
- **Kentucky Warbler:** Probably the bird of most concern, the Kentucky warbler tends to nest in moist, shady ravines and drainages (Severe population declines are occurring). The Basic Mesic Ravines (Ecosystem #1 on the map) present ideal habitat for this species.

Other birds noted by local experts that nest in close proximity to the ground at RMNA are Yellow-billed Cuckoo, Acadian Flycatcher, Yellow-throated Vireo, and Eastern Towhee. Ground-nesting waterfowl that could be impacted include Mallard and Black Duck.

Any disturbance to the species mentioned above during the nesting and fledgling season could result in rapid decline. While the Natural Area does not permit dogs, the public brings them anyway. At the moment, the biggest threat comes from dogs. Even a well-behaved dog on a leash is perceived by birds (and other wildlife) as a predator and can cause a species to abandon feeding or nesting, especially if it happens more than once. Their regular presence, leashed or not, would encourage the decline and extirpation of ground nesting species at RMNA. The second biggest threat comes from fragmentation. We are familiar with the use of that word, "fragmentation", when it comes to large forest blocks and the intrusion of developments and roads. However, there are many other types of fragmentation that can have the same impact. Fragmentation simply means that a system is divided, unnaturally, in a way that alters the natural setting. Fragmentation can be caused by sound, movement, and behavior, as effectively as it ca be caused by changing the ground surface and vegetation on it. This is particularly so when we look at species

and systems at smaller scales. Loud sounds, swift movements, and unfamiliar odors can fragment the life cycles of insects, birds, mammals, reptiles, and the rest of the food web. When fragmentation happens on a small scale it affects species at the base of the food chain. The impact races up the chain and results in a modified ecosystem.

RMNA Bird Species of Greatest Conservation Need (SGCN), as ranked by the Department of Conservation and Recreation and the Department of Game and Inland Fisheries.

Figure 37: *Bald Eagles, a Tier 2 species in Virginia, have only 5 confirmed nesting sites in the County. They were seen in great enough numbers during survey to suspect they may try and nest at RMNA, perhaps in one of the giant white pine trees.*

Below are the species occurring at RMNA that have been identified by state officials (DCR, DGIF) to be of greatest conservation need in the state of Virginia. Each species is assigned a Tier level, with Tier 1 being of the most concern. All occur at RMNA. For an explanation of the Tier rankings, see the excerpt following the list.

[While the birds below are species needing statewide conservation efforts, there are species at RMNA that may be at higher risk due to the current proposed changes in public access and trail use policy. For example, the Kentucky Warbler (Tier 4 below) is at much higher risk at RMNA than the Bald Eagle (Tier 2). As mentioned prior, all ground nesting species are at risk, including Black-throated Blue Warbler, Black-and-white Warbler, Worm-eating Warbler, Ovenbird, Hooded Warbler, Louisiana Waterthrush, and Kentucky Warbler *(Moderate risk of decline due to increased trail activity and proximity to habitat. High risk of mortality and extirpation from RMNA due to dog presence).*]

Latin	**Common**	**Tier**
Aimophila aestivalis	Bachman's sparrow	1
Dendroica virens	Black-throated green warbler	1
Anas rubripes	American black duck	2
Dendroica cerulea	Cerulean warbler	2
Haliaeetus leucocephalus	Bald eagle	2
Troglodytes troglodytes	Winter wren	2
Protonotaria citrea	Prothonotary warbler	4

Aythya marila	Greater scaup	4
Butorides striatus	Green heron	4
Certhia americana	Brown creeper	4
Chaetura pelagica	Chimney swift	4
Coccyzus americanus	Yellow-billed cuckoo	4
Contopus virens	Eastern wood-pewee	4
Dendroica petechia	Yellow warbler	4
Dumetella carolinensis	Gray catbird	4
Helmitheros vermivorus	Worm-eating warbler	4
Hylocichla mustelina	Wood thrush	4
Mniotilta varia	Black-and-white warbler	4
Oporornis formosus	Kentucky warbler	4
Pheuctitus ludovicianus	Rose-breasted grosbeak	4
Pipilo erythrophthalmus	Eastern towhee	4
Piranga olivacea	Scarlet tanager	4
Podiceps auritus	Horned grebe	4
Seiurus motacilla	Louisiana waterthrush	4
Spizella pusilla	Field sparrow	4
Stelgidopteryx serripennis	Northern rough-winged swallow	4
Sturnella magna	Eastern meadowlark	4
Tyrannus tyrannus	Eastern kingbird	4
Vermivora pinus	Blue-winged warbler	4
Vermivora pinus	Northern parula	4
Vireo flavifrons	Yellow-throated vireo	4
Wilsonia canadensis	Canada warbler	4

Tier 1: Critical Conservation Need. Faces an extremely high risk of extinction or extirpation. Populations of these species are at critically low levels, facing immediate threat(s), or occur within an extremely limited range. Intense and immediate management action is needed.

Tier 2: Very High Conservation Need. Has a high risk of extinction or extirpation. Populations of these species are at very low levels, facing real threat(s), or occur within a very limited distribution. Immediate management is needed for stabilization and recovery.

Tier 3: Extinction or extirpation is possible. Populations of these species are in decline or have declined to low levels or are in a restricted range. Management action is needed to stabilize or increase populations.

Tier 4: Moderate Conservation Need. The species may be rare in parts of its range, particularly on the periphery. Populations of these species have demonstrated a significant declining trend or one is suspected which, if continued, is likely to qualify this species for a higher tier in the foreseeable future. Long-term planning is necessary to stabilize or increase populations.

Mammals of RMNA: Approximation 1

While we did have the best tracker in the region lined up for survey, time constraints did not allow for him to partake. Therefore no systematic coordinated survey was implemented to quantify mammal variety, richness, or behavior at RMNA. With that said, a great number of species have been noted in the past decade, several of which were present during this Ecosystem Survey. Though we are trying to focus on those species actually documented, it is worth noting a few probable species. The 466 acres of forest and several miles of shoreline provide ideal habitat for uncommon local species such as star-nosed mole, Keen's myotis, silver-haired bat, southern bog lemming, eastern woodrat, meadow jumping mouse, river otter, and bobcat *(as noted by the Ivy Creek Foundation)*.

As noted in the 2004 report prepared by the Albemarle County Biodiversity Work Group, species that are tolerant of human presence are on the rise. This is a regional pattern, and the historic decline of sensitive species continues. Those species that are adapted to edge habitats, land disturbance, and human presence are relatively stable. However, those requiring protected, cool and moist forest habitats are in serious decline. Fragmentation by roads and trails further compromises the patchwork of mature and sheltered forests that we still have. At RMNA the rich basic-mesic ravine forests are such places. The integrity of these systems relies upon preventing further division and minimizing human presence. In suburban settings and at RMNA, the biggest threat to small mammals is the presence of non-native domesticated carnivorous animals (Cats and Dogs).

Were one to investigate in a systematic and thorough manner, many of the 51 mammal species reported as being in Albemarle County (2004) would be encountered. Of those 51, the following species have been observed and confirmed at Ragged Mountain Natural Area.

List of Confirmed RMNA Mammals:

Latin	**common**
Canis latrans x Canis lycaon	eastern coyote
Castor canadensis	American beaver
Eptesicus fuscus	big brown bat
Homo sapiens sapiens	modern human
Lontra canadensis	river otter
Lynx rufus	bobcat
Nycticeius humeralis	evening bat
Odocoileus virginianus	white-tailed deer
Perimyotis subflavus	eastern pipistrelle
Procyon lotor	raccoon
Sciurus carolinensis	eastern gray squirrel
Tamias striatus	eastern chipmunk
Ursus americanus	American black bear

Amphibians and Reptiles of RMNA: Approximation 1

Figure 38: *Eastern garter snake (Thamnophis sirtalis sirtalis).*

Figure 39: *Pickerel frog (Lithobates palustris)*

Ragged Mountain Natural Area provides extensive and ideal habitat for a wide variety of amphibians and reptiles. With habitat variety ranging from deep and moist forested ravines to dry and exposed outcrop barrens and talus, nearly all the variety is present to accommodate the various habitat needs of all local species. The ground in the old basic oak-hickory and basic-mesic forests of RMNA is littered with organic debris, decaying logs, and a substantial amount of cobbles and boulders. With the added presence of cold, clean springs, small streams and miles of shallow-water shoreline, there's scarcely a Piedmont species of frog, toad, salamander, snake, turtle, skink, or lizard that would not be there. As if these qualities weren't enough for providing ideal habitat, we have a maturing forest with all of its understory structure and shelter.

Reptiles documented included the garter snake pictured above, an enormous black rat snake and a colorful northern watersnake eating a bluegill. Both of these observations were made in the rocky woodlands on the west and south slopes of the hill leading to the new bridge. The eastern fence lizard most definitely saw us, even though we did not see it, and many additional skinks and snakes are undoubtedly present in the rich and varied systems of RMNA. Despite being one of the most well-known species of turtle in Virginia, the eastern box turtle is a species of great conservation need. This species, is observed on occasions at RMNA. It is at risk of extinction or extirpation if local and regional management action is not taken to stabilize populations and conserve needed habitat. The state of Virginia has thus listed the box turtle as a Tier 3 conservation species. RNNA is an important conservation area for this species because it offers plenty of suitable habitat (moist forests).

Of the 20 amphibian species confirmed in Albemarle County, 13 were noted during our survey. Given the fact that no systematic survey was done for Amphibians, the number is quite robust. Species of Salamander not documented to date that are likely to occur at RMNA are eastern newt (*Notophthalmus viridescens*), southern two-lined salamander (*Eurycea cirrigera)*, and red-backed

salamander (*Plethodon cinereus)*. Due to the excellent upland habitat present, and especially in the Basic-mesic areas of RMNA (cool, sheltered ravines with seepages and streamlets), there may be a high likelihood of encountering rare or uncommon Albemarle species. This probability is supported by the logic that the very same conditions that have preserved the rich upland plant communities may also offer refuge for upland species that were once more common in the higher elevation portions of the Piedmont landscape. The uncommon species that may occur in the clear and rocky spring-fed brooks of the rich ravines of RMNA are the Red Salamander (*Pseudotriton ruber*), Seal Salamander (*Desmognathus monticola*), and the Spring Salamander (*Gyrinophilus porphyriticus*). Species that may find refuge in the mucky shallow pools of the seepages, the new wetland area in the south spillway, in woodland depressions that hold rainwater, and in the newly vegetated margins of the back-water coves, include the spotted salamander (*Ambystoma maculatum*), marbled salamander (*Ambystoma opacum*), mud salamander (*Pseudotriton montanus*) and the four-toed salamander (*Hemidactylium scutatum*).

List of Confirmed Amphibians and Reptiles of RMNA:

Frogs	
Acris crepitans	northern cricket frog
Hyla versicolor	gray tree frog
Lithobates catesbeianus	bullfrog
Lithobates palustris	pickerel frog
Lithobates sylvaticus	wood frog
Pseudacris crucifer	spring peeper
Pseudacris feriarum	upland chorus frog
Rana clamitans	green frog
Toads	
Anaxyrus americanus	American toad
Anaxyrus fowleri	Fowler's toad
Salamanders	
Desmognathus fuscus	northern dusky salamander
Eurycea bislineata	northern two-lined salamander
Plethodon glutinosus	slimy salamander
Snakes	

Nerodia sipedon	northern watersnake
Pantherophis obsoletus	black rat snake
Thamnophis sirtalis	gartersnake
Skinks	
Plestiodon fasciatus	five-lined skink
Plestiodon laticeps	broadhead skink
Turtles	
Chelydra serpentina	snapping turtle
Chrysemys picta	painted turtle
Terrapene carolina	eastern box turtle***

***** Eastern Box Turtle listed as Tier 3 in Virginia:** [***Tier 3: Extinction or extirpation is possible.*** *Populations of these species are in decline or have declined to low levels or are in a restricted range. Management action is needed to stabilize or increase populations. DCR/DGIF*]

Damselflies and Dragonflies of RMNA: Approximation 1

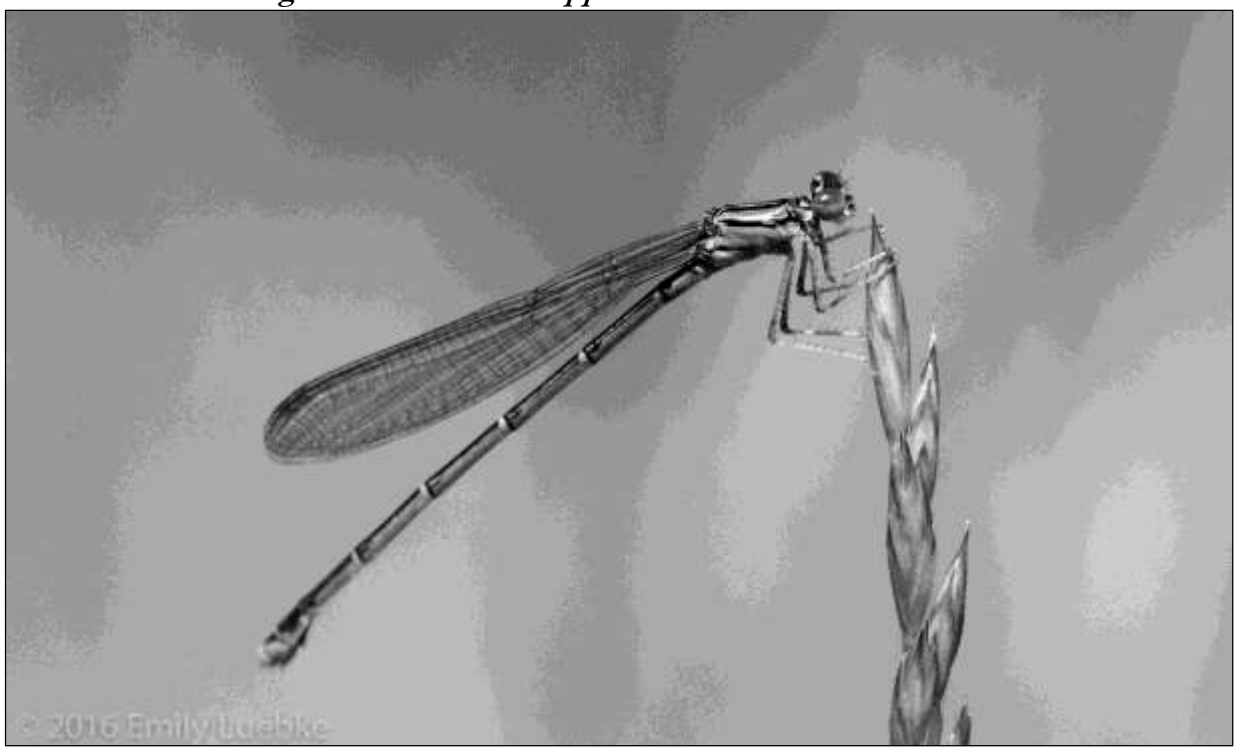


Figure 40: *Orange bluet damselfly (Enallagma signatum). Odonata will recolonize RMNA in 2016 in the wake of the elevated water.*

Because of very recent reservoir renovations and the resulting water level rise, the biological clock has been completely reset for most aquatic macroinvertebrates. Natural vegetation has not had a chance to regenerate, and it will be competing the non-native grasses that were sown in disturbed areas following construction efforts (including *Lolium arundinaceum*, tall fescue). Efforts were made by local experts to perform a baseline survey of dragonfly and damselfly species. This involved systematic surveys for insects in flight as well as an attempt to collect larvae along the shoreline. After a year or so we presume that sediment, rotting organic material, and native vegetation will begin to accumulate and create habitat more conducive to *Odonata* larvae.

Figure 41: *Common whitetail dragonfly (Plathemis Lydia).*

With the survey having access to only a limited flight season, very few species were observed. Most of these are likely to be new arrivals from local and regional ecosystems. This is not entirely bad, as it presents a very interesting research and study situation. The list of species generated during this survey is a true baseline measurement. Inventories from this point forward can be compared to the 2016 spring baseline inventory below for determinations of recolonization rates and various other valuable indications for ecosystem renewal and health.

While species inventories will likely continue through the 2016 season, below is a list of species observed prior to June 1, 2016.

Dragonflies and Damselflies of RMNA: Approximation 1
(Baseline measure of recolonization following stabilized water levels.
All observations were of adults in flight. No larvae present as of 5-16-2016)

Dragonflies	
Aeshna umbrosa	Shadow Darner
Anax junius	Common Green Darner
Basiaeschna janata	Springtime Darner
Celithemis elisa	Calico Pennant
Didymops transversa	Stream Cruiser
Epiaeschna heros	Swamp Darner
Epitheca cynosura	Common Baskettail
Gomphus lividus	Ashy Clubtail
Ladona deplanata	Blue Corporal
Libellula cyanea	Spangled Skimmer
Plathemis lydia	Common Whitetail
Sympetrum vicinum	Autumn Meadowhawk
Damselflies	
Enallagma signatum	Orange Bluet
Ischnura posita	Fragile Forktail

Butterflies of RMNA: Approximation 1

Figure 42: *Eastern tiger swallowtail (Papileo glaucus) nectaring from wild azalea (Rhododendron perycliminoides)*

No portion of ecosystem survey effort distracts me more than the butterflies. The potential to see new and varied species has me excited well in advance of survey efforts. On occasions where it did not detract from time constraints and ecosystem survey objectives, species were noted in passing. This was particularly the case when commuting from the parking area to our survey plots, either on foot or in vehicle. Without a concerted effort to document butterfly species, our observations were limited. During our survey we documented 14 species. Ecosystem and host plant variety are relatively high at RMNA, and thus the butterfly diversity is high. We expect dozens more species to be documented in the coming year as observations by those partaking in this survey will continue.

RMNA presents a great variety in systems, and particularly now following reservoir renovations. Missing from the prior assemblage will be a variety of species specifically adapted to wetlands. Extensive native wetland plant communities had established in at least two locations at RMNA prior to the renovation. All of these are now buried beneath water, and due to the lack of flat terrain, it is unlikely that they will return. However, species variety should still be high. The forests, including the dry heaths, acidic oak-hickory areas, and base-rich areas, provide slightly different conditions that help increase the potential for butterfly species variety. Add to this all of the new open areas, and we have the stage set for quite the butterfly foray.

The extensive new peninsula in the center of the reservoir will enter early phases of woody succession in the coming years, offering new flora species and the nectar and host-plant services the hold. The new parking area margins and the unique conditions of the south spillway add further variety to new open areas landscape. All of these areas have the potential to support species that are well adapted to disturbance and the early successional meadows, prairies, woodlands and barren that will follow. Pioneer species of plants such as milkweeds, goldenrods, asters, legumes, brambles, and a great variety of sedges and grasses, will help to increase the overall variety in butterflies at RMNA. I expect these areas alone to double the size of the species list below in the coming summer months.

Hotspots for butterflies noted during survey included the area near the water tower on the east side, both high-base outcrop woodlands (RMNA-02, RMNA-05) and surrounding forest, the blueberry and blackberry heaths along the trails in the northeast portion of RMNA, and the open areas around the new dam and parking lots.

Butterflies of RMNA: Approximation 1

(Early season window of survey limited observations to 14 species)

Amblyscirtes hegon	salt and pepper skipper
Atalopedes campestris	sachem skipper
Celastrina ladon	spring/summer azure
Cupido comyntas	eastern tailed blue
Epargyreus clarus	silver spotted skipper
Erynnis juvenalis	Juvenal's dusywing
Nymphalis antiopa	mourning cloak
Papilio glaucus	eastern tiger swallowtail
Papilio polyxenes	black swallowtail
Papilio troilus	spicebush swallowtail
Polygonia comma	eastern comma
Polygonia interogationis	questionmark
Speyeria cybele	great spangled fritillary
Strymon melinus	gray hairstreak

Other Fauna

In addition to encountering the birds, mammals, amphibians, reptiles, dragonflies, and butterflies listed above, we were fairly continuously in the company of hundreds of other species of insects, spiders, mites, centipedes, millipedes, mollusks, and even a crustacean or two. With a very full plate of tedious work in front of us (identifying and counting every single tree and shrub in each survey plot), we were forced to simply smile, sigh, and move on, with most of the animals we encountered being left in our wake. On the occasion where an animal forced itself upon us, or made a continuous and steady presence, we documented it as time would permit. Also noted in the list below are species of fish encountered by fisherman at RMNA. The resulting list of "Other" fauna:

"Other" fauna:

Latin	**common**
Anabrus simplex	Mormon's cricket
Apheloria virginiensis corrugata	almond scented millipede
Arphia sulphurea	sulphur-winged grasshopper
Bombus pensylvanicus	American bumblebee
Cambarus spp.	crayfish unidentified
Cicindela sexguttata	six-spotted tiger beetle
Frontinella communis	bowl and doily spider
Habronattus viridipes	jumping spider
Hendersonia occulta	eastern land snail
Laphria spp.	golden-backed robberfly
Lepomis macrochirus	bluegill
Leucauge venusta	orchard orbweaver
Micrathena gracilis	spined micrathena
Micropterus salmoides	largemouth bass
Pomoxis nigromaculatus	black crappie
Psychomorpha epimenis	grapevine epimenis
Tibicen canicularis	dog-day cicada
Xylocopa virginica	eastern carpenter bee

References:

Albemarle County Biodiversity Work Group. 2004. *Albemarle County Biodiversity: A Report on its History, Current Conditions, Threats, and Strategies for Future Protection.* URL:*http://www.albemarle.org/upload/images/forms_center/departments/Community_Development/forms/Comp_Plan_Round_4/R423BiodiversityWorkGroupReportmainbw.pdf* Accessed January-May, 2016.

Albemarle County Geographic Information Systems (GIS), public interface: *http://gisweb.albemarle.org/GISWeb/Welcome.aspx* County of Albemarle, VA. 401 McIntire Road, Charlottesville, VA 22902. Accessed March-May, 2016.

Etterson, Matthew A, Russell Greenberg, and Tom Hollenhorst. 2014. *Landscape and regional context differentially affect nest parasitism and nest predation for Wood Thrush in central Virginia, USA.* US EPA and Smithsonian Migratory Bird Center. The Condor Ornithological Applications. Volume 116, 2014, pp. 205–214. DOI: 10.1650/CONDOR-13-045.1

Evans, Arthur V. *Beetles of Eastern North America.* Princeton University Press. 2014. Print.

Godfrey, Michael A. *Field Guide to the Piedmont:* Chapel Hill: University of North Carolina Press, 1997. Print.

Fleming, Gary P. and Karen D. Patterson 2013. *Natural Communities of Virginia: Ecological Groups and Community Types.* Natural Heritage Technical Report 13-16. Virginia Department of Conservation and Recreation, Division of Natural Heritage, Richmond, Virginia. 36 pages.

Floyd, Devin. 2015 *Significant At-Risk Ecological Communities at the Horizons EcoVillage property, A Baseline Ecosystem Survey and Recommendations for Conservation and Interpretation.* Charlottesville, Virginia. Center for Urban Habitats, Survey Department. Published for private landowner use and occasional other use, with permission. 67 pages.

Floyd, Devin. 2015 *The Quarry Gardens at Schuyler: Ecosystem Inventory.* Charlottesville, Virginia. Center for Urban Habitats, Survey Department. Published for private landowner use and occasional other use, with permission. 107 pages.

Hilty, John. 2015. *Trees, Shrubs and Woody Vines of Illinois.* http://*www.illinoiswildflowers.info* . Accessed February-May, 2016.

Iowa State University Department of Entomology. © 2014. Bugguide.net website. *www.bugguide.net* Data accessed April, 2015.

Ivy Creek Foundation**.** Public website: *http://ivycreekfoundation.org/raggedmountain/florafauna.html* P.O. Box 956, Charlottesville, VA 22902. Accessed May, 2016.

Kaufman, Kenn, Jim P. Brock. 2006. *Field Guide to the Butterflies of North America.* Houghton Mifflin Harcourt. Print.

Newcomb, Lawrence. *Newcomb's Wildflower Guide.* New York: Little, Brown and Company, 1977. Print.

McKnight, Karl B., Joseph R. Rohrer, Kirsten McKnight Ward, and Warren J. Perdrizet. 2013. *Common Mosses of the Northeast and Appalachians.* Princeton University Press, 6 Oxford Street, Woodstock, Oxfordshire OX20 1TW. Print.

Omernik, James M., Alan J. Woods, Douglas D. Brown. *Map of Level III and Level IV Ecoregions of Delaware, Virginia, Maryland, West Virginia and Pennsylvania. Sourced at www.epa.gov/wed/pages/ecoregions/reg3_eco.htm* United States Environmental Protection Agency. Accessed May, 2015.

Omernik, James M., Alan J. Woods, Douglas D. Brown. *Level III and IV Ecoregions of Delaware, Maryland, Pennsylvania, Virginia, and West Virginia.* United States Environmental Protection Agency. Corvallis, Oregon. July, 1999.

Roody, William C. 2003. *Mushrooms of West Virginia and the Central Appalachians.* The University Press of Kentucky. 663 South Limestone Street, Lexington, Kentucky 40508. Print.

Smith, James W., Virginia Division of Mineral Resources, *Virginia Minerals, Vol. 7, No. 2.,* April 1961.

United States Department of the Interior. U.S. Geological Survey. *Digital representation of the 1993 Geologic Map of Virginia (2003).* www.mrdata.usgs.gov/geology/state. Google Earth file utilized: vageol.kml. February-May, 2015.

United States Department of State Geographer. ©2015 Google. Google Earth. Accessed November-May 2016.

Virginia Botanical Associates. 2014. Digital Atlas of the Virginia Flora (http://www.vaplantatlas.org). c/o Virginia Botanical Associates, Blacksburg, Virginia.

Virginia Department of Conservation and Recreation - Division of Natural Heritage and Virginia Department of Game and Inland Fisheries. 2013. Atlas of Rare Butterflies, Skippers, Moths, Dragonflies, and Damselflies of Virginia. Accessed at *www.vararespecies.org* on several occasions from April-May, 2016.

Virginia Department of Conservation and Recreation - Division of Natural Heritage and Virginia Department of Game and Inland Fisheries. 2013. *Atlas of Rare Butterflies, Skippers, Moths, Dragonflies, and Damselflies of Virginia.* Accessed at *www.vararespecies.org* on May14, 2016.

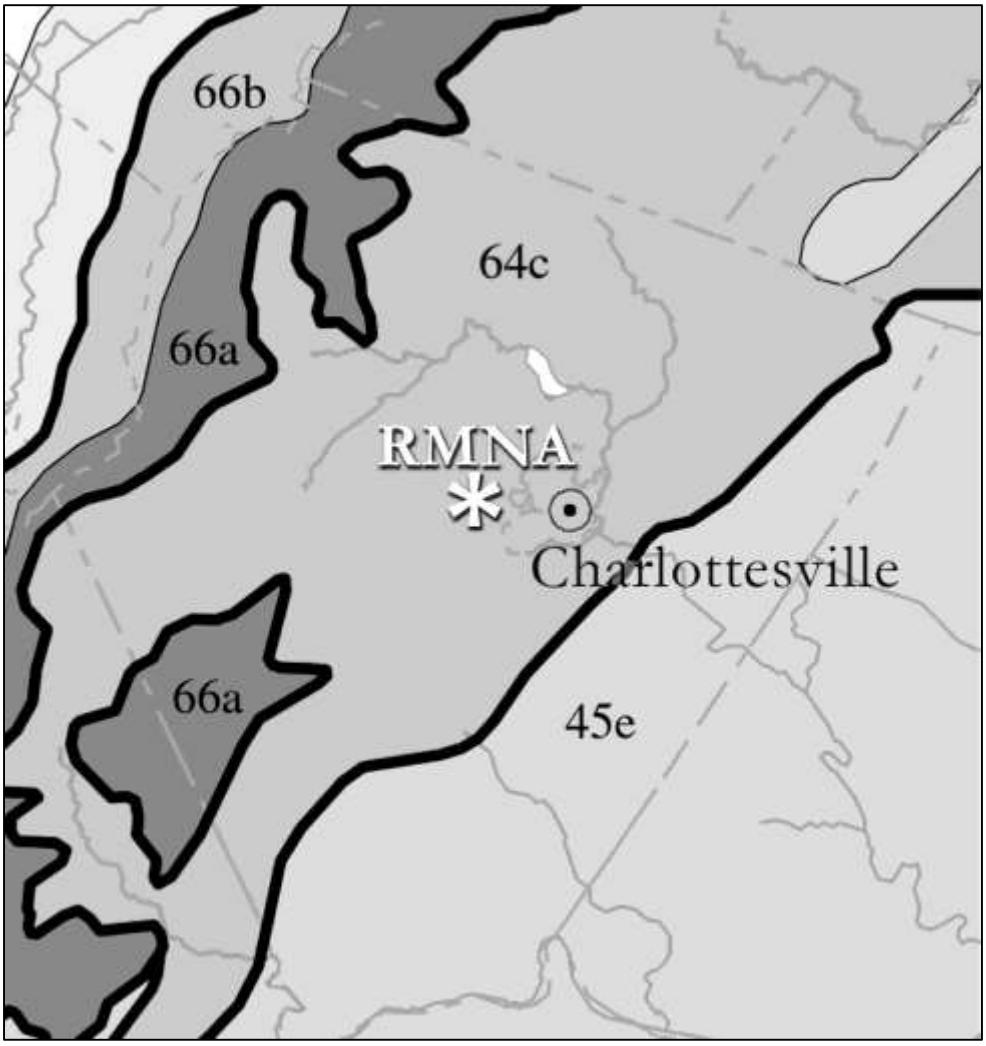
Virginia Department of Game and Inland Fisheries. 2010. *Species of Greatest Conservation Need.* Accessed in May of 2016 at *http://www.bewildvirginia.org/species/*

Virginia Natural Heritage Program. 2007. *Vegetation Plot Data from Ragged Mountain Natural Area, Albemarle County.* Unpublished data extracted from VAPLOTS database, Virginia Dept. of Conservation and Recreation, Richmond.

Weakley, A.S., J.C. Ludwig, and J.F. Townsend. 2012. Flora of Virginia. Bland Crowder, ed. Foundation of the Flora of Virginia Project Inc., Richmond. Fort Worth: Botanical Research Institute of Texas Press.

Appendix A. Survey Location on Ecoregion Map

Located east of the Blue Ridge Ecoregion, Ragged Mountain Natural Area is situated in the heart of the southern portion of the Piedmont Uplands Ecoregion. Within only 7 miles southeast is the transition to the Northern Inner Piedmont, and only 9 miles to the northwest is the Northern Blue Ridge Ecoregion. These ecoregions are different from one another because of a variety of factors. But, an important factor is floristic land cover. RMNA is close to the confluence of many different ecoregion types. This plays a role in biological richness. The potential for anomalies and the mixing of typically disparate plant communities is high. Southerly species may be found growing close to northern species. Blue Ridge flora occur alongside typical Piedmont plants. This ecoregion proximity and resulting richness is yet another important interpretive facet of RMNA.



ECOREGION MAP
45e: Northern Inner Piedmont (Southern Piedmont)
64c: Piedmont Uplands (Northern Piedmont)
66a: Northern Igneous Ridges (Blue Ridge)
66b: Northern Sedimentary and Metasedimentary Ridges

Appendix B. Explanation of Study Area Ecoregions 45e, 64c, 66a

(excerpts quoted from *LEVEL III AND IV ECOREGIONS OF DELAWARE, MARYLAND, PENNSYLVANIA, VIRGINIA, AND WEST VIRGINIA* by Alan J. Woods, James M. Omernik, Douglas D. Brown. July, 1999.)

"Ecoregion 45e, NORTHERN INNER PIEDMONT, is characteristically underlain by highly deformed and deeply weathered Cambrian and Proterozoic feldspathic gneiss, schist, and melange. It is intruded by plutons and is veneered by clay-rich weathering products (i.e. saprolite). Ultisols occur widely and have developed from residuum; they are typically clay-rich, acid, and relatively low in base saturation. Higher, more westerly soils have a mesic temperature regime; they contrast with the thermic soils of the Carolina Slate Belt (45c), Outer Piedmont (45f), and Triassic Uplands (45g).

Streams have silt, sand, gravel, and rubble bottoms materials and bedrock is only occasionally exposed; overall, streams are more silty and sandy than in the Ridge and Valley (67). Differences in stream gradient considerably affect fish habitat in the Piedmont (Jenkins and, 1993). Gradients are usually low to moderate in the Northern Inner Piedmont (45e) and are usually greater than those of the Outer Piedmont (45f) or the Middle Atlantic Coastal Plain (63).

The potential natural vegetation is mapped as Oak-Hickory-Pine Forest by Kuchler (1964). Dominants include hickory *(Carya* spp.), shortleaf pine *(Pinus echinata*), loblolly pine *(Pinus taeda)*, white oak *(Quercus alba)* and post oak *(Quercus stellata)*. The potential natural vegetation is distinct from the Appalachian Oak Forest of the adjacent Triassic Lowlands (64a), Northern Igneous Ridges (66a), and the Northern Sedimentary and Metasedimentary Ridges (66b).

Today, loblolly – shortleaf pine forests are common. Dominant landuses are forestry and agricultural activity. Urban and suburban areas occur especially in the extreme northeast. ("Good" timber production areas are more common in the Inner Piedmont (45e) than in the Outer Piedmont (45f) (U.S. Soil Conservation Service, 1981a). Chestnut oak *(Quercus prinus)* is abundant on the level and gently sloping uplands of Ecoregion 45e but becomes less common in the Outer Piedmont (45f) where it is regarded as an outlier from farther west (Clark and Ware, 1980). Livestock, poultry, and dairy farms occur and corn, small grain, rye, tobacco, and hay are grown.

Figure 1 shows the boundaries that divide the ecoregions. The Inner Piedmont (45e) and Outer Piedmont (45f) were separated using topographic, soil temperature, and geologic rationale. The line between them is transitional and roughly divides more rugged terrain from less rugged; it also approximates the eastern limit of monadnocks (Terwilliger and Tate, 1994), the foresters' line for natural regeneration of loblolly pine (*Pinus taeda*) (US Soil Conservation Service, 1981a), the Tallapoosa-Rappahannock lithofacies line (Hack, 1982), and the broad transitional, boundary between mesic and thermic soils (Marc Crouch, Natural Resources Conservation Service, June, 1998). The Northern Inner Piedmont (45e) and the Triassic Uplands (45g) line was drawn on the basis of geology and separates the Triassic sedimentary strata of Ecoregion 45g from the much older, mostly metamorphic rocks of Ecoregion 45e. The boundary between the Northern Inner Piedmont (45e) and the Blue Ridge Mountains (66) is based on topography; Ecoregion 66 has far greater relief, steeper slopes, and much higher elevations than Ecoregion 45e. The Northern Inner Piedmont (45e) extends southward into North Carolina."

"Ecoregion 64c, PIEDMONT UPLANDS, is characterized by rounded hills, low ridges, relative high relief, and narrow valleys and is underlain by metamorphic rock. Irregular plains and narrow valleys typically have elevations that often range from about 450 feet to 1,000 feet (137-304 m) and a local relief that is often 130 feet to 330 feet (40 to 101 m). Ruggedness increases toward the southwest and local relief can be as much as 590 feet (180 m) adjacent to the incised Susquehanna River. Here gorges containing high-gradient streams and waterfalls occur, including Otter Creek, Tucquan Glen, Wildcat Run, Counselman Run, Kelly Run, Ferncliff Run, and Oakland Run (Geyer and Bolles, 1979, pp. 442-465;

Guilday, 1985, p. 19). The Piedmont Uplands (64c) has substantially higher relief than the Triassic Lowlands (64a), Piedmont Limestone/Dolomite Lowlands (64d), or the Outer Piedmont (45f). Channel gradient is generally moderate and is greater than that of neighboring ecoregions with less relief; Piedmont fish habitats vary in relation to gradient (Jenkins and Burkhead, 1993 (1994).

The Fall Zone occurs near the eastern edge of Ecoregion 64c and is characterized by areas of high stream gradient, exposed bedrock, islands, falls, and a mixture of metamorphic and sedimentary rock. Parts are suited to many upper Piedmont and montane fishes. The Fall Zone is an ecologic barriers to lowland, calm-water species. The Great Falls of the Potomac is the largest physical river barrier of natural origin in Virginia and is insurmountable to fishes at low and normal river levels; it has barred anadromous fishes from potential spawning grounds and may have curtailed the upstream distribution of Coastal Plain fish species (Jenkins and Burkhead, 1993 (1994)).

Metamorphic rocks of Lower Paleozoic and Precambrian age underlie the ecoregion and are folded and faulted; lithology is distinct from the sedimentary rocks of the neighboring Southeastern Plains (65). Schists of the Wissahickon and Peters Creek formations predominate and Precambrian gneisses are common in the east. Very resistant quartzite and phyllite of the Chickies, Antietam, and Harpers formations form the highest areas, the Pigeon Hills and Hellam Hills. Scattered outcrops of very basic serpentinite also occur.

Deep Ultisols and Inceptisols are common and have developed from residuum. Chester and Glenelg soils are common. These Ultisols are capable of supporting highly diversified farms, even though they are less fertile than the soils of Ecoregion 64d. Soils derived from quartzite are commonly stony and are often forested. Chrome soils from serpentinite occur locally and are low in calcium and high in magnesium, chromium, and nickel.

Scattered serpentine barrens occur on chrome soils and support a specialized vegetation composed of dry oak/pine forests (e.g., *Quercus marilandica, Q. stellata, Q. velutina, Pinus virginiana*), greenbrier (*Smilax rotundifolia*), prairie grasses (e.g., *Schizachyrium scoparius, Sporobolus heterolepis*), and herbs (e.g., *Aster depauperatus, Cerastium arvense var. villosissimum, Talinum teretifolium*) (Cuff and others, 1989, p. 56). Most of these are rare in Pennsylvania and some are threatened, including the prairie dropseed (*Sporobolus heterolepis*) (Wiegman, 1985, p. 57). In addition, the buckmoth (*Hemileuca maia)* occurs only in the serpentine barrens and is threatened in Pennsylvania (Opler, 1985, p. 88). Pitch pine (*Pinus rigida*) is a co-dominant in serpentine barren woodlands and an important component of bluestem-dropseed savannas; it is found at seven serpentine barren sites in Chester, Delaware, and Lancaster counties. Those at Nottingham County Park and at Goat Hill State Forest Natural Area are among the largest remaining barrens in the eastern United States (R. Latham, Department of Geology, University of Pennsylvania, written communication, 1995). Grazing, quarrying, and suburban development continue to threaten the remaining barrens (Wiegman, 1985, p. 57) and The Nature Conservancy has given them second-highest priority on their state biodiversity conservation agenda (Roger Latham, Department of Geology, University of Pennsylvania, written communication, 1995).

The potential natural vegetation is mapped as Appalachian Oak Forest (dominated by white and red oaks); it distinct from the Oak-Hickory-Pine of the Inner Piedmont (45e) (Kuchler, 1964). Some Mixed Mesophytic Forest also occurred. Remnants of the original vegetation can be found in the cool, very rugged Otter Creek gorge, where virgin chestnut oak (*Quercus prinus),* hemlock (*Tsuga canadensis*), beech (*Fagus grandifolia*), sugar maple (*Acer saccharum*), and basswood (*Tilia heterophylla*) still grow (Erdman and Wiegman, 1974, p. 98).

Today, forests are less extensive than they were originally and there is more agriculture than in the Inner Piedmont (45e). Extensive urban, commercial, and industrial development occurs in the Philadelphia area. Suburban development is common, especially near Philadelphia, Wilmington, and the major transportation corridors. Farms become progressively more common with distance from the cities. Grain, potatoes, and hay are produced and many of the farms have pastures for dairy and beef cattle or ranges for poultry. Farming is favored by nearness to market, rather fertile soils, and Pennsylvania's longest growing season, up to 200 days. Agricultural erosion has been a serious problem in many places (Kunkle, 1963).

The boundary of Ecoregion 64c follows the limit of the Lower Paleozoic and Precambrian metamorphic rocks; they are distinct from the largely sedimentary rock of the surrounding ecoregions. The Northern Piedmont (64) is divided from the Middle Atlantic Coastal Plain (63) by the Fall Line. The southern boundary is close to Braun's (1950) natural vegetation line. The western boundary with the high, rugged, forested Blue Ridge Mountains (66) is based on topography and vegetation density."

"Ecoregion 66a, NORTHERN IGNEOUS RIDGES, extends southwestward from South Mountain, Pennsylvania, to near the Roanoke River. It consists of pronounced ridges separated by high gaps and coves. Mountain flanks are steep and well dissected. Crestal elevations tend to rise southward, from 1,000 to 1,575 feet (305-480 m) in Pennsylvania, to a maximum of over 3,750 feet (1,143 m). Local relief also increases southward to a maximum of about 1,300 feet (396 m). Precambrian and Paleozoic metavolcanic and igneous rock underlie Ecoregion 66a. Typically occurring in Virginia are basalt and metabasalt of the Catoctin Formation, granite and granodiorite of the Virginia Blue Ridge Complex, and andesite, tuft, and greenstone of the Swift Run Formation. Metarhyolite and metabasalt occur in Pennsylvania; diabase, metabasalt, and metarhyolite are found in Maryland. Inceptisols, Alfisols, and Ultisols have commonly developed from the bedrock. Catoctin, Myersville, and Hayesville soils are widespread. Low fertility, acidity, stoniness, and steepness are characteristics of these soils. The natural vegetation was Appalachian Oak Forest (dominants: white and red oaks) (Kuchler, 1964). Today, the Northern Igneous Ridges (66a) remain extensively forested. On South Mountain, however, localized dairy farming and poultry raising occur; in addition, orchards are found on Arendtsville soils."

Appendix C: Expanded Conservation Status Definitions

(Quoted directly from the DCR's 2013 publication titled "Natural Communities of Virginia: Ecological Groups and Community Types" - see bibliography for full source description)

"State ranks are assigned by the Virginia Division of Natural Heritage and apply to an element only as it exists in the state, regardless of its range-wide status."

SX: "Extirpated - Presumed extirpated from the state. Not located despite intensive searches of historical sites and other appropriate habitat, and virtually no likelihood that it will be rediscovered."

SH: "Historical - Possibly extirpated (Historical). Historically known from the state, but not verified for an extended period, usually >15 years; this rank is used primarily when inventory has been attempted recently."

S1: "Critically Imperiled - Critically imperiled in the state because of extreme rarity or because of some factor(s) making it especially vulnerable to extirpation from the state; generally with 5 or fewer occurrences state-wide, and/or covering less than 50 ha (124 ac) in aggregate; or covering a larger area but highly threatened with destruction or modification".

S2: "Imperiled - Imperiled in the state because of rarity or because of some factor(s) making it very vulnerable to extirpation from the state. Generally with 6–20 occurrences state-wide, and/or covering less than 250 ha (618 ac) in aggregate; or covering a larger area but threatened with destruction or modification."

S3: "Vulnerable - Vulnerable in the state either because rare and uncommon, or found only in a restricted range (even if abundant at some locations), or because of other factors making it vulnerable to extirpation. Generally with 21-100 occurrences state-wide; or with a larger number of occurrences subject to relatively high levels of threat; may be of relatively frequent occurrence in specific localities or geographic parts of the state."

S4: "Apparently Secure-Uncommon but not rare, and usually widespread in the state. Some cause for long-term concern due to declines or other factors."

S5: "Secure-Demonstrably widespread, abundant, and secure in the state, and essentially ineradicable under present conditions."

"Global ranks (i.e. range-wide conservation status ranks) are assigned at NatureServe's Headquarters or by a designated lead office in the Heritage/Conservation Data Center Network."

GX: "Extirpated - Eliminated throughout its range, with no restoration potential due to extinction of dominant or characteristic taxa and or elimination of the sites and ecological processes on which the type depends."

GH: "Possibly Extinct (Historical) - Presumed eliminated throughout its range, with no, or virtually no, likelihood that it will be rediscovered, but with potential for restoration (e.g., Castanea dentata Forest)."

G1: "Critically Imperiled - Critically imperiled globally. At very high risk of elimination due to extreme rarity, very steep declines, or other factors."

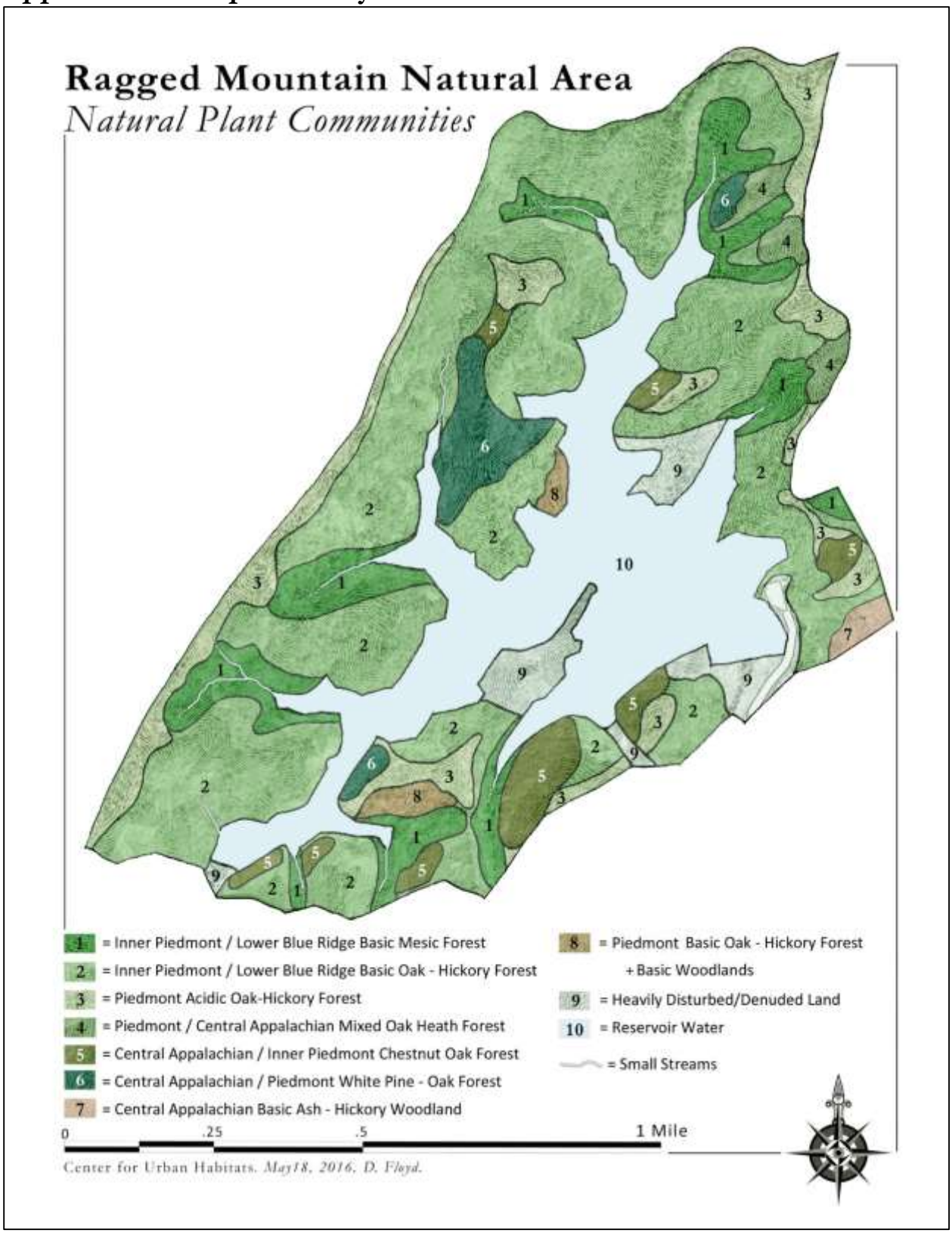
G2: "Imperiled-Imperiled globally. At high risk of elimination due to very restricted range, very few occurrences, steep declines, or other factors."

G3: "Vulnerable-Rare or uncommon. At moderate risk of extinction or elimination due to a restricted range, relatively few occurrences, recent and widespread declines, or other factors."

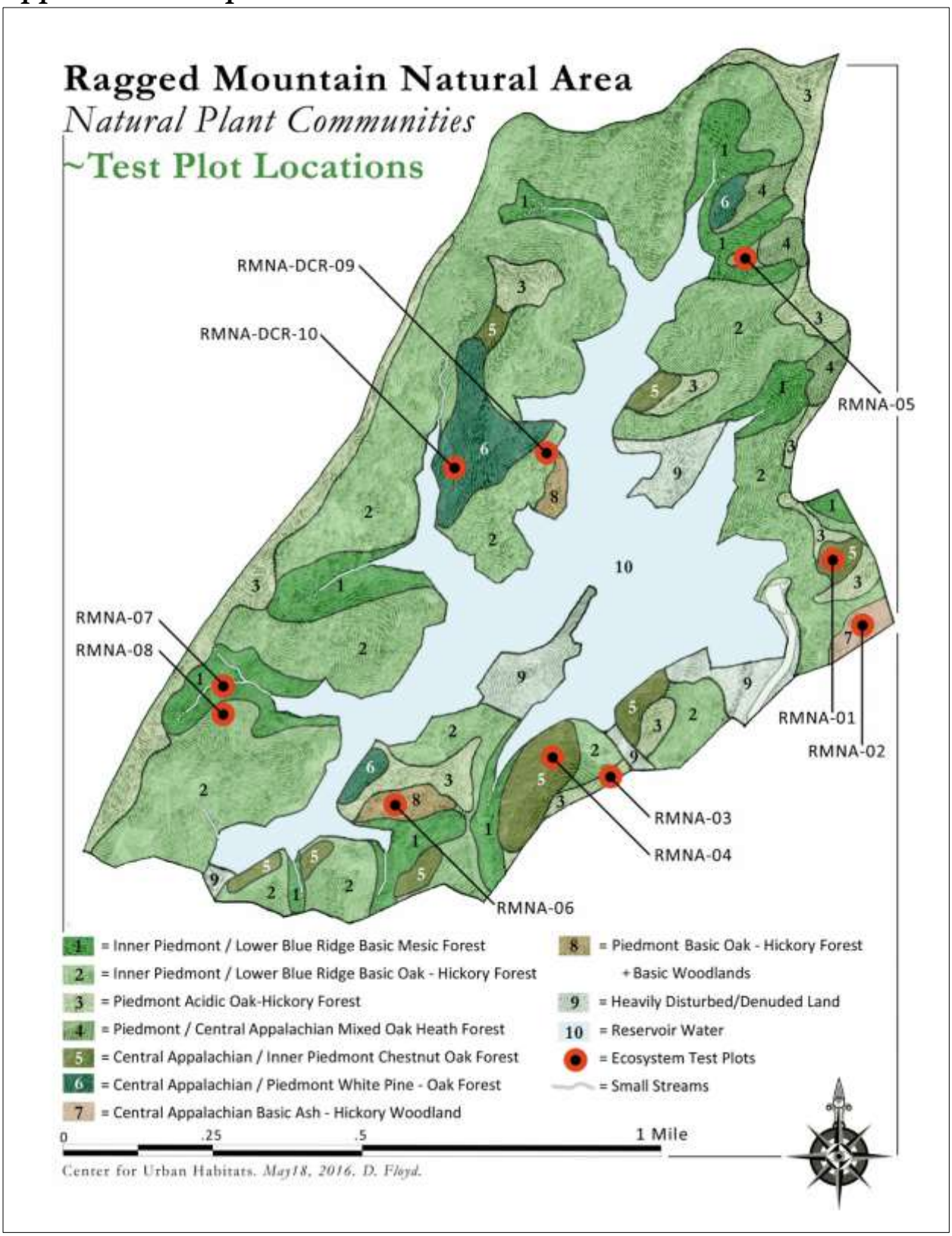
G4: "Apparently Secure-Uncommon but not rare. Apparently secure, but with cause for long-term concern. May be quite rare in parts of its range, especially at the periphery; apparently not vulnerable in most of its range."

G5: "Secure-Demonstrably widespread, abundant, and secure. Common, widespread, and abundant, although it may be quite rare in parts of its range, especially at the periphery; not vulnerable in most of its range."

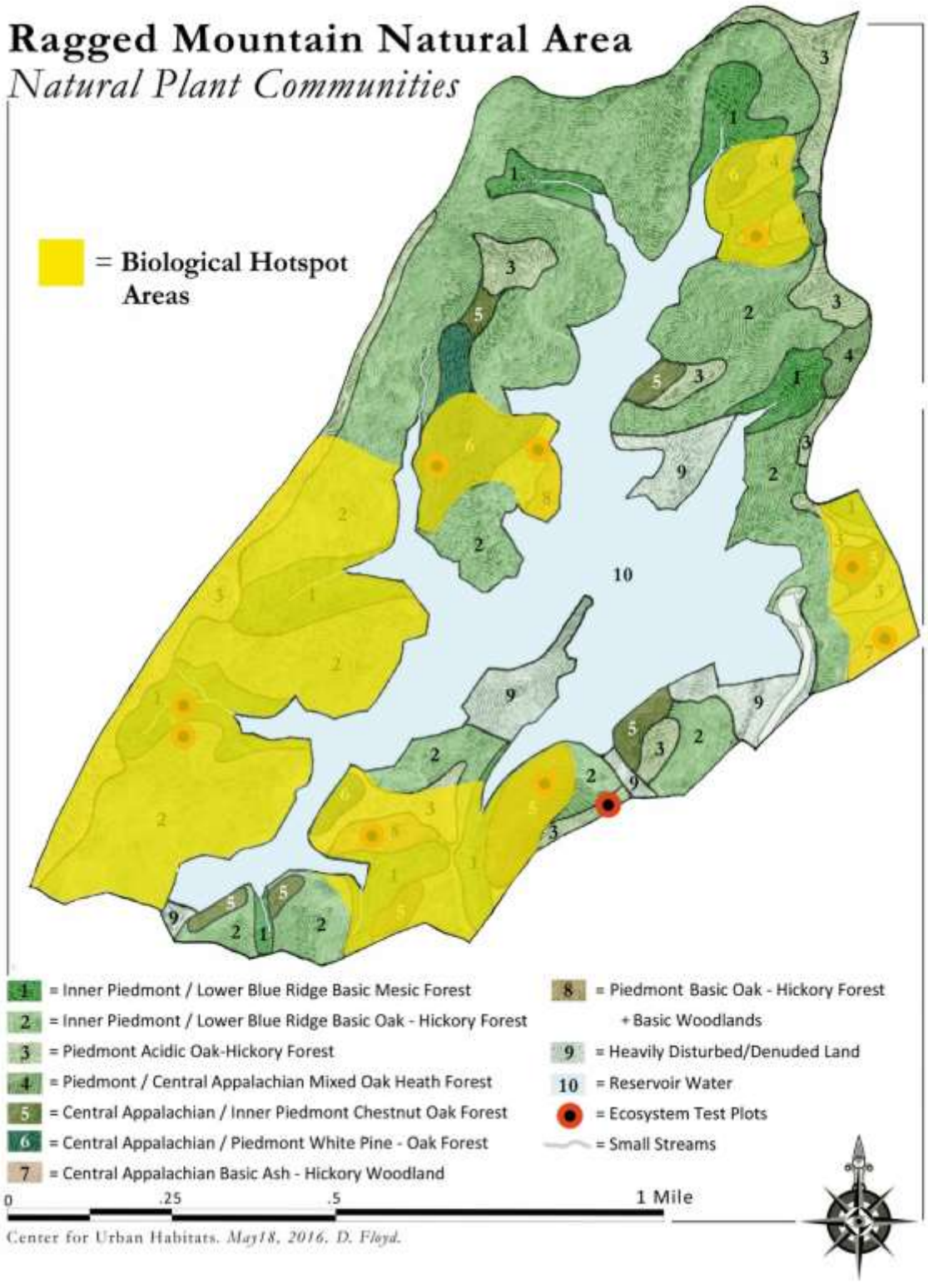
Appendix D: Map of Ecosystems of RMNA



Appendix E: Map of Test Plot Locations



Appendix F: Map of Biological Hotspot Areas



Appendix G: Biological Hotspot Explanation

A Biological Hotspot as it pertains to the natural resources of Ragged Mountain Area, is an area that has the following:

1. unusual, rare, or threatened species.
2. great variety in species, habitats, and landforms over short distance (making them excellent areas for study, education, and conservation)
3. unusual mixes of species due to the unique site characteristics
4. excellent state of Native preservation AND are at risk due to human impact
5. old forest (>100 years old)
6. higher biodiversity in all life forms when compared to other areas at RMNA
7. plant species and communities that are unique when compared to the broader regional landscape
8. species that are rare or threatened in Albemarle Co. and/or Virginia
9. high level of sensitivity due to the high numbers of ground-nesting forest species of birds and variety and richness of ground-dwelling animals such as amphibians and reptiles

Appendix H: Ecosystem Cover Class Data Form *Example*

Only Page 1 of 7 included here, as all sheets have the same format.

CENTER FOR URBAN HABITATS

Forest Stratum Field Form

PLOT #: 87 (TT5)

Stratum (Circle one): Upper Middle Lower Shrub ~~Herbaceous~~ Other

Stratum Codes: H

PLOT NAME: West Side Rich Ravine

Maximum plant height: N = Nonvascular Flora, H = 0-2' (all herbs + woody plants), S = 2'-20', T1 = 21'-32', T2 = 33'-66', T3 = 67'-115', T4 = >115'

PROJECT: RMNA Ecosystem Survey

Cover Classes: 1 = trace, 2 = a few (<1%), 3 = 1-2%, 4 = 2-5%, 5 = 5-10%, 6 = 10-25%, 7 = 25-50%, 8 = 50-75%, 9 = 75-100%. Record cover values for each stratum AND for total cover in entire sample.

RECORDER (s): RJB, DSF DATE: 5.15.2016

Frequency: Count every individual in the Forest Layer and put total here.

NN	Pic	Out	?Id	Latin	common	Cover Class	Freqency	Relative Frequency (%)	DBH range (min-max)
				Actaea racemosa	black cohosh	6			
				Arisaema triphyllum	jack in the pulpit	3			
				Lindera benzoin	spicebush	3			
				Rubus phoenicolasius	wine berry	4			
				Parthenocissus quinquefolia	Virginia creeper	3			
				Vitis sp.	grape sp.	2			
				Galearis spectabilis	showy orchis	3			
				Microstegium vimineum	Japanese stilt grass	3			
				Polystichum acrostichoides	christmas fern	3			
				Collinsonia canadensis	richweed	3			
				Amphicarpaea bracteata	hog peanut	8			
				Circaea canadensis	enchanters nightshade	5			
				Aruncus dioicus	goats beard	2			
				Phegopteris hexagonoptera	broad beech fern	5			
				Sanicula canadensis	black snake root	2			
				Adiantum pedatum	maidenhair fern	3			
				Uvularia perfoliata	perfoliated bellwort	2			
				Viola sororia	common blue violet	2			
	✓			Deparia acrostichoides	silvery	6			
	✓			Homalosorus pycnocarpos	glade fern	3			
				Viburnum acerifolium	maple leaved vib	1			
				Botrypus virginiana		1			
				Obolaria virginica	pennywort	2			
				Galium circaezans	forest bedstraw	2			
				Toxicodendron radicans	poison ivy	3			
				Celastrus orbiculatus	oriental bittersweet	2			
		✓		Osmunda claytonia	interrupted fern	—			
	✓	✓		Sanguinaria canadensis	bloodroot	—			
	✓			Carex prasina	drooping sedge	2			
				Cynoglossum virginianum	wild comfrey	2			

PLOT # RMNA 87 PAGE 1 of 7

(N: 1652)

Appendix I: Ecosystem Classification Data Form *Example*

All 4 pages of form included, as each page is different.

CENTER FOR URBAN HABITATS

ECOSYSTEM CLASSIFICATION DATA COLLECTION FIELD FORM

PLOT# RMNA-04 PLOT NAME Oak Heath (OH6)

PROJECT 2015 RMNA Ecosystem Survey DATE 12-18-2015

COUNTY/CITY Albemarle County STATE VA

RECORDER (initials) DSF SURVEYORS (initials) DSF, RTB, DMC, JRS

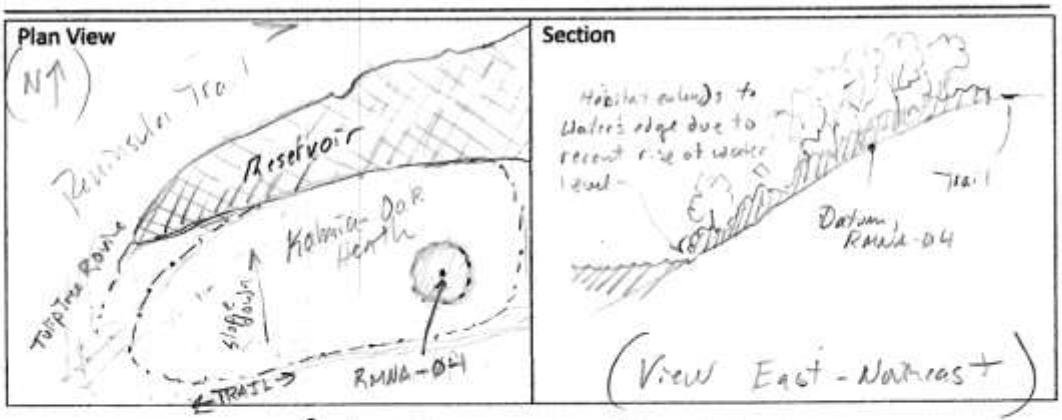
ECOREGION (Omernik Level IV) Piedmont Uplands ELEVATION RANGE (ft.) 830-870

LATITUDE (centroid) 38.02622 LONGITUDE (centroid) -78.56445

PLOT SIZE (sq. ft.) 8611 PLOT DIMENSIONS (sq. ft.) — x — or 52.4' radius

ESTIMATED ECOSYSTEM SIZE (circle one) < 1 acre 1-10 acres **10-50 acres** (10-12 acres) 50-100 acres Unknown

PLOT LOCATION DESCRIPTION Plot located in the east half of the largest Oak Heath at RMNA + Approx. 300' SW of the water's edge.



GEOLOGIC FORMATION Central Virginia Blue Ridge Anti-Clinorium complex

ROCK TYPES PRESENT porphyroblastic biotite-plagioclase augen gneiss

SURFACE COVER *(Excluding flora, total = 100%)*

Bedrock	%	Organic matter	85 %	Boulders	2 %	Cobbles/Gravel	3 %
Decaying Wood	7 %	Mineral Soil/Sand	3 %	Water	%	Other	%

SLOPE rise (x)= 6' run(y)= 20'

100x/y=
- ☐ 0-3% (level or nearly so)
- ☐ 3-8% (gentle/undulating)
- ☐ 8-16% (sloping/rolling)
- ☐ 16-30% (moderate/hilly)
- ☒ 30-65% (steep)
- ☐ 65-75% (very steep)
- ☐ 75+% (extremely steep)

ANGLE OF INCLINE

$\tan^{-1}$ x/y = θ (degrees)

Single measure 16.7° or

Average of ____

(Range: ____ to ____)

ASPECT

☐ north	☐ south
☐ northeast	☐ southwest
☐ east	☐ west
☐ southeast	☒ northwest 328°

LANDFORM

☐ ridge / interfluve	☐ seep / swale / non-alluvial bottom
☐ saddle / gap	☐ bedrock outcrop
☐ dune	☐ alluvial flat / alluvial terrace / floodplain
☐ beach / overwash flat	☐ boulderfield / talus / debris slide
☐ slope bench / ledge / step	☐ floodplain levee
☑ side slope	☐ hill / knob / monadnock
☐ interdune flat / interdune swale	☐ channel shelf / stream margin / bar
☐ fan piedmont	☐ rolling / dissected upland
☐ tidal flat	☐ backswamp / slough / oxbow
☐ cove	☐ sag pond / basin
☐ ravine	☐ sag pond / basin
☐ cliff / escarpment / face	☐ OTHER:

Topographic Position

☐ undulating / flat plain	☐ lower slope
☐ crest / interfluve	☐ toe slope
☐ upper slope	☐ plain/level/bottom
☑ middle slope	☐ basin/depression

Evidence of Disturbance

☐ ditching/hydrologic alternation	☐ clearing
☐ dogwood anthracnose	☐ spruce decline
☐ oak decline	☒ grazing/browsing
☐ exotic plants	☐ fire
☐ hemlock adelgid	☐ wind/ice damage
☐ trails/roads	☐ erosion
☐ gypsy moth	☑ logging
	☐ Other

Disturbance Comments: Deer browsing on Vaccinium pallidum & Kalmia latifolia. Fire dependent habitat type has Acer rubrum extending into the middle canopy, indicating that the site has not seen fire in a long time.

SOIL DRAINAGE CLASS	SOIL MOISTURE REGIME
□ rapidly drained	□ Xeric
☑ well drained	☑ Dry-mesic
□ moderately well drained	□ Mesic
□ somewhat poorly drained	□ Wet-mesic
□ poorly drained	□ Sub-hydric
□ very poorly drained	□ Hydric

ASSESSMENT AND NOTES

Write a brief word picture of community. Describe the representativeness of the plot to the vegetation type being sampled and any variation within the occurrence in terms of vegetation structure, floristics, and environment. Note vertical stratification or horizontal zonation patterns. Describe dominant and characteristic species and inclusion communities (if present). If community occurs as a mosaic describe spatial distribution and associated community types. Include landscape context information (adjacent communities). Describe any special or unusual features of the vegetation or habitat. If possible, note the origin and (for moderately even-aged forests) approximate age of the stand. Record the presence at the site of species not sampled in the plot. Note, where appropriate, the approximate distance and direction to water sources, such as river channels, perennial streams, intermittent streams, and seepage or runoff areas. For riparian and other wetland sites note the height of primary and secondary water marks and/or the presence of fluvial features.

This plot was positioned in the east half of an extensive heath located near the center of the south portion of RMNA. This forest is nearly identical to other Oak Heaths on the property, but has slightly more variety in biota (largely due to its size). The lay of the land has become a notable trademark for Kalmia heaths at RMNA, with aspects always being Northwest and slopes being steep. The habitat stops abruptly along the new watershed ridge at its north side and meets an acidic oak-hickory assemblage at its south. The west margins transition abruptly to a forest with Tuliptree dominance, In the heath still, but along this westside, are the anomalous Prenanthes serpentaria, Athyrium asplenioides and singular occurrence of Pteridium aquilinum. Acer rubrum has become a regular tree present in all layers documented and Fagus grandifolia looks here and there. Hamamelis virginiana occurs occasionally. This forest is likely to be between 75-100 years old and is showing evidence of fire exclusion in Acer and Fagus. Downed trees, organic material pockets, and outcropping boulders and cobbles offer niches for interesting mosses and fungi.

Representative Community Type: Inner Piedmont Chestnut Oak Forest

USNVC CEGL Code: CEGL006299 **Global/State Ranks:** G5/S5

- Quercus montana / Kalmia latifolia / Chimaphila maculata (Polytrichum juniperinum, Leucobryum glaucum) Forest -

KEY FOR FIELD FORM:

Cover Class

Record species cover in the following classes:
1 = trace
2 = a few (<1%)
3 = 1-2%
4 = 2-5%
5 = 5-10%
6 = 10-25%
7 = 25-50%
8 = 50-75%
9 = 75-100%.
Record cover values for each stratum (on the Field Form). Check "Out" for taxa outside the plot but in ecosystem. Check "ID" for taxa of questionable identification.

Stratum Height
Maximum plant height:
N = Nonvascular Flora
H = 0-2' herb layer (all herbs + woody plants)
S = 2'-20' height (shrub layer)
T1 = 21'-32' height
T2 = 33'-66' height
T3 = 67'-115' Canopy height
T4 = >115' Upper canopy

Accurate formula for calculating tree height. Stand approximately the same distance away from the tree as the tree is tall, and on the same contour (if possible):
(*Tan* ∠ to tree top *x* distance to tree) + (*Tan* ∠ to tree base *x* distance to tree)= Tree Height

Number of Survey Stratum Sheets (attach) 5

Appendix J: Trees and Shrubs of RMNA. *Education Hike Checklist*

*NOTE: Non-native and Introduced species noted with " * ".*

- ☐ *Acer rubrum*, red maple
- ☐ *Ailanthus altissima*, tree-of-heaven*
- ☐ *Albizia julibrissin*, mimosa*
- ☐ *Amelanchier arborea*, downy serviceberry
- ☐ *Aralia spinosa*, devil's walking stick
- ☐ *Berberis bealei*, Chinese mahonia*
- ☐ *Berberis thunbergii*, Japanese barberry*
- ☐ *Betula lenta*, sweet birch
- ☐ *Carpinus caroliniana*, American hornbeam
- ☐ *Carya cordiformis*, bitternut hickory
- ☐ *Carya glabra*, pignut hickory
- ☐ *Carya ovalis*, red hickory
- ☐ *Carya ovate*, shagbark hickory
- ☐ *Carya tomentosa*, mockernut hickory
- ☐ *Castanea dentata*, American chestnut
- ☐ *Celtis occidentalis*, common hackberry
- ☐ *Celtis tenuifolia*, dwarf hackberry
- ☐ *Cercis canadensis*, eastern redbud
- ☐ *Cornus florida*, flowering dogwood
- ☐ *Diospyros virginiana*, common persimmon
- ☐ *Elaeagnus umbellata*, autumn olive*
- ☐ *Euonymus alatus*, burning bush*
- ☐ *Euonymus americanus*, strawberry bush
- ☐ *Fagus grandifolia*, American beech
- ☐ *Fraxinus americana*, white ash
- ☐ *Gaylussacia baccata*, black huckleberry
- ☐ *Gleditsia triacanthos*, honey locust
- ☐ *Gymnocladus dioica*, Kentucky coffee-tree*
- ☐ *Hamamelis virginiana*, witch-hazel
- ☐ *Hydrangea arborescens*, wild hydrangea
- ☐ *Ilex cornuta*, Chinese holly*
- ☐ *Ilex opaca*, American holly
- ☐ *Juglans nigra*, black walnut
- ☐ *Juniperus virginiana*, eastern red cedar
- ☐ *Kalmia latifolia*, mountain laurel
- ☐ *Ligustrum sinense*, Chinese privet*
- ☐ *Lindera benzoin*, spicebush
- ☐ *Liriodendron tulipifera*, tuliptree
- ☐ *Lyonia ligustrina*, maleberry
- ☐ *Malus baccata*, Siberian crabapple*
- ☐ *Morus rubra*, red mulberry
- ☐ *Nyssa sylvatica*, black gum
- ☐ *Ostrya virginiana*, hop-hornbeam
- ☐ *Paulownia tomentosa*, royal paulownia*
- ☐ *Philadelphus inodorus*, scentless mock orange
- ☐ *Photinia villosa*, smooth Oriental photinia*
- ☐ *Pinus echinata*, shortleaf pine
- ☐ *Pinus strobus*, eastern white pine
- ☐ *Pinus virginiana*, Virginia pine
- ☐ *Prunus avium*, sweet cherry
- ☐ *Prunus serotina*, wild black cherry
- ☐ *Prunus subhirtella*, spring cherry
- ☐ *Quercus alba*, white oak
- ☐ *Quercus coccinea*, scarlet oak
- ☐ *Quercus falcata*, southern red oak
- ☐ *Quercus montana*, chestnut oak
- ☐ *Quercus rubra*, northern red oak
- ☐ *Quercus stellata*, post oak
- ☐ *Quercus velutina*, black oak
- ☐ *Rhododendron periclymenoides*, wild azalea
- ☐ *Ribes rotundifolium*, Appalachian gooseberry
- ☐ *Robinia pseudoacacia*, black locust
- ☐ *Rosa caroliniensis*, Carolina rose
- ☐ *Rubus flagellaris*, common dewberry
- ☐ *Rubus occidentalis*, black raspberry
- ☐ *Rubus pensylvanicus*, Pennsylvania blackberry
- ☐ *Rubus phoenicolasius*, wineberry*
- ☐ *Sassafras albidum*, sassafras
- ☐ *Symphoricarpos orbiculatus*, coralberry*
- ☐ *Tilia americana*, basswood
- ☐ *Tsuga canadensis*, eastern hemlock
- ☐ *Ulmus rubra*, slippery elm
- ☐ *Vaccinium pallidum*, hillside blueberry
- ☐ *Vaccinium stamineum*, deerberry
- ☐ *Viburnum acerifolium*, maple-leaved viburnum
- ☐ *Viburnum prunifolium*, blackhaw

Compiled by D. Floyd. 2016. Center for Urban Habitats

Appendix K: Non-native Flora of RMNA: *Approximation 1*

NOTE: Sorted by ecosystem prevalence

	Latin	***common***	***Ecosystem (s)***
1.	*Celastrus orbiculatus*,	Oriental bittersweet	1, 2, 3, 6, 7, 8
2.	*Elaeagnus umbellata*,	autumn olive	1, 2, 3, 7, 8
3.	*Microstegium vimineum*,	Japanese stiltgrass	1, 2, 3, 7, 8
4.	*Ailanthus altissima*,	tree-of-heaven	1, 2, 7, 8
5.	*Lonicera japonica*,	Japanese honeysuckle	1, 2, 3, 7
6.	*Rubus phoenicolasius*,	wineberry	1, 2, 7, 8
7.	*Symphoricarpos orbiculatus*,	coralberry	1, 2, 7, 8
8.	*Allaria petiolata*,	garlic mustard	1, 2, 7
9.	*Cardamine hirsuta*,	hairy bittercress	2, 7, 8
10.	*Ligustrum sinense*,	Chinese privet	2, 3, 7
11.	*Prunus avium*,	sweet cherry	1, 2, 7
12.	*Euonymus alatus*,	burning bush	2, 7
13.	*Photinia villosa*,	smooth Oriental photinia	1, 2
14.	*Potentilla indica*,	Indian strawberry	1, 8
15.	*Verbascum thapsus*,	common mullein	2, 7
16.	*Youngia japonica*,	Japanese hawkweed	1, 8
17.	*Albizia julibrissin*,	mimosa	2
18.	*Berberis bealei*,	Chinese mahonia	1
19.	*Berberis thunbergii*,	Japanese barberry	1
20.	*Gymnocladus dioica*,	Kentucky coffee-tree	2
21.	*Hosta ventricosa*,	blue plantain-lily	2
22.	*Ilex cornuta*,	Chinese holly	8
23.	*Malus baccata*,	Siberian crabapple	8
24.	*Paulownia tomentosa*,	royal paulownia	1
25.	*Perilla frutescens*,	perilla	7
26.	*Persicaria longiseta*,	long-bristled smartweed	7
27.	*Stellaria media*,	common chickweed	7
28.	*Taraxum officinale*,	common dandelion	8

Broad beech fern *(Phegopteris hexagonoptera)*