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Ecological Study of the East Fork Ridge Mesic Forest Area

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Introduction:

The Oak Ridge Reservation (ORR) consists of approximately 33,000 to 36,000 acres. This large forested area of land contains numerous unique habitats and communities that are disappearing from other areas in Tennessee and the Southeast US. In 2004 John Devereux Joslin, Jr. investigated one community in the north end of the Oak Ridge Reservation called the East Fork Ridge Mesic Forest Area. This sloping community consists of a mixed mesophytic forest, which means the forest has a variety of tree species that prefer moist environments. Based on his observations and on dendro-chronology (i.e., determining the age of a tree by counting rings), he concluded that this area may be an old-growth forest and recommended further research of this distinctive area.

So what is an old-growth forest? It is difficult to find a concise definition for old-growth forest, but the easiest explanation is that it is an area that has not been disturbed by human interference. For example, there should be no history of logging or farming in the forest. Other names commonly used to describe these natural areas are virgin forest, primeval forest, ancient forest, and pristine forest.

Problem Statement:

The purpose of this study was to investigate and analyze the East Fork Ridge Mesic Forest and to determine if it should be classified as an old-growth forest. In order to accomplish this task, we were first required to research information related to this topic and establish four defining characteristics of an old-growth mixed mesophytic forest. These characteristics were based on the article "Characteristics of Old-growth Mixed Mesophytic Forests" by William Martin (Martin 1992). We then had to collect and analyze data from the forest and compare it to these predetermined characteristics in order to determine if it was old-growth. Our specific objectives for this project were as follows:

1) Establish four defining characteristics of old-growth in a mixed mesophytic forest, which are described below in objectives 2, 3, 4, and 5.
2) Locate and record more than 7 large canopy trees (>75 cm diameter at breast height [dbh]) per hectare.

3) Confirm diversity of species by identifying at least 20 different species of forest canopy trees over 12.5 cm dbh with no species demonstrating a frequency greater than 0.50.
4) Verify a basal area of between 20.6-42.4 square meters (sq. m) per hectare.
5) Investigate evidence of human disturbance.
6) Identify benefits and display the importance of preserving old-growth forests

Procedures:

In order to measure the objectives of our investigation on the study of the mesophytic forest area at the Oak Ridge Reservation, our research team performed the following procedures:

1) The four individuals of the research team were divided into two-member crews.
2) For purposes of convenience and accuracy, each crew created a zone across the slope using different colored tape (yellow-crew1 and blue-crew2) to mark boundaries. As the crew finished a zone, it would move up the slope and make a new boundary line. The use of these crew zones ensured that no trees or disturbances were missed and that no trees or disturbances were recorded twice.
3) Crews identified trees within their zone that appeared to be over 50 cm dbh. A dbh tape measure was used to measure the exact dbh for each tree, and this data was recorded on a data sheet.
4) The crews then identified the species of the tree and recorded it on the data sheet.
5) The crews marked the tree with a flag using a coding system that identified the date, the crew, and a number for that tree.
6) As crews transversed the slope, they looked for any evidence of human disturbances. Any disturbance was marked with a flag, coded the same way as the trees except the initial T was replaced by a D, and described on the data sheet.
7) The crews sampled three transects, measured the diameter of all trees above 15 cm dbh within an 8 meter zone along the transect, placed these trees into size classes, and determined a ratio of size classes. This information was used to extrapolate the basal area for all trees under 50 cm dbh. The extrapolated basal area was then added to the calculated basal area of all trees over 50 cm dbh to find the entire basal area for our plot. The extrapolation was necessary because while it was

manageable to measure every tree in the plot over 50 cm dbh, such a task was not practical for all trees under 50 cm dbh.

8) The crew walked the perimeter of the research plot and marked points with a global positioning system (GPS). We then used this data to calculate the area of forest we surveyed.

Results:

1) The **area of surveyed forest** was 6.1 acres and is marked on the topographic map labeled as Figures 1 and 2 below.

   6.1 acres / 2.47 acres per hectare = **2.47 hectares**

2) 30 large dbh canopy trees within 2.47 hectare plot.

   30 trees / 2.47 ha = **12.15 large canopy trees (>75 cm) per hectare**

3) **20 different species of trees are displayed on Table 1.** Seventeen of theses species had at least one tree over 50 cm. The other 3 species had at least one tree in the range of 12.5 – 49.9 cm.

4) The **actual basal area for all trees over 50 cm** per hectare plot was calculated to be 20.39 sq. meters per hectare**,** which is reflected in Table 2.

   50.36 sq. m total basal area for plot / 2.47 hectares = **20.39 sq. m per hectare**

5) The **estimated basal area for all trees in the 12.5 – 49.9 cm range** was calculated to be 11.31 sq. m per hectare and is reflected in Table 3.

   27.93 sq. m total estimated basal area for plot / 2.47 hectares = **11.31 sq. m per hectare**

6) **The total basal area of the entire plot** was estimated to be 31.69 sq. m per hectare by adding the actual basal area of the > 50 cm trees to that of the estimated basal area of the 12.5 – 49.9 cm trees

   20.39 sq. m + 11.31 sq. m **= 31.7 sq. m per hectare total estimated basal area**

7) The only significant disturbance we observed was a barbwire fence running along the northwest border of the plot. We also observed several minor disturbances, such as flags and stakes, that remain from previous research of this area.

Figure 1. Topographic map showing GPS-determined perimeter of the research area

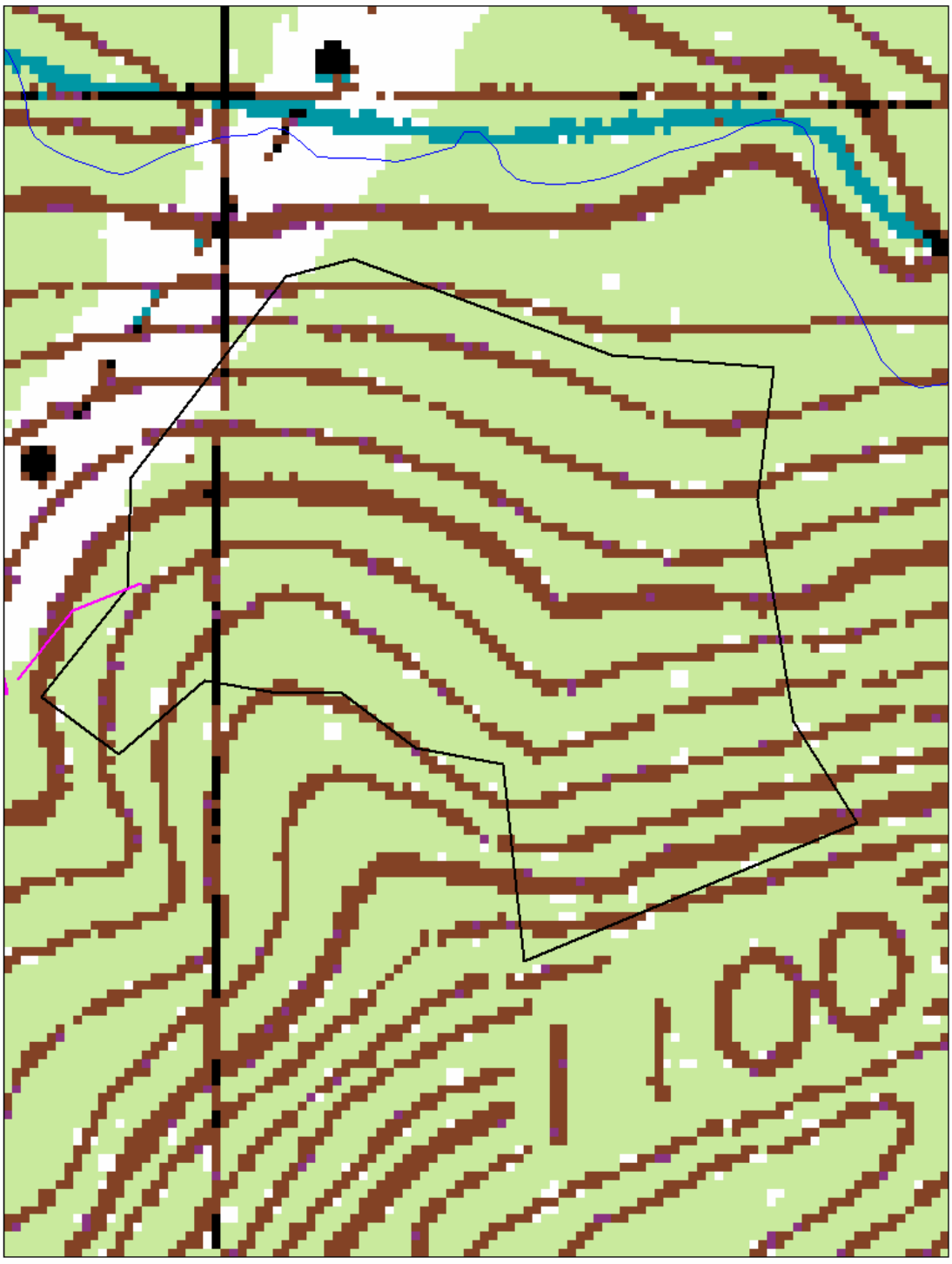


Figure 2. 1935 Arial photograph showing GPS-determined perimeter of the research area

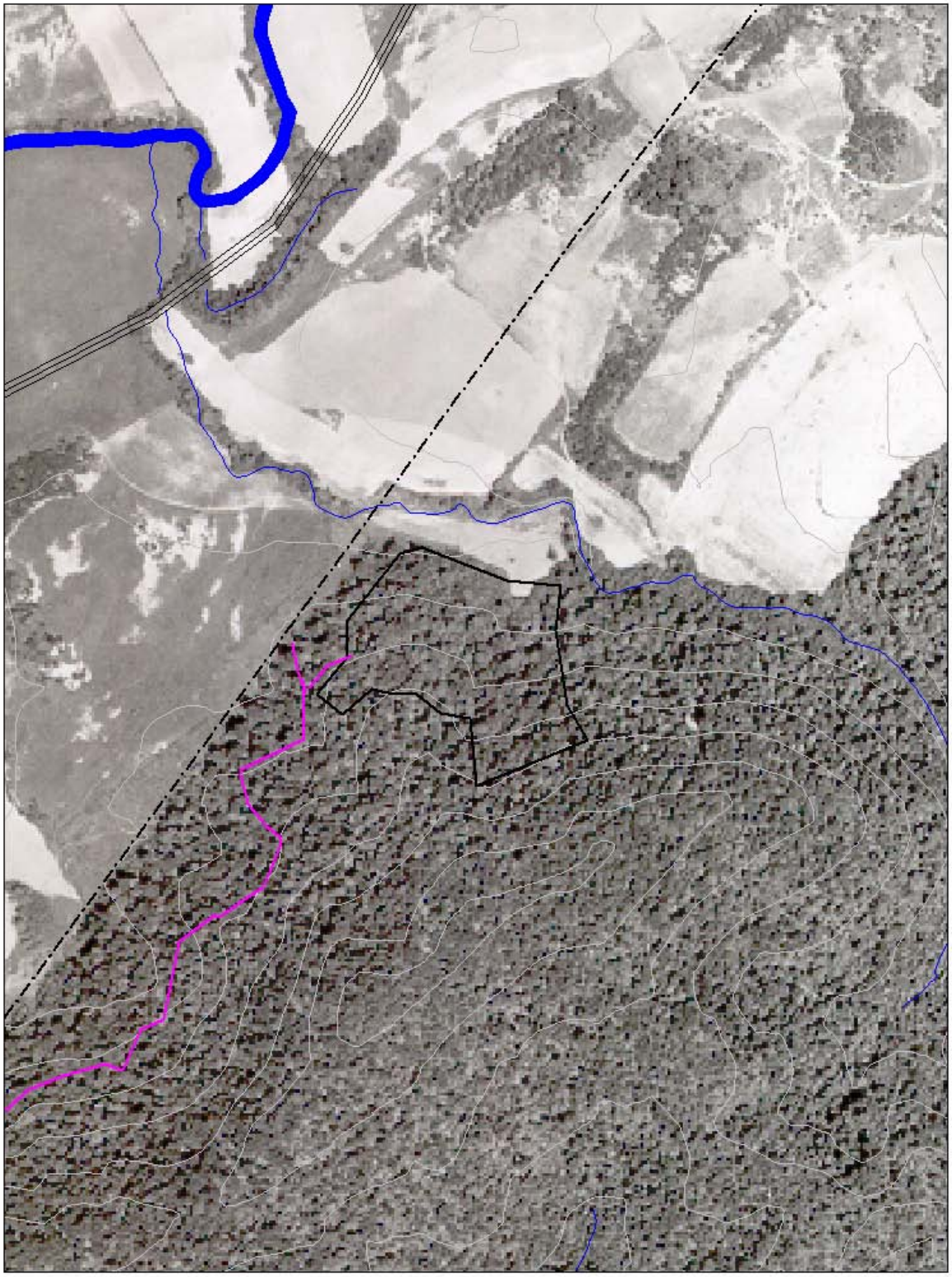
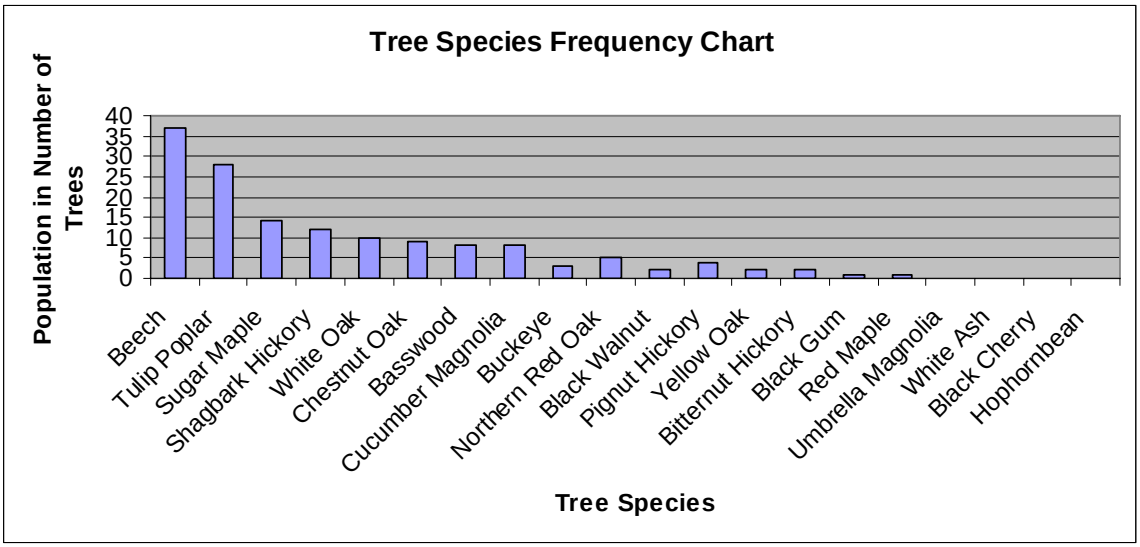
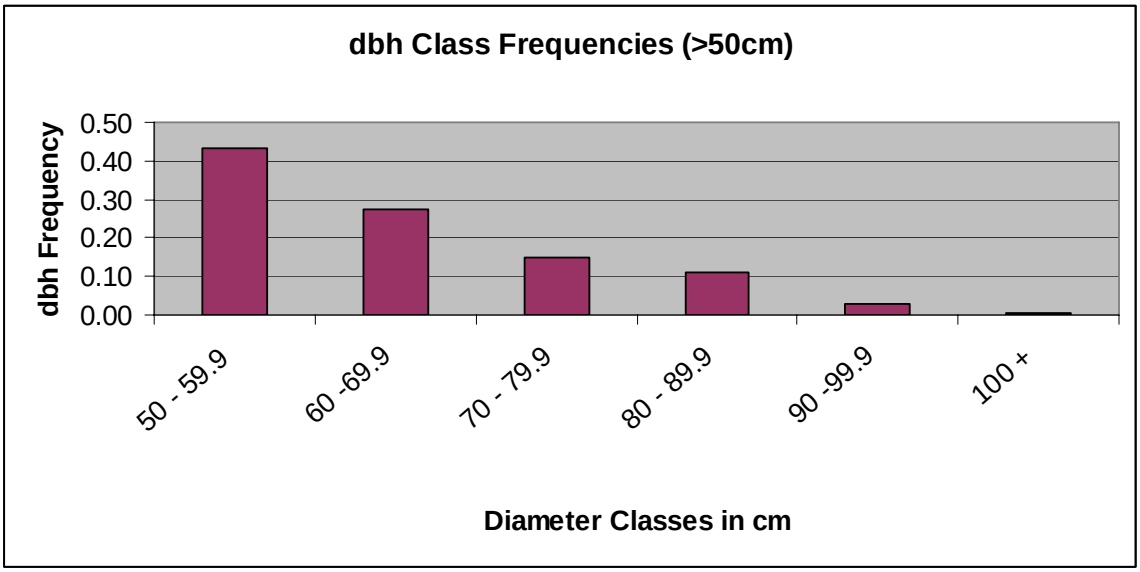


Table 1



Species	Population	Frequency of trees > 50 cm dbh	Population	Frequency of trees > 75 cm dbh
Beech	37	0.25	14	0.47
Tulip Poplar	28	0.19	3	0.10
Sugar Maple	14	0.10	2	0.07
Shagbark Hickory	12	0.08	1	0.03
White Oak	10	0.07	2	0.07
Chestnut Oak	9	0.06	1	0.03
Basswood	8	0.05	1	0.03
Cucumber Magnolia	8	0.05	4	0.13
Buckeye	3	0.02	0	0.00
Northern Red Oak	5	0.03	0	0.00
Black Walnut	2	0.01	0	0.00
Pignut Hickory	4	0.03	0	0.00
Yellow Oak	2	0.01	1	0.03
Bitternut Hickory	2	0.01	1	0.03
Black Gum	1	0.01	0	0.00
Red Maple	1	0.01	0	0.00
Umbrella Magnolia	0	0.00	0	0.00
White Ash	0	0.00	0	0.00
Black Cherry	0	0.00	0	0.00
Hophornbean	0	0.00	0	0.00
TOTALS	**146**	**1**	**30**	**1**

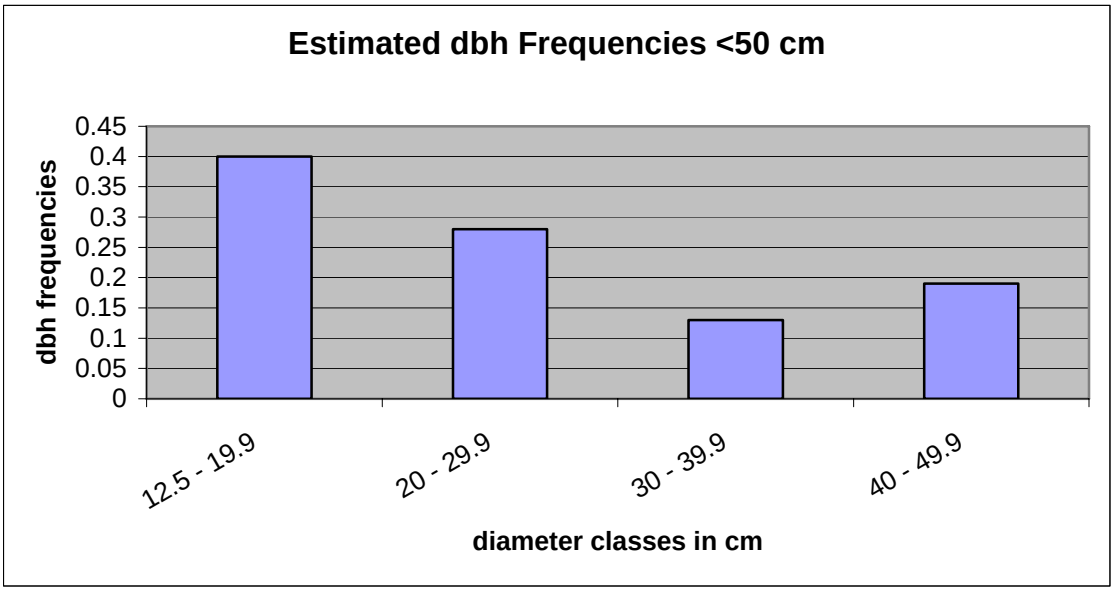
Table 2



Diameter Classes (cm)	Frequency	Population	Basal Area (sq. m)
50 - 59.9	0.43	63	14.778
60 - 69.9	0.27	40	13.39
70 - 79.9	0.15	22	9.52
80 - 89.9	0.11	16	8.93
90 - 99.9	0.03	4	2.8
100 +	0.01	1	0.94
TOTALS	**1**	**146**	**50.358**

50.358 sq. m /2.47 hectares = 20.39 sq. m basal area per hectare

Table 3



Diameter Classes (cm)	Frequency	Population	Basal Diameter (sq. m)
12.5 - 19.9	0.4	30	3.15
20 - 29.9	0.28	21	6.01
30 - 39.9	0.13	10	5.46
40 - 49.9	0.19	14	13.31
TOTALS	**1**	**75**	**27.93**

27.93 sq. m / 2.47 hectares = 11.31 sq. m per hectare

Conclusions:

We have determined that the East Fork Ridge Mesic Forest Area is an old growth forest based on the following conclusions:

1) There are 12.15 large canopy trees (>75 cm) per hectare, which greatly exceeds the 7 large trees per hectare required to be classified as old-growth.
2) The criteria for diversity of species was met when we observed 20 different species of trees. This met the minimum requirement of 20 different tree species per forest to be categorized as old-growth. See table 1 for the 20 specific species that we observed.
3) The basal area per hectare was calculated to be 31.69 sq. m per hectare, which falls in the required range of 20.6 – 42.4 sq. m per hectare in order to be considered old-growth.
4) There were no major disturbances in this area that would provide evidence that this forest is not old-growth.

Discussion:

Based on the classification of this forest as old-growth, it is inherent that steps be taken to preserve it. The evidence presented in this report is significant because it reflects the extreme value of this forest community and highlights the need for its existence.

Old-growth forests are home to a vast number of species. Snags, leaf litter, and fallen trees provide shelter, nesting, foraging, and denning for mammals, salamanders, myriads of arthropods, bald eagles, hawks, owls, and ospreys, just to name a few. It is recorded that woodpeckers and 39 species of songbirds prefer old-growth forests. Much of the biodiversity is apparent in the fungi, lichens (some of which can take 150-200 years to develop), and herbaceous plants (some of which can take 40-150 years to grow). Many of these plants disperse at very slow rates and once they are eliminated, they may take thousands of years along with the correct habitat to return.

Old-growth forests are excellent record keepers. Trees, for instance, provide reliable records concerning information about the climate, rainfall, atmospheric conditions, etc. over the lifespan of the tree. These records are useful because old-growth forests will have been around and undisturbed for a very long time. There is also an unseen record of thousands of years of

genetic heritage. These species will contain the genes that have allowed them to survive global climate changes, diseases, etc.

The medical field depends on the compounds created by Mother Nature. In America 118 of the top 150 drugs sold are derived from or modeled after compounds found in nature. For example, aspirin is made from a synthetic version of salicin from the bark and leaves of a willow tree. Taxol is an anti-cancer drug extracted from the bark of the Pacific yew tree. It is also being studied to treat arthritis, Alzheimer's disease, and cardiac problems. The potential for an old-growth forest to contain unknown treatments and cures is endless.

Environmentally speaking, old-growth forests provide habitats to build rich soil, act as natural filtration systems for water and air, and reduce harmful global warming gases. These areas also have the potential to help address some of our pressing energy issues by utilizing natural biological processes. These forests of yesterday hold the answers of tomorrow.

If we have the opportunity to preserve such an area, then it is our responsibility to do so. The biodiversity and immense collection of information are simply too precious to lose. Disrupting such an area can be likened to burning the last copy of a valuable reference book. Old-growth forests are undisturbed time capsules bursting with information, which could be used for future needs. It is simply throwing away priceless information forever, which could result in unknown species loss. If lost, it is estimated to take 1500-2500 years to return to its original state. This is a travesty, which cannot be afforded. This area needs to be protected and preserved for future generations.

Recommendations:

1. Take appropriate legal measures to preserve this old-growth forest.
2. Continue research to determine the specific boundaries of the old-growth forest.
3. Conduct GPS project to map out the position of each tree along with its species and diameter information.
4. Explore possible ways to generate community interest and share this resource with area residents, while minimizing the negative impact to this area.

Applications in the classroom:

1. We experienced the value of hands-on learning and research methods in the educational process.
2. Playing the role of "student" has helped us to relate to our own students and given us the opportunity to see things from their perspective.
3. We have developed a stronger sense of environmental awareness and a passion towards science that we can share with our students and community.
4. Modeling real world data using mathematics.
5. Using graphs to interpret data from scientific research.
6. Lastly, we recognize the value of becoming involved in a project larger than ourselves. We hope to use this experience to motivate our students to succeed.

Bibliography

Joslin, John Devereux. 2004. The ORR NERP's Mesic Natural Area -- Primeval Forest? Report to Pat Parr of Oak Ridge National Environmental Research Park.

Martin, William H. 1992. Characteristics of Old-growth Mixed Mesophytic Forests. Natural Areas Journal 12:127-135.