

Biological Resources and Biodiversity

“... it is difficult to believe that it lies with [man] so to remodel the work of nature as it would be remodeled, by a destruction not only of individuals, but of entire species; and not only of a few species, but of every species, with the very few exceptions which he might spare for his own accommodation.” - [James Madison, excerpt from speech to the Agricultural Society of Albemarle, Charlottesville, Virginia, May 12, 1818]

GOAL: Recognize the importance of protecting biological diversity in both the Rural Area and the Development Areas for the ecological, aesthetic, ethical, and economic benefits to the community.

Introduction

Biodiversity is short for biological diversity. It describes the variety of living organisms of all kinds - animals, plants, fungi and microorganisms - that inhabit a particular area or ecosystem. Protecting and understanding biodiversity is a task that requires a long-term, large-scale view.

Most commonly, biodiversity is measured by the number of species present in an ecosystem. However, biodiversity also includes genetic diversity within those species in the ecosystem, and the diversity of different ecosystems across landscapes. These three levels (species diversity, genetic diversity, ecosystem diversity) interact in an extremely complex manner, and these interactions provide the life support of all species.

Species Diversity

Species diversity can be described as the variety of organisms that live in a particular area or habitat and that may be linked as biotic communities, usually through food webs. Perhaps because the living world is most widely considered in terms of species by the public, the concept of biodiversity is commonly interpreted to mean species diversity or “species richness,” which may be described at various levels, from local to regional.

Genetic Diversity

Genetic diversity is the heritable variation within and among populations of organisms. As a plant, animal, fungus, or microorganism population becomes smaller due to human impact, habitat destruction, or natural change, genetic variability tends to be lost by chance. The loss of genetic variability usually affects the viability and survival of a species by reducing its ability to reproduce or to deal effectively with environmental factors such as disease, weather, predation, etc.

Ecosystem Diversity

Ecosystem diversity describes the variety of different natural systems found in a region and is delimited and characterized by the boundaries and interactions among biological communities and the physical landscapes that support them. The interactions among animals, plants, and microorganisms with the physical environment produce a wide variety of ecosystems that may be described at a range of temporal and spatial scales.

Importance of Biodiversity

Why should we care about biodiversity?

- 1) **Biodiversity is essential to human life.** Human life depends on the products of living organisms, worldwide. Whether these animals, plants, or microorganisms are wild or domesticated, they provide food, medicine and industrial products essential to mankind. Furthermore, these products form the backbone of the world's economy. That is, fisheries, forestry, agriculture, and other industries depend on animal and plants and therefore rely directly on a diversity of biological resources. Soil bacteria are essential for productive farmlands. Other bacteria provide crucial vitamins and enzymes. Biodiversity of species, landscapes, and ecosystems also provides for ecological services, such as: retention of clean water, production of oxygen, consumption of carbon dioxide, resistance to parasites and disease organisms, control of agricultural pests, pollination, and critical recycling of inorganic nutrients upon which all natural productivity depends.
- 2) **Biodiversity preserves aesthetic and economic value.** Many people come to Albemarle County because of its great natural beauty, views of the Blue Ridge, wooded hillsides and pastures, and scenic creeks and rivers. Natural, diverse landscapes and the proximity to wildlife provide enrichment to our citizens that is unique in its impact and that is irreplaceable. The natural environment of Albemarle County complements its historic resources and together these features drive the tourism industry that is so vital to our economy. Protection of biodiversity is integral to maintenance of Albemarle's overall environment.
- 3) **Humanity has an ethical responsibility to care for other forms of life on earth.** We as humans have a responsibility to care for other species on Earth, whether or not those species have direct economic use. Rather than simply using the Earth's resources for present purposes, human beings have a responsibility to care for the Earth's future. Biodiversity is integral to the functions of ecosystems, sustains animal and plant species, and minimizes the effects of both natural and human-caused environmental disturbance.

Albemarle County Trends

Albemarle County lies within the Southern Appalachian - Eastern Deciduous Forest, the most species-diverse portion of temperate North America. Over the decades, forest clearing and regrowth, burning, development and other activities and events have affected the Albemarle County landscape. In addition, and especially since 1950, the human population of Albemarle County and Charlottesville has grown rapidly.

Perhaps the greatest threat to our natural environment is the increasing demand for - and increasing economic value - of land. Residential, commercial and industrial development continue to expand onto our rich and diverse landscape, causing fragmentation of habitats and conversion of land in the Rural Area to more intensive uses. In addition, the use and management of properties within Development Areas have similar impacts on the habitats and biological resources of the County. As a result, populations of some species have disappeared and others are undergoing major reductions. Consequently, we must anticipate erosion over time of our ecosystems and the services they provide us and attempt to take corrective measures.

For example, in Albemarle County today, only a few patches of old growth forest still exist. Tree varieties characteristic of mature forests have suffered reductions, and some have been lost through disease (such as the American Chestnut). Various native species have been lost or diminished through habitat loss (neotropical migratory birds), and a number of exotics and non-native species have been introduced (such as the Paradise Tree, *Ailanthus*); such exotics present particularly insidious problems, as they often become unwelcome pests, which outcompete and replace natives.

Prominent animal losses or substantial declines in species formerly native to this area include the passenger pigeon, wolf, puma, and bison. Recent bird declines include the loggerhead shrike, wood thrush, whippoorwill, and Bewick's wren. In turn, species accustomed to open fields or meadows or edge areas such as the robin, cowbird, deer, and ground hog have increased in numbers. Losses of larger predators such as wolves, mountain lions, bobcats and coyotes have led to increases in smaller predators, such as raccoons, skunks and opossums; these smaller, opportunistic predators have been seriously augmented by feral or free-ranging domesticated animals, mostly cats and dogs, both of which are persistent and efficient predators. Fresh waters have perhaps suffered the most through clearing of land, sedimentation, and pollution. As a result, fishes have declined drastically, and Albemarle's freshwater mussels, such as the green floater and the James spiny mussel, are designated as endangered.

Although the preservation of one particular endangered species may not seem at first glance to be critical, it is important to consider that this is one indicator that the ecosystem is becoming ecologically unsustainable. That is, the presence of an endangered species is often indicative of a decline in the general health of its habitat. (See Table 2 – 4)

Table 2 – 4: Albemarle County Natural Heritage Resources

Updated June 1998

Scientific Name	Common Name	Global Rank	State Rank	Federal Status	State Status	Last Seen in County Since 1980?
COMMUNITIES						
	Eastern Hemlock Forest					Y
	Chestnut Oak Forest					Y
	Low Elevation Basic Outcrop Barren					Y
INVERTEBRATES						
Fusconaia Masoni	Atlantic Pigtoe	G2	S2		LT	Y
Lasmigona Subviridis	Green Floater	G3	S2		SC	Y
Pleurobema Collina	James Spiny mussel	G1	S1	LE	LE	Y
Pyrgus Wyandot	Appalachian Grizzled Skipper	G2	S2			N
Speyeria Idalia	Regal Fritillary	G3	S1			No Date
Stygobromus Spinosus	Blue Ridge Mountain Amphipod	G2G3	S2S3			Y
REPTILES						
Pituophis Melanoleucus	Pine Snake	G5	SU			No Date
VASCULAR PLANTS						
Alnus Incana SSP Rugosa	Speckled Alder	G5T5	S2			N
Betula Papyrifera	Paper Birch	G5	S2			Y
Calycanthus Floridus Var Glaucus	Smooth Sweet-Shrub	G5T5	S1?			N
Corallorhiza Maculata Var Occidentalis	Western Spotted Coralroot	G5T?	S1			Y
Cornus Canadensis	Bunchberry	G5	S1			Y
Elymus Canadensis	Nodding Wild-Rye	G5	S2?			N
Phlox Buckleyi	Sword-Leaved Phlox	G2	S2			Y
Prunus Nigra	Canada Plum	G4G5	S1			N
Rorippa Sessiliflora	Stalkless Yellowcress	G5	S1			N
Sida Hermaphrodita	Virginia Mallow	G2	S1			Y
Solidago Randii	Rand's Goldenrod	G5T4	S2S3			Y

Definitions of Abbreviations Used on Natural Heritage Resource Lists

State Rank

The following ranks are used by the Virginia Department of Conservation and Recreation to set protection priorities for natural heritage resources. Natural Heritage Resources, or "NHRs," are rare plant and animal species, rare and exemplary natural communities, and significant geologic features. The criterion for ranking NHRs is the number of populations or occurrences, i.e. the number of known distinct localities; the number of individuals in existence at each locality or, if a highly mobile organism (e.g., sea turtles, many birds, and butterflies), the total number of individuals; the quality of the occurrences, the number of protected occurrences; and threats.

- **S1** - Extremely rare; usually 5 or fewer populations or occurrences in the state; or there may be a few remaining individuals; often especially vulnerable to extirpation.
- **S2** - Very rare; usually between 5 and 20 populations or occurrences; or with many individuals in fewer occurrences; often susceptible to becoming extirpated.
- **S3** - Rare to uncommon; usually between 20 and 100 populations or occurrences; may have fewer occurrences, but with a large number of individuals in some populations; may be susceptible to large-scale disturbances.
- **S4** - Common; usually >100 populations or occurrences, but may be fewer with many large populations; may be restricted to only a portion of the state; usually not susceptible to immediate threats.
- **S5** - Very common; demonstrably secure under present conditions.
- **SA** - Accidental in the state.
- **S#B** - Breeding status of an organism within the state.
- **SH** - 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.
- **S#N** - Non-breeding status within the state. Usually applied to winter resident species.
- **SU** - Status uncertain, often because of low search effort or cryptic nature of the element.
- **SX** - Apparently extirpated from the state.
- **SZ** - Long distance migrant whose occurrences during migration are too irregular, transitory and/or dispersed to be reliably identified, mapped and protected.

Global Rank

Global ranks are similar, but refer to a species' rarity throughout its total range. Global ranks are denoted with a "G" followed by a character. Note that GA and GN are not used and GX means apparently extinct. A "Q" in a rank indicates that a taxonomic question concerning that species exists. Ranks for subspecies are denoted with a "T". The global and state ranks combined (e.g. G2/S1) give an instant grasp of a species' known rarity. These ranks should not be interpreted as legal designations.

Federal Status

The Division of Natural Heritage uses the standard abbreviations for Federal endangerment developed by the U.S. Fish and Wildlife Service, Division of Endangered Species and Habitat Conservation. LE - Listed Endangered; T - Listed Threatened; PE - Proposed Endangered; PT - Proposed Threatened; C - Candidate (formerly C1 - Candidate category 1); E(S/A) - treat as endangered because of similarity of appearance ;T(S/A) - treat as threatened because of similarity of appearance.

State Status

The Division of Natural Heritage uses similar abbreviations for State endangerment. LE - Listed Endangered; PE - Proposed Endangered; SC - Special Concern - animals that merit special concern according to VDGIF (not a regulatory category); LT - Listed Threatened; PT - Proposed Threatened; C – Candidate.

Habitat Fragmentation

The major causes, world-wide, for the reduction of species are destruction and fragmentation of habitat. Other causes include introduction of exotic and non-native species and over-exploitation. Here, we are concerned with fragmentation, which is of particular concern to Albemarle.

Fragmentation is the carving-up of habitats into ever-smaller areas, with the accompanying lack of connections, called “corridors,” among the fragments. While fragmentation is known to be biologically and ecologically destructive to biodiversity, the prediction of effects with a high degree of certainty can be problematical, requiring expert assessment.

Benefits of Unbroken Habitats

Conventional wisdom dictates that the more contiguous a habitat or ecosystem, the greater number and variety of birds, animals, and plants it will support. Also, it is often assumed that unbroken habitats provide continuous protective pathways for the safe movement or migrations of animals or expansions of plants. These statements, however, can be misleading, as they apply mainly to species that are at least somewhat obligate to the habitat or ecosystem in question. Whereas fragmentation can be devastating to those species, it can also actually increase the total number of species. But the downside to that apparent benefit is that those latter species are likely to be what ecologists call “weedy” or “opportunistic,” and hence undesirable (for example the cowbird, which is a nest parasite on warblers and other birds and is a major factor in their decline.)

Forests, in particular, are an important asset for Albemarle. Many birds, mammals, reptiles, amphibians, and aquatic species depend upon this dominant habitat for their survival. Additionally, the protection afforded by the forest’s leafy canopy helps improve air quality and modulates microclimate. Forested areas also protect and maintain the purity of groundwater and stream and river water. Forests serve as filters to trap sediment and absorb pollutants from overland runoff. Loss of topsoil and silt into surface waters can smother the gravel bottoms that

are breeding habitats of most of our stream fishes and the aquatic insect larvae that are the food for these fishes. Forests along rivers and streams help make waterways livable for many species. For example, many shrubs, grasses, and vines grow well in moist and fertile soils of large unbroken forested areas, but may not do well elsewhere. Plant material falling into the water also provides a food source. Shade from the tree canopy helps maintain a low water temperature, and tree roots help stabilize the bank and provide shelter.

Finally, forests contribute to Albemarle's natural beauty, complement the cultural resources of the area and enhance the County as a desirable place to live, recreate, and visit.

Effect of Habitat Fragmentation on Species

The decline of many plant and animal species in Albemarle can be attributed to large-scale tree clearing, or by development activities such as woodland subdivisions, power lines, and roads. The

habitat fragments that these activities produce differ from the original habitat in two important ways:

- 1) the center of a fragmented area is closer to the fragment's edge;
- 2) the amount of edge relative to the amount of interior habitat is dramatically increased.

Because of fragmentation, the center of the habitat is closer to the edge, which exposes the species within to increased predation and competition. Furthermore, the habitat's edge represents a dynamic environment into which many other species can invade. Thus, fragmentation not only increases the number of predators within the edge, but some of these predators compete for the same food supply as species within the habitat. For instance, predatory animals may decimate insect and amphibian populations in edge areas.

Forest fragmentation also reduces the ability of a species to move freely across a habitat to forage, to find mates, or to disperse to neighboring habitats. The resulting isolation and reduced population numbers may, in turn, lead to loss of genetic variability, which reduces a species' viability and its ability to deal with environmental fluctuations, disease and predation. Also, many plant species that rely on animals to transfer seeds are also affected, which can have widespread ecosystem consequences.

The interactive sequence of events described in the preceding paragraph is termed an "environmental cascade," which does not end at the level of the habitat. Some regional effects of forest clearing and fragmentation, for example, include changes in reflected solar radiation, air and soil temperature, wind, and incidence of fire. Plant cover offers shade and protection of soils, particularly in forest communities, which maintain relatively cool, moist, and shaded environments during spring and summer days, and trap heat during the night. Effects of large-scale clearing and development are currently having nation-wide to global ramifications, with marked changes in species diversity and ecosystem services.

Habitat fragmentation is currently being addressed, in part, in Albemarle through land use policies and voluntary measures to protect forestry and open space in general, such as Rural Areas zoning and Agricultural/Forestal Districts. The Agricultural/Forestal Industries Support Committee stated, “Continued forest fragmentation is probably the biggest threat to the future viability of the forest industry in Albemarle County.... Forest sizes below 40 acres are difficult to manage economically.” The Mountain Protection Committee concurred, “The principle threat to the County’s mountain forests and farms has now become fragmentation and conversion to residential land use.” This Comprehensive Plan continues to support and promote forestry and agriculture as priority land uses in the Rural Area. However, certain areas of the County may require additional protection to insure that biological diversity is maintained. This may be accomplished through an implementation program that stresses education and voluntary actions.

Implementation of a Biodiversity Program

OBJECTIVE: Increase the community's awareness of the importance of biodiversity to encourage protection of biological resources.

Building Biodiversity Awareness

We should value our natural surroundings as ecosystems that provide essential services to humans. Destruction and fragmentation of habitat is usually not deliberate, but results from other activities such as building a new home. Therefore, increasing the public's awareness of biodiversity, and how the public's actions affect our ecosystems, is key to implementing a successful program. Other than the Shenandoah National Park and other publicly owned parks and school sites, almost all of the land in Albemarle County is owned privately. Thus a motivated, informed citizenry can greatly effect changes in the health of ecosystems through increased awareness of the importance of biodiversity.

Strategy: Develop and disseminate educational and technical material for the purposes of informing the general public, developers, and private land owners, including residents of urban Development Areas, on the value of biodiversity and volunteer techniques that can be used to protect biological resources located on their land.

Recommendations:

- Develop material and conduct educational sessions to provide information to the public on the importance of biological resources to our County and the positive effect these resources have on maintaining our high quality of life.
- Develop illustrations and other materials that demonstrate biological resource protection efforts that developers can consider utilizing when developing a site.
- Educate individual landowners through pamphlets and other methods on immediate volunteer efforts they can do to protect biological resources on their property.

The County could provide information at meetings or in leaflets to explain the importance of biodiversity and to inform landowners how to protect biological resources on their land. For example to:

- Seek to reduce habitat fragmentation by maintaining large contiguous areas of forests, meadows, wetlands, and streams.
- Plan to allow old growth forest areas to develop.
- Resist the urge to remove all dead timber.
- Minimize lawn areas; plant and maintain meadows instead.

- Avoid exotic and non-native plants; use native shrubs and trees that produce berries.
- Sow seeds of native wild flowers.
- Keep livestock out of the streams.
- Put up nesting boxes.
- Minimize the use of pesticides.
- Preserve fencerows in a natural state as habitat for wildlife.
- Do not allow domesticated pets to roam free, especially at night.
- Learn to recognize and suppress invasive non-native plant species such as garlic mustard (*Alliaria petiolata*) and mile-a-minute (*Polygonum perfoliatum*).

OBJECTIVE: Through a Biological Resources Inventory, develop systematic knowledge of the types and distributions of biological resources in Albemarle County, and develop an understanding of the requirements of our ecosystems.

Conducting a Biological Resources Inventory

The County needs to develop systematic knowledge of the type and distribution of biological resources in the area. The *Open Space and Critical Resources Plan*, adopted in 1992, recommended completion of a critical resource inventory to plan for open space and significant resource protection in the Rural Area. Areas containing significant biological resources may be identified by a number of criteria, such as habitats of specific plant or animal types, catchment or filter areas, riparian areas, mountain areas, unbroken patches of forests, and patches of land that have been relatively undisturbed by humans.

Sources for the preliminary identification of areas of concern include: aerial photos, satellite images, multispectral imagery, and digitized spatial data bases. Data bases available for Albemarle County include surface water distribution, elevations, soil types, vegetative cover types, and land classified by usage type. These databases can be used to construct layers in a Geographic Information System (GIS), to be incorporated into the existing County GIS system.

Other sources include the citizens of the County. Many local residents are avid, experienced naturalists and could provide much information on the distribution of plant and animal species and communities. Local foresters also have a great deal of firsthand knowledge of the distributions of forests of different types. A biodiversity committee composed of knowledgeable and interested citizens is essential for the coordination of the Biological Resources Inventory.

Strategy: Establish an advisory committee to assist the County in overseeing the development of a Biological Resources Inventory and the integration of such an inventory into the planning process.

Appointing a Biodiversity Committee

A Biodiversity Committee should be appointed to oversee the development of a Biological Resources Inventory and its integration into the planning process. The committee should be composed of interested citizens representing environmental, agricultural, forestry, and business interests. Members might include local foresters and farmers, conservation biologists, skilled amateur naturalists, a representative of the Shenandoah National Park, land owners, developers and other concerned citizens. The Biodiversity Committee should be a continuing committee. It should assist the staff in developing an action plan for protecting biological resources, and should periodically report to the Board of Supervisors on the state of our biological resources.

The responsibilities of this committee would be to:

- 1) develop public educational materials on biodiversity;
- 2) develop methods and oversee a Biological Resources Inventory to be conducted for the County;
- 3) solicit regional cooperation among nearby counties in collaborating on a regional inventory;
- 4) determine criteria for identifying the types of biological resources to be inventoried;
- 5) assess prospects for donations to the Inventory of time, expertise or other resources from the community, including the University of Virginia;
- 6) evaluate methods of conducting the Inventory;
- 7) recommend one or more approaches for conduct of the inventory to the Board of Supervisors, with estimates of costs;
- 8) assist staff in developing an action plan (discussed below) that specifies detailed steps for achieving protection of biodiversity as outlined in the Comprehensive Plan; and
- 9) provide periodic reports to the Board of Supervisors on the state of biodiversity in the County.

OBJECTIVE: Conserve ecological communities to ensure their continued genetic diversity, and protect ecosystems that provide essential services to humans.

Strategy: Staff will develop an action plan, with assistance from the Biodiversity Committee, and through a public participation process, to protect significant areas of biological resources.

Developing and Implementing an Action Plan for Achieving Biodiversity

Following the completion of the Biological Resources Inventory, staff should develop an action plan in conjunction with the biodiversity committee. This plan should provide specific details for achieving the protection of biodiversity and biological resources as outlined in the Comprehensive Plan. Actions to be addressed in the action plan at a minimum should include:

- How the information obtained from the biological inventory will be incorporated into the land-use decision making process. Procedures to protect biological resources may be similar to the implementation procedures for significant resources outlined in the Open Space Plan.
- Establishing educational programs.
- Procedures for the establishment/maintenance of a biological resource database.
- Voluntary measures that could possibly be utilized by the County such as use-value assessments of rural lands, agricultural/forestal districts, conservation easements, etc. to protect areas identified as significant biological resources.
- Whether there is a need for hiring a County staff member with expertise in conservation biology, and/or training existing County staff in principles of conservation biology.

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