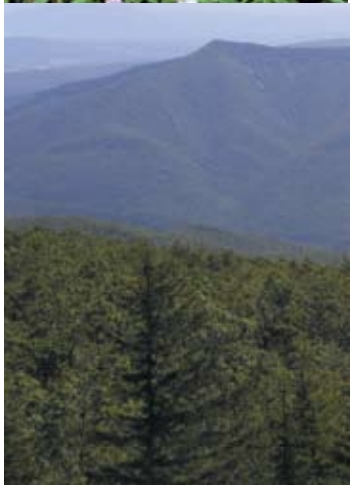


The State of Chesapeake Forests

Introduction:

At first glance, forests are thriving in the Chesapeake Bay watershed. Chesapeake forests as a whole represent one of the most expansive hardwood forests in the world and contain a tremendous diversity of plants, wildlife, and habitats. These same forests provide residents with invaluable services, like clean air and water, wood for builders and craftsmen, and places for recreation and spiritual renewal. Residents also see trees almost everywhere they go—while driving to work, walking in their communities, and visiting local parks. However, we are slowly losing and fragmenting these forests, eating away their ability to protect the Bay and provide people with the goods and services they desire. Within these seemingly healthy forests, many forces are threatening functions that are critical to the environment, economy, public health, and quality of life of the region.

Natural and human-induced disturbances like fires, storms, and pests have shaped the extent, diversity, growth, longevity, and character of Chesapeake forests for thousands of years. However, new forces like sprawling development, air pollution, invasive species, and overabundant deer populations magnify stress on forests and may significantly alter future forest ecosystems.[1] How governments, forestland owners, developers, environmental groups, and others respond to the cumulative impacts of these forces of change will determine the future of Chesapeake forests and our ability to sustain the health of the Bay.

Why are Forests Important to the Chesapeake Bay Watershed?

In a phrase, healthy forests are the key to watershed function. In a general sense, the declining health of the Chesapeake Bay can be traced to the replacement of forestland with farmland and development across the Bay watershed. The loss of forestland is so damaging because the Bay ecosystem is dependent on trees, having evolved in a landscape that was almost completely covered by forests. The wildlife and plant communities that Native Americans utilized and early European explorers such as Captain John Smith encountered were dependent on forests for food and shelter. Fish and other aquatic organisms lived in streams where forests moderated temperatures, controlled water flow, offered habitats in submerged roots and fallen branches, prevented excess sediment and nutrients from entering streams, and leached a "watershed tea" of nutrients that formed the foundation of the freshwater food chain and supported the Bay's benthic or bottom-dwelling communities.

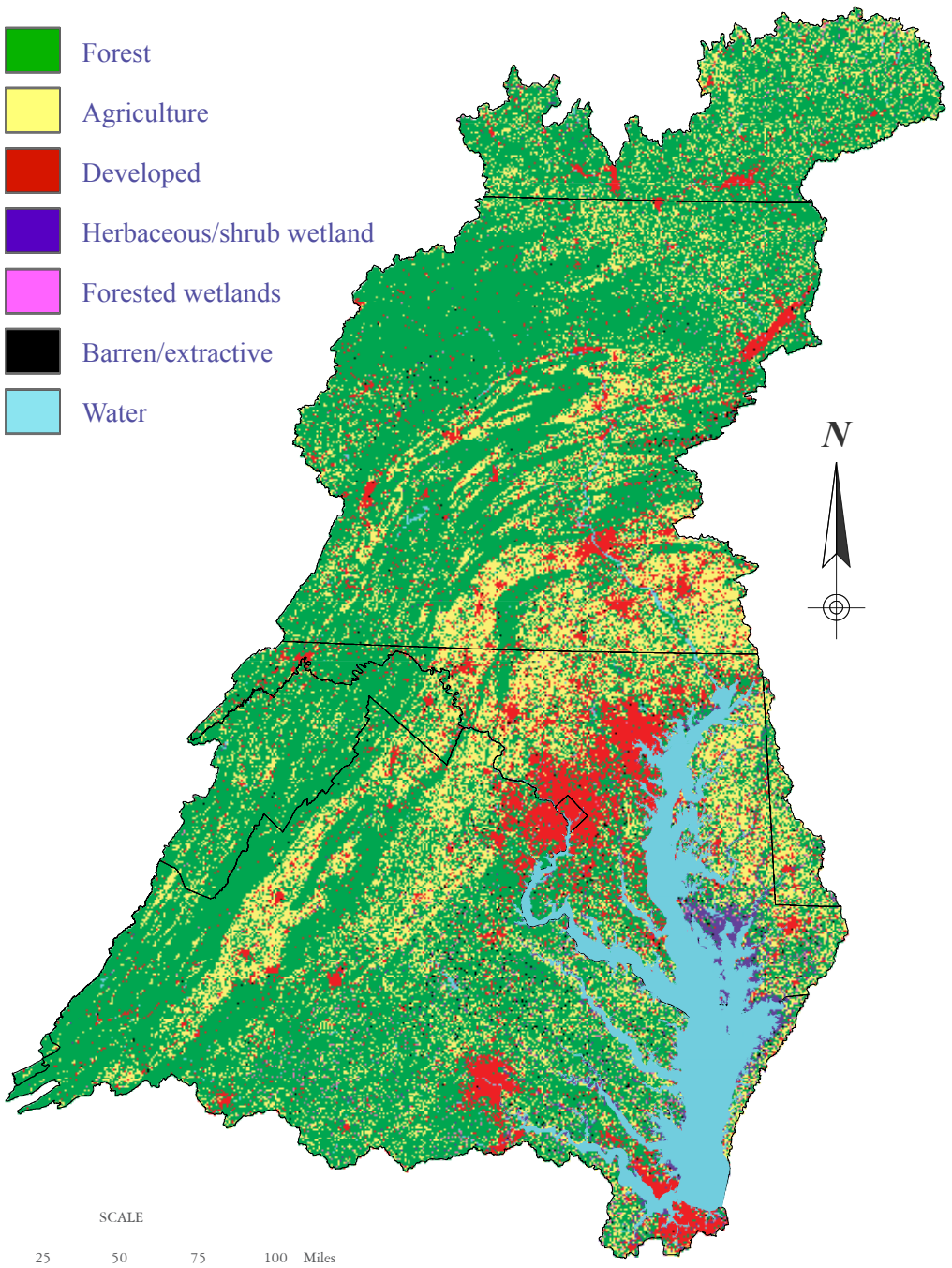
While forest conditions have changed considerably over the past 400 years, Chesapeake forests remain critical to the health of the Bay and its watershed. People are more dependent than they realize on the varied benefits provided by forests. When it comes to forests, we are likely getting much more than we pay for.

Chesapeake forests:

Protect Water Quality - Forests act as 'sponges' by capturing rainfall, reducing runoff, maintaining the flow of streams, filtering nutrients and sediment, and stabilizing soils. Riparian forests that buffer streams significantly reduce the amount of excess nutrients (such as nitrogen and phosphorus) that enter the water, sometimes by as much as 30 to 90 percent. Mature trees also provide root systems that hold soils in place, helping to stabilize streambanks and reduce erosion.

Offer Habitat for Fish and Wildlife - Healthy forests provide food, shelter, nesting sites and safe migration paths for the Chesapeake Bay's aquatic and land animals. Streamside forests shade the water beneath their canopies, maintaining cooler water temperatures in summer, an important factor for spawning fish. Decaying leaves and wood are essential

Land Cover, 2000



INTERPRETATION: Forestland makes up 60% of the total land cover. Agriculture (21%) and development (9%) are focused in and surrounding the Richmond-Washington-Baltimore corridor and in the valleys of the Appalachian Mountains. Remaining forested (1%) and herbaceous/mixed wetlands (2%) are found along river corridors and coastal areas.

SOURCE: MA RESAC 2000

links in the Bay's food chain.

Improve Air Quality - Forests absorb or trap nitrogen, particulates and other pollutants in the atmosphere that are released by cars, factories, farming, and construction. In cities, tree canopies reduce summer temperatures and the generation of harmful pollutants like ozone.

Improve our Quality of Life and Encourage Recreation - Forests offer us places in which to reflect and experience natural beauty and solitude. They foster active outdoor recreation, such as fishing, hiking, camping, and cross-country skiing. Tourism and recreation contribute to the region's economy.

Enhance the Economy - Forests provide billions of dollars a year to the Bay watershed economy in the form of services like clean air and water, wood and paper, jobs and income, higher property values, improved physical and mental health, and recreational opportunities.

What Does a Healthy Forest Look Like?

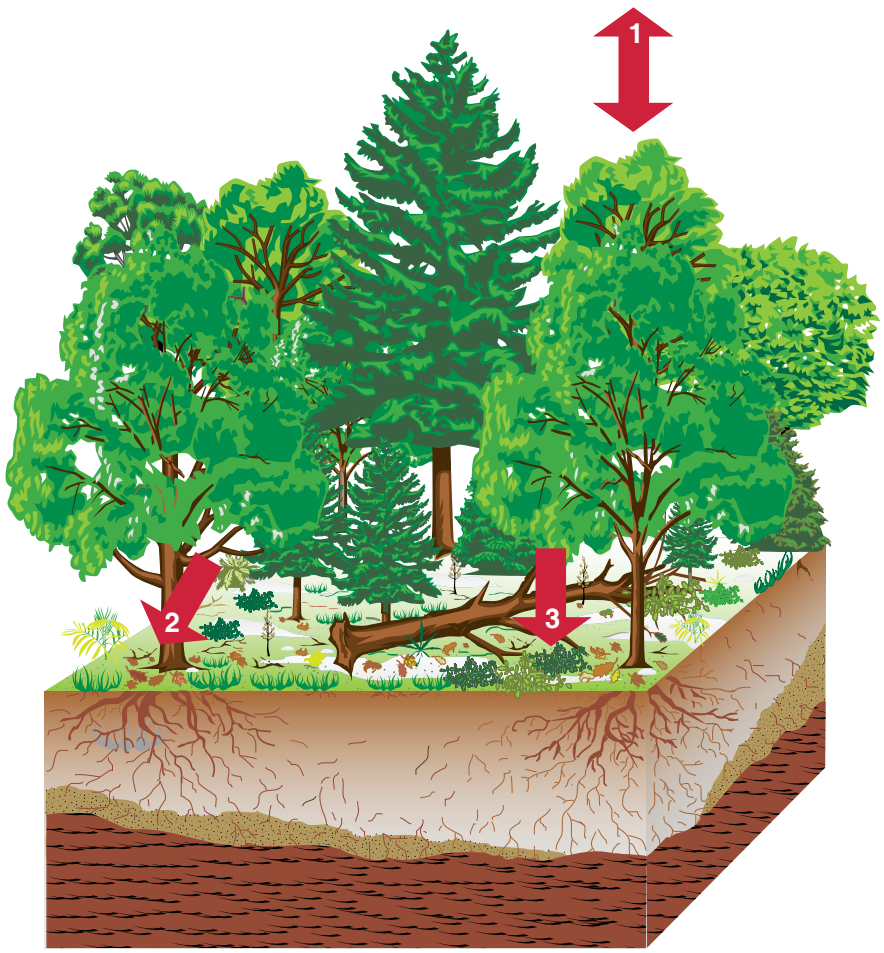
A healthy forest is a complex, dynamic community of plants, animals, and soil. Healthy forests contain multiple layers of vegetation—each providing important functions. It is this complexity of interdependent parts and diversity of structure that makes forestland capable of providing clean water and diverse habitats. The top layer, referred to as the canopy, provides protection and shade for plants and animals, while also intercepting and slowing rain. Below the leafy roof is the understory—a layer of smaller trees and shrubs. Here, young trees begin to grow and eventually replace older ones as they die. The next layer, the forest floor, includes the grasses, herbs, vines, mosses, and other plants that live close to the soil. Plants, microorganisms, worms, insects, fungi, bacteria, and other living things populate the rich layer of decaying leaves and wood that forms the forest floor. This layer is rich in organic material and a storehouse of nutrients. The litter on the forest floor also protects the underlying soil. Healthy forests often contain more living biomass in the soil below ground than what is found above it.

Healthy forests also contain a diversity of plant species, ages, and sizes that allow the ecosystem to bounce back from disturbances and provide a variety of habitats. A rich diversity of species provides insurance in case disease, drought, or other conditions severely deplete any one species. Healthy forests are also dynamic, constantly adapting to disturbances like wildfires, storms, and pests. For example, the current dominance of oak throughout Chesapeake forests has been supported by the tree's ability to survive frequent, low-intensity fires that cleared out less fire tolerant competition like red maple.

Many of the Chesapeake's forests remain healthy and serve our needs today. However, centuries of widespread deforestation, destructive land management practices, and the impacts of pests and invasive plants have significantly altered the health of forests and, subsequently, their ability to sustain watershed health. Today's Chesapeake forests have recovered greatly from their condition at the turn of the twentieth century but still contain the legacy of past land uses. As a result, today's forestland is:

- Less abundant, particularly in the heavily populated Coastal Plain
- More heavily fragmented, restricting wildlife movement
- Of even-age and-size; "born" in the early 1900s
- Less biologically diverse
- More structurally homogenous, having lost layers of vegetation and large woody material on the forest floor

Forest Functions



1
- intercepts and slows percipitation
- removes carbon and other pollutants
- releases oxygen
- moderates climate by releasing water into the air and provides shade

2
- filters and traps pollutants from the forest floor and soil
- moderates floods

3
- stores nutrients and water
- prevents erosion

The Setting: Chesapeake Bay Watershed

Around 18,000 years ago as the last Ice Age ended, rising sea levels fed by melting glaciers dramatically inundated the Susquehanna River gorge and intruded into river valleys branching off east and west. This nascent bay developed into the shape we associate with the modern Chesapeake Bay around 5,000 years ago. The Bay is the largest and was once the most productive estuary in the United States. Its watershed encompasses 64,000 square miles—over 44 million acres. At the heart of the American experience and home to some of our most powerful political and economic engines in the country, the region's rolling hills and temperate climate have helped shape the national psyche.

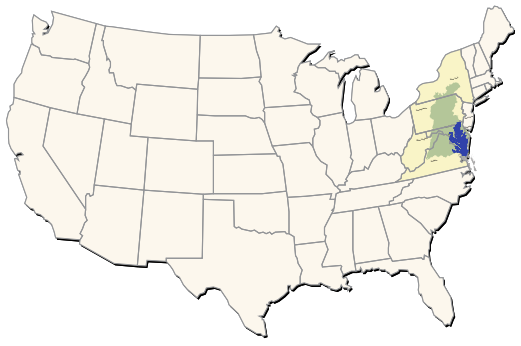
"The Chesapeake Bay, rich in cultural heritage as the cradle of our nation, and internationally known as a magnificent estuary abundant in natural resources, is truly an American treasure deserving of national recognition."

Chesapeake Executive Council

The expansive Chesapeake Bay watershed extends from Cooperstown, New York in the north to Cape Henry, Virginia in the south and from the Appalachian Mountains in the west to the Atlantic Ocean in the east falling 4,000 feet to the sea. More than 40 major rivers wind their way to the Bay and ultimately, the Atlantic Ocean through expansive mixed forests, freshwater ponds, and rich tidal marshes, forming a complex and intimately interconnected natural system. This complex ecosystem supports more than 3,600 species of plants and animals and has shaped the commerce and culture of the region for 400 years.[2]

The Bay itself is 200 miles long and ranges in width from 3.4 miles near Aberdeen, Maryland to 35 miles near the mouth of the Potomac River.[3] It has an intricate shoreline that snakes over 5,000 miles in length—more than the shoreline of the entire Pacific Coast of the United States. But describing the Bay itself does not fully illustrate the importance of the land's influence on the water. While the Bay itself is quite large, its watershed is 16 times more expansive giving the estuary the largest land to water volume ratio of any water body on Earth.[4] The principle reason for the Bay's dominance in these statistics is not its size, but rather its extreme shallowness. The Bay's average depth is only 21 feet, meaning a person could wander over more than 700,000 acres of its bottom and still keep their head above water. This shallowness also gives the Bay its amazing productivity but also points out its sensitivity to what goes on in its watershed.

As water flows through the watershed, sediment, nutrients, chemicals, and other substances, wash off the surrounding land into streams, and eventually find their way to the Bay. Due to its broad



Comparing Watershed Area to Water Body Volume Around the World

Waterbody / Watershed	RATIO Land (km.²) to Water (km.³)
Chesapeake Bay	2,743 to 1
Gulf of Finland	382 to 1
Great Lakes	120 to 1
Baltic Sea	79 to 1
Hudson Bay	25 to 1
Mediterranean Sea	3 to 1

Source: Costanza 2003

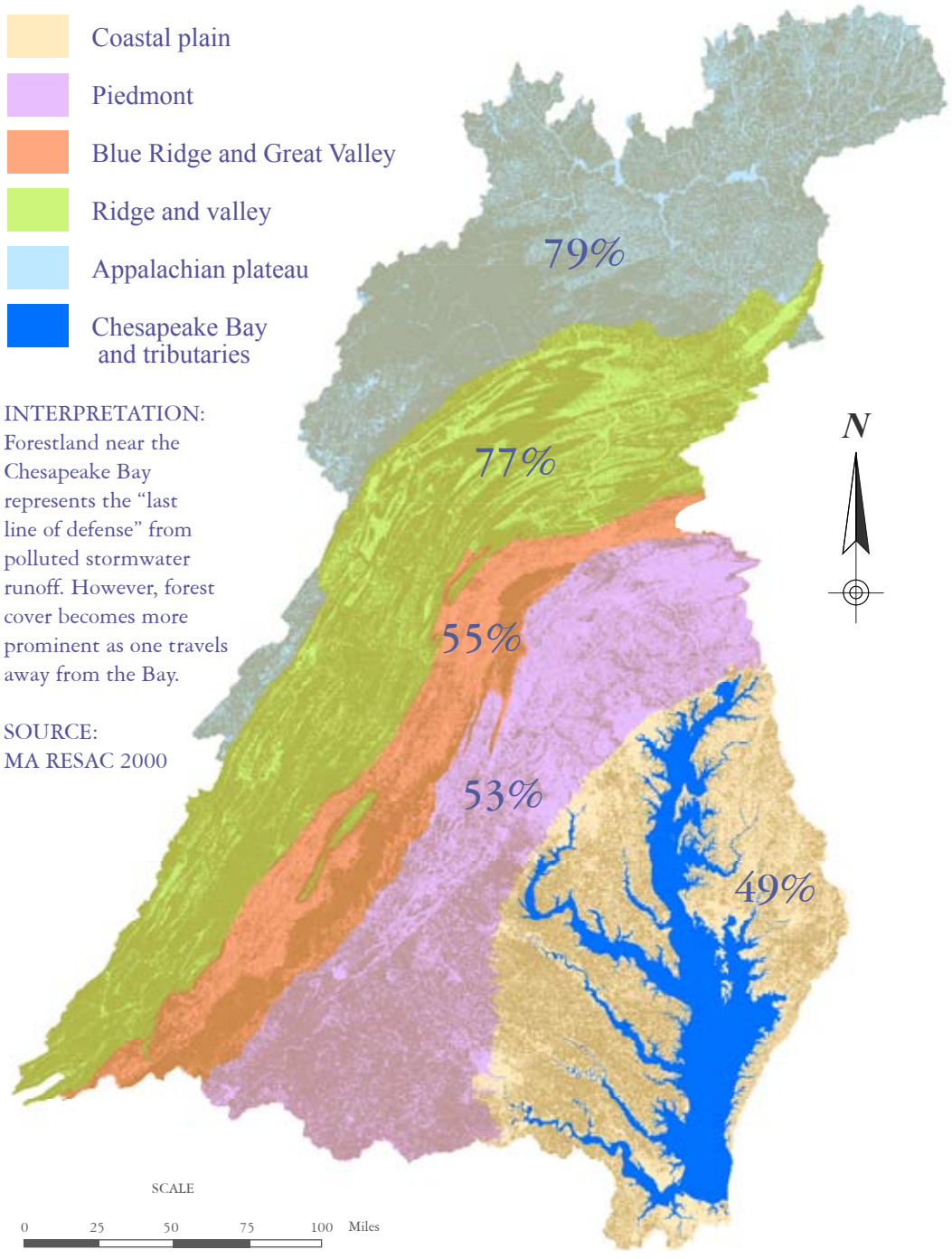
and shallow nature, pollutants easily settle in the estuary. Once pollutants enter the Bay, they tend to stay for long periods. It is easy to understand how development, agriculture, and many other activities on land, even those that occur hundreds of miles from the Bay, are strong determinants of the estuary's health. The good news is that actions taken to protect and improve the land, and its forests, no matter where they occur, have a cumulative ability to restore the Bay.

While not as extensive as before European settlement, forestland now covers 58% of the Bay watershed, a larger proportion than any other single land cover. The largest remaining blocks of forestland occur in regions with steep slopes and on poorly drained soil—areas not particularly amenable to development or agriculture. In general, forest cover increases as you travel farther away from the Bay. Larger blocks of forest are protected as state and federal forests or parkland.

Agricultural land is most often found in valleys, on the fringes of the urban centers, and in the relatively flatter central portion of the Bay watershed and coastal peninsula of the Eastern Shore.

Over 16 million people inhabit the Bay watershed with most people living in the urban centers of Baltimore, Maryland; Washington, D.C.; and Richmond, Virginia.[3] Other smaller urban centers include the York-Lancaster-Harrisburg region, the Binghamton area in New York, and the Virginia "Tidewater" region (Norfolk, Hampton, and Newport News) near the mouth of the Bay.

Percent Forest by Physiographic Region



INTERPRETATION: Forestland near the Chesapeake Bay represents the "last line of defense" from polluted stormwater runoff. However, forest cover becomes more prominent as one travels away from the Bay.

SOURCE: MA RESAC 2000

Land Use / Land Cover in the Chesapeake Bay Watershed, 2003

State	Land Area (thousands of acres)	Percent of Watershed	Forest	Agriculture	Mixed[1]	Developed
Pennsylvania	14,310	35%	63%	22%	9%	6%
Virginia	13,810	34%	56%	22%	11%	12%
Maryland	5,830	14%	45%	26%	11%	18%
New York	3,962	10%	62%	19%	13%	5%
West Virginia	2,284	6%	65%	24%	8%	3%
Delaware	451	1%	40%	42%	13%	5%
Washington D.C.	39	0.1%%	6%	0%	2%	92%
Chesapeake Bay Watershed	40,686	100%	58%	23%	10%	9%

1: Vegetation that is not any other land use (includes grassland, large residential lots, horse pastures, etc.)

Source: Chesapeake Bay Program's Phase IV Watershed Model

Watershed Categories

Highly forested:
≥75% forest, <10% developed

Forested with developed:
≥75% forest, 10-19% developed

Rural-mixed resources:
<75% forest, <40% agriculture, <10% developed

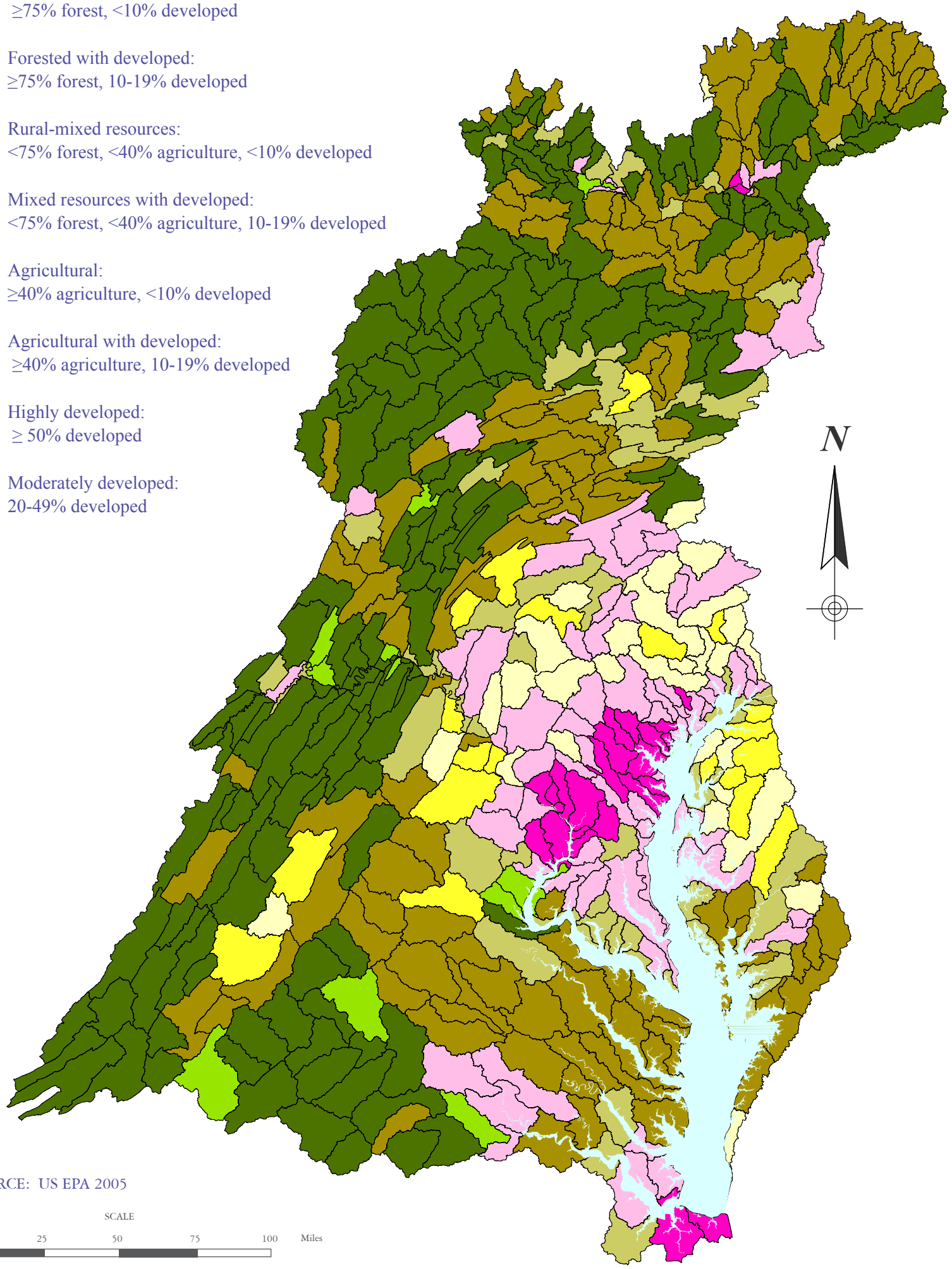
Mixed resources with developed:
<75% forest, <40% agriculture, 10-19% developed

Agricultural:
≥40% agriculture, <10% developed

Agricultural with developed:
≥40% agriculture, 10-19% developed

Highly developed:
≥ 50% developed

Moderately developed:
20-49% developed



SOURCE: US EPA 2005

Forces of Change

New forces like sprawling development and an overabundance of deer are significantly altering forest ecosystems.[1] The effects of the following forces of change on the special characteristics and critical ecosystem functions of Chesapeake forests are discussed throughout this report.

Sprawl

Between 1982 and 1997, the Chesapeake Bay watershed lost over 750,000 acres of forestland to development—a rate of 140 acres a day and equivalent to the loss of 20 cities the size of Washington D.C.[5] Additionally, by 1997, people in Mid-Atlantic region were using almost 130% percent more area of development than they did in 1954. This inefficient use of land, often referred to as sprawl, is characterized by low-density development located away from existing community services such as schools, stores, and wastewater treatment facilities. The loss of forestland is significant because it represents a permanent loss of water filtering capacity, wildlife habitat, and many other functions.

Roads, housing subdivisions, farms and other human uses also divide 60% of Chesapeake forests into disconnected fragments surrounded by other land uses.[6] Fragmentation introduces a suite of negative influences including invasive species and wildfire.[7]

Parcelization

"Parcelization" is the breakup of larger land ownerships into smaller ones. Over the past ten years, the number of family forest owners in the Bay watershed increased by nearly 25% representing 23,000 new family forestland owners per year. In addition, the average size of forested landholdings decreased from 21 to 16 acres per family forest owner.[8] This parcelization of forests often corresponds with a decline in the percentage of forestland that is actively managed for wildlife, timber, recreation, or other uses, which increases the risk of conversion and fragmentation and restricts access to residents.[9] For foresters who provide professional advice to landowners, this also represents a daunting administrative challenge. The economic lure of forestland speculation, transfer of forestland within families, and changing economics in the forest products industry have all contributed to the parcelization of Chesapeake forests.[10]

Lack of sustainable management

Essentially, few forests of the Chesapeake Bay watershed have been untouched by logging, mining, development, or other activities over the past 400 years. Where fragments of original forests remain their size and the nature of what surrounds them often renders these remaining old forests less resilient to major disturbances. Sustainable forest management is needed to mitigate human influences and to ensure the future provision of ecosystem services like water filtration, habitat, and carbon sequestration. While governments and forest product companies have worked hard to increase the use of sustainable management, its practice on family owned land is lacking; a fact important to the Bay watershed where families own 64% of all forestland. As an indicator, only a third of family forestland owners have sought professional advice on land management questions and even fewer have developed forest stewardship plans.[8]

Additionally, landowners that do decide to utilize their land for wood products, recreation, or other uses often do not seek out and use professional assistance and can end up damaging the long-term economic and environmental value of their forest. For example, by removing the biggest, best, and most valuable trees, a short-term management practice called "high grading" leaves poorer quality trees to regenerate the forest, eliminates wildlife food sources and nesting sites, and reduces the long-term economic value of the forest.

Overabundant deer

In many forests across the Bay watershed, white-tailed deer have become one of the greatest threats to forest health. The original forest has become fragmented and surrounded by farms and suburban gardens, deer have far more plentiful and nutritious food sources. This fragmented landscape results in numerous refuges for deer where hunting is prohibited. Locally high deer populations are eliminating forest regeneration—depleting biodiversity across the Bay watershed—by consuming large amounts of vegetation, and influencing forest composition by selectively browsing.

Fragmentation

Parcelization

Invasive Insects and diseases

Invasive forest pests and associated diseases will continue to alter forest conditions in the Bay watershed. Some past introductions such as chestnut blight, Dutch elm disease, beech bark disease, and gypsy moth have had long-term, devastating impacts on Chesapeake forests.

Invasive plants

The Chesapeake Bay watershed is infested with invasive plants; many of which are now permanent components of Chesapeake forests. In addition, the disturbed habitats in which invasives thrive in will continue to spread with human activity. Invasive plants, often exotic, grow and reproduce rapidly, killing, and out-competing other species in the process. In addition, as invasives take over habitats they lower the quality of food sources and shelter options for wildlife, eliminate host plants of insects, and compete with plants for pollinators. Invasive plants are especially problematic for a forest reestablishing in a clearing.

Fire suppression and wildfires

The removal of naturally occurring forest fires has had major impacts on Chesapeake forests and increased their vulnerability to catastrophic wildfires. Tree species vulnerable to fire like red maple and tulip poplar have thrived, while fire-resistant species like oak have declined.[11] The prolonged absence of fire has increased the density of some species. Dense vegetation is more prone to drought and excessive accumulation of woody debris on the forest floor increases the likelihood of severe wildfires.

Air pollution

Prolonged exposure to nitrogen deposition and other air pollutants over decades has led to the acidification of forest soils in the Bay watershed. This, in turn, has caused tree mortality, stunted growth, and increased the transfer of pollutants from forests to streams. Air pollution can also increase the susceptibility of trees and other plants to a multitude of stressors including insects and diseases.

Climate change

Climate change will directly affect tree growth and survival in Chesapeake forests due to higher temperatures and altered precipitation regimes. An analysis of potential affects on tree species noted that 37 of the 75 tree species considered would be reduced in overall abundance under climate change scenarios. Changes in tree species abundance would also shift current forest habitats northward essentially pushing out maple/beech/birch and expanding oak/hickory and southern pines.[12]

Forests may experience indirect affects of climate change such as a higher abundance of pests, greater fire frequency, and changes in climate-sensitive soil processes such as erosion and decomposition. Potential changes in the frequency of extreme weather events such as hurricanes may also affect forests.

Clockwise from top left: Japanese barberry, Japanese honeysuckle, Kudzu, Canada thistle, and English ivy.

Photos by: Barry Rice, James H. Miller, and Dan Tenaglia

Chapter in Perspective

This publication provides a base of information and analysis related to forestland in the Chesapeake Bay watershed. The collection of data, graphics, case studies, and other information was compiled in order to understand more fully the value, trends in condition, and threats to the sustainability of Chesapeake forests. Each chapter includes a model indicator that organizations can use to track trends in forest conditions and health over time. The indicators are based on The Montreal Process Criteria and Indicators—an internationally developed process for assessing progress toward sustainable forest management. While much of this report paints a bleak view of the trends in forest condition, choices can be made that will better ensure the long-term sustainability of forests. To this end, a collection of potential strategies are also presented to guide future conservation, restoration, and management efforts of state agencies, regional environmental groups, and other organizations interested in the sustainability of Chesapeake forests and the Bay itself.