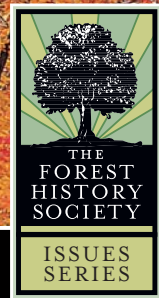


A M E R I C A N Forests

A History of Resiliency and Recovery



DOUGLAS W. MACCLEERY

AMERICAN FORESTS

FOREST HISTORY SOCIETY ISSUES SERIES

The Forest History Society was founded in 1946. Since that time, the Society, through its research, reference, and publications programs, has advanced forest and conservation history scholarship. At the same time, it has translated that scholarship into formats useful for people with policy and management responsibilities. For seven decades the Society has worked to demonstrate history's significant utility.

The Forest History Society's Issues Series is one of the Society's most explicit contributions to history's utility. The Society selects issues of importance today that also have significant historical dimensions. Then we invite authors of demonstrated knowledge to examine an issue and synthesize its substantial literature, while keeping the general reader in mind.

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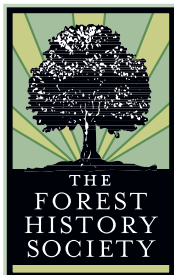
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Forest History Society
Durham, North Carolina



The Forest History Society is a nonprofit educational and research institution dedicated to the advancement of historical understanding of human interaction with the forest environment. It was established in 1946. Interpretations and conclusions in FHS publications are those of the authors; the institution takes responsibility for the selection of topics, competency of the authors, and their freedom of inquiry.

Previous editions of *American Forests* were published with support from the American Forest Foundation, U.S. Forest Service, Weyerhaeuser Company, Westvaco Corporation, Champion International Corporation, Reed-Henry Fund at the Seattle Foundation, MeadWestvaco Corporation, Starker Forests Inc., and the Lynn W. Day Endowment for Publications in Forest History. The electronic version of the current 2011 revision was supported by the U.S. Forest Service.

Printed in the United States of America

Forest History Society
701 William Vickers Avenue
Durham, North Carolina 27701
(919) 682-9319
www.foresthistory.org

©2011 by the Forest History Society

First published in 1992 by the USDA–Forest Service, FS-540
Second printing, with revisions, 1993 by the Forest History Society
Third printing, 1994 by the Forest History Society
Fourth printing, with revisions, 1996 by the Forest History Society
Revised edition, 2002 by the Forest History Society
Revised edition, 2011 by the Forest History Society

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Design by Zubigraphics, Inc.

Library of Congress Cataloging-in-Publication Data
MacCleery, Douglas W.

American forests: a history of resiliency and recovery / Douglas W. MacCleery.
p. cm. — (Forest History Society issue series)

Cover title: American forests.

ISBN 0-89030-048-8

1. Forests and forestry—United States—History. I. Title.

II. Title: American Forests. III. Series.

SD143.M32 1992

333.75'0973—dc20

92-29771

CIP

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FOREWORD

During the early 1990s, when the Forest History Society conceived the Issues Series line of books, targeting a general audience for the first time with forest history information, the topic of *American Forests: A History of Resiliency and Recovery* was a natural. It was intended primarily to answer the question of how much forest was there at the beginning of American colonization and how much forest is here now. At the time, no one anticipated how successful the book, nor the Issues Series, would be.

First published in 1992, during the following ten years it was reprinted four times, with significant updates or revisions to graphs and to a lesser extent text. It has reached over 25,000 households, classrooms, and legislative offices with an unbiased overview of the changes America's forests experienced from colonial times to the present. Conservatively, a hundred thousand students have benefitted either directly or indirectly by the publication. But these numbers understate the intrinsic value of such basic information.

The book has been used as a resource in educational programs with teachers across the nation, in continuing education with resource professionals, by journalists writing about forest issues, and even as a text in some introductory college courses. Many forest managers tell us that they keep extra copies in their office to hand out to visitors who ask basic questions about forests and forestry. We personally like to carry copies when we travel. There is nothing so pleasing as seeing the incredulous look of the person sitting next to you on the plane when they realize that today in the United States we have more trees and forest area in the nation than we did in 1920.

Recently, a lawyer who is also a forest landowner remarked that reading *American Forests* was a life-changing experience. The book concisely and eloquently put a voice to what many people intuitively know and hope to be true. It fed his optimism that human innovation can have positive unintended consequences. Who could have thought that the invention of the combustion engine and use of fertilizers to increase agricultural productivity would also lead to a massive addition of forests and open space in America? It wouldn't have happened without the confidence and desire of humans trying to find answers to problems, trying to improve human welfare. The book also illustrates how raising the alarm can lead to changes that help us avoid potential disasters. The predicted timber famine in the early 20th century never occurred.

This is not to say that everyone was happy with the book. Many comments were received that the book didn't go far enough. It talked about how the forests had changed but didn't go into detail about the loss of old-growth forests. It mentioned that some wildlife species have become endangered because of forest changes, but its focus was more on game species. We agreed. We also realized that to accommodate all of the items that deserve more attention would compromise the point of the books: to provide an attractive, easy to read, historical handling of an important natural resource issue. So these topics and many others have become working titles for their own Issues Series book when funding becomes available.

In 2008 as we embarked on yet another update, we decided with the author to provide a more extensive revision than what was done previously. Readers will find additional topics are covered in this volume reflecting changes in forests and forestry during the last two decades. We also decided to make it free! With this sixth version of the book we are making it fully accessible on the Forest History Society web site (www.foresthistory.org). Teachers who adopt the "If Trees Could Talk" middle school curriculum (based loosely on *American Forests* and available free on the FHS website) will have direct access. It will also be available as an electronic book through other distributors. We hope these efforts will result in many more times the number of people who have benefitted from the story within.

Support for the original and subsequent editions of *American Forests* came from the U.S. Forest Service, the American Forest Foundation, Weyerhaeuser Company, the former Westvaco Corporation and Champion

International Corporation, the Reed-Henry Fund at the Seattle Foundation, the MeadWestvaco Corporation, Starker Forests Inc., and the Lynn W. Day Endowment for Forest History Publications. We believe this revised edition is timely in light of continued challenges to American forests posed by relentless urbanization, wildfire, and invasive species. With continued innovation and human ingenuity, the American forest story of resiliency and recovery will continue through the next century.

Recent Issues Series books include topics on forest sustainability, forest biotechnology, wetlands, and fires. FHS has another dozen or more contemporary topics under consideration. In a democracy, the best decisions are made by informed policy makers with support from informed citizens. Forest cycles are long and a historical context is essential. The Issues Series highlights the FHS credo: By understanding our past we shape our future.

R. Scott Wallinger and Steven Anderson

OVERVIEW

Forests are resilient. It is a tribute to this inherent quality of American forests and to the success of the policies that were put in place in response to public concerns that forest conditions over much of the United States have improved dramatically since 1900. The following snapshot compares the forest situation as it was in 1900 with the way it is today:

- Between 1850 and 1910, forests were being cleared for agriculture at the rate of 13.5 square miles per day—about 190 million acres were cleared during this period. Due to the spectacular improvement in agricultural productivity, net forest loss to agriculture had largely halted by the 1920s. Today, the U.S. has less land under cultivation than it did in 1920, yet feeds hundreds of millions more people, both in the U.S. and internationally.
- Today about one-third of the land area of the U.S. is forested. This is about two-thirds of the forest area that existed in 1600. The area of forestland today is about the same as it was in 1920.
- The area consumed by wildfire each year has fallen 80–90 percent (see Figure 16 on page 36). This reduction created an environment in which millions of acres of forest could regenerate naturally and set the stage for improving forest conditions and increasing investment in tree planting and management on both private and public lands. In recent years, due to a multi-year drought in the West and a multi-decade increase in forest density, the area burned by wildfire has increased.

- Populations of whitetail deer, wild turkey, elk, pronghorns, and many other wildlife species have increased dramatically (see Figures 17, 18, 19, and 20 on pages 38 and 39). But some species, especially some having specialized habitat conditions, remain cause for concern.
- Tree planting on all forestland rose dramatically after World War II, reaching record levels in the 1980s. Many private forestlands are now actively managed for tree growing and other values and uses (see Figure 21 on page 41).
- The 50 to 80 million acres of cutovers or “stumplands” that existed in 1900, due largely to repeated wildfires, have long since been reforested. Many of these areas today are mature forests. Others have been harvested a second time, and the cycle of regeneration to young forests has started again.
- Eastern forests have staged a major comeback (see Figure 13 on page 30).
- Forest growth nationally has exceeded harvest since the 1940s (see Figure 25 on page 47). Today forest growth exceeds harvest by 40 percent and the volume of annual forest growth is four times greater than it was in 1920.
- Because of this favorable growth/harvest situation, the average volume of wood per acre in U.S. forests today is *50 percent* greater than it was in 1953. In the eastern United States, average volume per acre has *almost doubled* since 1953.
- Recreational use on national forests and other public and private forestlands has increased manyfold (see Figure 26 on page 48).
- The efficiency of wood utilization has improved substantially since 1900. Much less material is left in the woods. Many sawmills produce two or three times as much usable lumber and other products per log input they did in 1900. Engineering standards and designs have reduced the volume of wood used per square foot of building space, and preservative treatments have substantially extended the service life of wood. These efficiencies have reduced by millions of acres the area of annual harvest that otherwise might have occurred.

- American society in the 20th century changed from rural and agrarian to urban and industrialized. This has caused a shift in the mix of uses and values the public seeks from its forests (particularly its public forests). An increased demand for recreation and protection of biodiversity is driving forest management in some areas. In spite of this shift, today's urbanized nation is also placing record demands on its forests for timber production. We are no less dependent on the products of forest and field today than were the subsistence farmers of America's past (see Figure 31 on page 63).

INTRODUCTION

Forests are a key element in the broad sweep of United States history. The forest landscape has changed greatly over time, as has public concern for trees, water, and wildlife. The conservation movement of the early 20th century and the policy changes that resulted from that movement have been leading factors affecting the forests of today.

The single most important event in the evolution of the modern American landscape was the clearing of forests for agriculture, fuelwood, and building material.

People depended heavily on the products of the forest both in their personal lives and in the general economy. Wood was virtually the only fuel used in this country until the last half of the 19th century. Wood warmed people, cooked their food, produced iron, and drove locomotives, steamboats, and stationary engines. People used lumber, timbers, and other structural products as the primary material for building houses, barns, fences, bridges, and even dams and locks. These wood products were essential to rural economies across the nation, as well as to industry, transportation, and the development of towns and cities. American forests—the products derived from them and the land they occupied—were, in a very real sense, the economic foundation of the nation.

Forests were also habitat for the wildlife that supplemented the diet of millions of Americans for centuries. However, even more important to the American diet was food produced on land cleared of its forests and employed for agricultural use. This was by far the primary cause of forest loss.

In the spiritual dimension, the forest, and the wildness it represented, also played an important role in the identity of the nation. This was expressed

in the writings of Henry David Thoreau, Ralph Waldo Emerson, George Perkins Marsh, and others, and was first evidenced politically during the late 1800s by efforts to address concerns over the decline of wildlife populations and the loss of forests. There is no question that without its forests, the United States of America would have had a decidedly different history, and would be a decidedly different place than it is today.

American Forests Prior to European Settlement

The original forest covered about one billion acres, or about half of the U.S. land area (including Alaska). About three-quarters of that forest covered the eastern third of the country. Today there are 751 million acres of forest, about 70 percent of the original forest. About 286 million acres have been converted to other uses since 1600, primarily to agricultural lands (see Figure 1).

Forests remained the dominant feature of the landscape in eastern North America for centuries after initial settlement. In 1796, almost two centuries after the first European settlements, a French naturalist visiting the new American nation wrote that “the most striking feature [of the country] is an almost universal forest, starting at the Atlantic and thickening and enlarging to the heart of the country.” He said that in his travels to America’s interior he “scarcely passed, for three miles together through a tract of unwooded or cleared land.”

This country’s forest was and is magnificent and diverse. East of the Mississippi River, deciduous and coniferous forests blanket New England; open and sunlit pineries cover the southern coastal plain and Piedmont; remarkably varied and productive central hardwood forests extend from the central and southern Appalachians through the Ohio Valley and central Midwest; extensive pine and oak woodlands of the prairie fringe grow in Texas, Missouri, Indiana, Illinois, and Ohio; and the cool deciduous and coniferous boreal forests shade the northern Lake States.

West of the Mississippi River, rainfall diminishes, and forests and woodlands give way to treeless prairies and deserts. But in mountainous areas of the West where rainfall is sufficient, and along the Pacific Coast, exten-

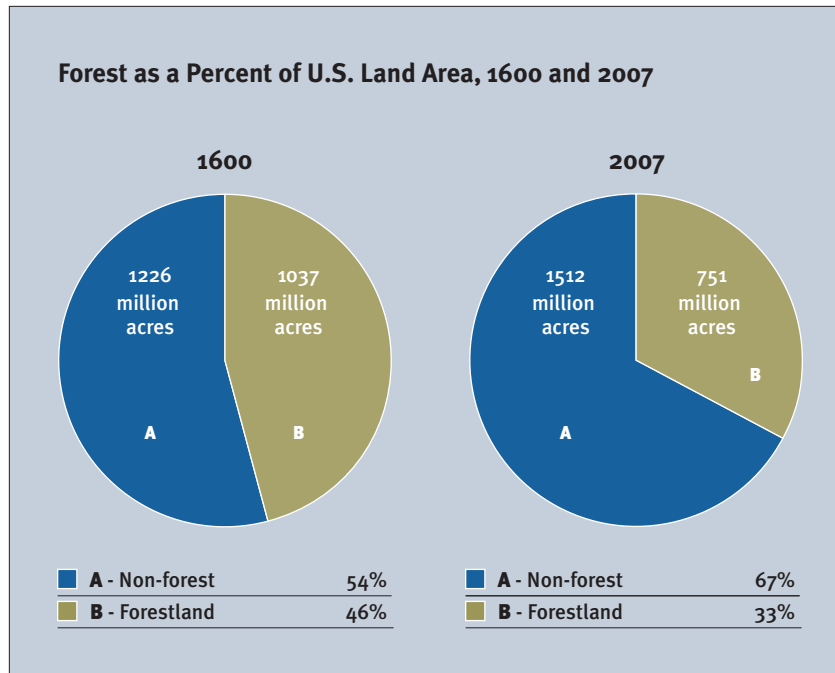


Figure 1. Forests covered about one billion acres, or almost half of the nation's land area, in 1600. Some of this land gave way to agriculture, reducing the acreage of U.S. forestlands. Almost 300 million acres of forest have been converted to other uses since 1600—primarily to agriculture. Today about a third of the nation is forested, more than two-thirds of the area that was forested in 1600. Today's forests are substantially changed from what they were in 1600.

sive forests flourish. Fire-maintained lodgepole pine, ponderosa pine, and mixed-conifer forests cover the slopes of the Rocky Mountains and areas east of the Cascade and Sierra ranges in Washington, Oregon, and California. The most magnificent western forests grow along the rain-drenched and fog-shrouded coasts of the Far West, where coast redwood and Douglas-fir, Sitka spruce, and hemlock form vast, cathedral-like stands.

Besides being impressed by North America's seemingly boundless forests, early explorers were astounded by the abundance and variety of its wildlife. They reported prolific numbers of large mammals in the eastern forests, such as whitetail deer, elk, moose, and bison. They also spoke of incalculable numbers and remarkable variety of bird-life: game birds such as ruffed

grouse, wild turkey, and heath hens, and waterfowl including ducks, geese, herons, egrets, and ibises. The most abundant bird on the North American continent was the passenger pigeon, which darkened the sky in numbers that seem incredible today.

NATIVE PEOPLES' EFFECT ON AMERICAN FORESTS

One popular myth is that, prior to European contact, America was dominated by impenetrable, relatively uniform ancient forests that cloaked the landscape in a long-term, static balance with the environment. The reality was far different. Pre-European settlement forests were exceedingly dynamic, shaped by myriad natural and human influences, disturbances, and catastrophic events that had a profound effect on the age and species mix of both plants and animals. The diversity of forest conditions that resulted from these influences was a major factor in creating the wildlife variety and abundance that so impressed early European settlers.

Forests both in the country's East and West were not pristine. They were often strongly influenced by native peoples. In the eastern and southeastern forests, humans often lived in fixed villages and practiced a maize-based agriculture. Domesticated crops commonly accounted for half or more of their diet, with the remainder provided by wild berries, nuts, fruits, and wild game gathered from the adjacent forests and grasslands.

Although pre-European settlement population figures are constantly debated and revised, what is truly significant is the impact of these peoples on the land. In addition to areas largely cleared of trees for crops, thousands of additional acres around each village were burned periodically to improve game habitat, facilitate travel, reduce insect pests, remove cover for potential enemies, enhance conditions for berries, and drive game. For example, in New England it was reported that the native peoples underburned the woods twice a year, in the spring and in the fall. Roger Williams wrote that "this burning of the Wood to them they count a Benefit, both for destroying of vermin, and keeping downe the Weeds and thickets."

Early observers reported prolific numbers of animals along forest edges and openings, indicating a forest in which natural or human-induced disturbance was common. Even elk and bison, normally associated with the western prairies, were present in the eastern forest. In the early 1600s, bison were found grazing along the Potomac River in what is now Virginia and

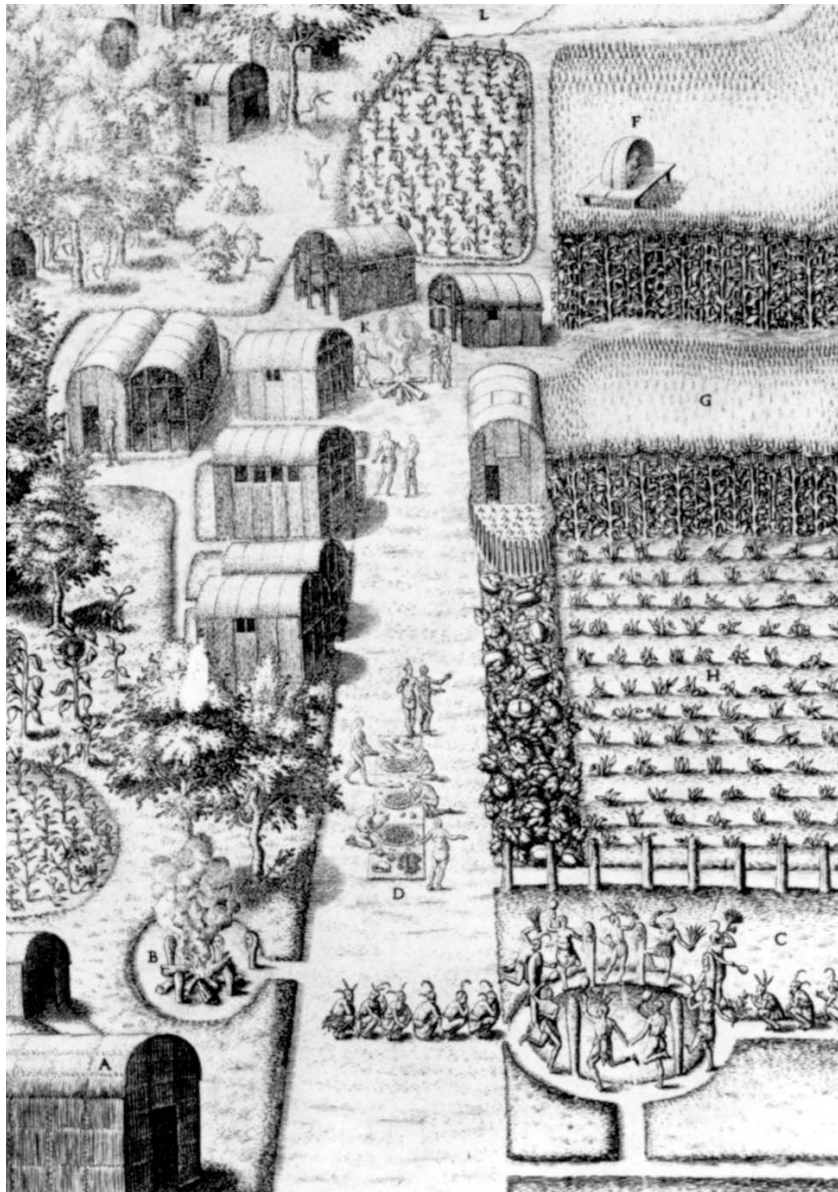


Figure 2. During the late 1580s the Indians of the village of Secoton, near Sir Walter Raleigh's colony of Roanoke in present-day North Carolina, raised abundant corn crops as well as some sunflowers and squash. This engraving by Theodore DeBry is after a watercolor by John White, the original leader of the colony.

Maryland. Bison were reported in Pennsylvania. The presence of these grazing animals indicates abundant grass and forbs that could only have been created by fire.

The South was dominated by fire-created forests, such as longleaf pine savannas on the Coastal Plain and Piedmont. The deciduous forests of the Appalachian Mountains were also burned frequently by native peoples. Virginia's Shenandoah Valley—the area between the Blue Ridge Mountains and the Alleghenies—was one vast grass prairie. Native peoples burned the area annually.

On the western fringe of the eastern forest, fire-dominated forests, such as oak and pine savannas, covered tens of millions of acres. These forests were heavily influenced by fires sweeping off the prairies. Fire-created prairies extended into Ohio, Pennsylvania, and even western New York. Evidence of the dominant role fire played in these forests is demonstrated by the fact that, when farms finally began to move out onto the prairies reducing wild fires, millions of acres of open oak savannas and even treeless areas to the east of these farms became dense forests and woodlands within two decades.

Today, with rising interest in protecting more forests in their “natural” condition, the complex pre-European settlement history raises technical and policy questions over whether and how to allow wildfire to assume its natural role in these areas, and whether to seek to replicate pre-European settlement human influences. It is difficult and sometimes impossible to distinguish natural from human-caused influences in pre-European settlement forests: North American forests have been both occupied and influenced by humans from the time these forests advanced north behind the retreating continental glaciers more than eight thousand years ago.

CHANGES BROUGHT TO THE NEW WORLD, 1500–1785

European settlement ushered in a vast increase in the impact of humans on the forest. The abundance of land and resources and the scarcity of labor was a defining difference between America and Europe, where the situation was reversed. This difference was profound, affecting everything from the way resources were utilized to the type of stewardship applied to the land, as well as the adoption of slavery.

Both fishing and fur trading thrived before permanent settlements were established in what is now the United States. Fur trading based on beaver,

otter, lynx, and many other forest-dwelling animals was one of North America's first industries, and its success depended on the active involvement of native peoples as hunters and trappers. The astoundingly productive Atlantic fishery formed the foundation of a lucrative industry that began along the Atlantic coast in the 1500s.

Lumber was also one of the first exports from the New World. In 1621, only a year after the *Mayflower* arrived, the Pilgrims sent the ship *Fortune* back to England "laden with good clapboard as full as she could stow." Soon the colonies became the source of white pine ship masts, oak planking, and cedar timbers, upon which the English navy depended. The forests of England had long since been depleted of ship-grade material; supplies from the Baltic States, where England was then obtaining its masts and timbers, were of lower quality, expensive, and subject to political disruption. By the middle of the 1600s, the colonists had established a booming business in ship masts, naval stores (such as pitch and turpentine), timbers, and other forest products.

Early European colonists viewed the seemingly endless forest as a mixed blessing. On one hand it provided an abundant and available source of fuel and building materials. It yielded game that for decades after settlement remained an important food source. But the forest was also habitat for wolves, eastern panthers, and other predators that found colonial livestock easy prey and against which the colonists waged unrelenting war. It provided cover for sometimes hostile Indians. But most importantly, it occupied potential cropland that could be liberated only after intensive and back-breaking labor using hand tools.

For the first three centuries of United States history, most Americans were farmers. Ninety-five percent of the people lived on the land in 1800. Most were subsistence farmers. From this perspective, the predominant view that emerged in the early 1600s and that continued for almost three hundred years, was that the forest was both inexhaustible and an obstacle to the preferred agricultural use of the land.

The colonists cleared the forests using techniques learned from the native inhabitants, but with the substantial advantage of iron tools and draft animals. Initially, white settlers sought abandoned Indian fields, which required less labor to clear than did a mature forest. Clearing forests was extremely laborious and time consuming. About one man-month of effort was required



Figure 3. Castle Creek in the Black Hills during the 1870s (top) and following a century of fire exclusion (bottom) that allowed a forest to expand in area and become much more dense.



for each acre of mature forest cleared (assuming the axman was strong and healthy). Trees were either felled with an ax and removed before planting, or they were killed in place by girdling (removing the bark in a band around the tree) and left standing. In both cases, fire helped clear the undergrowth.

The settlers planted crops brought from Europe, such as wheat and other grains, as well as those borrowed from American Indians—corn, squash, tobacco, beans, and pumpkins. Other crops first domesticated by the native peoples of the Americas included: both white and sweet potatoes, tomatoes, blue grapes, peanuts, sunflowers, both sweet and chili peppers, strawberries, cocoa beans (chocolate), vanilla, avocados, pineapple, cassava, cotton, and gourds. American agriculture still relies heavily on native crops. Today almost 60 percent of the value of U.S. crop production consists of plants first domesticated by native peoples.

The most significant difference between European and native agriculture was that the Europeans possessed livestock and draft animals. Within a few years after settlements were established in an area, the numbers of livestock increased dramatically. In 1634 the Massachusetts Bay Colony had a population of four thousand people, fifteen hundred cattle, four thousand goats, and “swine innumerable.”

Because labor was scarce, the common European practice of herding livestock was generally not practiced. Instead, hogs, cattle, and other livestock were turned untended into the woods, which meant that fences were needed to keep them out of crops and gardens.

Next to clearing the forest and constructing farm buildings, the most labor-intensive activity in creating a farm was building fences. One observer wrote that “it is inconceivable the cost and care which a single large farm requires in that single item.” A square forty-acre field enclosed by a wooden zigzag fence required about eight thousand fence rails. An average farmer could split fifty to one hundred rails in a day.

Until woven wire and barbed wire were introduced in the latter half of the 19th century, farm fences were made of wood or stone. The volume of wood used in farm fencing substantially exceeded that of lumber until the 1840s. By 1850 there were about 3.2 million miles of wooden fence in the United States, enough to encircle the earth one hundred twenty times.

The abundant forests also provided European settlers a level of physical comfort in winter unknown in the forest-depleted Old World. In 1629,



Figure 4. Fencing. Hand-split rails are stacked in zigzag fashion. Although these rail fences have a firm place in American pioneer folklore because of Abraham Lincoln's well-known youthful chores, they consumed large quantities of wood and were impractical when the westward-moving frontier reached the prairie region.

a Massachusetts colonist, Rev. Francis Higgins, wrote that a “poor servant here...may afford to give more wood for timber and fire...than many noble men in England can afford to do.”

Such comfort came at a price. In the late 1700s, about two-thirds of the volume of wood removed from the forest was used for energy. Wood provided virtually all of the energy consumed in the United States. Heating and cooking was done in inefficient fireplaces. It was not uncommon for a single household to consume fifteen to forty cords of wood annually. Thus in a single year more wood went up the chimney in smoke than had been used to build the house that was being heated. The average per capita consumption of fuelwood was about 4.5 cords per year throughout the colonial period.

Wood for fuel went far beyond meeting domestic needs for heating and cooking. It was also used to produce iron and other metals critical to the country's economy. Virtually all iron produced in America throughout the 18th century was smelted using wood charcoal. The reason was clear: wood was abundant, the technology was simple, and it could be done in a small operation. Blacksmiths found charcoal iron malleable and easy to shape into a variety of tools and other iron products.

Nearly every American colony had a number of iron-making furnaces. By the late 1700s many individual ironworks were producing 1,000 tons or more of iron per year. Thus the impact on the forest locally was significant. A 1,000-ton ironworks required between 20,000 and 30,000 acres of forest to sustain itself over time.

As settlers continued to clear forests for farms, firewood, and energy production, wildlife populations dropped dramatically. Even before the middle of the 1700s, many game animals and furbearers, such as deer, eastern elk, wild turkey, and beaver, were becoming scarce in many areas. Trappers practically eliminated beaver east of the Appalachians by 1700. These areas would not see the beaver's return for almost two and a half centuries. Wild turkeys were considered rare in many locations by 1670, and the bison was gone from the East before the Revolution of 1776.

This decline in game species was not primarily the result of habitat loss. On the contrary, habitat conditions in many parts of the colonies would have been ideal for deer, wild turkey, and beaver. The problem was in the social and property arrangements designed for the taking of desired species.



Figure 5. Charcoal making in 1900 using methods unchanged for centuries. The wood is stacked in the shape of a cone, covered with earth, and then ignited and carefully tended.

Because wildlife crosses property lines at will, and ownership to it does not pass until it is killed, normal property arrangements do not work. Individuals therefore have little incentive to conserve game if their neighbors do not, because in economic terms they suffer a known loss with little perceived benefit. Today this difficulty in conserving common property assets is called the “tragedy of the commons.”

In Europe, the “commons” problem was effectively, if undemocratically, dealt with by the nobility, who decreed that all wild game was the property of the crown and any commoner caught taking it would be severely

punished. But this institutional arrangement did not cross the Atlantic. Initially it was not perceived as a problem because of the small human population and abundant wildlife. It soon became apparent that some form of regulation was needed, but it would be well into the 20th century before the country could muster the social will to institute and enforce effective game regulations.

Westward Expansion and Eastern Industrial Growth

The massive Louisiana Purchase of 1803 doubled the nation's land area, and by 1850 the land base for the forty-eight contiguous states was in place. Acquired land was added to the public domain. Throughout most of the 19th century, the government viewed it as in the national interest to rapidly transfer most public domain lands to private ownership. The work became the largest and longest-lasting privatization effort in the history of the world. The increase in land transfers reflected a parallel increase in population.

It had taken the colonies a century and a half to reach a population of three million people. However, in the sixty-five-year period between 1785 and 1850, the U.S. population increased more than seven times, to 23.3 million people.

Since it required an average of about three acres of cropland to support each person, the area of cropland grew at about the same rate as the population. By 1850 the total cropland area, which had been about twenty million acres in 1800, had grown to seventy-six million acres. Clearing for pasture and hayland substantially added to that figure. Farmers and settlers carved much of this agricultural land out of the forest (see Figure 6).

Expansion of population and industry put increasing pressure on U.S. forests, both east and west of the Appalachians. Water-powered mills operated next to New England rivers and streams. Farms in New England, which had previously functioned at subsistence levels, prospered as they provided for the communities growing up next to these mills. Farmers cleared large areas to pasture sheep that would provide wool for the textile industry; beef cattle provided meat and hides to growing areas in the

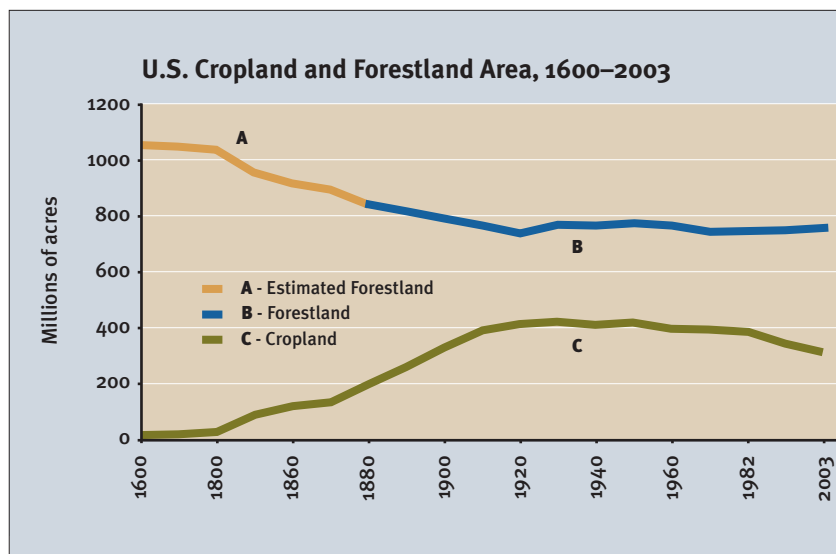


Figure 6. The nation’s forestland area is about the same size today as it was in 1920, when the acreage devoted to cropland stabilized. Two factors contributed to this stabilization. First, as horses, mules, and other draft animals were replaced by farm tractors and motor vehicles, cropland formerly used to feed draft animals was freed for use in human food production. Second, after 1930 agricultural productivity began to improve due to genetically-improved crops, irrigation, and increased use of fertilizers. Today U.S. farmers produce crop yields per acre five times greater than those produced in 1930.

East, both for domestic use and for export. In the South, forests were cleared for cotton, tobacco, and other crops.

USE OF THE FOREST FOR FUEL

The volume of wood used in 1850 was almost six times the volume of fifty years earlier. By mid-century, wood still supplied more than 90 percent of the nation’s heat energy needs; domestic heating and cooking accounted for the largest use of wood fuel (see Figure 7).

The increasing scarcity and expense of fuelwood spurred innovations in the form of cast-iron wood stoves, which were four to six times more efficient in the use of wood than fireplaces. In the fifty-five years between 1790 and 1845, the U.S. Patent Office issued more patents for stoves (over eight

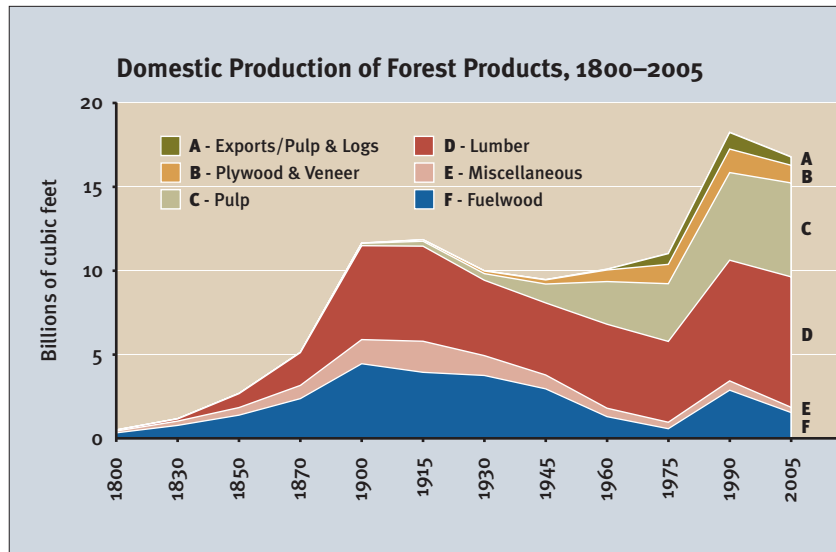


Figure 7. During the first half of the 19th century, domestic output of forest products rose at the rate of population growth. Heating and cooking was the largest use of wood during this period, averaging from one-half to two-thirds of total wood use. In 1850 wood provided over 90 percent of the nation's energy. Today, wood provides about 2.5 percent of U.S. energy demand, slightly more than hydropower.

After 1900, fossil fuels largely replaced wood fuels, and wood substitutes, such as steel and concrete, replaced wood in some structural applications. In addition, there were significant gains in efficiency in the utilization of wood in logging operations, at the mill, and in end-product uses. The rising real price of wood encouraged such changes. The price of timber, adjusted for inflation, had risen steadily since 1800, increasing about five times during the century. The real prices of most materials that competed with wood were steady or declining during this period. Since the 1970s, the real price of timber has not increased.

hundred) than for any other object. But in spite of their obvious advantages, adoption of wood stoves was gradual, occurring first in towns, where wood was expensive as well as difficult to store because of its bulk. Fireplaces continued to predominate for cooking and heating in rural areas well into the mid-1800s.

While increased use of wood stoves began to reduce the per capita consumption of fuelwood for domestic purposes, increases in industrial uses



Figure 8. Southern Appalachian farm eked a living out of the forest.

of fuelwood (including ironmaking and fuel for growing numbers of steamboats and railroad locomotives) offset these gains. Consequently, the per capita consumption of fuelwood for all purposes remained at more than four cords per year until the late 1800s. Because the population expanded more than fourteen times between 1800 and 1900, and per capita consumption of fuelwood remained constant, there was increasing pressure on many forest areas. This led to forest depletion in some areas and local shortages. A traveler reported that on the 240-mile journey between New York and Boston in the early 1800s he passed through less than 20 miles of woodland, scattered in four or five dozen separate parcels.

Fuelwood remained the primary product of the forest until the 1880s, when the volume of lumber finally exceeded it. Although the volume of wood used for energy continued to increase until 1900, it supplied a progressively lower proportion of U.S. energy needs. As the country began to turn to coal, and later to oil for its energy needs, wood dropped from

supplying more than 90 percent of the nation's energy in 1850 to 75 percent in 1870 to about 10 percent in 1920 (most of which was consumed by farm families). Yet even the move to coal increased the demand for wood in the form of millions of mine props to support deep mining operations in the mountains. Today wood energy supplies about 3 percent of U.S. energy needs, two-thirds of which is produced in industrial processes.

IRONMAKING

Production of charcoal iron continued to increase after 1800. In 1810 England had not one charcoal iron furnace; all were coal- or coke-fired. In the United States at that time, there were no coke-fired furnaces.

In the 1850s the tonnage of coke iron produced finally exceeded that of charcoal iron. Even so, charcoal iron production continued to rise until 1900. Charcoal iron continued to be used after 1900 for specialty products. Because of its special properties, some early car makers specified it for engine blocks. The last charcoal fired iron furnace finally shut down in 1945.

TRANSPORTATION

By the early 1800s, the United States was one of the largest nations in the world. The transportation system, more than anything else, tied the disparate and often quarreling states together. America's forests figured heavily in building this system.

The nation's first highways were its rivers, where wooden keelboats and, after 1830, steamboats transported goods. Steamboats were made of wood and, until the Civil War, used wood for fuel. In 1840 almost 900,000 cords of wood were sold for steamboat fuel, representing one-fifth of all fuel-wood sold.

Following steamboats came railroads. After 1850 railroads began expanding rapidly, linking growing cities and providing access to market for agricultural and forest products. Although called the "iron road," railroads used far more wood than iron. Except for the engine and rails, railroads were made of wood: cars were wood, ties were wood, the fuel was wood, the bridges and trestles were wood, and station houses, fences, and telegraph poles were wood.

The number of miles of U.S. railroads increased from less than 10,000 miles to more than 350,000 miles between 1850 and 1910. By the late

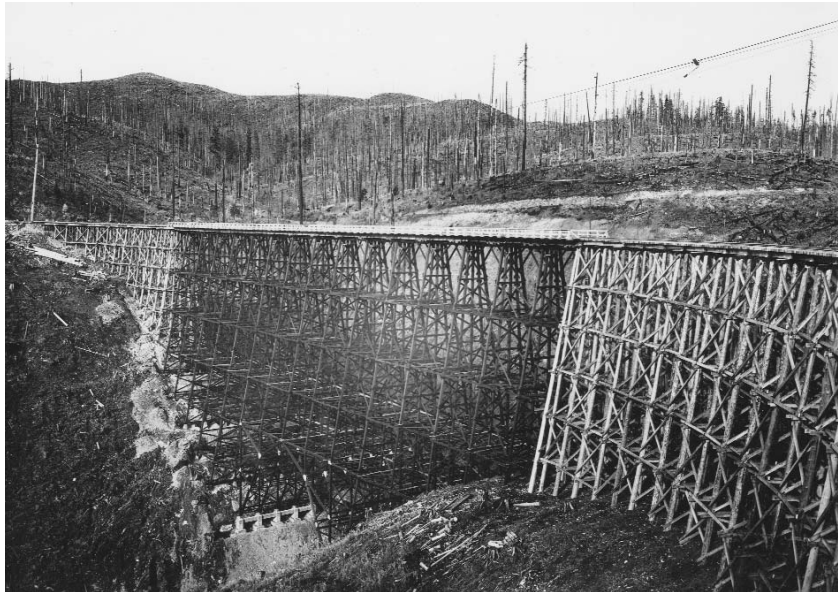


Figure 9. Railroad bridges and trestles (top) were constructed of pilings and large timbers. Railroads consumed vast quantities of wood, as these stacked cross-ties show (bottom).

1800s, railroads accounted for 20 to 25 percent of the country's total consumption of timber.

By far the most significant railroad use of wood was for crossties. Each mile of track required more than 2,500 ties. Crossties were not treated with preservatives until after 1900, so because of their rapid deterioration in contact with the ground, they had to be replaced every five to seven years. Given the miles of track in 1910, that would be equivalent to replacing the ties on some 50,000 miles of track annually. Just replacing railroad ties on a sustained basis required between 15 million and 20 million acres of forestland in 1900.

POPULATION AND AGRICULTURAL GROWTH

The five decades from 1850 to 1900 witnessed an unprecedented demand for and impact on the nation's natural resources. Its forests, croplands, grasslands, and wildlife populations and habitats felt increasing pressure. Rising population and increasing urbanization drove this demand.

Between 1850 and 1900, the population tripled, from twenty-three million to seventy-six million. Even the bloody decade of the Civil War showed a 27 percent increase. Immigration added to this population growth, amounting to 32 percent of the nation's growth during the last half of the 19th century.

Increased industrialization might logically reduce a nation's demands on its forests. Coal replaced wood fuels and objects formerly made of wood, such as buildings, fences, bridges, nails, and machinery, were increasingly made of brick, iron, steel, and other materials. In fact, industrialization in Europe was partly a response to diminishing wood supplies. In America, however, other factors were the driving force, including improving transportation systems and adoption of European industrial technologies.

In the second half of the 19th century, extensive land was cleared for farming. During this period, while the U.S. population tripled, the total area of cropland increased by over four times, from seventy-six million to three hundred nineteen million acres.

For every person added to the U.S. population during the 19th century, farmers put another three to four acres under the plow. Except for the decade of the Civil War, the increase in the area cleared for cropland paralleled the increase in U.S. population (see Figure 10). Between 1850 and

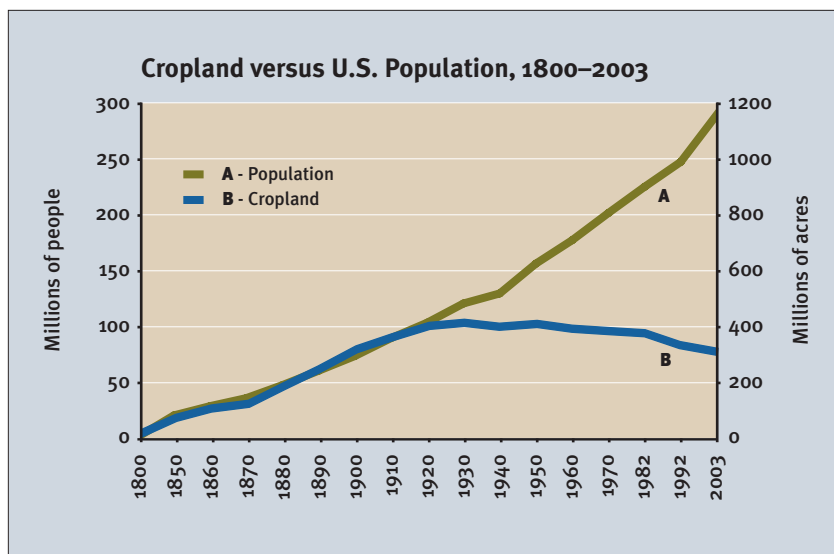


Figure 10. The U.S. population increased more than 14 times during the 19th century. Since farm productivity did not increase on a per acre basis during the century, farm clearing continued at about the rate of population growth.

Between 1850 and 1900, the U.S. population increased over three times, from 23 to 76 million people, while the area of cropland increased four times, from 76 to 319 million acres. For every person added to the U.S. population during the 19th century, farmers were putting another 3 to 4 acres of cropland under the plow. The area of pasture and hay land increased even more than that of cropland.

In the 1920s, the inexorable, three-century-long conversion of U.S. forests to farmland largely halted. In 2010, the U.S. has less land under cultivation than it did in 1920. This has occurred in spite of the fact that the U.S. population has almost tripled since 1920, from 106 to 309 million in 2010, and that U.S. farmers also feed, through exports, the equivalent of more than 100 million additional people in other lands.

The vast improvement in agricultural productivity, which made possible the stabilization of cropland area, is a truly remarkable accomplishment which has been a major benefit to American forests.

1910, farmers cleared about one hundred ninety million acres of forest for crops and pasture, an amount greater than the total over the previous two hundred fifty years of settlement. In fact, during the sixty years between

1850 and 1910, the nation's farmers cleared at an average rate of 13.5 square miles of forest per day.

All sections of the country contributed to forest clearing for agriculture between 1850 and 1910, with about forty-four million acres (23 percent) occurring on the Pacific Coast and in the Southwest; and 146 million acres (76 percent) in the East and South. Ohio was typical of farm clearing in the Midwest. In 1800 about 96 percent of the state was covered with deciduous forests, with the remainder in grass prairies probably maintained by fires set by native American peoples. Fifty years later, forest still covered about 60 percent of the state; but by 1900 forests covered only 25 percent of the state. In the productive farm country of the western half of the state, forest cover in some areas was reduced to 4 percent of the land or less.

It was well into the 20th century before real gains in per acre agricultural productivity were made. Such gains were essential to reduce the rate of cropland clearing to feed a growing population, and were a prerequisite to reducing pressures on the nation's remaining forests and wildlife habitats.

EXPANSION OF LUMBER PRODUCTION

Throughout the first half of the 1800s, most sawmills were small-scale, two- to five-person operations. Census figures for 1840 indicate that the number of sawmills in the United States was 31,649, or an average of twenty-five mills for every county. The numbers were much greater for eastern counties than for areas newly settled, with some counties along the Atlantic seaboard having more than one hundred mills, and pioneer counties in the Midwest and South having fewer than ten mills.

Until 1850 small country sawmills handled most of the nation's wood needs—either as a result of farm clearing or from farm woodlots. Often it was the farmers themselves who cut the timber and cordwood and operated the sawmills.

Although farmers cleared at record levels after 1850, the process generated too little wood to meet rapidly increasing demand. The location of the clearing was also a problem; rural communities could meet their wood needs with local production, but the large quantities of lumber and other wood products that cities demanded required new arrangements for manufacturing and transporting forest products. Also away from the city and away from the forests, prairie farmers west of the Mississippi began to

demand large quantities of wood for houses, barns, fences, outbuildings, and fuel. As the physical distance between consumers and forests grew, logging and sawmilling increasingly became large-scale, industrial operations.

Lumber production increased dramatically, rising more than eight times between 1850 and 1910, from 5.4 billion board feet to 44.5 billion board feet annually, a rate more than double the rate of population growth.

Farmers and loggers burned limbs, tops, and other logging debris, believing that the logged areas could be converted to cropland or improved pasture. These uncontrolled slash fires burned nearly continuously and under some weather conditions resulted in massive wildfires that destroyed property and lives.

The South escaped much of the destructive post-logging fires that occurred in the North, perhaps because many of the native southern pine stands were of a more open type that had been maintained by frequent natural or Indian-set fires. Southern farmers continued the native practice of burning the woods, which reduced undergrowth and fuel buildup necessary for large wildfires.

DECLINES IN WILDLIFE

The 19th century witnessed dramatic declines in a wide range of wildlife species. In the East, the once enormously abundant passenger pigeon was decimated by over-hunting and loss of habitat. In the West the buffalo was one of the most dramatic examples of a large number of wildlife populations that by the last half of the 19th century had been severely diminished. By 1890 people had eliminated the whitetail deer from much of its range east of the Mississippi, including all the New England states west of northern Maine, as well as Maryland, New Jersey, Ohio, most of Pennsylvania, and the Lake States except the extreme northern portions of Michigan, Minnesota, and Wisconsin.

No longer was wildlife abundant. The population was decimated because of unrestricted market hunting of all kinds of wildlife for food, furs, and feathers as well as habitat modification caused by farm clearing, logging, and extensive wildfires. Even many songbirds—such as robins and meadowlarks—were heavily hunted for food.

Emergence of a Call for Conservation Efforts

Before the turn of the century a growing number of people became concerned about what was happening to the nation's woodlands and wildlife. The combination of logging, massive wildfires, farm clearing, and wildlife depletion began to call into question the notion of the forest's inexhaustibility. Fears about future timber supplies combined with implications for increased flooding and watershed damage, declining wildlife populations, harm to the beauty of the American landscape, and even concerns about how forest clearing was affecting the climate itself. George Perkins Marsh raised concerns about the adverse effects farm clearing had on watersheds and other environmental values. His 1864 book, *Man and Nature*, became a catalyst for public concern. As early as 1865, Frederic Starr predicted an impending "national famine of wood"—a concern that would be raised frequently over the next few decades. Use of the term "famine" was apt, for wood in its various forms was among the most widespread and essential materials both for domestic use and industry.

The rapidity of change led to public concern as people in some areas watched the landscape, in forty or fifty years, lose 80 percent of its forested land. At first the conservation movement was not organized. Groups with common interests moved more or less independently, seeking to achieve similar results through their efforts. Some of these groups advocated setting aside land in protective areas: Yosemite in California (1864); Yellowstone in Wyoming (1872); and the Adirondack Preserve in New York (1885). In 1891 Congress authorized the president to designate forest reserves out of public domain lands but made no provision for their management. The forest reserves, unlike the park preserves, were generally not tied to the

preservation of a nationally significant unique area. These forest reserve designations, which had grown to forty million acres by 1897, generated considerable opposition, because no one knew how such set-asides would address society's need for water, forage, wood products, and other resources.

Scientists—including foresters like Bernhard E. Fernow and geologists like John Wesley Powell and Arnold Hague—prepared reports, wrote articles, and testified to Congress about the need to protect forested watersheds, water for irrigation, trees, forage, and wildlife. Citizen groups—the American Forestry Association and the Boone and Crockett Club—also advanced the cause. The result of these efforts was that Congress gave the forest reserves a management mandate (through the 1897 Organic Act) to “preserve and protect the forests,” to “secure favorable conditions of water flows,” and to “furnish a continuous supply of timber for the use and necessities of the citizens of the United States.”

Congressional and presidential actions to reserve national forests from public domain lands signaled a shift away from three centuries of national policy that was designed to transfer public land to private ownership. By 1900 more than a billion acres of public domain lands, more than half the land area of the contiguous forty-eight states, had been transferred to private ownership.

The turn of the century also signaled a general change in how people viewed natural resources. It was becoming clear that the myth of forest and wildlife inexhaustibility was untenable and that the existing rates of forest and wildlife use and depletion were not sustainable. While new approaches were called for, it was not clear what shape these approaches would take.

In addition to those advocating land set asides, the idea of “conservation as wise use” emerged and received widespread public support under the dynamic advocacy of Gifford Pinchot and his friend and mentor, President Theodore Roosevelt. Pinchot and other conservation leaders were influenced strongly by “progressive era” thinking, which put great faith in science and the rational approach. Their view supported faith in efficiency but strong distrust of the “special interests” in politics. From this progressive era came the idea of conservation as the “wise use” of natural resources. Under this view, current use of resources should protect the basic productivity of the land and its ability to serve future generations. Over the years, those advocating land preservation and those promoting wise use have

sometimes been in conflict over the appropriate conservation policies to be applied in particular circumstances.

The late 1800s also saw the establishment of conservation groups and associations to champion forest and wildlife protection. The American Forestry Association, formed in 1875, and the Sierra Club, formed in 1892, are both tangible examples of public concern for the forested environment. Other concerned groups included the Boone and Crockett Club (1888), National Audubon Society (1905), and Izaak Walton League (1922).

CONDITION OF FORESTS AND WILDLIFE IN 1900

The following snapshot of the condition of the nation's forest and wildlife in 1900 helps frame the natural resource situation that faced these early conservation leaders:

- Wildfire commonly consumed twenty million to fifty million acres annually (an area the size of Virginia, West Virginia, Maryland, and Delaware combined).
- There were about eighty million acres of “cutovers” that continued to be either idle or lacking desirable trees.
- The volume of timber cut nationally greatly exceeded that of forest growth.
- There was no provision for reforestation. Aside from a few experimental programs, long-term forest management was not practiced.
- Due to its abundance, wood was still relatively cheap; because of this, large quantities were left after logging, sawmills were inefficient, use of wood in buildings was based on custom rather than sound engineering, and huge volumes of wood simply rotted.
- Massive clearing of forestland for agriculture continued during the last fifty years of the 19th century resulting in forest loss. For example, forest cover in many areas east of the Mississippi had fallen from 70 percent to 20 percent or less. In the last decade of the century, America's farmers cleared forests at the average rate of 13.5 square miles per day. Some of this land included steep slopes that were highly erodible.
- Formerly abundant wildlife species were severely depleted or nearing extinction. Among them were whitetail deer, wild turkey, pronghorn, moose, black bear, bighorn sheep, and bison. Furbearers, especially beaver, had been eliminated from significant portions of their ranges.



Figure 11. Cutover and abandoned forestland in northern Michigan at the beginning of the 20th century.

Waterfowl were severely affected, including wood ducks, Canada geese, and plumed wading birds (such as herons, egrets, and ibises). The passenger pigeon, once the most abundant bird on the North American continent, was nearly extinct by 1900; the heath hen, an eastern relative of the western prairie chicken, was on the brink of extinction; and the great auk, a flightless bird along the northeast coast, was extinct.

CONSERVATION POLICY FRAMEWORK

The policy framework that emerged by the 1930s to address these issues emphasized protection of forests from wildfire and of wildlife from overharvest. It also emphasized the management of both forests and wildlife using scientific principles. Specific actions focused on:

- Promoting and encouraging the protection of forests, regardless of ownership, from wildfire, insects, and disease
- Acquiring scientific knowledge about the management of forests and wildlife, and improving the use of wood products

- Encouraging the productive management of private forestlands through tax incentives and technical and financial assistance
- Adopting and enforcing strong state and federal wildlife conservation laws
- Acquiring and managing public lands both for commodity and amenity uses and values

Public policy also focused on cooperative efforts among federal, state, and private sector interests to achieve common goals.

In addition to policy changes, a number of changes in technology also assisted forest conservation efforts. These included:

- Substitution of fossil fuels for wood fuels
- Substitution of metal and concrete for wood in structural applications
- Substitution of chemicals derived from fossil fuels for those derived from animals and vegetation
- Replacement of draft animals with internal combustion engines

Many of these changes decreased the demand for wood while increasing agricultural productivity per land area, thereby reducing the need to clear forests for agriculture.

The following are some significant developments in the history of American forests after 1900.

STABILIZATION OF TIMBER CONSUMPTION AFTER 1910

One significant development in the forest conservation picture after the turn of the century was the stabilization of timber consumption, followed by a modest but persistent decline in the total timber volume used. Per capita consumption rates for wood, which in 1905 were over five hundred board feet per year, dropped to less than two hundred board feet by 1970. Even though population continued to increase, by the 1940s national wood production was about 15 percent lower than in the early 1900s.

There were various reasons for the leveling off and subsequent decline of timber consumption. One was technology. Fossil fuels replaced wood fuels and wood substitutes, such as steel and concrete, replaced wood in structural applications. The rising real price of wood encouraged such shifts. The price of timber, adjusted for inflation, had risen steadily since 1800,

increasing fivefold during the century. The real prices of competing materials were steady or declining during this period and throughout most of the 20th century as well.

After World War II, increasing real prices for wood created powerful incentives not just to use wood substitutes but also to improve the efficiency with which wood was used. Tree sizes and species formerly left behind were removed. Sawmills invested in wood-saving technologies. More efficient new products such as plywood and various panel products were developed.

Statistics reflect these changes in technology. In 1940 plywood accounted for less than 3 percent of U.S. production of solid wood products consumed. By 2007 plywood and other panel product's share had risen to 16 percent. Expanded use of preservative treatments also reduced the demand for wood. By 1920 virtually all crossties were being treated, and by 1960 railroad use of wood had dropped to one-fifth of what it had been in 1900.

STABILIZATION OF FOREST AREA

By the 1920s, a change occurred that was little recognized or commented upon at the time. That was that the inexorable three-hundred-year loss of forestland in the United States had substantially halted. For the first time in American history, the net area of cleared farmland stabilized, rather than rising at the rate of population growth. Farm clearing of forests continued after 1920 in some areas, but it was offset by farmland abandonment and reversion back to forest in other areas (see Figure 6 on page 14).

Cropland stabilized primarily for two reasons. First, rapidly increasing numbers of motor vehicles and farm tractors made it unnecessary to continue raising large numbers of draft animals. Twenty-seven percent of all cropland was devoted to growing food for draft animals in 1910. By 1950 the number of draft animals had dropped so dramatically that the equivalent of seventy million acres had been released to grow crops for human consumption. The second reason for the stabilization of cropland was that after 1935, spurred by the development of genetically improved hybrid crops and expanded use of chemical fertilizers and liming, agricultural productivity improved. Today American farmers commonly produce five or more times the crop yield per acre that they did in 1920. In 2006, there was actually less land under cultivation than there had been in 1920.



Figure 12. Introduction of motor vehicles greatly reduced the need for growing food for draft animals, which caused millions of acres of former agricultural lands to revert back to forests.

Today the area of U.S. forestland is about two-thirds what it was in 1600. While some agricultural lands continue to revert back to forests, that is being offset by forest loss due to urbanization.

THE EASTERN FOREST COMES BACK

Although the United States has about the same aggregate area of forest as it did in 1920, some areas have considerably more and some have less. Beginning in the mid-1800s, marginal agricultural land in the East and South was gradually abandoned as more productive farmlands in the Midwest were developed, the abandoned farmland often reverting to forest (see Figure 13). This reversion to forest has not been generally recognized by the public.

The reasons for reversion to forest include two related factors working in concert. The first was the growth of cities, which accelerated the transition of U.S. agriculture from subsistence to commercial farming. The second was the nation's progressively improving transportation system, which opened up more productive western lands that could supply the growing cities. The steep slopes, small fields, and less productive lands of the East

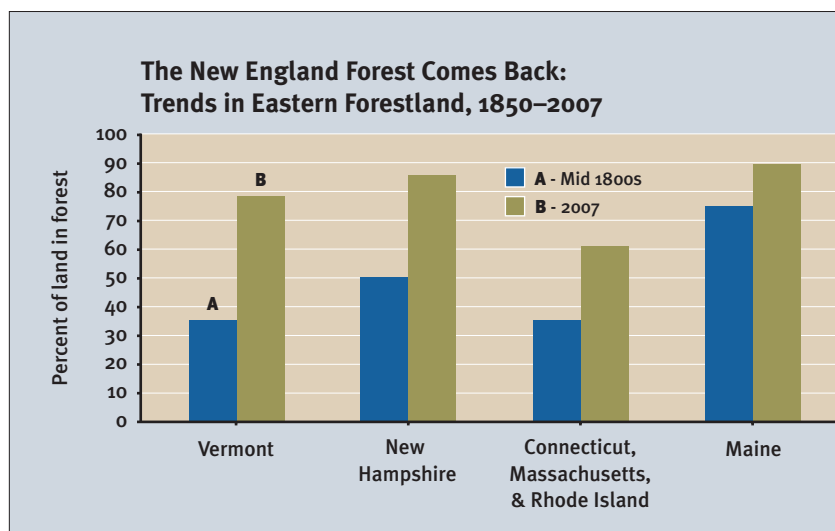


Figure 13. The amount of forestland in many parts of the East and South has actually increased by tens of millions of acres since 1900. With the exception of Florida and Wisconsin, every state east of the Mississippi has seen an increase in forestland since 1920; although the specific amounts and timing vary by state. The reasons for reversion back to forest are complex. The growth of the cities accelerated the transition of U.S. agriculture from subsistence to commercial. At the same time, the nation's progressively improving transportation system opened up more productive western lands to provide for the growing cities. The steep lands, small fields, and less productive lands of the East and southern Appalachians were unable to compete commercially with the lands of the Ohio Valley and much of the rest of the Midwest. The process of farmland reversion back to forest was greatly accelerated by the Great Depression.

and southern Appalachians could not compete with lands of the Ohio Valley and the rest of the Midwest. The opening of the Erie Canal in 1835 was the first major step in this reversion to forest that occurred in the Northeast. Vermont is typical of the abandonment: in the 1850s, only about 35 percent of Vermont was forest, with the remainder primarily crops and pasture. Seventy-eight percent of the state had become forest by 2007.

As surely as the Erie Canal and the railroads created a prosperous Midwest, they signaled the decline of agriculture in New England. The agricultural land abandonment that started in the Northeast in the 1850s gradually spread during the next century to other parts of the East, to the

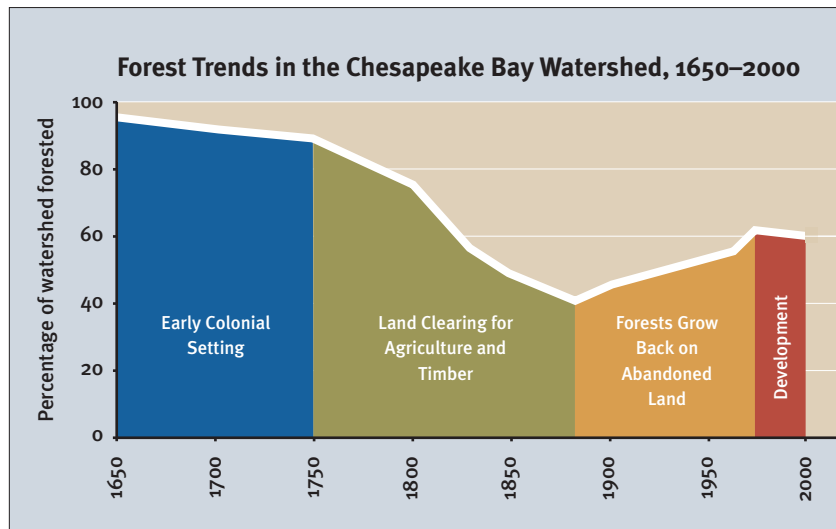


Figure 14. This shows the time sequence for forest loss and recovery in the Chesapeake Bay watershed in the east central U.S. Forest loss proceeded gradually during the early colonial period. It accelerated rapidly after 1750, and especially after 1800, as the human population in the Chesapeake Bay Region exploded and agricultural clearing proceeded apace with population. By the 1880s, this trend in forest loss reversed as people of the Chesapeake Bay Region increasingly obtained their food from outside the area, and, especially after the 1930s, agricultural productivity increased. Since the 1960s the forest area of the region again began to decline, this time as the result of urban and suburban expansion.

South, and eventually even to less productive farmlands of the Midwest. It culminated in massive farm abandonment during the Great Depression of the 1930s.

In many ways, the forest and farm landscape of the Appalachians, as well as many other parts of the East and South, has come full circle. By the 1960s and 1970s, the pattern of forest, fields, and pastures was similar to that prior to 1800, its appearance much like it must have been before the American Revolution.

RISE OF THE RESOURCE PROFESSIONAL

In the early years, the lack of technically trained foresters seriously handicapped the introduction of scientific forest management early in the century.



Figure 15. Progressively over time and space, agricultural uses replaced forests in much of the Eastern United States. By the 1850s this trend began to give way in some places to natural succession and reversion to forestland in areas less suited to mechanized farming. Central Massachusetts images, 1880s (top) and the same scene in 2000 (bottom).



In 1900 only a handful of foresters worked in the U.S.; most of them had studied the European experience, including conditions that often applied poorly to American forests. Therefore, one of the first steps in the scientific management of U.S. forests was to expand the number of trained forestry professionals.

In 1900 only two colleges offered forestry curricula—Cornell and Yale. By 1915 there were thirteen; and ten more were operating by the time of World War II. In 1909 only ninety-one foresters received bachelor's and master's degrees. That figure had risen dramatically by 1939, when twelve hundred received such degrees.

U.S. forestry research and practical experience also increased, providing a sound foundation from which forestry professionals could work. By the 1950s, more and more wildlife biologists, soil scientists, hydrologists, forest engineers, and people in other natural resource disciplines were graduating from U.S. colleges. In 2000, about 2000 baccalaureate, masters, and doctorate degrees were awarded in forest science programs in the U.S.

INCREASED RESEARCH FOR SCIENTIFIC MANAGEMENT

Forestry research shifted as interest in the subject grew. Before 1900 forestry research focused on identification and description of trees, shrubs, and forest vegetation, timber use, consumption, and probable future timber supplies. That began to change after 1900.

In 1910 the Forest Service established the Forest Products Laboratory in Madison, Wisconsin. Its purpose was to seek ways to improve the utilization of wood products. Even before 1910, Forest Service researchers had been working with railroad companies seeking ways to extend the service life of wooden crossties through preservative treatments and other methods.

In 1915 the Forest Service created the Research Branch for scientific and technical investigations. Forestry research grew further with passage of the McSweeney-McNary Act in 1928. The act expanded forestry research and authorized regional forestry research stations and a nationwide forest inventory program. Research at forestry schools and state agricultural experiment stations also grew during the 1930s.

Following World War II, research improved and developed in the Forest Service, as well as at forestry schools and state agricultural research sta-

tions. The forest industry also stepped up its research efforts, making headway in silviculture, genetics, insect and disease control, and plantation and nursery practice.

Today, research, extension, and education for natural resources include a wide variety of disciplines, including physical sciences and social sciences. Between 2001 and 2008, the USDA–Forest Service, which employs more than 500 research scientists, saw funding for research at a relatively constant \$300 million per year (in 2005 dollars). Funding for forestry research at universities that receive federal funding increased from \$256 million in 2000 to \$282 million in 2006 (2005\$). The forest industry also provides funding for both internal and external research amounting to about \$30 million in 2003.

FIRE PROTECTION

In the first two decades of the century, wildfire ran essentially unchecked through America's forests. Natural fire has always been an important ecological factor in most North American forests and fire was also used as a management tool by many native peoples. But the extensive logging and land clearing during the 19th century greatly increased both the extent and the destructiveness of wildfires.

Before 1930 from twenty million to fifty million acres commonly burned each year; few forest areas were effectively protected. In the 1920s there were about eighty million acres of land that were unstocked, largely due to repeated wildfires. Few if any areas were replanted after logging, at least in part due to the risk of loss to fire.

It became clear that the fire problem had to be addressed. Europe, which had a negligible fire problem, left foresters without a model.

In 1902 a series of catastrophic fires near Yacolt, Washington, burned more than a million acres and took thirty-eight lives. These fires encouraged the forest industry to set up private fire protection associations. In 1910 devastating fires in northern Idaho and northwestern Montana, known as the "Big Burn," left considerable property damage and the loss of 78 Forest Service firefighters. This event helped galvanize federal efforts in fire control. William B. Greeley, who was in charge of the Idaho and Montana region of the Forest Service at the time of the 1910 fires and later became Forest Service chief, campaigned vigorously for stronger fire suppression

programs. The fires influenced Congress in 1911 to pass the Weeks Act, which authorized federal matching funds for state fire-control agencies.

The Clarke-McNary Act in 1924 augmented cooperative federal and state fire suppression efforts as well as existing funding under the 1911 Weeks Act. This fire control system covered federal, state, and private lands in a cooperative effort. By the end of the 1930s these programs began to show results. However, it took three decades before wildfires were reduced to present levels. Of all the efforts to educate the public about fires, the introduction in 1944 of Smokey Bear as a symbol of fire prevention was perhaps the most successful and widely recognized.

By the late 1950s, as a result of increasingly sophisticated fire protection, suppression, and public education, both the area burned and size of fires had been substantially reduced. In recent years, a multi-year drought in the West, and the increasing density of forests, have led to an increase in the area burned (see Figure 16).

Over the years, there has been increasing recognition that strict wildfire protection has caused some unintended results in some areas and that fire can play an important ecological role in many forest and grassland ecosystems. This has led to increasing flexibility in fire management policies, allowing the reintroduction of fire on a controlled basis into forest ecosystems where it is appropriate to do so.

EXPANSION OF STATE EFFORTS IN FOREST CONSERVATION

State forestry programs preceded federal action. In 1885 California and New York established forestry commissions, and the Empire State even set aside the Adirondack Preserve to protect water supplies for the Erie Canal. However, it was not until the 1911 Weeks Act provided federal matching funds to forest fire protection agencies that state programs grew. The 1924 Clarke-McNary Act further bolstered federal support of states through a major study of forestland taxation and assistance with tree nurseries.

During the 1920s and 1930s many states reexamined their constitutions to see if property tax changes could be made that would give special consideration to forestlands. The tax problem for forest managers was that although landowners were taxed annually (often on the total value of land and timber), they produced income from timber harvesting only after long intervals. This situation, and the possibility that taxes might substantially

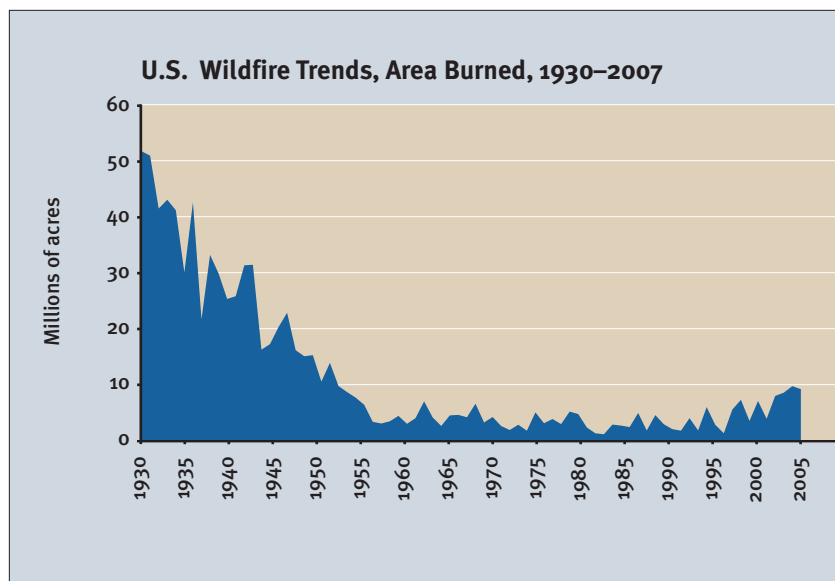


Figure 16. Wildfires scorched twenty to fifty million acres of land each year during the 1930s, a fact that ultimately made fire control a national priority. By 1960 the area burned had been reduced by 90 percent, to between two and four million acres annually. This remarkable accomplishment was due to cooperative federal, state, and local efforts in fire prevention, suppression, and public education. Since 2000, due to drought and an increasing density of forests, the area burned by wildfire has increased.

Reducing the risk of loss to wildfire was a prerequisite to effective forest management in the U.S. It reduced the risk for long-term investments in timber growing. However, the nation still loses a substantial volume of timber to insects, diseases, and wildfire, amounting to about half of the volume of wood the nation consumes annually.

increase during a managed forest's rotation, created incentives for premature harvest and disincentives for reforestation following logging. Nationally, the property tax situation was modified piecemeal. Today forestland generally receives a more favorable tax treatment.

In the 1940s, with passage of various state forest practice laws, the Forest Service campaign for federal regulation ended when states became the regulators of private forest practices. Early forest practice laws emphasized fire protection and reforestation. Recent revisions include requirements for successful reforestation and reflect broad concerns for the environment. Game

also fell under state regulation, even game in national forests. In most states, fish and game agencies, funded largely by sport license fees, developed bag limits and hunting seasons in an effort to enhance the wild populations. Predator controls shifted from extermination to balanced maintenance as a way to ensure long-term wildlife health.

Over the years there have been a variety of federal and state programs designed to assist non-corporate forest landowners. These range from education and technical assistance to financial assistance, quite often in the form of sharing the cost of qualifying activities, such as reforestation or erosion control.

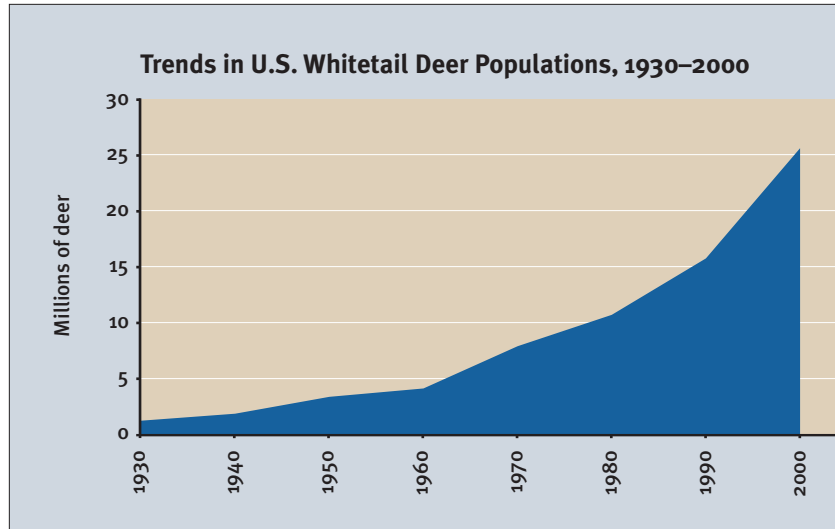
RISE IN WILDLIFE CONSERVATION

Beginning in the late 1800s, organized sportsmen waged a protracted and ultimately successful war against market hunting. These groups vigorously supported enforcement of game laws, self-taxation to support state game management, and acquisition of habitat reserves and management areas. Sportsmen formed the National Audubon Society out of concern over commercial plume hunting. Such organized efforts saved scores of game and non-game species from extinction (see Figures 17, 18, 19, and 20).

Before 1920 the primary focus was on eliminating market hunting and establishing a strong framework for the regulation of hunting. A regulatory framework eventually emerged to:

- Halt market hunting of wildlife for meat and most other products, including feathers (regulated market hunting of furbearers continued)
- Eliminate spring shooting of waterfowl and other game birds
- Establish state regulation of resident game and non-game species
- Prohibit hunting of song birds, plume birds, and other migratory non-game birds; prohibit interstate commerce in wildlife products taken in violation of state law
- Enact federal regulation of sport hunting of waterfowl and other migratory game birds

After 1920 the emphasis on game conservation expanded from regulating to improving the art and science of wildlife management. Wildlife management became part of the curriculum at many colleges and universities, and state fish and game departments devoted to scientific wildlife



Figures 17–20. Whitetail deer, elk, pronghorn antelope, wild turkey, and many other wildlife populations, both game and non-game, have increased dramatically since 1930. These increases are the result of effective hunting laws, increases in habitat acreage of managed forests, the adaptation of species to a variety of forest conditions, and the dedicated work of federal and state

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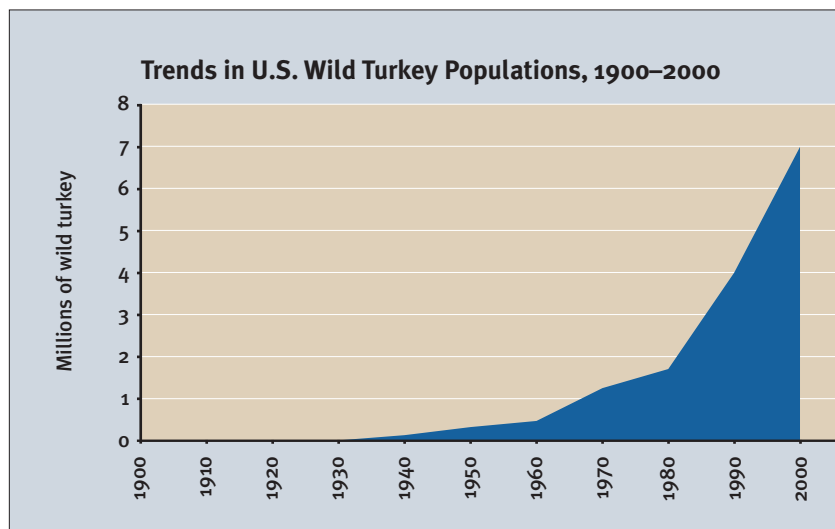


Figure 18.

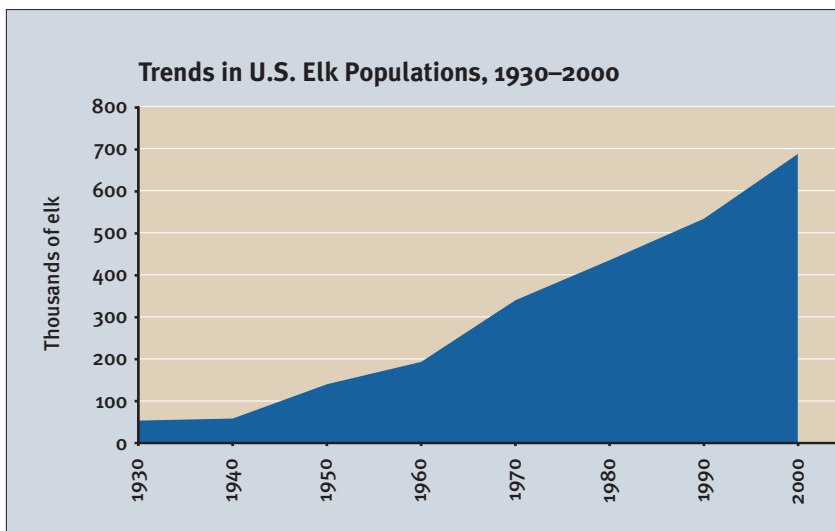


Figure 19.

wildlife agencies and private groups, such as the National Wild Turkey Federation and Rocky Mountain Elk Foundation. In spite of this, there remains concern over some wildlife species needing specialized habitats, such as the northern spotted owl on the Pacific Coast, the red cockaded woodpecker in the South, and some neo-tropical birds.

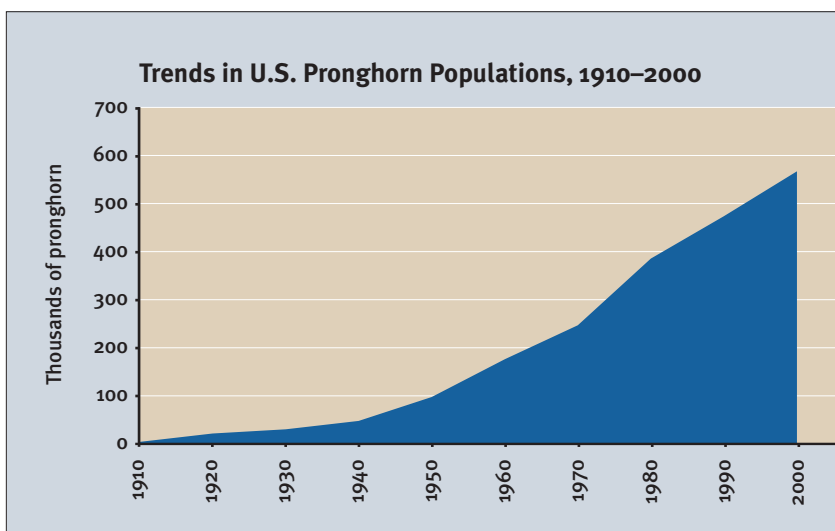


Figure 20.

management and game law enforcement were established. Before 1930 most state game departments were staffed by political appointees whose competence and tenure depended on the governor.

Increased wildlife professionalism, coupled with improving habitat conditions, especially on millions of acres of abandoned farm lands in the East and South, provided the foundation to reintroduce wildlife species into formerly occupied ranges.

THE EASTERN NATIONAL FORESTS

By 1915 national forests of the West had been established in the form they retain today. These national forests, which included 162 million acres in 1915, were essentially carved out of the public domain. At that time there were no federal forests in the East because the public domain had been transferred to private ownership before the conservation movement began.

The impetus for eastern national forests had two sources: some groups advocated federal acquisition to provide general protection for cutover lands, and other groups focused on the need for flood prevention. These parallel interests converged to influence passage of the 1911 Weeks Act, authorizing the acquisition of federal lands to protect the watersheds of navigable streams.

The first acquisitions under the Weeks Act were in the southern Appalachians and in the White Mountains of New Hampshire. By 1925 land had been purchased to establish the national forests today known as the Monongahela in West Virginia; the Pisgah and Nantahala in North Carolina; the George Washington and Jefferson in Virginia; the White Mountain in New Hampshire; the Sumter in South Carolina; the Chattahoochee in Georgia; the William B. Bankhead in Alabama; the Cherokee in Tennessee; and the Allegheny in Pennsylvania.

The major acquisition of eastern national forests was during the Great Depression. At that time twenty-six national forests were established, ranging from the Ocala in Florida to the Nicolet in Wisconsin; from the Green Mountain in Vermont to the Mark Twain in Missouri.

By 1945, when acquisition of national forestland in the East substantially slowed, about twenty-four million acres of depleted farmsteads and cutover and burned woodlands had been incorporated into the eastern national forest system and placed under long-term management.

CHAPTER FOUR

Postwar Demands on U.S. Forests

The period after World War II ushered in a substantial increase in demand for a variety of forest products as well as non-timber uses and values. Prior to the late 1940s, management of national forests was generally custodial or focused on meeting demands for resources in the surrounding area. After the war, as millions of GIs returned home and started families, demand for timber to use in housing increased dramatically, and the nation looked to the national forests to meet that demand. The roads into national forests had improved by the late 1940s and many of the more accessible private lands had been logged to provide timber for the war effort.

National forest timber sales increased from about three billion board feet in the late 1940s to about eleven billion board feet by the early 1960s. By the 1960s, national forests met about one-sixth of the nation's total consumption of wood volume, and a quarter of its softwood sawtimber needs, a primary source of lumber and plywood for housing.

This increase not only met the critical need for timber, it also took pressure off private forestlands, many of which had been heavily used to meet the needs of the war effort.

FOREST GROWTH, INVENTORY, AND RECREATION IN THE LATE 1900S

Standing inventory was affected by this demand, as was regrowth (see Figures 21 and 22). Balancing harvest with growth in a system of multiple owners, and the transition from old growth to second growth, proved challenging (see Figure 23).

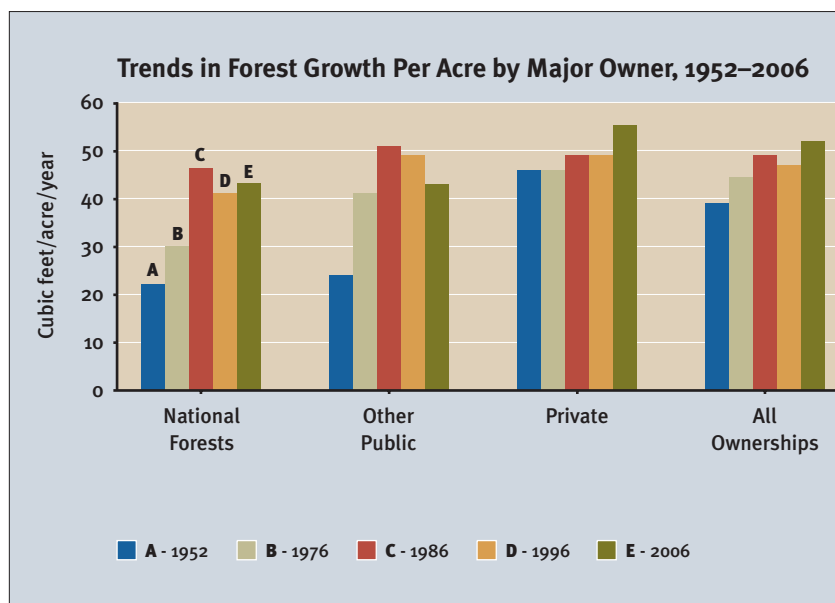


Figure 21. Forest growth has increased on all ownerships over the last several decades. Between 1952 and 2007 net annual growth for all U.S. forests almost doubled.

The 1950s also witnessed a substantial increase in demand for other national forest uses and values. An increasingly mobile and affluent population began to look to these lands for outdoor recreation. National forest recreational visits increased from eighteen million in 1946 to ninety-three million in 1960 (see Figure 24).

The increased demands on national forests led to new laws in the 1960s. The Multiple Use-Sustained Yield Act of 1960 required that national forests be managed for a variety of uses and values, including outdoor recreation, wildlife, timber, grazing, and watershed protection. In effect, this law reflected the uses and management already occurring on these lands.

Increasing public demands also set the stage for major controversies over how these lands should be managed. The Wilderness Act, passed in 1964 after much debate, provided for the preservation of significant areas of national forestland in their natural and untrammeled condition. Timber sales and most other commodity uses were prohibited in these areas. By

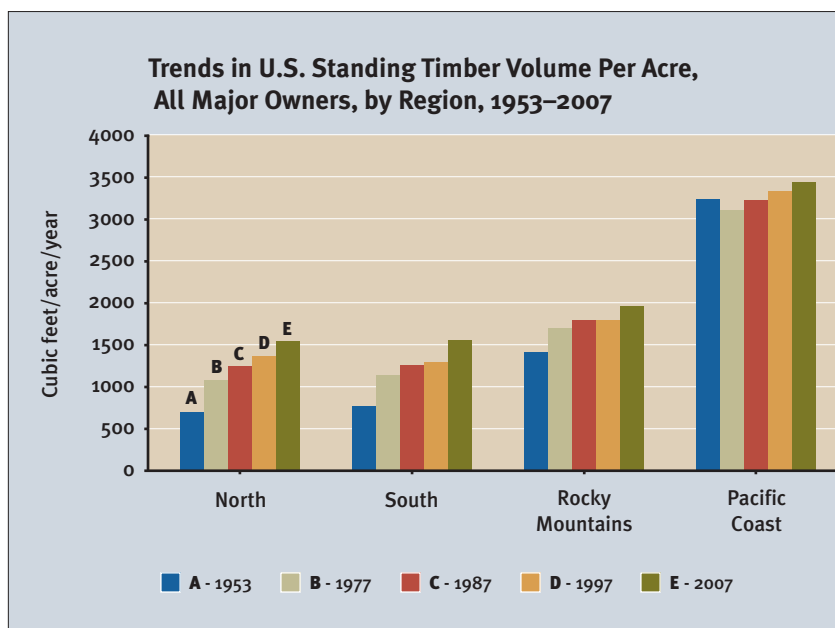


Figure 22. Since 1952, the amount of timber standing in U.S. forests has increased dramatically in all regions except the Pacific Coast, where per acre volume declined slightly in the 1970s and early 1980s because of the harvest of old growth timber, but now exceeds 1952 levels. Wood volume per acre has increased by 50 percent nationally since 1952. In the East, it has doubled.

1990 over thirty-three million national forest acres had been designated as wilderness. Approximately half of this land is forested.

RISE OF PRIVATE FOREST MANAGEMENT

Until the 1920s, the forest products industry showed little interest in forest management. In fact, timber companies often sold cutover tracts for farmland or even let it revert to the counties for nonpayment of taxes. Tax codes had an effect on land use; because property taxes were based on the combined value of land and timber, landowners were implicitly encouraged to cut timber and thereby reduce their tax burden. There was little incentive for long-term investment.

By 1960 many states had changed their tax codes to base timberland taxes on bare land values, taxing the timber only upon harvest. Modified

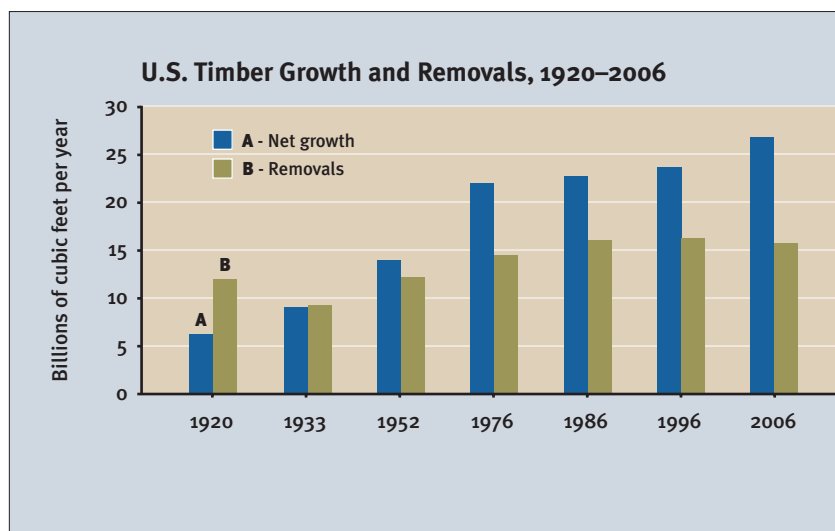


Figure 23. In 1920, timber harvest rates nationally were double the rate of forest growth; but by 1952, net annual growth had exceeded annual harvest from all U.S. forests. By 1997, net annual growth was almost four times what it was in 1920. In 2007, net growth exceeded harvest by 72 percent.

tax codes, state laws encouraging—even regulating—fire protection and reforestation, and the rising real price of wood products prompted increased management of private forestlands for long-term timber growing, especially following World War II.

Between 1952 and 1987, integrated forest product companies (companies owning both land and processing facilities) increased their holdings by 11.6 million acres, half of which was in the South. Industrial tree planting rates also increased dramatically after 1950, rising from an average of about seven thousand acres a year just prior to 1945 to 1.2 million acres during the 1980s (see Figure 25). Much of this tree planting was in the South and Pacific Coast. By 1990, integrated forest product companies owned about 70 million acres of productive non-reserved forestland, as well as processing facilities, and accounted for about 30 percent of U.S. timber harvest volume.

Since the mid-1990s this picture has changed dramatically. Industrial landowners have sold most of their land and these large-scale timberland ownerships have been restructured into Timber Investment Management

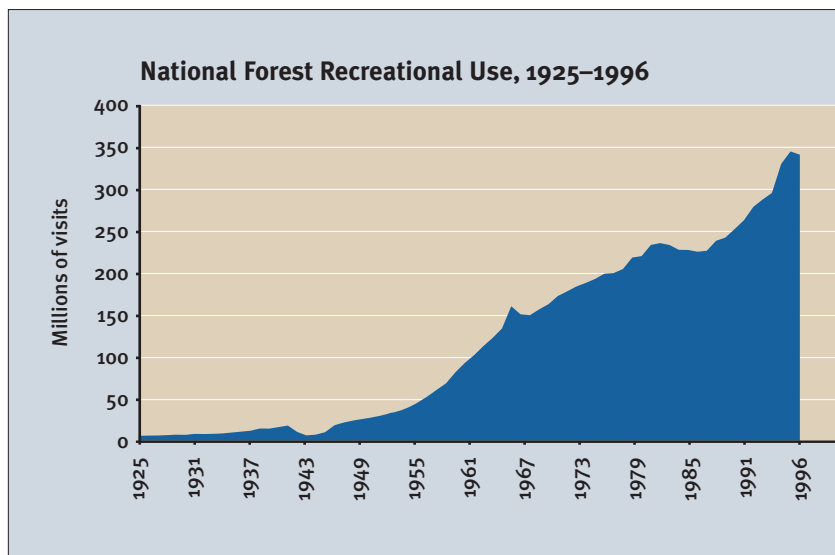


Figure 24. After World War II, steadily increasing national economic growth provided the basis for increasing personal income and leisure time. That, along with the proliferation of automobiles, revolutionized the recreational habits of the American people. Increasing recreational visits to national forests reflect a pattern common to other public lands as well.

Increased recreational demands came at the same time that the nation's public forests were also experiencing increased demands for other uses. Such pressures have been felt especially in the last three decades as conflicts over the use and management of public lands has intensified.

(The Forest Service changed the way it gathers recreational statistics after 1996. Because of this, recreational figures gathered after 1996 are not compatible with historic statistics and this chart ends with the year 1996.)

Organizations (TIMOs) or Real Estate Investment Trusts (REITs), which are primarily managers and holders of timberlands for institutional investors. This shift occurred, in part, due to changes in the U.S. tax code that: 1) are unfavorable toward integrated forest product industry ownership of timberland (by taxing both stumpage revenues and corporate dividends) and 2) provide favorable tax treatment to the new institutional owners—TIMOs and REITs—which are not enjoyed by integrated forest product companies. In addition to changes in the U.S. tax code, divestment of forest industry timberland was also associated with a decade of downsizing in production

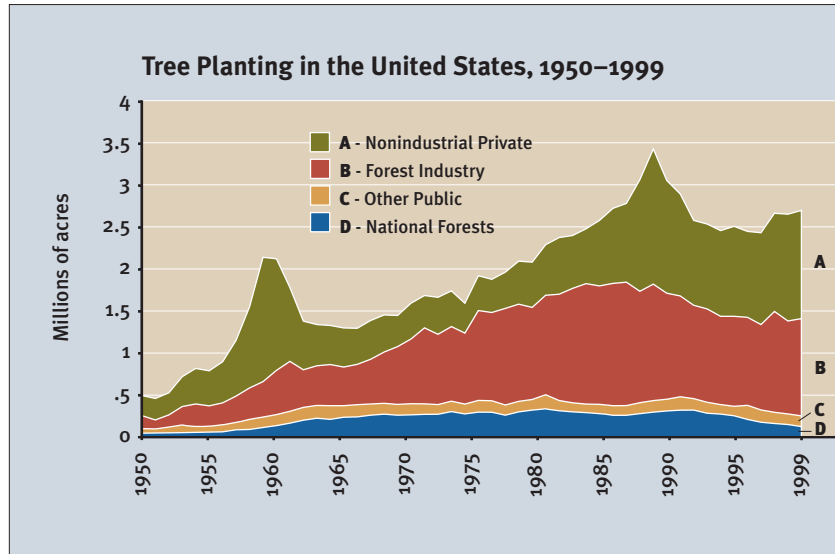


Figure 25. Tree planting has increased steadily since World War II, peaking in 1988. In the 1980s more than twenty-six million acres were planted. In recent years, tree planting has averaged between 2.4 and 2.6 million acres annually. In the 1990s, more than four hundred trees were planted for every child born in the United States. (Data stops at 1999 because the Forest Service is no longer gathering statistics on the area being planted by ownership class.)

capacity and corporate restructuring in the U.S. forest products industry. Economic globalization and structural changes (consolidations and mergers) resulted in refocusing or realignment of corporate objectives away from U.S. timberland management.

Today about 69 percent of U.S. productive forestland is privately held. These lands provide 92 percent of the nation's timber harvest volume (see Figure 26).

THE RISE AND FALL OF COMMERCIAL TIMBER PRODUCTION FROM FEDERAL LANDS

As the demands for other uses and values of public lands exploded after 1970, the national forests became the focus of increasingly intense controversy. This was reflected in the demands of growing numbers of economically affluent and politically influential urban dwellers for expanded recreational opportunities and increased set-asides of undeveloped lands as preserves

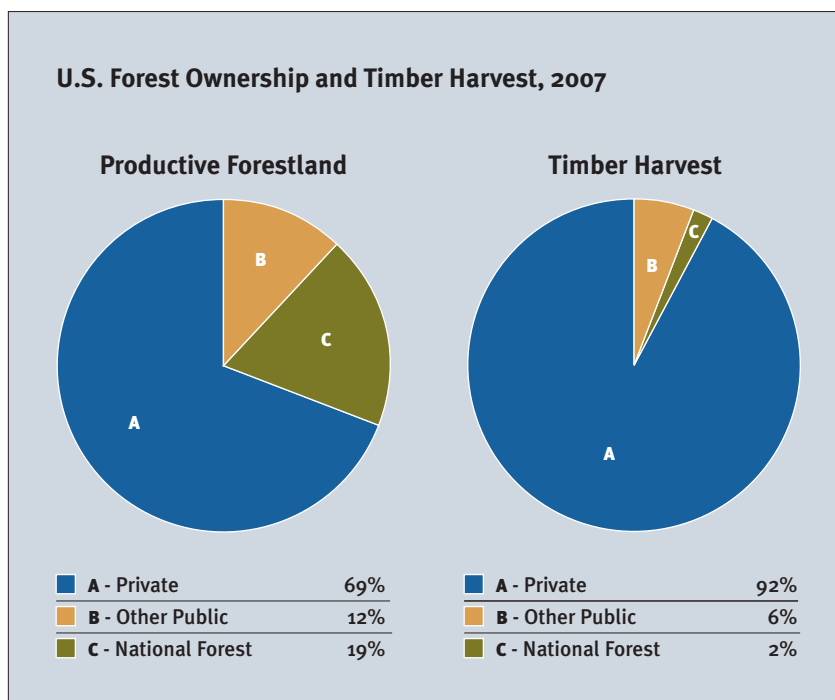


Figure 26. Just as they had encouraged improved wood utilization, increasing wood prices spurred private sector investments in timber growing, although investments for other than fire protection were not significant until after World War II, when many private forestlands began to be managed in earnest for tree growing. Today private forests comprise 69 percent of U.S. productive forestland, yet supply 92 percent of the wood volume harvested.

under which minimal management would occur. The national forests were also challenged to meet the requirements of national environmental laws passed during the 1970s that:

- expanded opportunities and legal standing for individuals to challenge Forest Service and other federal agency actions in court;
- created substantive legal requirements for federal agencies to meet (including greatly expanded environmental analysis and public involvement requirements); and
- created federal regulatory agencies to oversee implementation of these environmental laws. These agencies have substantially different organizational missions, cultures, objectives, and risk tolerances than the federal land managing agencies.

Since 1985, there has been a dramatic shift in the mission of federal and many other public lands, and the managing agencies are now largely focused on restoring and maintaining healthy ecological conditions and meeting the recreational and amenity preferences of local and national stakeholders. National forest timber sales have declined by more than 80 percent since 1985 and now provide less than 2 percent of U.S. timber consumption. Currently, all public lands combined provide about 8 percent of U.S. timber harvest.

Such changes were reinforced by significant changes in internal agency organizational values and culture brought about by a variety of circumstances. Primarily these changes included enhancement of Forest Service workforce diversity in professional disciplines and in race and gender, leading to an agency that is more reflective of the general population than had existed in the past.

In areas with a large proportion of public land, the reduction in federal timber sales in the 1980s substantially affected the forest products industry and economic foundation of communities adjacent to these lands, and led to a substantial loss in timber processing facilities. Thousands of jobs were lost as processing mills closed across the West, especially in the Pacific Northwest, and timber production moved to Canada and the Southeastern United States.

About the same time as the timber harvest reductions, federal lands in the western U.S. experienced an increase in uncharacteristically severe wildfire and insect and disease epidemics due to droughts and overly dense forest stands. Federal land managers estimate that over 100 million acres of federal forestlands are at unnaturally high risk of catastrophic wildfires and large-scale insect and disease outbreaks because of unhealthy forest conditions. A major expansion of residential development into rural areas, often adjacent to national forestlands, increased the level of risk associated with wildfires. As people in local communities became aware of this risk, they began supporting thinning and restoration of forests to reduce the risk of severe wildfires.

The use of thinning and controlled burning are critical management tools to restore and improve the ecological resiliency of many forests on federal lands. Yet the decline in the forest industry adjacent to many federal lands has substantially diminished the capacity to treat these stands through com-

mercial operations. That decline and loss of capacity continues and is adversely affecting both the ability of federal land managers to maintain healthy forest conditions and the economic viability of local communities adjacent to these lands.

Since U.S. wood demand has not diminished, the reductions in timber harvesting on national forests and other federal lands has resulted in increased harvests from private lands in the U.S. At the same time there have been substantial increases in lumber imports, mostly from Canada. Between 1990 and 2002, U.S. softwood lumber imports have increased by 62 percent, rising from 28 to 37 percent of U.S. softwood lumber consumption.

INCREASING SOCIAL INTEREST AND APPRECIATION OF FORESTS

The social forces that so dramatically changed the management of federal and many public lands over the last two decades are a reflection of the growing national and global interest in forests. This interest began in the late 1800s and led to the first national conservation movement and the establishment of the conservation framework discussed earlier. In the 1960s and 1970s public interest greatly expanded as a national environmental movement emerged, concerned about industrial air and water pollution which were significant in and around most U.S. cities. In 1962, Rachael Carson's *Silent Spring* galvanized public concern over pesticide use.

The 1970s were a time of turmoil when many of society's institutions were severely challenged and the modern environmental movement took form, moving beyond merely advocating wilderness preserves. Environmental quality became a high priority; Earth Day, a public celebration, followed closely on the heels of the National Environmental Policy Act, a federal watershed in managing lands and resources. Litigation became a weapon as public organizations made full use of new statutes. These new statutes included the Clean Air Act of 1970; the Clean Water Act of 1972; the Endangered Species Act of 1973; amendments to the Federal Insecticide, Fungicide, and Rodenticide Act; and the Toxic Substances Control Act of 1976. The National Environmental Policy Act and other statutes also mandated public involvement in federal land management decisions.

As forest conservation practices that were set in place decades before began to work and the demand for recreation and the establishment of natural areas increased, more forestlands have been set aside for parks,

wilderness areas, and similar designations under which timber removal is prohibited. The area of such set-asides has increased significantly in recent years. In 2007, about 74.6 million acres of forestland had been reserved. This area, the size of New Mexico, is almost three times the set-aside acreage of 1953 (see Figure 30 on page 60).

Interest in forests has expanded globally. In the 1992 United Nations Conference on the Environment and Development in Rio de Janeiro, also called the “Earth Summit,” the plight of the world’s forests took center stage. A set of non-binding Forest Principles were adopted, as well as an agenda for carrying them out. In addition, the Forest Service announced that clearcutting on the national forests would be severely restricted and that these lands would be managed based on ecological principles. Out of this UN conference emerged a number of new initiatives. Two of the most important of these were: 1) the growing movement to use independent, third-party entities to certify forestlands as being well managed or sustainably managed, and 2) the development of criteria and indicators of sustainable forest management.

RISING INTEREST IN CERTIFICATION OF FOREST MANAGEMENT

One reflection of the changing public attitude about forests is the increasing demand for products that have been certified by independent third parties as coming from well managed or sustainably managed forests. The development and expansion of forest certification is one of the most significant developments in forest management in the United States, and indeed over much of the developed world, in the past two decades.

The idea of forest certification originally arose from concerns in the 1980s about rapid deforestation, particularly the loss of tropical rainforest and illegal logging of tropical hardwoods. Led by nongovernmental organizations, forest certification and eco-labeling of wood products emerged in the 1990s. Certification programs developed guidelines for responsible forest management, including logging, and then certified the wood as harvested from properly managed forests, in some cases providing a quality logo on the wood product. For corporations, forest managers, and landowners who can demonstrate responsible forest management, certification emerged as a tool that promises market access or a competitive advantage.

There are three major certification systems operating in the U.S.—the Forest Stewardship Council (FSC), the Sustainable Forestry Initiative (SFI) and the American Tree Farm System (ATFS). In the U.S., the area of forests certified by FSC and SFI has increased from virtually none in 1998 to over 110 million acres today. As of August 2010, the FSC has certified 32,382,552 acres in the U.S. while the SFI program has certified 56,382,739 acres. In addition, about 24 million acres are certified under ATFS, a certification program tailored to family forest owners. The FSC and SFI figures including both the U.S. and Canada are 120,732,573 and 179,162,119 acres respectively. In Canada, another 156 million acres certified by the Canadian Standards Association are also recognized by the SFI program.

Interest in certification programs has recently increased due to green building rating systems and purchasing policies that favor certified products. Price premiums are beginning to emerge with this increased demand for certified products and some producers are finding certification is necessary to maintain a presence in certain markets.

MEASURING SUSTAINABLE FOREST MANAGEMENT

In 1993, the year after the Earth Summit, the United States committed to a national goal of sustainable forest management following the Forest Principles—the objective of which was to advance the conservation and sustainable development of forests and to provide for their multiple values, uses and environmental functions.

In 1995, as part of the Montreal Process, the United States and eleven other countries engaged in discussions that resulted in the adoption of a set of criteria and indicators (C&I). The C&I are intended to provide: 1) a common understanding of essential components of sustainable forest management, and 2) a framework for measuring, assessing, and evaluating a country's progress to this goal at the national level.

The Montreal Process C&I consist of seven criteria and 67 indicators:

- conservation of biological diversity (9 indicators);
- maintenance of productive capacity of forest ecosystems (5 indicators);
- maintenance of forest ecosystem health and vitality (3 indicators);
- conservation and maintenance of soil and water resources (8 indicators);
- maintenance of forest contribution to global carbon cycles (3 indicators);

- maintenance and enhancement of long-term multiple socioeconomic benefits to meet the needs of societies (19 indicators); and
- legal, institutional, and economic framework for forest conservation and sustainable management (20 indicators).

Each Montreal Process country was expected to seek to measure the indicators and develop a country-level report summarizing the results. The *National Report on Sustainable Forests—2003* is an attempt to provide a quantitative assessment of the state of the American forests. The report also identifies data gaps and makes recommendation for next steps to improve the collection of useful data.

The 2003 report describes the achievement of sustainability “as a journey—an ongoing dynamic process rather than a static condition.” The report also states that sustainability “is not a fixed target, and the pathway to sustainability may involve a range of acceptable outcomes, as well as a range of feasible courses to reaching those outcomes...” The pathway to sustainability entails attention to three spheres of activity: environment, society, and economy. It requires environmental functions to support economies and societies, economic performance for social well-being and environmental conservation, and social institutions that help foster both the economy and the environment. In 2008, an updated *National Report on Sustainable Forests—2010* was released for public comment. This draft report assesses trends in indicators since 2003.

FORESTS AND GLOBAL CLIMATE CHANGE

In recent years, public concerns over climate change and its effects have exploded. Forests have entered into this discussion in several aspects. One is how climate change is affecting forest health and sustainability. Another is how forests may be contributing to global levels of carbon dioxide and other greenhouse gasses and how the use and management of forests may be improved to contribute to reducing the buildup of greenhouse gasses.

There is little doubt that climate change is currently affecting forests in a variety of ways. The area damaged by wildfire has increased in recent years, as has the level and intensity of insect epidemics, especially in the coniferous forests of the West. Snowpacks have been reduced and the onset of snowmelt begins earlier. In the East, the intensity of rainfall events has

increased. In all areas of the country, the ranges of many species, both plant and animal, have been shifting northward and moving to higher elevations. It is likely that the implications of climate change on forests will be a major challenge for the public and forest managers for decades to come.

Forests, while affected by climate change, can also figure into strategies designed to reduce the level of carbon dioxide, the major greenhouse gas, from the atmosphere. Forests worldwide sequester enormous amounts of carbon. Due to deforestation, mainly in developing countries, forests also contribute about 20 percent of human-caused carbon emissions.

Three of the several emerging issues related to addressing climate change are: 1) the role of forests in sequestering carbon, 2) expanding the use of wood for energy, and 3) the use of wood as an energy efficient building material.

As U.S. forests are a large carbon sink, climate change may present opportunities for the U.S. forest sector. Since forest growth exceeds removals, U.S. forests currently sequester about 10 percent of U.S. greenhouse gas emissions. This could be increased somewhat through forest management activities.

From the early 1600s until the 1880s when it was superseded by coal, wood was the primary energy source in the U.S. Today biomass provides about 3 percent of U.S. energy production—more than hydropower. Worldwide, more than half the wood harvested is used for energy, mostly domestic heating and cooking in developing countries. In recent years, there has been enormous interest in expanding the use of wood and other bio-based fuels both to reduce U.S. dependency on imported oil and to reduce overall carbon emissions.

Major technical, economic, and feedstock challenges exist to a substantial expansion of wood energy. Most forest products processing facilities already utilize wood residues for process heat and power. There is substantial interest in cellulosic ethanol, which is more energy efficient and has lower environmental impacts, as compared to corn ethanol, which currently dominates the ethanol fuels market in the U.S.

Buildings in the U.S. are responsible for 40 percent of total carbon emissions. As interest in “green” building materials and practices grows, wood may be increasingly used in the green market place. Wood-based building materials typically can be produced with a much lower environmental foot-

print than alternative materials. Environmental life cycle assessment, or LCA, can provide an effective mechanism for evaluating the energy and other environmental impacts associated with raw material and building product choices. A key challenge is to develop acceptable standards and protocols for LCA that are both technically sound and also accepted by advocates of alternative building materials which often fiercely compete in the marketplace.

But even with an increase in sequestration in forests, increased use of biofuels, and expanded use of wood as a building material, a significant reduction in U.S. carbon emissions will be needed to reduce overall U.S. contributions to global atmospheric carbon.

U.S. Forests Today and Challenges for the Future

It is a measure both of the inherent resilience of our forests, and of the success of the policies put in place in response to public concerns in the early decades of this century, that forest conditions over much of the United States have improved dramatically since 1900:

- After two centuries of decline, the area of U.S. forestland stabilized about 1920 and is about two-thirds what it was in 1600.
- The area burned by wildfire each year has decreased by 80–90 percent since the 1930s. However, in recent years, the area burned by wildfire has increased, particularly in the western U.S.
- Forest growth nationally has exceeded harvest since the 1940s. Today forest growth exceeds harvest by 40 percent and the volume of annual forest growth is four times greater than it was in 1920.
- Because forest growth exceeds harvest, the average standing volume of wood per hectare nation-wide is about 50 percent greater today than it was in 1952; in the eastern U.S., average volume per hectare has almost doubled.
- Populations of many wildlife species have increased dramatically since 1900. But some species, especially some having specialized habitat conditions, remain a cause for concern.
- Tree planting on all forestland rose dramatically after World War II, reaching record levels in the 1980s (Moulton and Hernandez 1999).

The favorable forest situation summarized above has been the result of some fortuitous events over the past 100 years, but also is the result of public policies aimed at protecting forests and improving the climate for

investments on private lands. Some of the primary factors include (but are not limited to):

1. Agricultural productivity per acre increased more rapidly than population, which reduced or eliminated the need for additional agricultural clearing;
2. Stable and well-defined institutional frameworks for land tenure and land rights systems, backed up by the rule of law (creating incentives for private investment in forestland);
3. Taxation and regulatory systems that recognized the long-term nature of investments in the forest sector (also improving incentives for private investment);
4. Strong and relatively consistent markets for forest products discouraged conversion to non-forestland uses;
5. Strong agricultural and forestry institutions supported information delivery at the national, state (provincial), and local levels including: a) research and extension on forest management, b) long-term commitment to forest inventory and assessment, and c) effective emergency response systems to address wildfire, insects, disease and other natural events; and
6. Increases in per capita income and other measures of economic strength and diversity encouraged investment in the forest sector and resulted in citizens that value forests for their non-timber and environmental benefits.

Stable and secure land tenure in the United States has encouraged investment on private lands to the extent that the majority of forest products are harvested on such lands. The risk is low that forest products in the United States contain any significant proportion of illegal wood. For the past three years, the U.S. has ranked in the top 10th percentile of countries for regulatory quality, rule of law, and control of corruption, helping to create a positive investment climate.

FOREST WILDLIFE TODAY

Several species of American wildlife became extinct as a result of forest changes and human uses during the 20th century, including the passenger pigeon, heath hen, and Carolina parakeet. An even larger number of subspecies and wildlife populations were substantially diminished.

Many of those species that were threatened with extinction in 1900, however, have come back in abundance. Due to actions that were set in motion in the early decades of this century, today most forest-wildlife species are both more abundant and more widespread than they were at the turn of the century. Many species which would have been on an endangered species list, had one existed in 1900, are now abundant. Examples include: wild turkey; beaver; egrets, herons, and many other wading birds; many species of shorebirds; wood ducks and several other species of ducks; whistling swans; Rocky Mountain elk, pronghorn, bighorn sheep, and black bear; and even white-tailed deer throughout most of its range. Many other species, although not actually on the brink of extinction in 1900, are today both more abundant and more widespread than they were in 1900. Since the 1930s, forest wildlife that can tolerate a relatively broad range of conditions (so-called “habitat generalists”) has increased. Most American forest-wildlife species are habitat generalists. This may be due to the natural dynamics of North American forests causing frequent disturbances in the natural regime (see Figures 17–20, pp. 38–39).

Some species abundant in forests prior to European settlement, particularly large predators and herbivores such as wolves, elk, and bison that need large home ranges, have not returned to large areas where they formerly were common. Yet, even many of these species have come back in areas large enough to accommodate their needs for a home range. But, while there have been many successes, problems remain. Some species with specialized habitat requirements are of concern today. Examples include:

- The red-cockaded woodpecker and gopher tortoise, both natives of fire-created southern pine savannas and woodlands.
- The Kirtland’s warbler, which lives in young jack pine forests of Michigan.
- The northern spotted owl, which occupies mature and old-growth forests in the West.

Some forest-wildlife species require active management of young forests for their survival, for example Kirtland’s warbler. Many other species need a mixture of forest and forest edge environments, including a wide variety of game and of non-game species. Some, like grizzly bears, wolves, elk, and forest interior birds, need large, contiguous areas of habitat. Some require old and ecologically diverse forest. Others, like the red-cockaded wood-

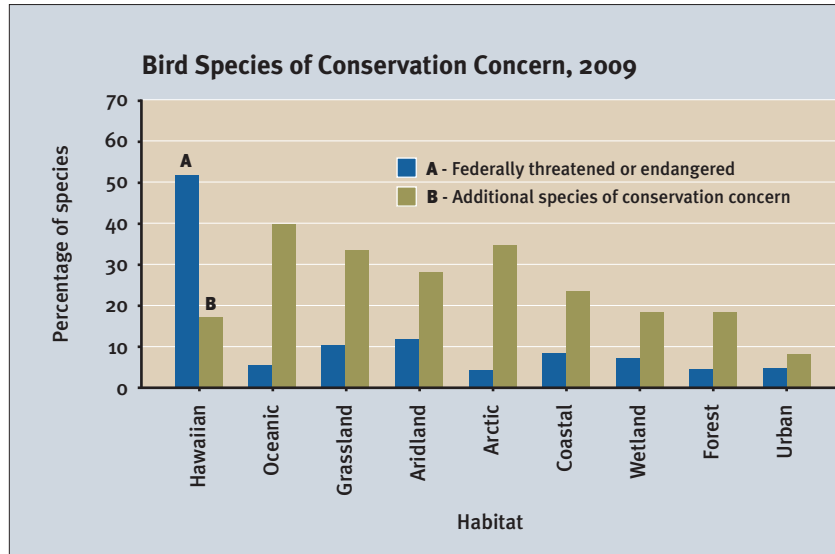


Figure 27. Percentage of bird species that are threatened, endangered, and of conservation concern by habitat. The United States is home to a tremendous diversity of native birds, with more than 800 species inhabiting terrestrial, coastal, and ocean habitats, including Hawaii. Among these species, 67 are federally listed as endangered or threatened. An additional 184 are species of conservation concern because of their small distribution, high threats, or declining populations. Forest birds have fared better overall than birds in other habitats.

pecker, need both mature forest and other specific habitat conditions, such as open savannas and woodlands created by frequent ground fires. Even the old-growth Douglas-fir forests in which the northern spotted owl lives are sub-climax forest types that will eventually move toward different forest conditions unless there are occasional, stand-replacing wildfires.

One measure of the ecological condition of U.S. forests is the population trends of bird species that depend on them. Both in terms of percentage of birds considered to be of conservation concern and population trends of birds dependant on forests, U.S. forests are in relatively good shape as compared to the other major habitat types (wetlands, arid lands, and grasslands). There are more bird species associated with forests than the other major habitat types combined.

Also, the population trends of forest birds has been stable or slightly increasing, while the populations of grassland and arid land birds has been

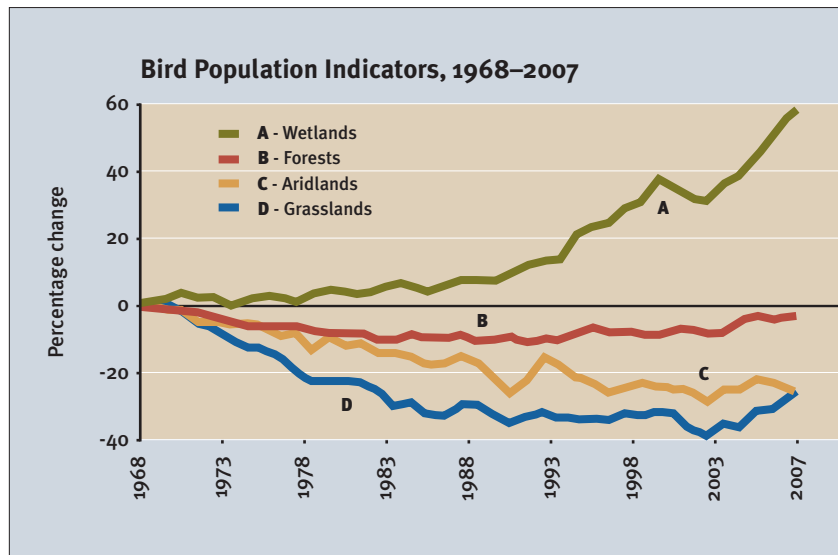


Figure 28. Bird population indicators based on trends for obligate species in four major habitats. The upward trend for wetland birds in the U.S. is a testament to the resilience of bird populations where the health of their habitat is sustained or restored. Population trends for grassland and arid land birds have shown dramatic declines while trends for forest birds has been stable or slightly increasing.

declining pretty dramatically. Populations of wetland birds have been increasing due to the ban on DDT and other conservation measures (Figure 28).

Figure 29 shows population trends of eastern, western, and boreal birds. Western birds are in better shape than eastern birds.

THREATS TO FORESTS TODAY

While an objective evaluation of the performance of conservation policies and practices since 1900 suggests some impressive gains, a variety of environmental trends are not positive and much work remains to be done. Problems include: 1) the rising loss and fragmentation of forests due to residential subdivision and urban development; 2) loss and deterioration of the forest and grassland habitats that once were created by frequent, low intensity fire; 3) the increasing impacts of climate change (increased wild-fire, insects and disease, and stresses on habitats and species); and 4) effects of air pollution on forests in some areas. Of particular concern are rare and

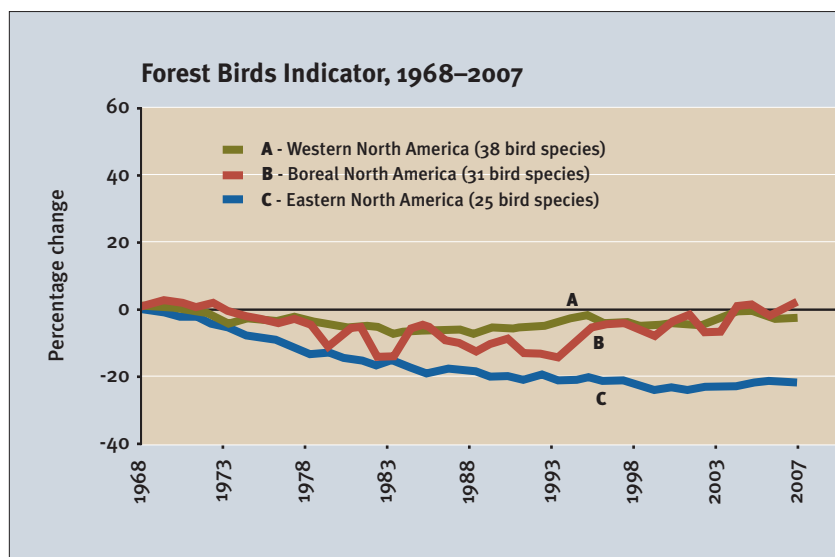


Figure 29. Population trends of eastern, western, and boreal North American birds. Eastern birds show the most significant change, declining steadily over the past 40 years and dropping nearly 25 percent since 1968. Trends for western and boreal birds declined and then showed a general increase recently. These figures are very dependent on the rigor and accuracy of monitoring efforts in each geographic range.

unique ecosystem types and species with specialized habitat requirements that are associated with them.

One significant general threat to forests is from introduced exotic plants, animals, and diseases. There is a long history of damage to forests from introduced biological agents, including white pine blister rust, chestnut blight, Dutch elm disease, gypsy moth and, more recently, hemlock wholly adelgid and the Asian long-horned beetle. Increasing world trade in forest products and of international trade generally only increases the opportunity for such introductions. Introduced exotic animals also pose a significant threat to displace and out-compete native wildlife species.

AMERICAN FORESTS: A TRANSFORMED HERITAGE

Today our forests represent a substantially transformed legacy—certainly in comparison to 1600. But our forests have also been substantially transformed since 1900, a dimension not commonly understood.

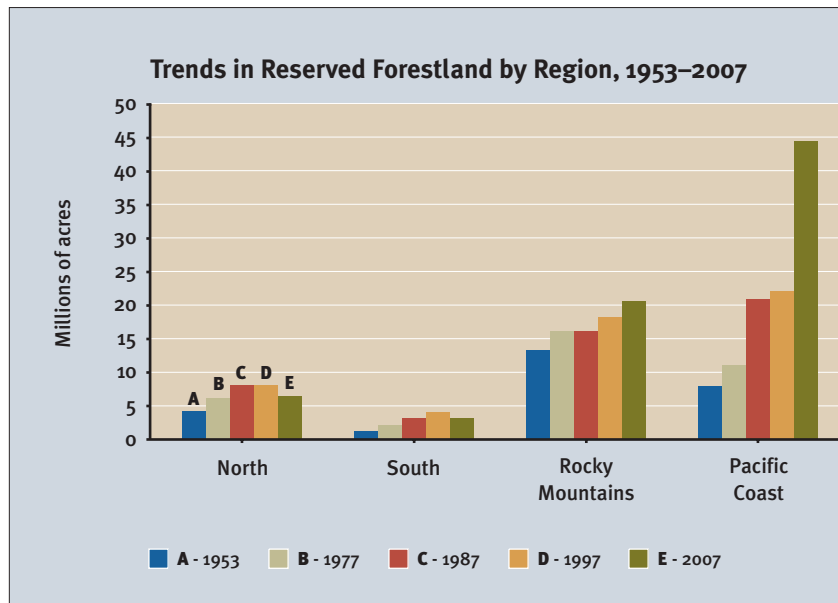


Figure 30. As personal incomes increased and the nation’s population became more urbanized and mobile, interest grew in setting aside land in parks, recreation areas, and reserves. In addition, the success of forest conservation practices began to demonstrate the nation’s ability to meet increasing wood product needs both from private and public lands. Consequently there has been a significant increase in the area of forestland set aside for amenity values in parks, wilderness areas, and similar designations under which timber harvest is prohibited.

Currently more than 74 million acres of forestlands have been so designated—almost three times what was set aside in 1953. This is an area about the size of Arizona. Withdrawals have centered in the Rocky Mountain and Pacific Coast regions, where the federal government is the largest forest landowner.

Attitudes about the nation’s forests have changed profoundly over the years. Native peoples viewed the forest in a spiritual context, but they also took a utilitarian approach and managed forests to serve their own ends. European Americans initially viewed forests both as an encumbrance to agriculture and as an inexhaustible resource. At first they used the forest—its wildlife, wood products, and land—to meet their subsistence needs for food and energy, much as the native population had done.

Later, the abundant wealth of the forests built the homes, cities, and transportation infrastructure of a growing nation. Lands previously occupied by forests were used to feed a rapidly increasing population.

More than a century ago, it became increasingly clear that old approaches were not sustainable. Americans began to view forests and wildlife not as products to be mined or foraged, but as resources that could be managed scientifically over the long term, yielding products and services without unduly disrupting the basic resource. We called this idea conservation.

As the nation's population has continued to urbanize, the principle of forest conservation for products and services has remained, but its role and scope have expanded. A few decades ago Americans started to view forests as attractive settings for outdoor recreation and as places for human spiritual renewal. Recently this view has evolved to a view of forests as ecosystems that support a complex web of life, of which humans are a part.

Although it is impossible to predict how the American view of forests may change in the future, the past provides information about how these forests came to be what they are today.

LESSONS OF THE PAST AND CHALLENGES FOR THE FUTURE

The U.S. population has more than tripled since 1900, and the standard of living is substantially higher. At the same time our forests and wildlife are, in most of their major dimensions, in significantly better condition today than they were a century ago.

American forests and wildlife have demonstrated a resilience and responsiveness to management undreamed of by conservationists at the turn of the century. These leaders were almost universally pessimistic about the future. Forest Service chief Gifford Pinchot and others predicted timber famine coupled with significantly increased wood product prices and consequent economic hardship. Wildlife leaders like William T. Hornaday predicted the imminent extinction of scores of species.

The timber famine never came; most species whose extinction was prophesied have since recovered and many are abundant today. Predictions by these early conservationists reflected what they felt was likely to occur if trends continued. Their words were a call-to-arms. Action was taken: new policies were debated and implemented. History has demonstrated that

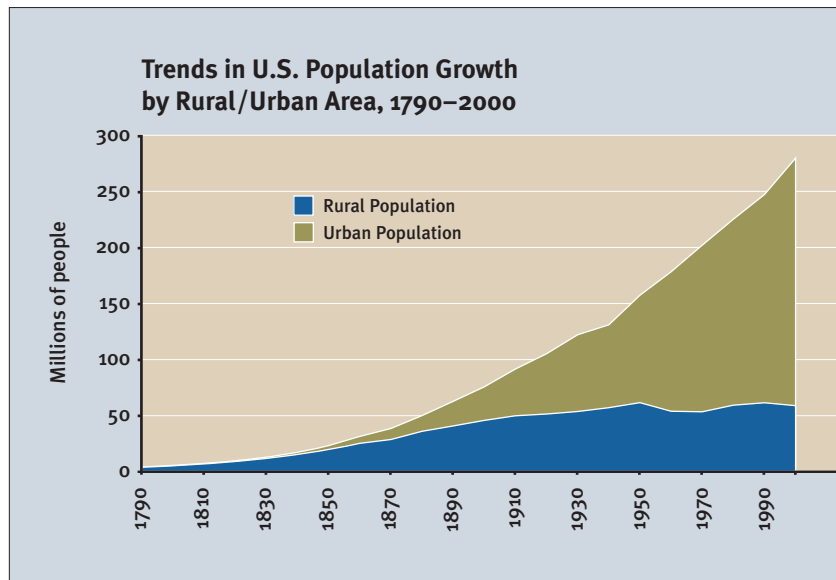


Figure 31. One of the most profound changes in American society in the 20th century has been its transition from a rural, agrarian society to an urban, industrialized nation. This change has been accompanied by a corresponding physical and psychological separation of its people from the land and resources that sustain them.

In a world of farms, forests, and small towns, the linkages between food and fields and between forests and home and hearth were clear and sustained by personal experience. In a world of cities and suburbs, of offices and air conditioning, these linkages have become more obscure, and for many people, virtually nonexistent. Yet today's urbanized society is no less dependent upon the products of its forests and fields than were the subsistence farmers of America's past.

these policies, coupled with the natural resilience of the resource, have caused forests and their wildlife to come back.

In addition to policy, certain actions and conditions unforeseen by early conservation leaders have also been important to the improved condition of forest and wildlife resources. One, of course, was resiliency; even projections by forestry experts have consistently underestimated forest growth. Wildlife specialists have also been surprised at the recovery rates of many species, once placed under protection and management.

Another action was consumers' conversion from wood energy to fossil fuels, relieving American forests of that burden as population grew. Indirectly, use of fossil fuels in internal combustion engines substantially reduced pressure to clear forestland for agriculture because it released millions of acres of cropland to grow food for humans rather than for draft animals. Petroleum was also the base for fertilizers and pesticides that substantially increased agricultural productivity after 1930.

American forests have been principal beneficiaries of the remarkable improvement in agricultural productivity over the last half century. The inexorable, three-century-long conversion of U.S. forests to farmland largely halted in the 1920s. Today less area is devoted to cropland than in 1920, despite an almost three fold increase in the nation's population. On top of this, U.S. farmers feed, through exports, the equivalent of more than one hundred million people throughout the world.

Finally, a factor unrecognized by early conservation leaders was the effect that increasing prices for wood products would have in encouraging reduced consumption and increased supply. Real price increases for wood created incentives for efficient use, including less left behind after logging, better utilization by sawmills, and more efficient use in end-product applications through improved engineering, protection from rot through preservative treatment, and similar measures. Price increases also encouraged use of substitutes for wood, such as steel and concrete. These market responses were the primary reason that wood consumption did not rise after 1910 as it had in previous decades. Projections of impending shortages were based on assumptions that such past trends would continue.

But there are still significant issues and controversies surrounding management of U.S. forests. In recent years the growing urbanization, affluence, and mobility of Americans has caused a virtual revolution in the expectations and demands that the public places on forests. Some of these demands are in direct conflict with traditional forest values and uses.

In the last decade, the debate between people advocating the use and management of forests for commodity products and people wanting to minimize human influences and emphasize amenity values (particularly on public forests) has become increasingly shrill and divisive. Utilitarian use of the forest for commodities versus its protection for amenity and natural values are often viewed as irreconcilably in conflict and on a personal

level, or when the focus is on an individual parcel of land, they frequently are. Yet, in a larger sense and scale, they are not only compatible; indeed, they are inextricably linked.

It is a measure of the success of its past conservation policies that the United States has the forest abundance that allows it the capacity, unique to only a handful of other nations, to consider such choices. But as always, there are limits to such choices. Society remains dependent on forests for a wide variety of economic products. Indeed, on a wood volume basis utilization of the forest for products has never been higher.

On a tonnage basis, the U.S. consumption of wood products in 2005 was 62 percent of the total weight of most other materials combined—steel, aluminum, plastics, and cement. Because of this, society's ability to continue to provide for the amenity side of the conservation spectrum will in no small part depend upon how much attention is paid to the commodity side as well.

As human population increases and demands on natural resources grow, the challenge for society and its land managers is to find ways to realize both commodity products and amenity values from the same area of forest. This increasingly must become the dual focus for the concept of land stewardship and forest sustainability.

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ABOUT THE AUTHOR

Douglas W. MacCleery is a professional forester who has worked in natural resource management at both the field and policy levels. He retired from the U.S. Forest Service in April 2010.

MacCleery has bachelor's and master's degrees in forestry from Michigan State University. He spent his early career in northern California as a field forester for the Forest Service where he assisted in the multiple purpose management of the national forests for timber production, recreation, wildlife management, livestock grazing, and watershed protection.

He then left the Forest Service for experience in the private sector, taking a position as a forest policy analyst for the National Forest Products Association in Washington, DC.

Between 1981 and 1987, MacCleery was deputy assistant secretary for natural resources and the environment in the U.S. Department of Agriculture, a position in which he had oversight of the Forest Service and Soil Conservation Service (now the Natural Resources Conservation Service).

In 1987 MacCleery returned to the Forest Service in Washington, DC. His work in the headquarters office of the Forest Service focused on writing about the historical evolution of forests and forest policy in the United States, as well as in evaluating and promoting forest policy reforms in the U.S. Forest Service and the U.S. forest sector in general. He has compiled a history of how U.S. forests have changed from pre-colonial times to the present. The focus is on how the relationship between humans and their forests has evolved over the years, on how the deteriorating forest and wildlife situation at the end of the 19th century led to the first national environmental movement, on the policies that emerged from that movement to address forest and wildlife depletion, and on how the forest and wildlife situation has changed since 1900 in response to those policies and to other factors.

The idea behind the history, which focuses on forests, agriculture, and wildlife, is that informed choices about the future of our forests and wildlife should be based in part on knowledge of how they came to be what they are today.

The forest debate continues...

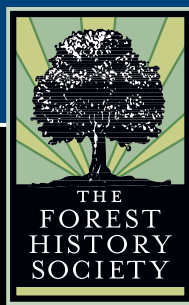
For more than a century, Americans have carried on a debate about the purpose of their forests, and the sometimes-heated discussions continue today. In his updated version of *American Forests: A History of Resiliency and Recovery*, Douglas W. MacCleery traces this debate from the time that forest management first came to the United States and became the center of the conservation movement to the present.

MacCleery's history of recovery establishes that the "timber famine" that Theodore Roosevelt and Gifford Pinchot so stridently forecast in the early 20th century never occurred. He shows that logged lands have come back, either through natural processes or by human effort, unless converted to agricultural or urban use. Also, many species of wildlife—once dwindled—are again abundant, forested watersheds are better protected, and the number of forest acres that burn each year has been dramatically reduced.

Nonetheless, as MacCleery points out, the new forests are different from the original forests, which had evolved according to nature's rhythms and in response to native peoples' significant manipulation. And while some wildlife species thrive under the new conditions, others do not. Appreciation of the forest as an ecosystem increases, but the debate continues.

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