SAMPLE

Earth's Dynamic Systems: Forests

The Lungs of the Planet

Aira Astralis

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Conclusion

This free sample contains the Introduction and Chapter 1. The complete book contains the full contents above.

Introduction

A forest is an ecosystem characterized by a dense community of trees. Hundreds of definitions of forest are used throughout the world, incorporating factors such as tree density, tree height, land use, legal standing, and ecological function.

The United Nations' Food and Agriculture Organization (FAO) defines a forest as, "Land spanning more than 0.5 hectares with trees higher than 5 meters and a canopy cover of more than 10 percent, or trees able to reach these thresholds in situ.

It does not include land that is predominantly under agricultural or urban use."

Using this definition, Global Forest Resources Assessment 2025 found that forests covered 4.14 billion hectares (10.2 billion acres; 41.4 million square kilometres; 16.0 million square miles), or approximately 31 percent of the world's land area in 2025. Forests are the largest terrestrial ecosystems of Earth by area, and are found around the globe.

45 percent of forest land is in the tropical latitudes.

The next largest share of forests are found in subarctic climates, followed by temperate, and subtropical zones. Forests account for 75% of the gross primary production of the Earth's biosphere, and contain 80% of the Earth's plant biomass. Net primary production is estimated at 21.9 gigatonnes of biomass per year for tropical forests, 8.1 for temperate forests, and 2.6 for boreal forests.

Forests form distinctly different biomes at different latitudes and elevations, and with different precipitation and evapotranspiration rates.

These biomes include boreal forests in subarctic climates, tropical moist forests and tropical dry forests around the Equator, and temperate forests at the middle latitudes. Forests form in areas of the Earth with high rainfall, while drier conditions produce a transition to savanna. However, in areas with intermediate rainfall levels, forest transitions to savanna rapidly when the percentage of land that is covered by trees drops below 40 to 45 percent.

The chapters that follow trace the story of forests from their Devonian origins and the slow evolution of the modern forest, through their classification, structure, and functioning, to the ways people measure and manage them today, the challenges they face from a changing climate, and what the future may hold.

Most deforestation today occurs in tropical forests. The vast majority of this deforestation is because of the production of four commodities: wood, beef, soy, and palm oil. Over the past 2,000 years, the area of land covered by forest in Europe has been reduced from 80% to 34%.

Chapter 1: The Discovery of Forests

The first known forests on Earth arose in the Middle Devonian (approximately 390 million years ago), with the evolution of cladoxylopsid plants like Calamophyton. Appeared in the Late Devonian, Archaeopteris was both tree-like and fern-like plant, growing to 20 metres (66 ft) in height or more. It quickly spread throughout the world, from the equator to subpolar latitudes.

It is the first species known to cast shade due to its fronds and forming soil from its roots.

Archaeopteris was deciduous, dropping its fronds onto the forest floor, the shade, soil, and forest duff from the dropped fronds creating the early forest. The shed organic matter altered the freshwater environment, slowing its flow and providing food. This promoted freshwater fish. Taken together, the world's forests hold the greatest share of the planet's living plant material of any land ecosystem, and their biomass per unit area is high compared to other vegetation communities.

The next great chapter of forest history came in the Carboniferous period, roughly 359 to 299 million years ago, when vast swamp forests of giant clubmosses, horsetails, and ferns spread across the lowlands of what is now Europe and North America. Because few organisms had yet evolved the ability to digest lignin, the dead trunks of these forests accumulated instead of decaying, and over millions of years they were buried and compressed into the coal seams that gave the period its name.

The forests we would recognize today took shape much later. Flowering plants appeared in the Cretaceous period and diversified rapidly, and by the start of the Cenozoic era, around 66 million years ago, forests dominated by modern tree families - oaks, willows, maples, and palms among them - had spread across the tropics and mid-latitudes, while conifers held the colder and drier ground. Grasslands expanded in drier regions during the past 20 million years, pushing forests into the areas where climate still favored them, which is broadly the pattern that exists today.

The word forest derives from the Old French forest (also forès), denoting "forest, vast expanse covered by trees"; forest was first introduced into English as the word denoting wild land set aside for hunting without necessarily having trees on the land.

Possibly a borrowing, probably via Frankish or Old High German, of the Medieval Latin foresta, denoting "open wood", Carolingian scribes first used foresta in the capitularies of Charlemagne, specifically to denote the royal

hunting grounds of the king.

The word was not endemic to the Romance languages, e.g., native words for forest in the Romance languages derived from the Latin silva, which denoted "forest" and "wood(land)" (cf. Cognates of forest in Romance languages—e.g., the Italian foresta, Spanish and Portuguese floresta, etc.--are all ultimately derivations of the French word. The precise origin of Medieval Latin foresta is obscure.

Some authorities claim the word derives from the Late Latin phrase forestam silvam, denoting "the outer wood"; others claim the word is a Latinisation of the Frankish forhist, denoting "forest, wooded country", and was assimilated to forestam silvam, pursuant to the common practice of Frankish scribes.

Uses of forest in English to denote any uninhabited and unenclosed area are presently considered archaic.

The Norman rulers of England introduced the word as a legal term, as seen in Latin texts such as Magna Carta, to denote uncultivated land that was legally designated for hunting by feudal nobility (see royal forest). These hunting forests did not necessarily contain any trees. Because that often included significant areas of woodland, "forest" eventually came to connote woodland in general, regardless of tree density.

By the beginning of the fourteenth century, English texts used the word in all three of its senses: common, legal, and archaic. Other English words used to denote "an area with a high density of trees" are firth, frith, holt, weald, wold, wood, and woodland. Unlike forest, these are all derived from Old English and were not borrowed from another language.

Some present classifications reserve woodland for denoting a locale with more open space between trees, and distinguish kinds of woodlands as open forests and closed forests, premised on their crown covers. Finally, sylva (plural sylvae or, less classically, sylvas) is a peculiar English spelling of the Latin silva, denoting a "woodland", and has precedent in English, including its plural forms.

While its use as a synonym of forest, and as a Latinate word denoting a woodland, may be admitted; in a specific technical sense it is restricted to denoting the species of trees that comprise the woodlands of a region, as in its sense in the subject of silviculture. The resorting to sylva in English indicates more precisely the denotation that the use of forest intends.

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ABOUT THE AUTHOR

Aira Astralis is a science writer specializing in astronomy and space exploration. Her work spans the full breadth of humanity's relationship with the cosmos -- from the earliest naked-eye observations to the engineering marvels of modern space missions.

Her books are built on a foundation of primary sources: peer-reviewed research, mission archives, and direct engagement with the scientific community. She writes for readers who want to understand not just what we know about the universe, but how we came to know it.

She believes that the most important frontier is not out there but in the gap between what scientists discover and what the public understands. Her books exist to close that gap.