2024 Louisiana Envirothon Forestry Study Guide

Introduction

Plant communities shape our world. Forests comprise 30.8 percent of global land area (Food and Agriculture Organization of the United Nations, 2020), while grasslands and rangelands make up approximately 50 percent of Earth's terrestrial surface (National Institute of Food and Agriculture, USDA). Humans rely on the biodiversity of forests for many services, including timber for homes, wood pulp for paper, biochemical models for future medications, recreation, aesthetic beauty, and countless others. Grasslands and rangelands are home to unique species such as bison and prairie dogs, and they provide fertile land to grow our crops and to raise livestock that are critical to feeding the world's human population. A good understanding of plant biology, forest and grassland ecology, and human impacts to these ecosystems will help to inform good management practices to conserve these areas for future generations.

1. Louisiana Forestry Guide: Forest Ecology

***Biodiversity*:** Louisiana's forests are home to a rich diversity of plant and animal species, many of which are unique to the region. Forests support a complex ecosystem that provides habitat for various wildlife, including endangered and threatened species.

Carbon Sequestration: Forests play a crucial role in mitigating climate change by absorbing carbon dioxide from the atmosphere through photosynthesis. Trees store carbon in their biomass, helping to reduce greenhouse gas emissions and combat global warming.

Water Quality and Watershed Protection: Forests act as natural filters, purifying water as it moves through the ecosystem. They help prevent soil erosion, reduce runoff, and improve water quality by trapping sediments and absorbing pollutants. Healthy forests contribute to the protection of watersheds, ensuring a clean and reliable water supply for communities.

Timber and Forest Products: Louisiana's forests are a valuable source of timber and forest products, supporting the state's economy. The timber industry provides employment opportunities and contributes to the production of lumber, paper products, furniture, and more.

Recreation and Tourism: Forests offer numerous recreational opportunities for outdoor enthusiasts. Activities such as hiking, camping, birdwatching, hunting, and fishing attract visitors, boosting tourism and local economies. Forests also provide scenic beauty and a tranquil environment for relaxation and appreciation of nature.

Cultural and Historical Significance: Forests hold cultural and historical significance for Louisiana's indigenous peoples and have been an integral part of their traditions and livelihoods for centuries. Preserving forests, helps protect cultural heritage and maintain connections to the past. ***Flood***

Mitigation and Coastal Protection: Forests act as natural buffers against flooding, absorbing excess water and reducing the risk of downstream flooding. In Louisiana's coastal areas, forests provide protection against storm surges and help stabilize the soil, contributing to coastal resilience.

2. **Key Tree Species in Louisiana-Search online for additional photos or view this** Leaf Key Guide.

Bald Cypress (Taxodium distichum): Known for its distinctive "knees" and its ability to thrive in wetland environments, the bald cypress is an iconic tree in Louisiana's swamps and bottomland forests.

Southern Pine Species: Louisiana has several pine species, including:

Loblolly Pine (Pinus taeda): A fast-growing pine that is widely distributed throughout the state and commonly used in the timber industry.

Longleaf Pine (Pinus palustris): Historically, longleaf pine dominated the landscape in Louisiana. These fire-adapted pines are known for their long needles and are valued for their timber, as well as their ecological importance.

Slash Pine (Pinus elliottii): Found in wetter areas, slash pine is valued for its timber and is often used in reforestation efforts.

Oak Species: Louisiana has various oak species, including:

Southern Red Oak (Quercus falcata): A large deciduous oak tree with distinctive lobed leaves that turn red in the fall.

White Oak (Quercus alba): Recognized for its light-colored bark and rounded leaves, white oak is highly valued for its durable wood.

Water Oak (Quercus nigra): Commonly found in bottomland areas, the water oak is known for its ability to tolerate wet soils.

Other Tree Species:

Sweetgum (Liquidambar styraciflua): Recognizable for its star-shaped leaves and spiky fruit balls, sweetgum is a hardwood species commonly found in Louisiana's forests.

American Beech (Fagus grandifolia): A large deciduous tree with smooth gray bark and distinctive serrated leaves, the American beech is found in upland hardwood forests of Louisiana.

Tulip Poplar (Liriodendron tulipifera): Also known as yellow poplar, this fast-growing tree with tulip-shaped flowers can be found in some areas of Louisiana, particularly in the northern parts of the state.

Black Tupelo (Nyssa sylvatica): Also called black gum or sour gum, this tree is known for its brilliant fall foliage and is found in both upland and wetland environments.

3. Geographic Information System (GIS)

GIS stands for Geographic Information System. It is a technology that allows for the capture, storage, analysis, and visualization of geospatial data. It combines geographic data (such as maps and satellite imagery) with attribute data (such as population statistics or land cover types) to provide valuable insights and support decision-making.

In forestry, GIS has several applications.

- ***Forest Inventory and Management***: GIS can be used to conduct forest inventories by integrating data from remote sensing, field surveys, and historical records. This helps in assessing forest resources, including tree species, age classes, density, and health. GIS can also assist in managing forests by modeling growth patterns, calculating timber volumes, and planning sustainable harvesting activities.
- ***Forest Planning and Landscape Analysis***: GIS enables the analysis of various factors that influence forest management decisions. It can help identify suitable locations for new plantations or restoration efforts based on factors like soil type, slope, and proximity to water sources. GIS can also assess the impact of land use changes or natural disturbances on forest ecosystems, facilitating land-use planning and conservation effort.
- ***Mapping and analyzing geographic (spatial) information***: locating endangered species habitat, forest cover typing, locating ecologically sensitive land types, ownership boundaries, transportation or facilities siting, capability analysis (including insect/disease potential, watershed condition, erosion potential)

4. What does it take to be a good urban forester?

Urban forestry is a specialized branch of forestry which is multi-managerial in nature involving forests, watersheds, wildlife, outdoor recreation, landscape esthetics, individual tree care, waste recycling, and wood production. It encompasses many disciplines other than traditional forestry, including arboriculture, horticulture, plant pathology, landscape architecture, entomology, community planning and development, and political science.

- ***Urban Planning and Design***: Understanding urban planning principles, land use regulations, and design concepts is crucial for urban foresters. This knowledge helps them integrate trees and green spaces effectively into urban environments, considering factors like urban heat island mitigation, tree canopy cover, pedestrian connectivity, and urban development patterns. It also allows them to collaborate with urban planners and architects to create sustainable and aesthetically pleasing urban landscapes.
- ***Urban Ecology and Biodiversity***: Urban environments pose unique challenges for maintaining healthy ecosystems. Additional education in urban ecology equips urban foresters with the knowledge of how urbanization impacts biodiversity, ecological processes, and wildlife habitats. It helps them identify strategies to enhance biodiversity and promote ecological resilience in urban areas, such as selecting appropriate tree species, creating urban wildlife corridors, and managing invasive species.
- ***Community Engagement and Urban Forest Advocacy***: Urban foresters often work closely with diverse communities, stakeholders, and local governments. Developing skills in community

engagement, public outreach, and advocacy can greatly enhance their ability to communicate the benefits of urban forests effectively. Additional education in these areas can help urban foresters build strong relationships with community members, raise awareness about the importance of trees, and foster community participation in urban forest planning and stewardship initiatives.

5. Invasive Species in Louisiana

Louisiana is affected by several invasive plant species that have had significant impacts on the local area. Here are a few examples:

Chinese Tallow Tree (Triadica sebifera): The Chinese tallow tree was introduced to Louisiana as an ornamental plant. It spreads rapidly and outcompetes native vegetation, forming dense stands that reduce biodiversity. It also has allelopathic properties, releasing chemicals that inhibit the growth of other plants. This invasive tree negatively impacts wetlands, prairies, and forests in Louisiana.

Giant Salvinia (Salvinia molesta): Giant salvinia is a free-floating aquatic fern that can cover water bodies, choking out native plants and disrupting aquatic ecosystems. It forms thick mats that impede water flow, reduce oxygen levels, and block sunlight, affecting fish populations and other aquatic organisms. It was likely introduced to Louisiana through the aquarium trade or as a hitchhiker on boats.

Chinese Privet (Ligustrum sinense): Chinese privet is a shrub that forms dense thickets in forests, wetlands, and disturbed areas. It outcompetes native vegetation, reducing biodiversity and altering habitat structure. It can also impact wetland hydrology and disrupt natural fire regimes. Chinese privet was introduced to Louisiana as an ornamental plant and has since spread through seed dispersal by birds and small mammals.

Hydrilla (Hydrilla verticillata): Hydrilla is an aggressive aquatic plant that forms dense mats in lakes, ponds, and slow-moving water bodies. It can crowd out native submerged vegetation, reduce water flow, and impede recreational activities like boating and fishing. Hydrilla was likely introduced to Louisiana through the aquarium trade or as a contaminant in boat hulls and equipment.

Air Potato (Dioscorea bulbifera): Air potato is a vine that can climb and smother native vegetation, negatively impacting forests, wetlands, and disturbed areas. It reproduces through bulbils (small tubers) that drop to the ground and sprout new plants. Air potato was introduced to Louisiana as an ornamental plant, and its spread is facilitated by the dispersal of bulbils by humans, animals, and water.

Japanese Climbing Fern (Lygodium japonicum): Japanese climbing fern is a fast-growing vine that can smother and outcompete native plants, particularly in wetland and riparian areas. It forms thick mats that alter habitat structure and reduce light availability. The fern was likely introduced to Louisiana as an ornamental plant and has since spread through spore dispersal by wind, water, and human activities.

These invasive plant species are introduced through various pathways, including intentional planting for landscaping or gardening, accidental escape from cultivation, or as contaminants in agricultural or horticultural products. Once established, they can spread rapidly and disrupt local ecosystems and understory, displacing native species, reducing biodiversity, and impacting the natural functions of the environment.

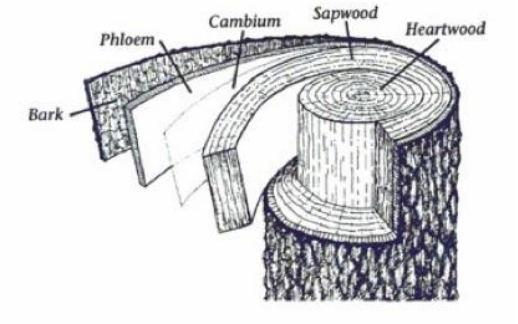
Management strategies for invasive plant species in Louisiana involve early detection and rapid response, manual or mechanical removal, herbicide application, and biological control methods, monitoring programs, public education. These efforts aim to prevent further spread and minimize the ecological and economic impacts caused by these invasive plants.

6. Dominant, Co-dominant, Intermediate, and Suppressed

In forestry, the terms dominant, co-dominant, intermediate, and suppressed are used to describe the vertical position and competitive status of trees within a stand. Here are their descriptions:

- ***Dominant:*** Dominant trees are the tallest, largest, and healthiest trees in a forest stand. They typically have well-developed crowns and receive abundant sunlight from above. Dominant trees have a competitive advantage over other trees, allowing them to access more resources, such as light, nutrients, and water. They play a significant role in shaping the structure and growth of the forest.
- ***Co-dominant:*** Co-dominant trees are the next in line in terms of height and size within a stand. They are typically smaller than dominant trees but still have well-formed crowns and receive a substantial amount of sunlight. Co-dominant trees have a similar competitive status to dominant trees, but they may be slightly overshadowed or have less access to resources. They contribute to the overall canopy structure and form an intermediate layer between the dominant and intermediate/suppressed trees.
- ***Intermediate:*** Intermediate trees are smaller in size and height compared to dominant and co-dominant trees. They may have a less well-developed crown and receive less sunlight due to competition from taller trees. Intermediate trees often grow in the understory, benefiting from some light filtering through the canopy. They are in a transitional stage, with the potential to grow and become co-dominant or remain suppressed depending on changes in resource availability.
- ***Suppressed:*** Suppressed trees are the smallest and weakest in a forest stand. They are unable to reach the upper canopy and receive limited sunlight due to competition from taller trees. Suppressed trees often have stunted growth, reduced crown development, and may be shaded by the dominant and co-dominant trees. They struggle to access resources and face challenges in reaching their full growth potential.

7. Tree Anatomy



(Anatomy of Tree Trunk)

- ***Bark*** -Protects the tree from pests, diseases, etc.
- ***Cambium*** – A layer of living tissue that forms new cells
- ***Heartwood*** – Provides support and strengthens the tree
- ***Phloem (sapwood)-*** Moves glucose from the leaves to the rest of the tree and roots
- ***Xylem***- Carries nutrients and water from the roots to the crown of the tree
- **Crown**- The crown, which consists of the leaves and branches at the top of a tree, plays an important role in filtering dust and other particles from the air. It also helps cool the air by providing shade and reduces the impact of raindrops on the soil below.

- ***Roots*** - A tree's roots absorb water and nutrients from the soil, store sugar and anchor the tree upright in the ground
- ***Trunk/Stem*** - The trunk, or stem, of a tree supports the crown and gives the tree its shape and strength. The trunk consists of four layers of tissue. These layers contain a network of tubes that runs between the roots and the leaves. These tubes carry water and minerals up from the roots to the leaves, and they carry sugar down from the leaves to the branches, trunk, and roots.

8. Silviculture

Silviculture is the practice of managing and cultivating forests to achieve specific objectives, such as timber production, wildlife habitat preservation, or ecosystem restoration. It involves the application of various techniques and principles to guide forest growth, regeneration, and stand development over time.

Here are descriptions of several silviculture practices:

- ***Clear-cutting:*** Clear-cutting is a method where all or nearly all trees within a designated area are harvested simultaneously. This practice involves removing the entire stand, leaving a relatively open space. Clear-cutting is often used for regenerating shade-intolerant tree species or for creating conditions suitable for early successional vegetation. It can facilitate even-aged stand development.
- ***Group selection:*** Group selection involves the removal of small groups of trees within a stand, creating openings while retaining some mature trees. These openings promote the establishment of shade-tolerant species and encourage a more diverse age structure. Group selection can be used to mimic natural disturbances and facilitate natural regeneration processes while maintaining some older trees for structural diversity.
- ***Single-tree selection:*** Single-tree selection, also known as selective cutting, involves the removal of individual trees scattered throughout the stand, usually based on their size, quality, or species. This practice maintains a multi-aged stand structure and allows for continuous timber production while retaining some mature trees. Single-tree selection can provide a more sustainable harvest approach and promote the development of diverse forest habitats.
- ***Seed tree:*** Seed tree is a method where a few mature, high-quality trees are left standing in a harvested area to provide a seed source for natural regeneration. The seed trees are carefully selected based on their ability to produce viable seeds and represent desirable genetic traits. Once natural regeneration occurs, the seed trees are typically removed, allowing the new cohort of trees to develop.
- ***Shelterwood:*** Shelterwood is a two or three-stage method used to establish new stands. In the first stage, a partial harvest is conducted, leaving a sufficient number of mature trees to provide shelter and shade for the regeneration of desirable tree species. In the subsequent stages, additional trees are gradually removed, allowing for increased light availability and the establishment of the new generation of trees. Once the new cohort is well-established, the remaining mature trees are harvested.

9. Factors that determine forest type:

Elevation, topography (slope), annual rainfall, soil type/depth, exposure to elements (harsh weather)

- ***Climate:*** Climate plays a significant role in determining forest type. Factors such as temperature, precipitation, and seasonality influence the distribution of different tree species and vegetation types. For example, tropical rainforests thrive in warm and wet climates, while coniferous forests are typically found in colder regions with ample precipitation.
- ***Soil Characteristics:*** Soil properties, including nutrient content, drainage, pH level, and texture, affect the types of trees that can grow in a particular area. Different tree species have varying soil requirements, such as acidic or alkaline soil, well-drained or poorly drained soil, or specific nutrient preferences. The soil composition and fertility shape the forest type and influence the growth and health of trees.
- ***Topography***: The physical features of the land, including elevation, slope, aspect, and water availability, impact forest type. For instance, mountainous regions may have different forest types at varying elevations, with different species adapting to different temperature and moisture conditions. Slope and aspect influence sunlight exposure and moisture availability, affecting the types of trees that can thrive in a particular area.

10. Forestry/ Urban Forestry Tools

Chainsaw	Clinometer	Densitometer	Drip Torch
			
Handheld Compass	**Increment Borer**	**Logger Tape**	**Staff Compass**
			

- ***Chainsaw-*** a portable mechanical saw used for trees, limbs, and performing various other tasks related to tree removal and timber harvesting
- ***Clinometer-*** a handheld device used to measure the angle of slope or inclination
- ***Densitometer***- Used for measuring the density of canopy cover
- ***Drip torch-*** Used to ignite fuels as part of a prescribed burn or wildfire operations to burn out vegetative fuel
- ***Handheld Compass***- a navigation tool used to determine direction and orientation. Used to navigating through the forest, taking bearings, and mapping
- ***Increment Borer-*** Used to take core samples to determine the rate of a tree's radial growth and its age
- ***Loggers Tape***- also known as forestry tape, is a measuring tool used to measure tree diameter and tree heights. Provides accurate and standardized measurements for forest inventory and timber estimation
- ***Staff Compass***- also known as a sighting compass, is a tool used to measure horizontal angles and directional measurements, such as determining azimuths, bearings, or angels between objects. Useful for mapping and boundary delineation.

11. Diameter at Breast Height (DBH) is the stem diameter of a tree 1.3 meters above the ground measured from the uphill side of the stem. In the United States, DBH is measured at 4.5 feet. (NCF Envirothon)

Why Measure at DBH?

- It provides a convenient point of measurement
- It provides a less fatiguing point of measurement
- It is a uniform point of measurement
- It has been accepted as a world standard
- DBH is normally high enough above the ground to avoid erratic taper resulting from root and butt deformities
- DBH is usually above the snow in the winter, but winter does present a challenge to accurately locate DBH

With the definition of DBH, it would seem the issue of where to measure diameters has been simply solved. However, the first time one heads to the field to measure tree diameters, it is likely that the technologist will run into some trees that pose a challenge to measure at DBH. (NCF Envirothon)

Please watch this short tutorial on measuring DBH: https://youtu.be/Vy2Lgg0_pqE

12. Forest Health

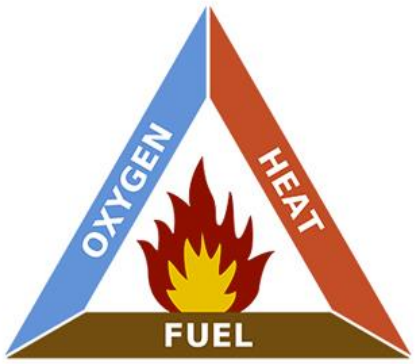
"Forest health has been defined by the production of forest conditions which directly satisfy human needs and by resilience, recurrence, persistence, and biophysical processes which lead to sustainable ecological conditions." (USDA).

Forest Fires

Fire is a natural part of many forest ecosystems, occurring in regular intervals that vary depending on the forest type, forest understory, climate, soil type, and other factors. Natural forest fires are typically started by lightning during the warm and dry seasons, which range from the snowmelt period in spring through the fall. Historically, since these lightning-caused fires occurred at regular intervals, they were successful in clearing out old, dead, and/or decaying vegetation bit by bit. Old vegetation was continually being recycled into new growth. When these types of fires are suppressed, the result is a build-up of fuel. Over a period of years, more and more fuel accumulates, setting the stage for a catastrophic event,

One of the ways to safely balance the role of fire with the encroachment of people and structures into forestland is through prescribed fire. Prescribed fire is when forest managers purposely set a fire to reduce fuel loads or obtain some other management objective. They are only undertaken during optimal weather conditions and with the utmost safety protocols in place. Prescribed fire is a tool that allows forest managers to mimic the historic benefits of wildfire, while maintaining a safer, more controlled strategy. (Michigan State University Extension)

Fire Triangle



Fire Management

Fire Suppression - "Suppression involves extinguishing a wildfire, preventing or modifying the movement of unwanted fire, or managing a fire when it provides benefits like vegetation reduction or improved wildlife habitat. Firefighters control a fire's spread by removing one of three ingredients a fire needs to burn: heat, oxygen, or fuel." (USDI)

Prescribed Burning - "Trees are stressed by overcrowding; fire-dependent species disappear; and flammable fuels build up and become hazardous. Reduces hazardous fuels, protecting human communities from extreme fires; Minimizes the spread of pest insects and disease; Removes unwanted species that threaten species native to an ecosystem; Provides forage for game; Improves habitat for threatened and endangered species; Recycles nutrients back to the soil; and Promotes the growth of trees, wildflowers, and other plants" (USDA)

Forest Fragmentation - a loss of forest and the division of the remaining forest into smaller blocks. Several scientific studies indicate that forest fragmentation can lead to increased fire occurrence, forest fragmentation can also lead to a loss conservation and biodiversity loss (Forest Fragmentation, Kurt Ritters 2007)

What are the major causes of wildfires in your state?
Wildfires are broken into different regions:

- **Southern** - Arson 55% debris---20%
- **Pacific** - lightning 58% arson-12%
- **Rocky** - lightning 29% equipment 19%
- **Eastern** - Arson 49% Miscellaneous 11%
- **North Central** - Arson 38% Debris 20%