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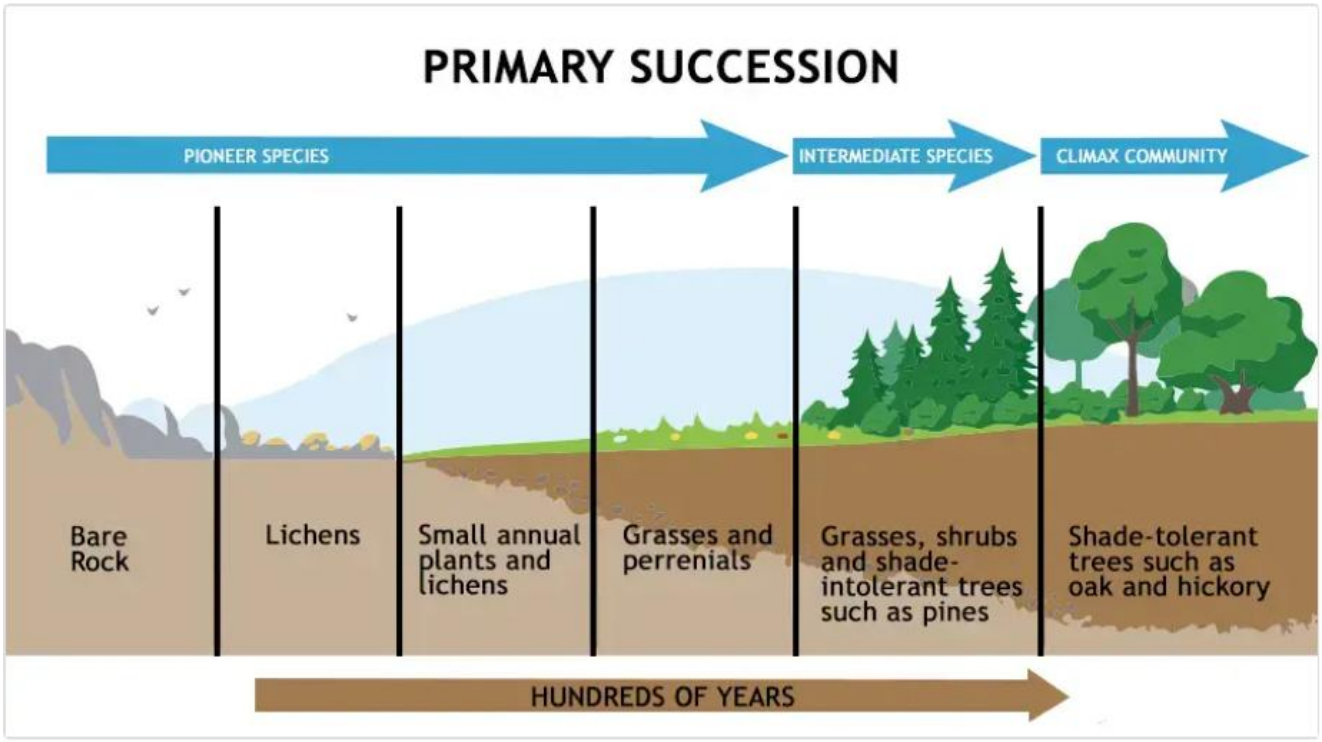
UNIT GUIDE 2023-24

2. Understand woodland structure and how a woodland develops

2.1. Define a minimum of two successional stages related to woodland development

Here are two successional stages related to woodland development:

1. Pioneer Stage /**Primary Succession**
This is the initial stage of woodland development, occurring on bare ground or disturbed areas. The presence of small, fast-growing plants like grasses, herbs, and lichens characterizes it. These pioneer species help to stabilize the soil and prepare it for future growth.



Pioneer Stage of woodland development https://biologynotesonline.com/ecological-succession/

Key Processes
Soil Stabilization: Pioneer plants bind the soil with their roots, preventing erosion and creating a more suitable environment for other plants.
Nutrient Enrichment: These plants add organic matter to the soil through their decomposition, improving its fertility.
Shade Creation: As pioneer plants grow taller, they provide shade, which can help reduce moisture loss and create more favourable conditions for shade-tolerant species.

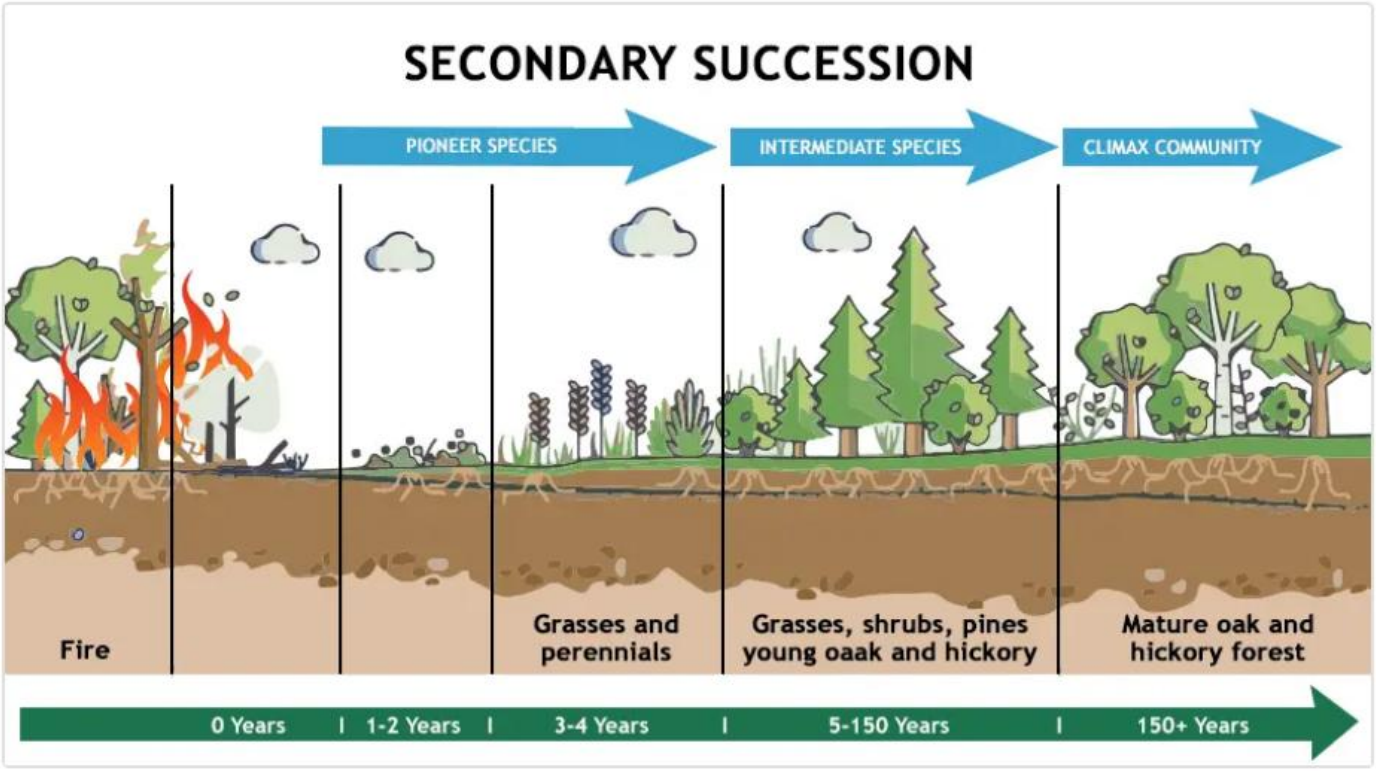


Fig: Secondary Succession

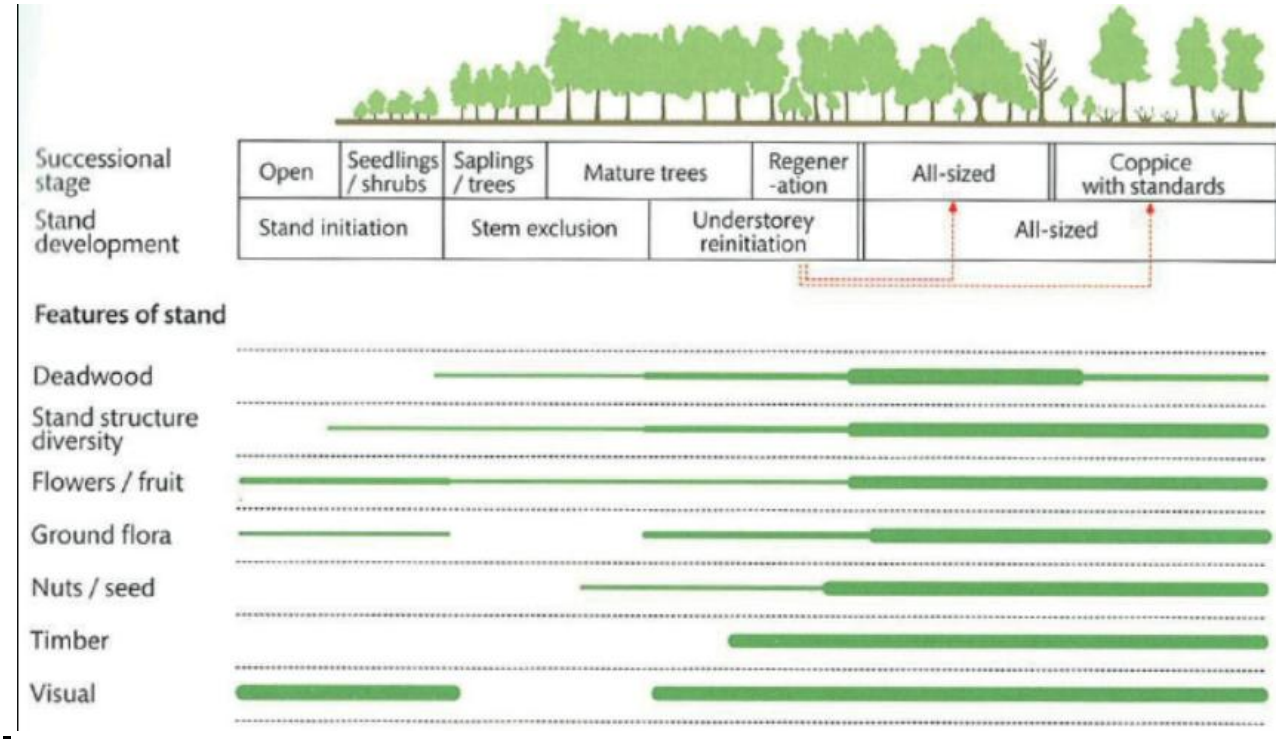
https://biologynotesonline.com/ecological-succession/

Secondary succession is the process by which a pre-existing ecosystem, such as a climax community, recovers after being disrupted or destroyed. This can occur due to natural disturbances like fires or human interventions like logging.

Unlike primary succession, which starts on bare rock or soil, secondary succession occurs on substrates that previously supported life. This means that the soil already contains seeds and remnants of the prior community, which speeds up the recovery process.

2. Shrub Stage

This stage follows the pioneer stage and is characterized by the establishment of woody shrubs and small trees. Shrubs like willow, blackberry, and hawthorn are common during this stage.



Shrub Stage of woodland development
https://www.researchgate.net/figure/Indicative-relationships-between-stages-of-woodland-development-and-relative-value-for-a_fig2_235720297

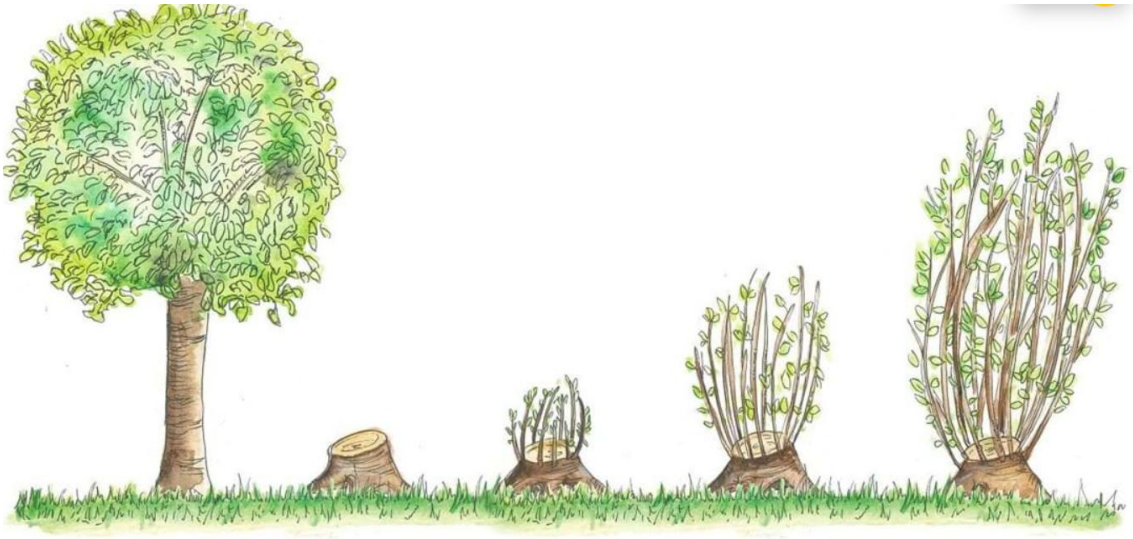
Key Processes
Species Diversity: A wider range of plant species starts to appear, including those more tolerant of shade and competition.
Structural Complexity: The woodland structure becomes more complex with the presence of shrubs and young trees, providing a habitat for a variety of wildlife.
Shade Increase: The growing shrubs and trees cast more shade, gradually reducing the amount of sunlight reaching the ground. This can favour the growth of shade-tolerant tree species.

These two stages represent the early phases of woodland development. Over time, the woodland will continue to evolve through subsequent stages, such as the sapling stage and mature forest stage, as tree species become established and the canopy closes.

2.2. Describe a minimum of four operations commonly used in woodland management

The Woodland Trust, a leading conservation charity in the UK, primarily uses these four techniques to manage their woodlands. Here's a brief overview of each:

Coppicing:
Coppicing is a traditional method of managing woodlands. This technique involves cutting trees down to ground level at regular intervals. The trees then regenerate from dormant buds located at the base of the stump, referred to as the stool, resulting in dense clusters of multi-stemmed trees. The newly formed stems grow more rapidly, ensuring a sustainable supply of timber, as opposed to the practice of harvesting older, thicker branches.
To coppice effectively, cut single-stemmed trees close to the ground, and for established stools, cut near the previous cut. Use a sharp tool suitable for the size of the wood. Angle the cut for water runoff and to prevent rotting. Protect the new shoots from browsing mammals like deer with measures such as creating piles around coppice stools with branches, building “dead hedges,” or erecting a fence. Organize coppice woodlands into coupes to allow light penetration for regrowth. Divide the woodland into equal sections for an annual coppicing cycle, retaining some well-formed trees in each coupe. Designate standard trees as markers for prominent features.



Hazel Coppicing

Recently coppiced hazel.
Credit: WTML

Poles harvested through coppicing.
Credit: Mark Zytynski / WTML

A freshly coppiced stool.
Credit: Keith Huggett / WTML

Cycle length:
Coppicing cycles can vary depending on the tree species and desired outcomes. Common cycles range from 5 to 20 years.
Benefits for biodiversity:
Coppicing creates a habitat mosaic with a variety of age structures, providing niches for different plant and animal species. It can support a wide range of invertebrates, birds, and mammals.
Timber uses:
Coppice wood has many uses, including fencing, fuel, and crafts. It's often used for small-scale woodworking projects and can be a sustainable alternative to plantation timber.
Environmental impact:
Coppicing can be a low-impact forestry practice, especially when managed sustainably. It can help to reduce erosion, improve soil health, and sequester carbon.

Which species are suitable for coppicing?
Most native tree species can be coppiced, with oak, sweet chestnut, willow, lime, hornbeam, field maple, rowan, alder, and hazel being the most used.

Timing for coppicing:
Coppicing should commence when trees exhibit vigorous growth. This may occur after 1-2 growing seasons, although it typically takes around 5-6 years. The optimal period for coppicing is from late September to early March, coinciding with the trees' dormant phase.
The frequency of coppicing varies based on the species and the intended products, for instance:
Hazel: a 7-year cycle for producing hurdles
Sweet chestnut: a 15-year cycle for generating fencing materials
Oak/Hornbeam: a 15-25-year cycle for sourcing firewood and construction materials.

In conclusion, the suitability of a species for coppicing can also depend on site conditions, such as soil type, moisture levels, and light exposure. Some species regenerate more readily from coppice stools than others. For example, hazel and willow are known for their vigorous regrowth, while oak and hornbeam may require more care to ensure successful regeneration. As mentioned, the coppicing cycle can be adjusted to produce different products. For example, shorter cycles can be used for fuelwood or fencing, while longer cycles can produce larger, higher-quality timber.

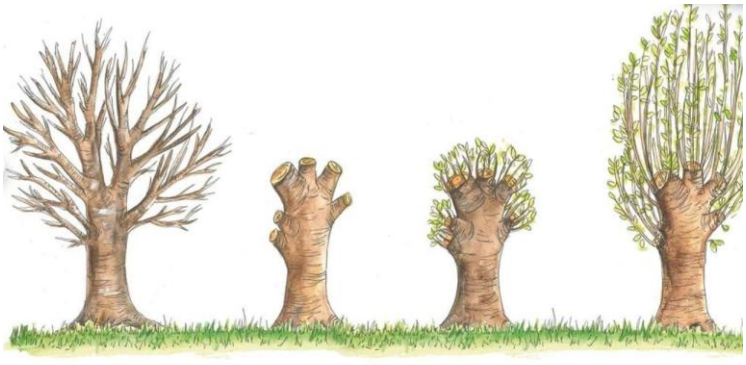
Pollarding is a form of pruning that involves cutting back the main stems of a tree to a specific height. This technique is often used to control the size and shape of trees, protect them from browsing animals, and create a more diverse habitat.

Timing: Pollarding is typically done in late winter or early spring when trees are dormant.
Benefits for wildlife: Pollarding can create a more diverse habitat structure, providing niches for a variety of bird and insect species. It can also benefit ground flora by increasing light levels.
Tree species: Pollarding is often used on trees with strong regrowth capabilities, such as willow, poplar, and elm. However, it can also be used on other species, such as oak and ash.
Maintenance: Pollarding requires regular maintenance to maintain the desired shape and prevent the tree from becoming too dense.
Visual impact: Pollarded trees have a distinctive, rounded appearance that can be a striking feature in a landscape.

Various species can be pollarded. Traditionally, willow, ash, beech, hornbeam, lime, and holly are pollarded to produce tree fodder; however, it is possible to pollard most native tree species.

Initiate the first cut on a maiden tree during the winter season. This should be done once the tree has reached the desired height for maintaining the pollard. It is advisable to carry out this process while the tree is still young, typically between the ages of 5 to 15 years. Although larger trees can also be topped and converted into pollards, the success of this method is contingent upon the tree's age, species, and the amount of shading it receives. Re-pollarding can be conducted in winter to obtain firewood and building materials. Additionally, trees can be pruned in the summer to produce tree fodder on a short rotation basis.

When the tree reaches the desired height, it is advisable to prune the branches located above the main trunk. The decision to remove some or all branches may vary based on the species of the tree or the specific outcome you wish to achieve. For instance, species such as ash or hornbeam may benefit from maintaining some branch coverage. Utilize an appropriate sharp tool that matches the size of the material being pruned. Ensure that the cut is clean and sloped to prevent rainwater accumulation, which can lead to rot, while also avoiding the separation of bark from the wood. All limbs should be trimmed close to the base of the stem to form the pollard head. In the following years, make cuts just above the previous pollard level to preserve those growth areas.
Ensure that your tree is pruned to a height that is inaccessible to potential browsing animals:
1.2 meters for roe deer and sheep
1.5 meters for fallow deer
1.8 meters for red deer and goats
2 meters or more for larger cattle.



Upper branches are removed from the trunk to promote dense regrowth on pollarded trees.

Pollarded trees in Hainault Forest
Trees, fairly recently pollarded, with their amputated branches around them.

Formative pruning: This involves shaping young trees to encourage healthy growth and desirable forms. It's often used in plantations and to create specific tree structures.

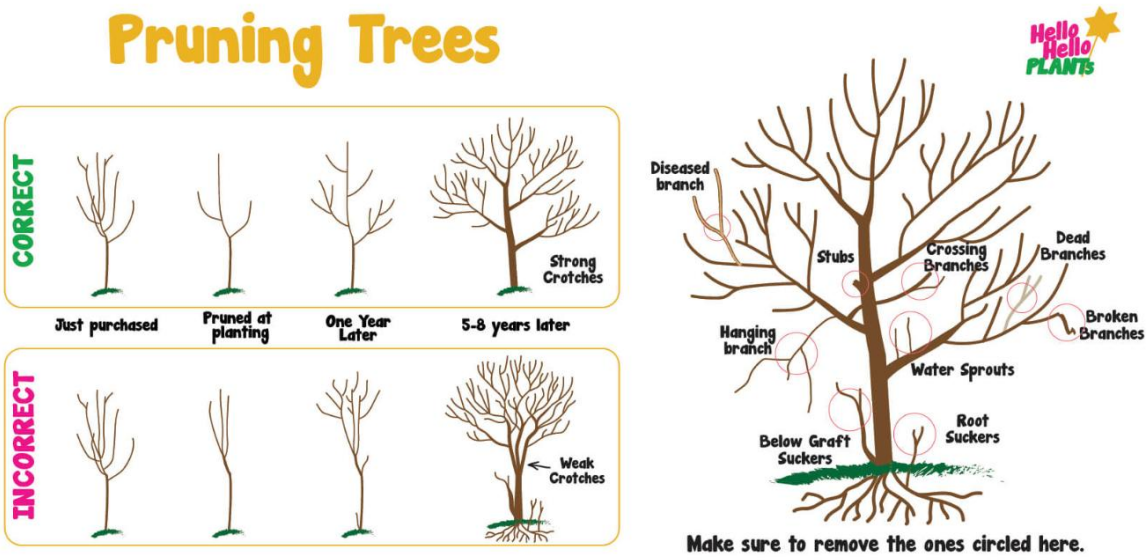
This practice is crucial for several reasons, such as:
Promoting tree health: Pruning aids in the prevention of diseases and pest infestations by enhancing airflow and allowing more sunlight to reach the foliage.
Improving visual appearance: It can be employed to shape ornamental trees in a visually attractive manner.
Increasing productivity: In the case of fruit-bearing trees, pruning can lead to improved yield and fruit quality.
Producing superior timber: In the realm of forestry, pruning contributes to the development of trees with long, straight trunks, which are optimal for timber harvesting.

Pruning Techniques and Timing:
The appropriate pruning methods and timing are contingent upon the species of the tree and the intended outcomes.

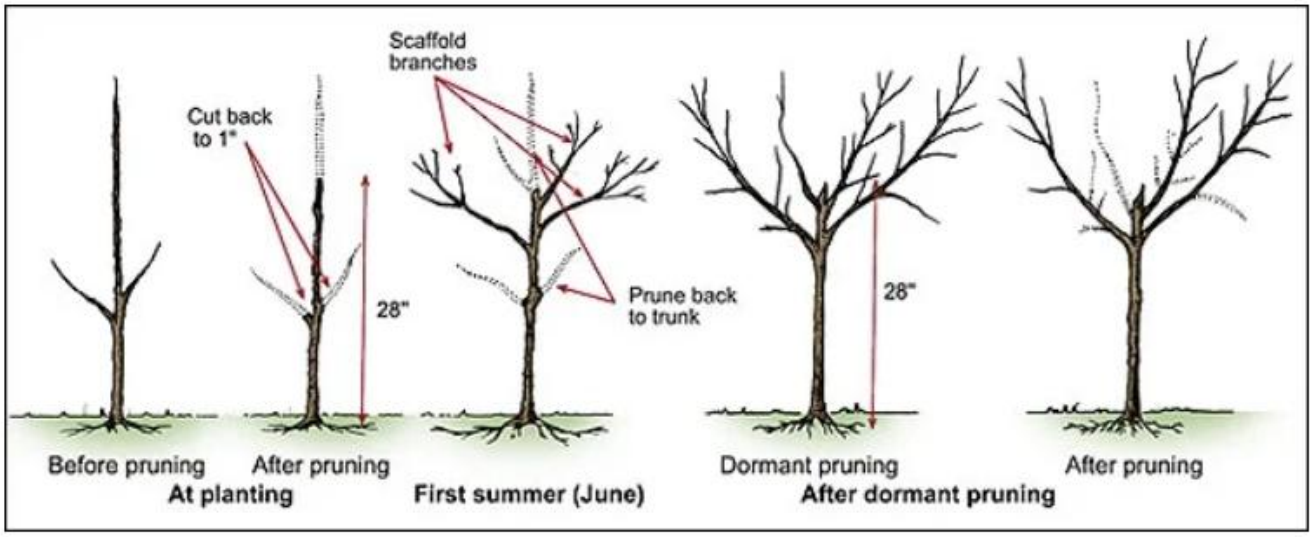
Below are some general recommendations:

Timing for Pruning:
Early spring: This period is typically optimal for pruning most tree species, as it allows for the healing of wounds before the onset of new growth.
Exceptions: Walnut: Pruning should occur in July or August to prevent excessive sap loss.
Cherry: Pruning is best done in July or August to reduce the likelihood of bacterial canker.
Avoid pruning: During extreme cold spells or drought conditions.
Methods of Pruning:
Eliminate lateral branches: When the branches are still small, utilize secateurs or a pruning saw to make clean cuts.
For timber production: Continuously remove side branches as the tree matures to promote a tall, straight trunk.
For fruit trees: Prune to sustain a low, open crown, ensuring maximum sunlight exposure.
Tree Species Appropriate for Formative Pruning Numerous native tree species can gain from formative pruning, such as Alder, Ash, Lime, Oak, Plane, Rowan, and Willow.

By comprehending the fundamentals of formative pruning and adapting techniques to specific tree species and goals, one can effectively manage young trees to achieve the desired outcomes.



https://www.thetutuguru.com.au/garden-info/gardening-advice/pruning/



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Thinning refers to the intentional removal of certain trees within a forested area to enhance the overall health, structure, and productivity of the ecosystem. By reducing competition for essential resources such as light, water, and nutrients, thinning fosters the growth of the most robust trees and contributes to a more diverse and resilient environment.
Advantages of thinning enhanced tree growth: Thinning provides remaining trees with improved access to resources, resulting in accelerated growth and development.
Increased biodiversity: A less dense canopy can facilitate the expansion of a broader variety of plant species and offer habitats for diverse wildlife.
Improved timber production: By concentrating on the most promising trees, thinning can enhance both the quality and quantity of timber harvested.
Decreased fire risk: Thinned areas are less likely to support the rapid spread of wildfires.

Thinning Techniques and Timing
Timing: It is advisable to refrain from thinning during the bird nesting season to safeguard wildlife.
Tree selection: Prioritize the retention of the healthiest and best-formed trees while removing those that are competing or exhibiting signs of stress.

Thinning intensity: The degree of thinning should be determined by the age, density, and species of the trees, with gradual thinning over several years often being the preferred approach.
Thinning methods:
Line thinning: Involves the removal of entire rows of trees.
Single-tree selection: Focuses on the removal of individual trees based on their health and growth potential.
Halo thinning: This entails the removal of trees surrounding mature specimens to reduce competition.
Considerations for Thinning Legal Requirements: In numerous regions, a felling license from the relevant forestry authority is necessary for thinning operations.
Tree health: Care should be taken to avoid damaging the trees intended for retention.
Long-term goals: It is important to consider the desired future structure of the woodland when planning thinning activities.

Large Eastern Redcedars dominate a degraded woodland at Shaw Nature Reserve in Gray Summit MO. The understory is overgrown with non-native woody species including bush honeysuckle (*Lonicera maackii*), privet (*Ligustrum obtusifolium*), and wintercreeper (*Euonymus fortunei*). The lack of recent fire has led to a build up in leaf litter, and native herbaceous species are mostly absent. Photo: CCSD & SNR staff.

Top: Woodland under management at Shaw Nature Reserve in March of 2017, after selective thinning of trees to open up the canopy and removal of most woody shrubs. Leaves of some persistent bush honeysuckle can be seen. Bottom: Same woodland in June of 2019 after the addition of a seed mix in 2018. Photo: CCSD & SNR staff.

https://mbgecologicalrestoration.wordpress.com/2023/02/28/seed-additions-facilitate-herb-layer-restoration-in-a-temperate-oak-woodland/

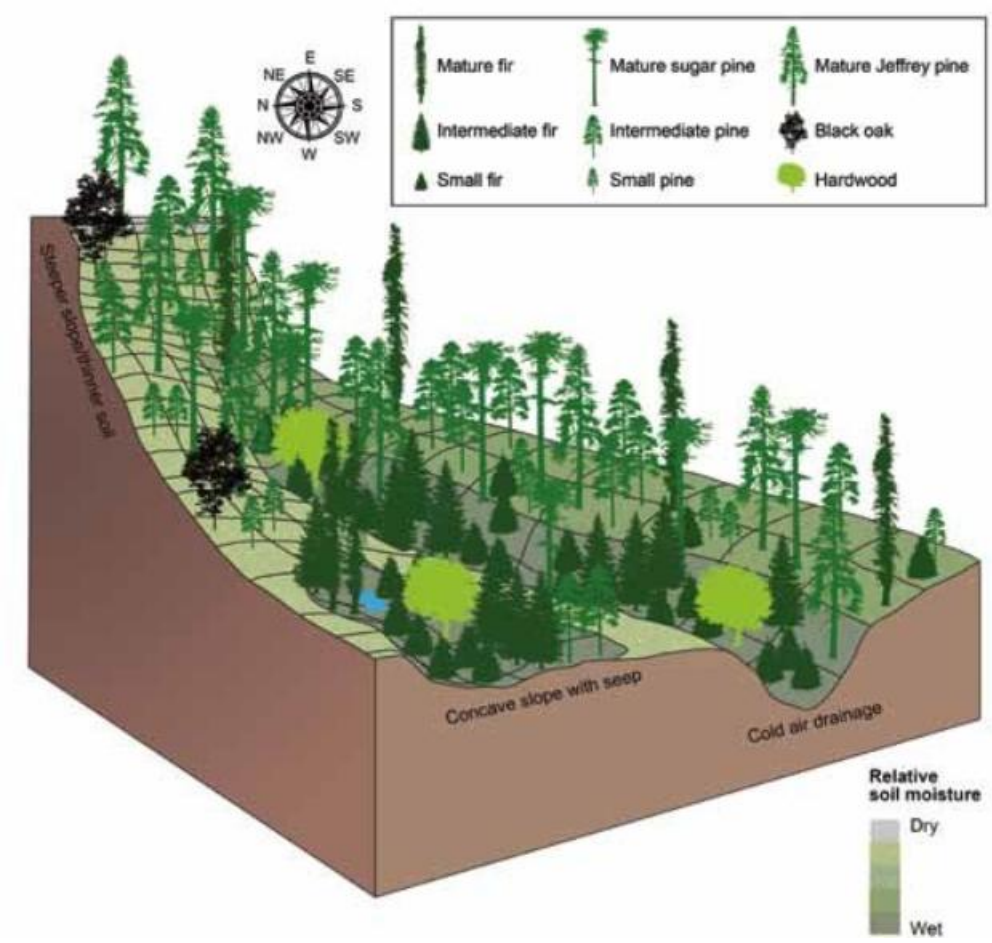
These four techniques Coppicing, Pollarding, Formative Pruning and Thinning help to create and maintain diverse, healthy woodlands that support a wide range of wildlife.

2.3. Describe the horizontal structure of a woodland

The horizontal configuration of woodlands exhibits considerable variation and is subject to a multitude of influences. These influences encompass natural factors such as land topography, waterways, climatic conditions, pests, tree diseases, geological features, and soil composition. Additionally, human activities can profoundly impact the structure of a forest. A notable distinction exists between plantations and naturally occurring stands. The accompanying diagram illustrates various structural forms found in managed woodlands.

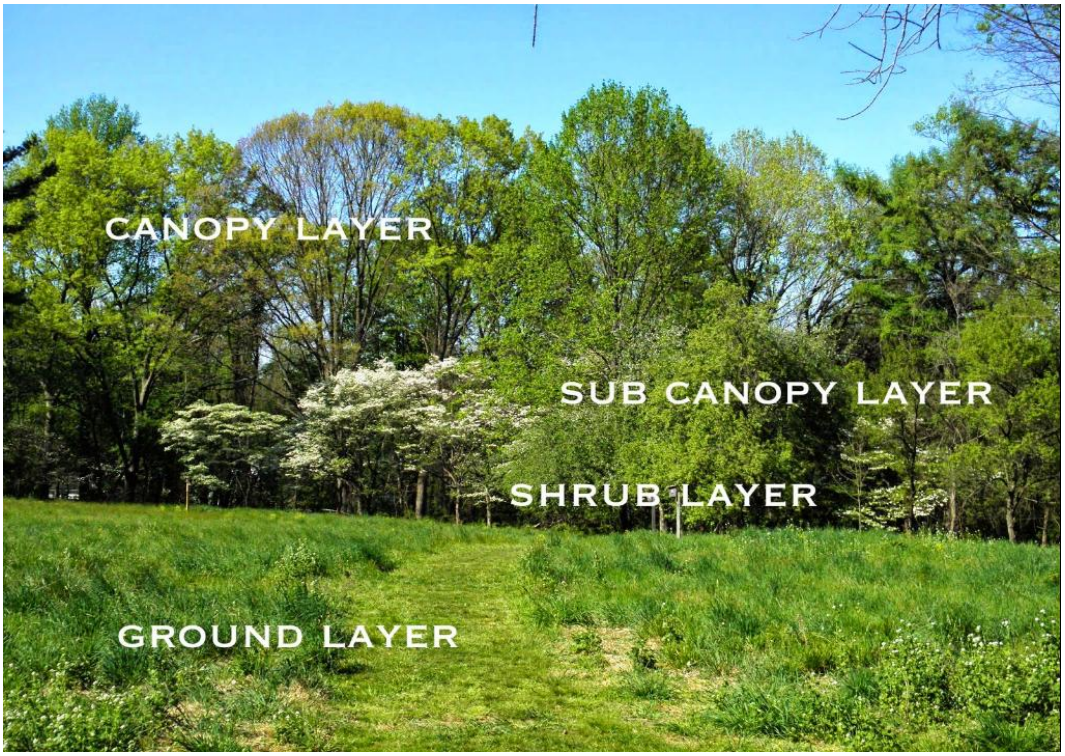
https://learningintheleaves.co.uk/woodland-ecological-structures#:~:text=Horizontal%20Structures%20of%20British%20Woodland,and%20older%20more%20established%20trees.

In an unmanaged forest, the characteristics of the terrain influence the horizontal arrangement of vegetation. Factors such as steep slopes, the intensity of prevailing winds, the presence of rivers, lakes, and marshes, or the cooler temperatures associated with dips and valleys can contribute to this phenomenon. Consequently, trees may struggle to thrive in certain areas or may grow less densely due to a scarcity of nutrients. Conversely, managed forests are typically situated on land that is easily accessible, suitable for planting, and capable of producing timber, thus lacking the geographical features previously mentioned. In contrast, older unmanaged forests are often located on land that is challenging to access and lacks commercial viability.



Horizontal Structure https://www.researchgate.net/figure/Stand-level-schematic-of-how-forest-structure-and-composition-would-vary-by-small-scale_fig4_228716639

2.4. Describe the vertical structure of a woodland

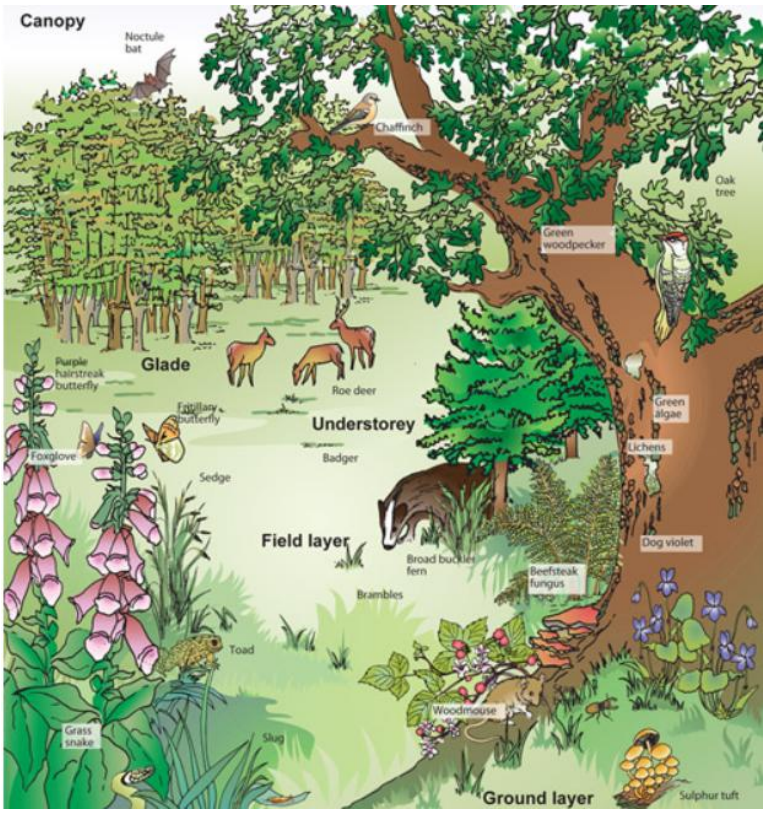


https://www.goodthingsbydavid.com/2015/05/layers-in-woodland.html

The vegetation found beneath the dominant trees in woodland can typically be categorized into several distinct layers based on their height. These layers may consist of an understorey, or shrub layer, featuring smaller trees that are adapted to thrive in lower light conditions. Additionally, there may be a field layer comprising grasses, ferns, and wildflowers, as well as a ground layer predominantly made up of mosses. The visibility of one or more of these layers in a specific woodland is influenced by the amount of shade produced by the overarching tree canopy. Furthermore, the arrangement of plant layers within a woodland plays a significant role in determining the distribution of animal species inhabiting that environment. The number of identifiable layers in woodlands can vary considerably. In certain forests, all four layers may be distinctly observable, while in others, only two may be present. Some woodlands may even exhibit more than four layers. The presence of these layers is contingent upon numerous factors, including local climate and environmental conditions, the species of plants in the area—particularly the dominant trees—and the amount of light that penetrates to the ground in specific locations. In woodlands where ample light reaches the forest floor, all four layers may be well established, whereas in areas with dense shade, growth beneath the dominant tree canopy may be limited. In practice, the plant layers are not entirely separate; rather, they intergrade with one another. The boundaries between these layers can be further obscured by climbing plants such as Ivy and Honeysuckle, which ascend through various layers in search of light, utilizing other plants, including trees, for support. Epiphytes, which are plants that grow on other plants for structural support, such as ferns, mosses, and lichens, may also adorn the branches of older, more established trees. Like the climbers, this adaptation allows them to access greater light availability. The classification of plants within a woodland into distinct layers serves primarily as a human convenience, yet it remains a valuable descriptive framework for recognizing the variations among individual woodlands.

2.5. Identify the four layers of the vertical structure

Most woods have several vegetation layers (Figure 1).



https://www.open.edu/openlearn/nature-environment/natural-history/neighbourhood-nature/content-section-1.1

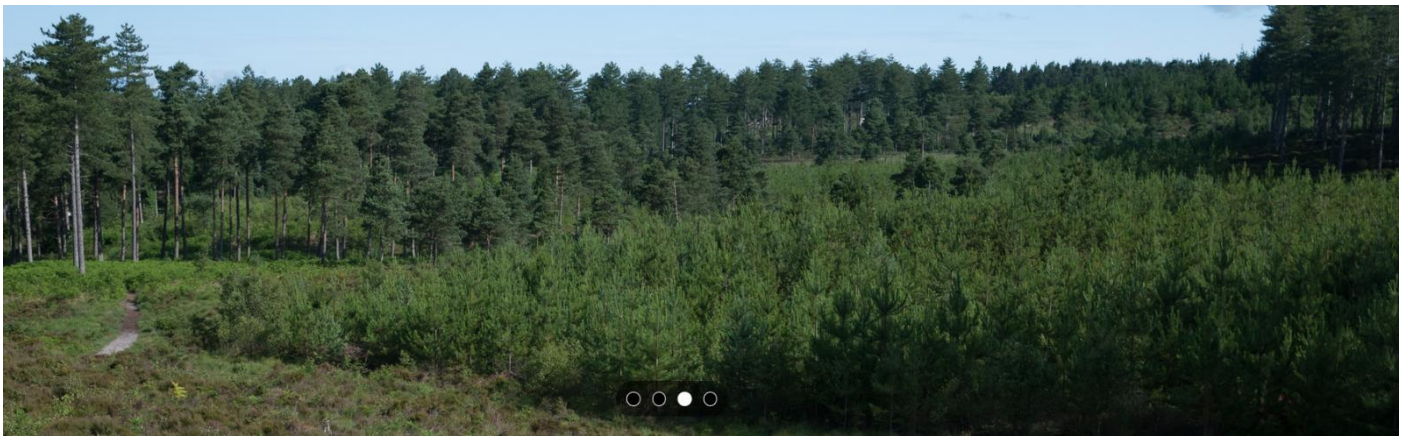
Woodland layers (from top to bottom):

There is the canopy, or top layer, where the tallest trees are found, such as **oak (Quercus robur)**, **ash (Fraxinus excelsior)**, **beech (Fagus sylvatica)** or **birch (Betula pendula)**. These trees receive the maximum amount of light available.
Understory: A layer of shorter trees and shrubs, such as **field maple**, **hawthorn**, and **hazel**, that are adapted to lower light conditions.
Herb or field layer: Ground-level vegetation, including ferns, flowering plants, and grasses.
Ground layer: **Mosses**, **lichens**, **ivy**, **fungi**, and **rotting leaves**, which provide habitat for invertebrates.
Climbing plants: Plants like **honeysuckle** that climb tree trunks to reach sunlight.
Epiphytes: Plants like **mosses**, **lichens**, and **ferns** that grow on trees for support but do not obtain nutrients from them.

Animal Habitats: The different layers of a woodland influence where various animals can be found:
Canopy: Large branches provide nesting sites for large birds like Buzzards. New leaves, especially from oak trees, offer food for caterpillars, which in turn attract small birds.
Understory: A well-developed understory provides nesting and food opportunities for smaller woodland birds.
Herb Layer: The field layer of flora and grasses supplies food for butterflies and other invertebrates.

Significance of woodland structure in influencing biodiversity. It outlines woodlands into four distinct layers and clarifies how the diversity within these layers affects the variety of plants and animals that can flourish in the woodland environment.
Key points:

Woodland structure: The arrangement and variety of layers within a woodland are essential for fostering biodiversity. Native woodlands typically exhibit greater biodiversity compared to plantations, particularly coniferous ones.



Coniferous plantations https://www.wildlifetrusts.org/habitats/woodland/coniferous-plantation

Coniferous plantations: These areas are often characterized by dense growth, resulting in limited light penetration to the forest floor, which restricts plant development and diminishes biodiversity. Nonetheless, certain bird species have adapted to thrive in such conditions.

Deciduous woodlands https://britishwildlife.fandom.com/wiki/Deciduous_Forest

Deciduous woodlands: These woodlands possess a more defined structure; however, excessive grazing by animals can severely affect their layers, leading to a decline in biodiversity, a situation frequently observed in regions like the New Forest.

Key Threats to Woodland Biodiversity
Deforestation: Clearing woodlands for agriculture, development, or other purposes.
Habitat Fragmentation: Breaking up large, continuous woodlands into smaller, isolated patches.
Outcompeting native species: Invasive plants can dominate understories, preventing native plants from growing.
Predation: Invasive animals can prey on native wildlife.
Climate Change:
Changes in temperature and rainfall patterns can stress trees and plants.

Increased frequency of extreme events: Storms, droughts, and wildfires can directly damage woodlands.
Deer and other herbivores: Excessive grazing can prevent plants from regenerating.
Weakening trees: Diseases and pests can make trees more susceptible to other threats.

The Role of Woodland Management
Effective woodland management can mitigate these threats by:
Promoting habitat diversity: Creating a variety of structures, such as deadwood and open areas.
Controlling invasive species: Using mechanical, chemical, or biological methods.
Adapting to climate change: Planting climate-resilient tree species and considering future conditions.
Managing herbivore populations: Implementing grazing controls or deer fences.
Monitoring for diseases and pests: Early detection and treatment can limit damage.
https://forestrycommission.blog.gov.uk/2023/09/13/why-woodland-management-matters/

A carefully managed woodland can be rich in biodiversity, supporting a variety of plant and animal life. The presence and variety of these layers are vital for the overall health and biodiversity of a woodland

2.6. Give four examples of plant species found in each of the vegetation layers

Canopy: The top layer, formed by the crowns of large trees. It intercepts much of the sunlight, making the woodland floor shady in late spring and summer. This limits plant growth, except for early blooming flowers like **bluebells** and **wood anemones**.

Layer	Species Common Name	Species Latin Name
Canopy Layer	**oak**	**(Quercus robur)**,
	ash	**(Fraxinus excelsior)**,
	beech	**(Fagus sylvatica)**
	birch	**(Betula pendula)**.

Understory: The layer below the canopy, consists of smaller trees and shrubs adapted to lower light conditions, such as **hazel**, **holly**, **hawthorn**, and **rowan**. Invasive rhododendrons can dominate this layer in some woodlands, but efforts are underway to eradicate them. Grazing by animals can also limit the development of this layer.

Understory	Species Common Name	Species Latin Name
	Rowan	**Sorbus aucuparia**
	Field Maple	**Acer campestre**
	Hazel	**Corylus avellana**
	Hawthorn	**Crataegus monogyna**

Herb Layer: The ground layer, which is most developed in areas with more sunlight, like clearings or coppiced areas. The types of plants and flowers found here depend on the openness of the canopy and the dominant trees. Common plants include **bluebells**, **wood anemones**, **bramble**, **wood sorrel**, **primrose**, **grasses**, and **ferns**.

Field Layer Herb Layer	Species Common Name	Species Latin Name
	bluebells	**Hyacinthoides**
	bramble	**Rubus fruticosus**
	wood sorrel	**Oxalis acetosella**
	wood anemones	**Anemonoides nemorosa**

Ground Layer: The ground layer is composed of **mosses**, **fungi**, **ivy**, **leaf litter**, and **decaying wood**. Mosses thrive in moist conditions, so they are less common in drier woodlands.

Ground Layer	Species Common Name	Species Latin Name
	ivy	**Hedera helix**
	Common Tamarisk-moss	**Thuidium tamariscinum**
	Fox-tail Feathermoss	**Thamnobryum alopecurum**
	Lady Fern	**Athyrium filix-femina**

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