



# Forest Ecology





# LESSON PLAN FOR FOREST ECOLOGY

<u>Learning Unit</u>	<u>Contents</u>		<u>Sessions</u>
1- Introduction	Definition, Scope		1
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		Wind	
	Edaphic Factors	Soil Formation	
		Soil Profile	
		Soil Properties	
		Soil Structure	
		Soil Water, Soil Air, Relationship	
Soil Organic Matter			

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<u>Learning Unit</u>	<u>Contents</u>		<u>Sessions</u>
2- Ecological Factors	Physiographic Factors	Configuration of Land Surface	
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		Slope	
		Aspect and Exposure	
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3- Ecosystem	Component of Ecosystem	Concept of Ecosystem	2
		Ecosystem Energetic - Primary & Secondary Production, Food Chains	
		Biogeochemical Cycles	
	Major Ecosystems	Terrestrial	
		Aquatic	

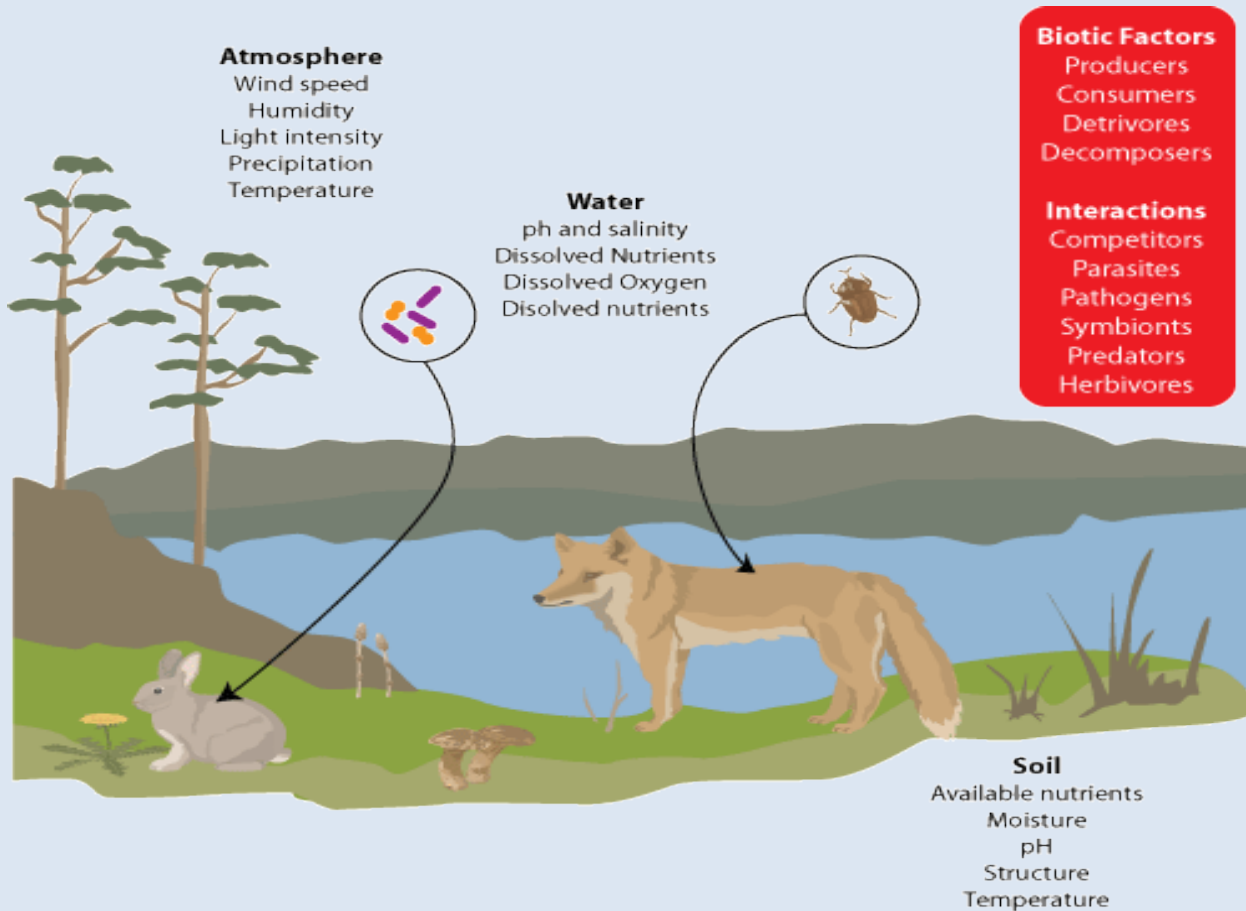
## LESSON PLAN FOR FOREST ECOLOGY

<u>Learning Unit</u>	<u>Contents</u>		<u>Sessions</u>
4-Forest biomes	Introduction, Types	Deserts Cold & Hot	1
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5- Basic Components of Ecosystems	Communities	Communities Structure, Disturbance	2
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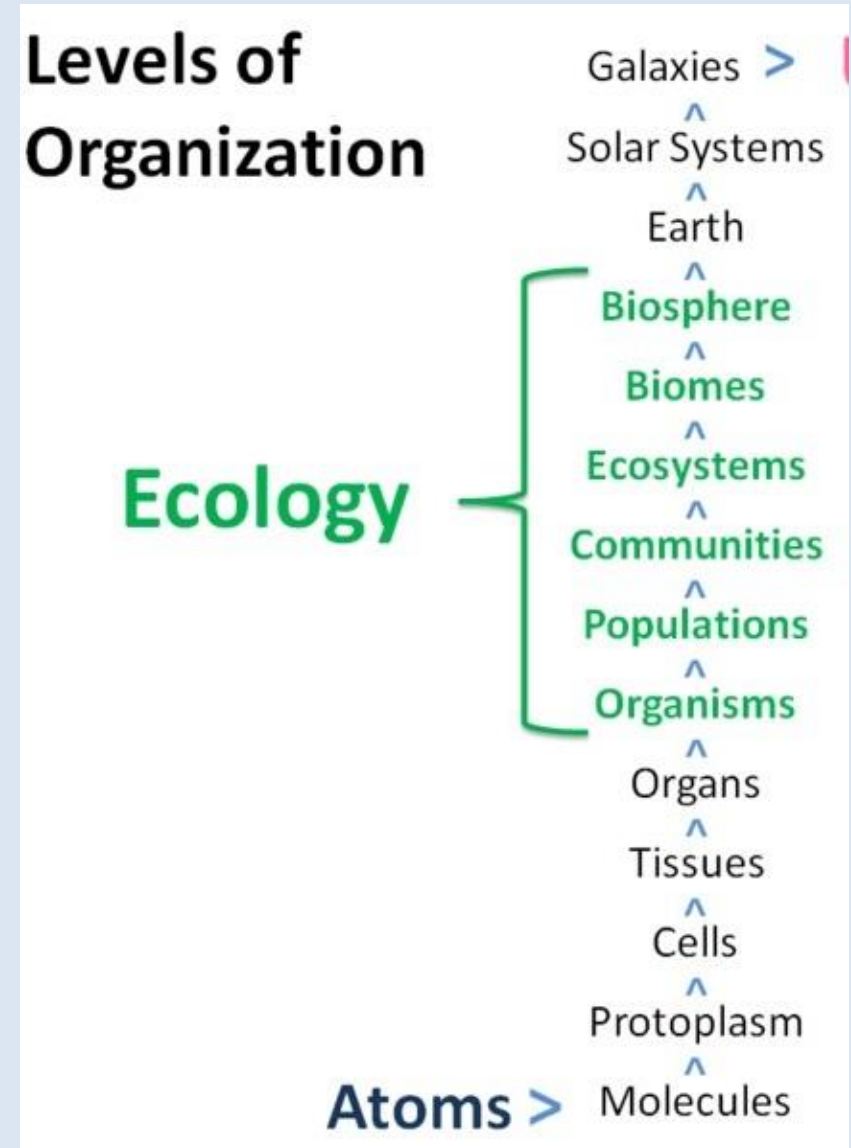
## LESSON PLAN FOR FOREST ECOLOGY

<u>Learning Unit</u>	<u>Contents</u>		<u>Sessions</u>
6- Succession	Introduction, Kinds	Mono-climax Theory	1
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10- Phytogeographical Zones	Phytogeographical Zones		1
11- Zoogeographical Zone	Zoogeographical Zone		1
12- Classification of Forests	Introduction & Types		4
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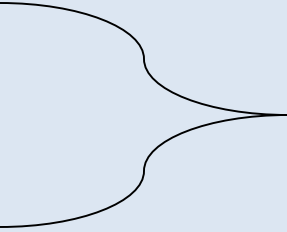
**Ecology** (from Greek: οίκος, *oikos*, "household"; and λόγος, *logos*, "knowledge") is the scientific study of the **distribution** and **abundance** of living **organisms** and the **interactions** among organisms and between organisms and their **environment**. The environment of an organism includes **abiotic** and **biotic** factors.



- Ecology is usually considered a branch of [biology](#).
- Ecology is a [multi-disciplinary](#) science.
- It focus on the higher levels of the organization of [life on earth](#) and on the interrelations between organisms and their [environment](#)
- Ecology draws heavily on many other branches of science, especially [geology](#), [geography](#), [meteorology](#), [pedology](#), [genetics](#), [chemistry](#), and [physics](#).
- Thus, ecology is considered to be a **holistic science**.



# LEVELS OF BIOLOGICAL ORGANISATION

Living (Bio) + Component	Abiotic environment	(=) Resultant Bio-system	Discipline Concerned with the enquiry
Genes Cells Tissues Organs  Organisms Populations Communities		Genetic Systems Cell System Tissue System Organ System  Organismic System Population System Ecosystems 	Genetics Cytology Histology Anatomy, Physiology  Ecology



<b>S. No.</b>	<b>Level</b>	<b>Description</b>
1	Organism	An individual plant or animal
2	Population	A group of individuals of one species
3	Community	The sum of populations of different species within a given area
4	Ecosystem	The sum of the communities and the non-living environment in an area
5	Biosphere	The sum of all ecosystem

**The interaction between biological units of various levels with their non-living surroundings or environment result in a hierarchy of bio-system.**

## Sub-Divisions

The science of ecology has many sub-divisions and each sub-division is related to a different level of biological organization:

Autecology

Study of an **individual** organism; life history of the organism and its response to the environment.

Population ecology

Study of abundance, distribution and /or dynamics of a **group of organisms** of same kind

Synecology

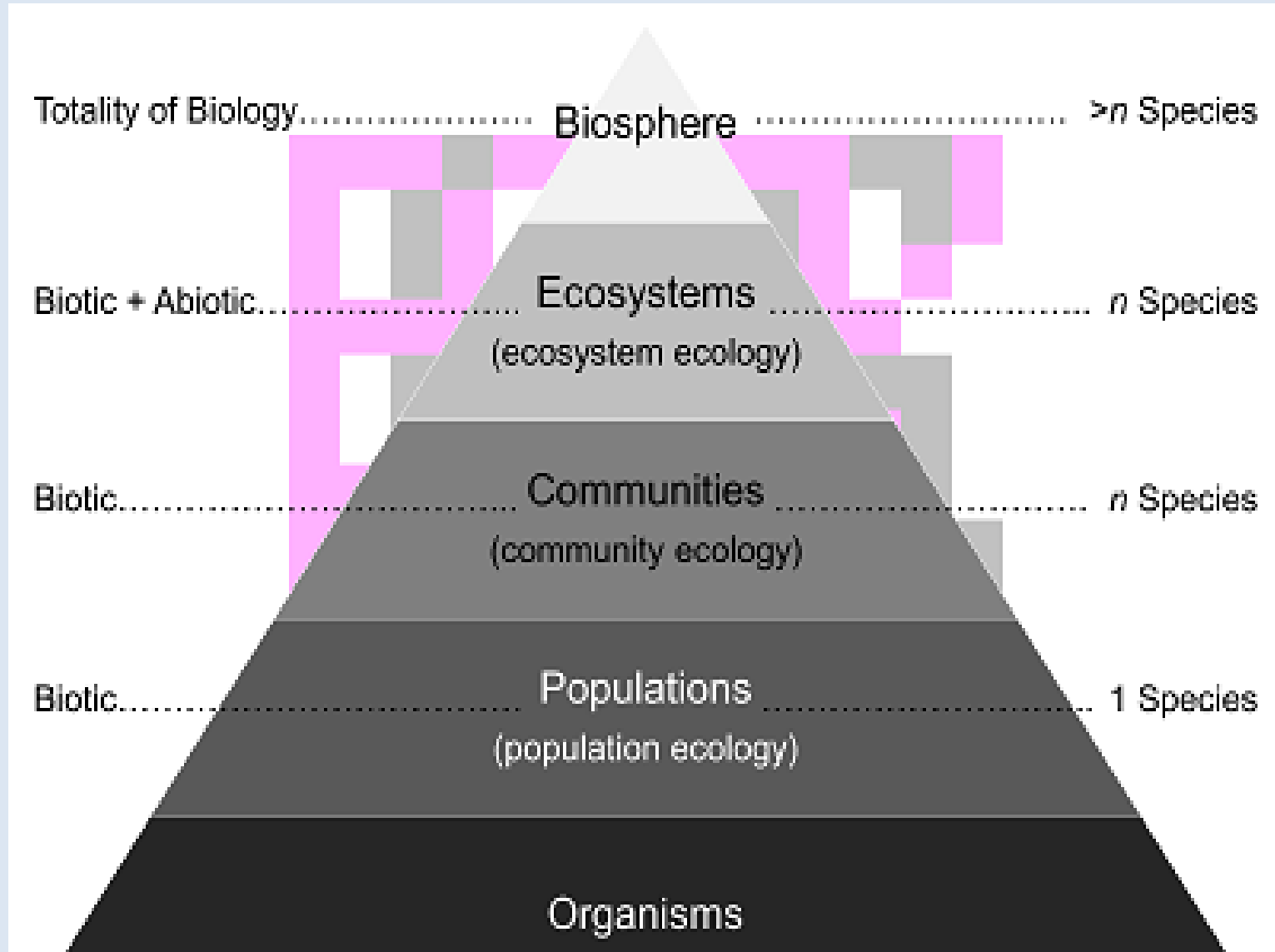
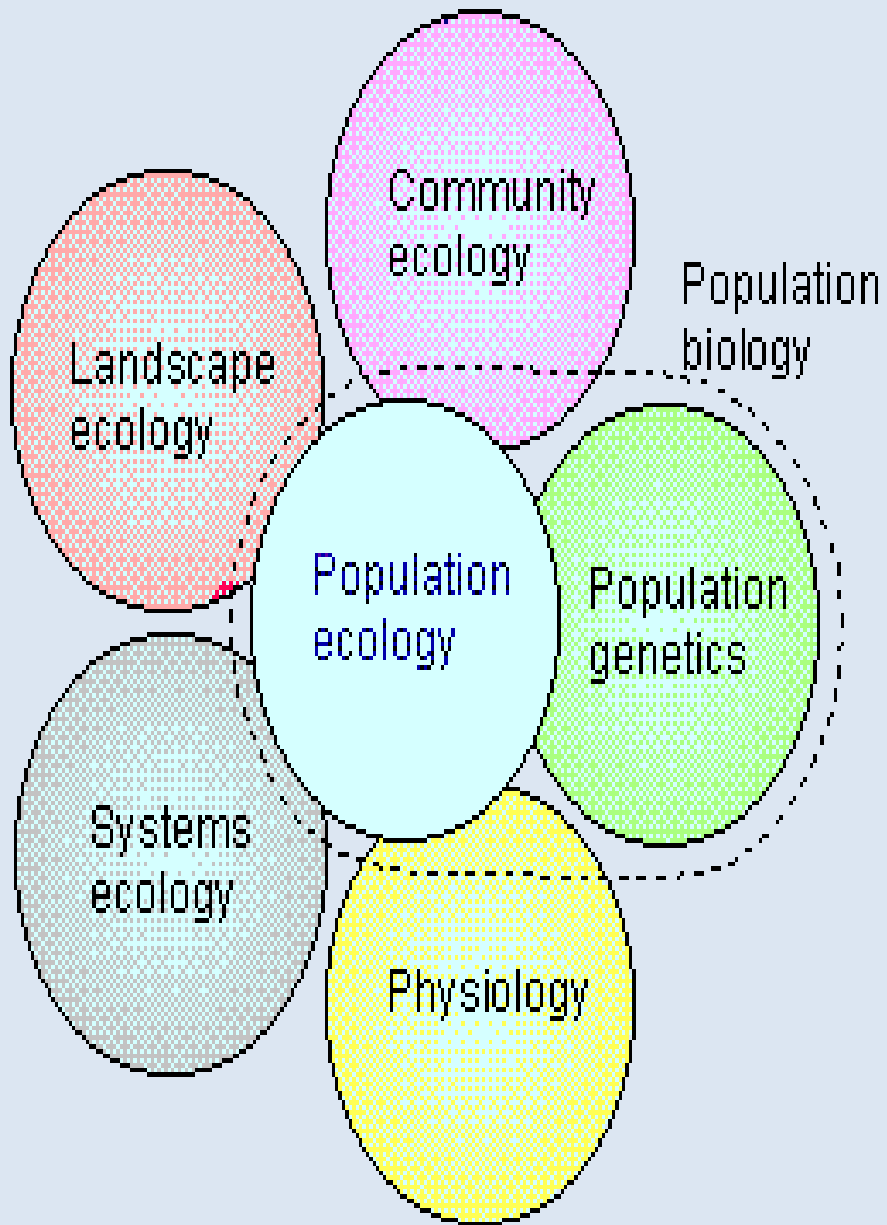
(community ecology)

Study of properties of a **community**, i.e. a natural assemblage of different species of organisms

Ecosystem ecology

**Study of an ecosystem**, biotic community and its abiotic environment.

## Disciplines of ecology

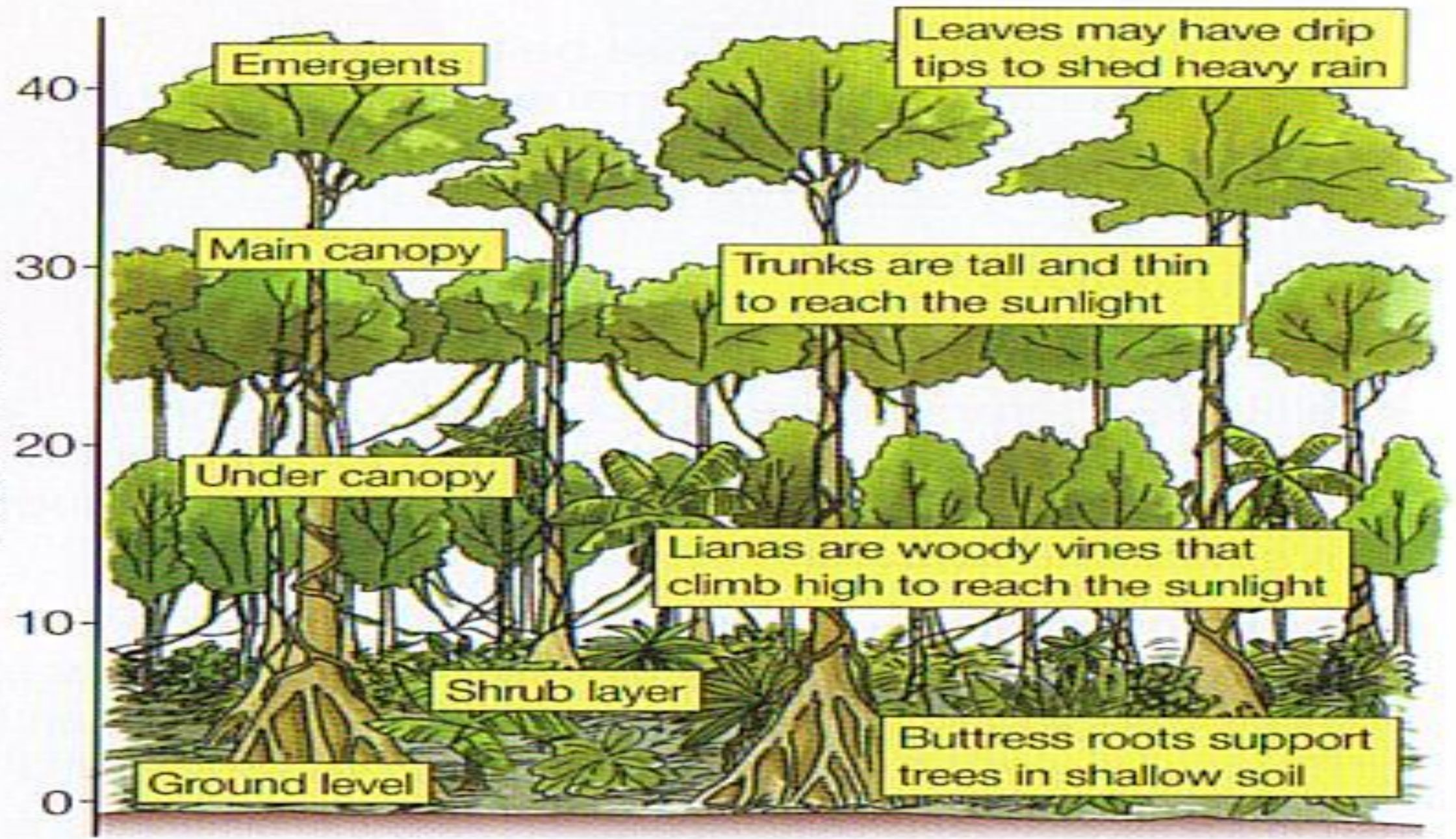




# Forest Ecology

- **Forest ecology** is the scientific study of patterns and processes in forests.
- **Scope of Forest Ecology-**
- Forests can be, and are, studied at any number of organizational levels, from the individual organism to the ecosystem.
- However, as the term forest connotes an area inhabited by more than one organism, forest ecology most often concentrates on the level of the population, community or ecosystem.

Height in metres



Emergents

Leaves may have drip tips to shed heavy rain

Main canopy

Trunks are tall and thin to reach the sunlight

Under canopy

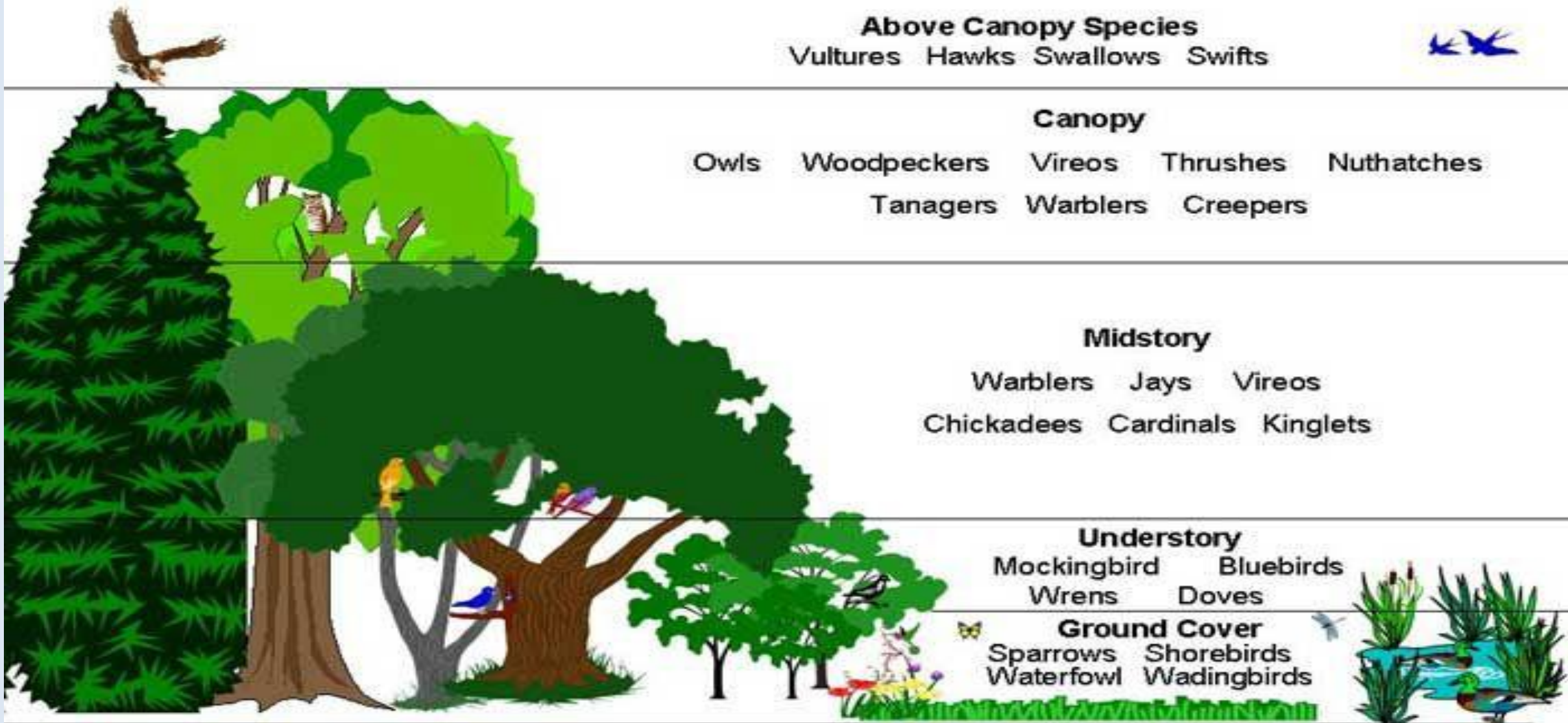
Lianas are woody vines that climb high to reach the sunlight

Shrub layer

Ground level

Buttress roots support trees in shallow soil





**Above Canopy Species**  
 Vultures Hawks Swallows Swifts

**Canopy**

Owls Woodpeckers Vireos Thrushes Nuthatches  
 Tanagers Warblers Creepers

**Midstory**

Warblers Jays Vireos  
 Chickadees Cardinals Kinglets

**Understory**

Mockingbird Bluebirds  
 Wrens Doves

**Ground Cover**

Sparrows Shorebirds  
 Waterfowl Wadingbirds

**Canopy**

Junipers  
 Pines  
 Cedars  
 Maples  
 Hickories  
 Oaks  
 Elms  
 Pecans

**Midstory**

Ash  
 Maples  
 Sweetgum  
 Hackberries

**Understory**

**Tall Shrubs**  
 Dogwoods  
 Viburnums  
 Hawthorne  
**Low Shrubs**  
 Agaritas  
 Yaupons  
 Wax Myrtles

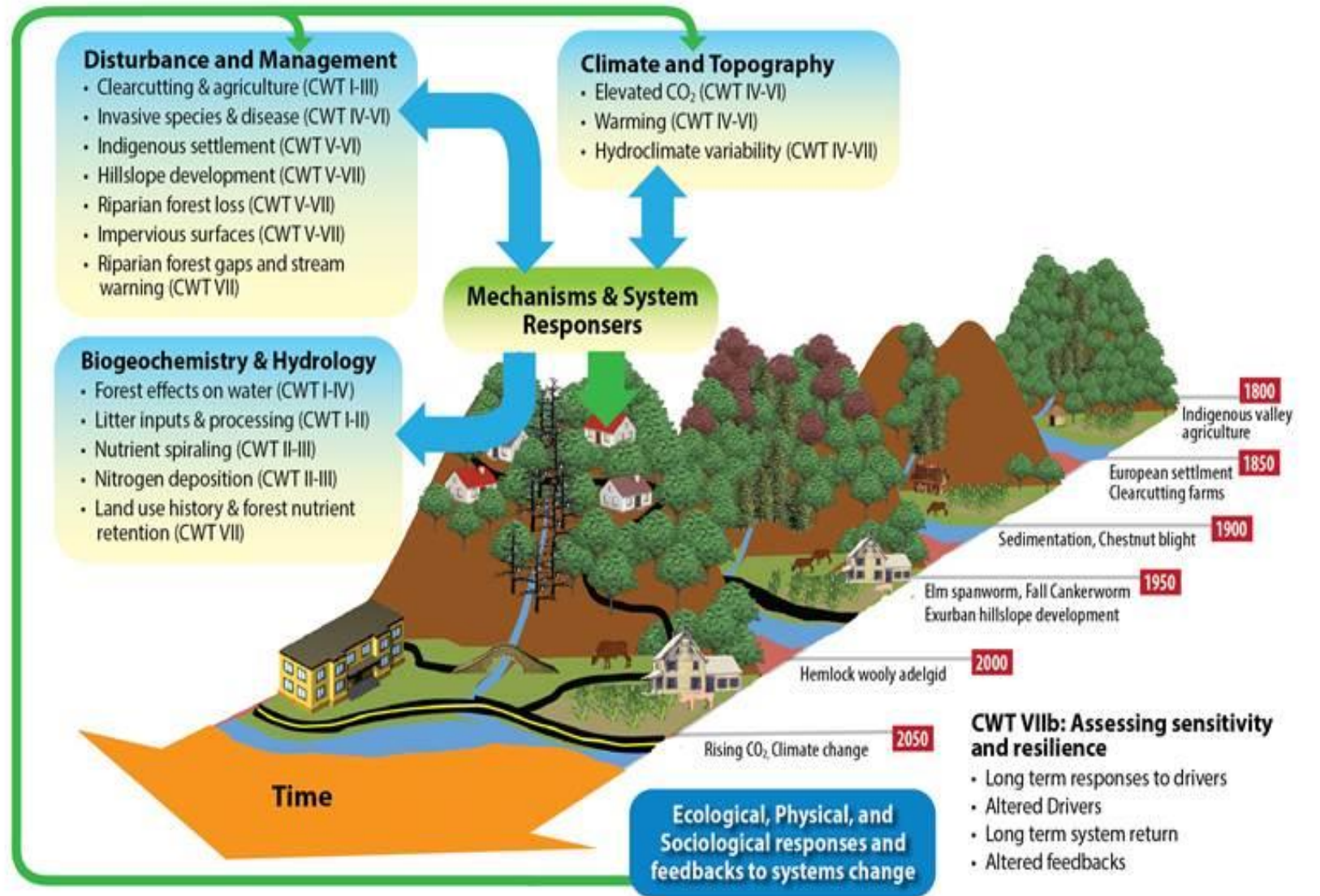
**Ground Cover**

**Prairie**  
 Gramas  
 Bluestems  
 Paspalums  
**Wetland**  
 Sedges  
 Rushes  
 Cattails



# Ecological Study of forests

- Enumeration of plant species
- Classification of species into groups
- Distribution of species in forest, both in space and time (Management practice)
- Plantations need ecological studies
- Wildlife habitat management
- Population regulation



USDA Forest Service Coweeta Hydrologic Laboratory - Long-term ecological research at Coweeta

<https://coweeta.uga.edu/>

# Application aspects of Forest Ecology

- **Production** forestry vs. **Protected** areas
- **Secondary** forests
- Forest management- **regeneration, silvicultural** systems
- The presence of trees makes forest ecosystems and their study unique in at least four ways.
  - Community diversity & complexity
  - Energy potential
  - Death in the forest ecosystem
  - Water
- Forest ecology is related to silvics and silviculture.
- Silvics-the **study of the life history and general characteristics of forest trees** and crops, with particular reference to environmental factors, as the basis for the practice of silviculture.

# Forest ecology and conservation

## ECOSYSTEM CONCEPTS

- Levels of biological organization
- Native species
- Keystone
- Population viability/ thresholds
- Ecological resilience
- Disturbances
- Connectivity/fragmentation

## ECOSYSTEM MANAGEMENT CONCEPTS

- Coarse and fine filter approach
- Risk is an inherent aspect of decision-making
- Adaptive management
- Ecosystem-based management
- Protected area

## ECOLOGICAL PRINCIPLES

- Protection of species and species subdivisions will conserve genetic diversity
- Maintaining habitat is fundamental to conserving species
- Large areas usually contain more species than smaller areas with similar habitat
- All things are connected but the nature and strengths of those connections vary
- Disturbances shape the characteristics of populations, communities, and ecosystems
- Climate influences terrestrial, freshwater and marine ecosystems

## APPLICATION OF ECOLOGICAL CONCEPTS AND PRINCIPLES

### COARSE AND FINE FILTER APPLICATIONS

- Use coarse and fine filter approaches
- Representation, in a system of protected areas
- Retain large contiguous or connected areas
- Maintain or emulate ecological processes
- Manage landscapes and communities to be responsive to environmental change
- Manage towards viable populations of all native species
- Preserve rare landscape elements, critical habitats and features, and associated species
- Minimize the introduction and spread of invasive alien species that disrupt ecological resilience and population variability

### PLANNING APPLICATIONS

- Set objectives and targets for biodiversity in plans
- Manage biodiversity at multiple levels of biological organization and multiple time and spatial scales
- Incorporate spatial and temporal approaches to land use that are compatible with an area's natural potential
- Avoid land uses that convert natural ecosystems and restore damaged ecosystems
- Avoid, mitigate or as a last option compensate for the effects of human activities on biodiversity
- Employ adaptive management of natural resources to maximize learning
- Given that humans are a powerful agent of change,

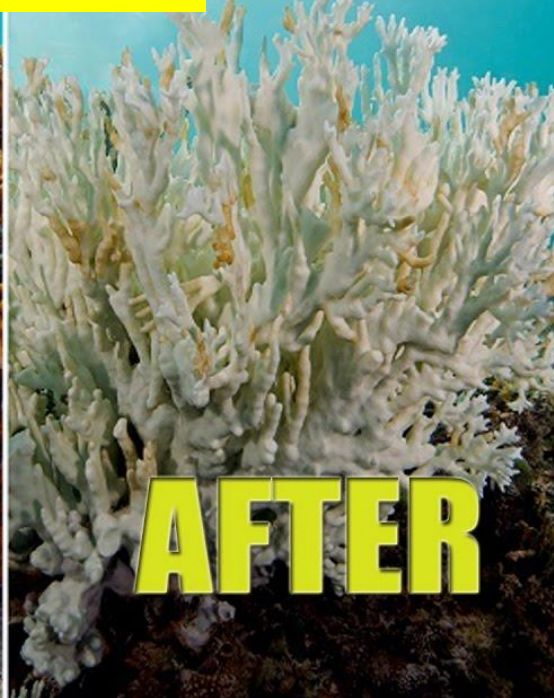


## Ecological crisis

- An ecological crisis occurs with the resilience of a system ( environment/ species/ population) is stretched beyond its limits which results in loss of adaptive capacity to cope with the perturbations that interfere with that ecosystem, landscape or species survival.
- It may in the form of environment quality degrades compared to the species needs, after a change in an abiotic ecological factor (for example, an increase of temperature, less significant rainfalls). It may be that the environment becomes unfavourable for the survival of a species (or a population) due to an increased pressure of predation (for example **overfishing**). It may be that the situation becomes unfavourable to the quality of life of the species (or the population) due to a rise in the number of individuals (overpopulation).



ecological factor



# CORAL BLEACHING

Have you ever wondered how a coral becomes bleached?

## HEALTHY CORAL

1 Coral and algae depend on each other to survive.



Corals have a symbiotic relationship with microscopic algae called zooxanthellae that live in their tissues. These algae are the coral's primary food source and give them their color.

## STRESSED CORAL

2 If stressed, algae leaves the coral.



When the symbiotic relationship becomes stressed due to increased ocean temperature or pollution, the algae leave the coral's tissue.

## BLEACHED CORAL

3 Coral is left bleached and vulnerable.



Without the algae, the coral loses its major source of food, turns white or very pale, and is more susceptible to disease.

## WHAT CAUSES CORAL BLEACHING?



**Change in ocean temperature**  
Increased ocean temperature caused by climate change is the leading cause of coral bleaching.



**Runoff and pollution**  
Storm generated precipitation can rapidly dilute ocean water and runoff can carry pollutants — these can bleach near-shore corals.



**Overexposure to sunlight**  
When temperatures are high, high solar irradiance contributes to bleaching in shallow-water corals.



**Extreme low tides**  
Exposure to the air during extreme low tides can cause bleaching in shallow corals.



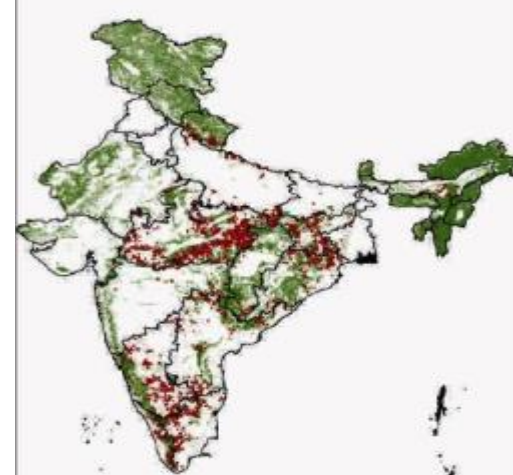
Invasive African cat fish *Clarias gariepinus* were posing threat to birds and other wildlife especially aquatics of the Park.



## Predation



## Over Population



a Lantana camara



Fire storm



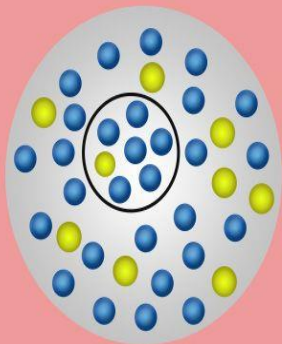


# Ecological crisis

- Ecological crises vary in length and severity
- Occur within a few months or taking as long as a few million years.
- They can also be of natural or anthropic origin.
- They may relate to one unique species or to many species, as in an [Extinction event](#).
- An ecological crisis may be local (as an [oil spill](#)) or global (a rise in the sea level due to [global warming](#)).
- This may lead to bottle neck effect or founder effect

# Founder Effect

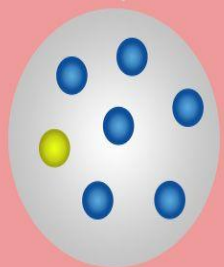
# Bottleneck Effect



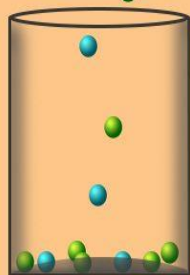
Original Population



Critical Event



New Population



## FOUNDER EFFECT

The phenomenon, which occurs when a small group of individuals becomes isolated from a large population

One origin of the bottleneck effect

Causes: Migration of very small individuals from the main population

Does not affect the original population

Probability of Inbreeding: High

Produces a population with a non-random sample of genes of the original population

## BOTTLENECK EFFECT

The phenomenon, which occurs when a population rapidly decreases in size

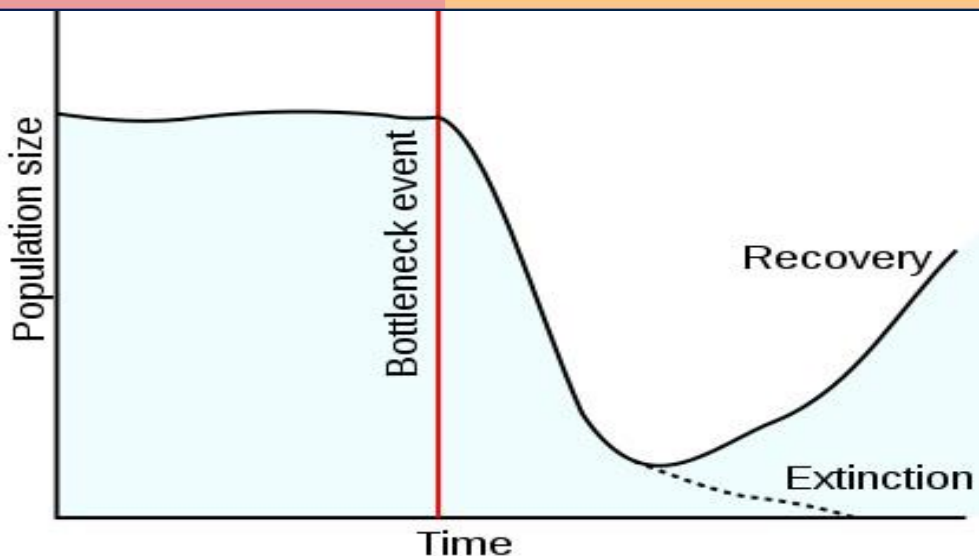
Can have different origins

Causes: A sharp reduction of the population size by environmental events such as droughts, floods, fires, earthquakes, diseases, etc.

Affects the original population

Probability of Inbreeding: Very high

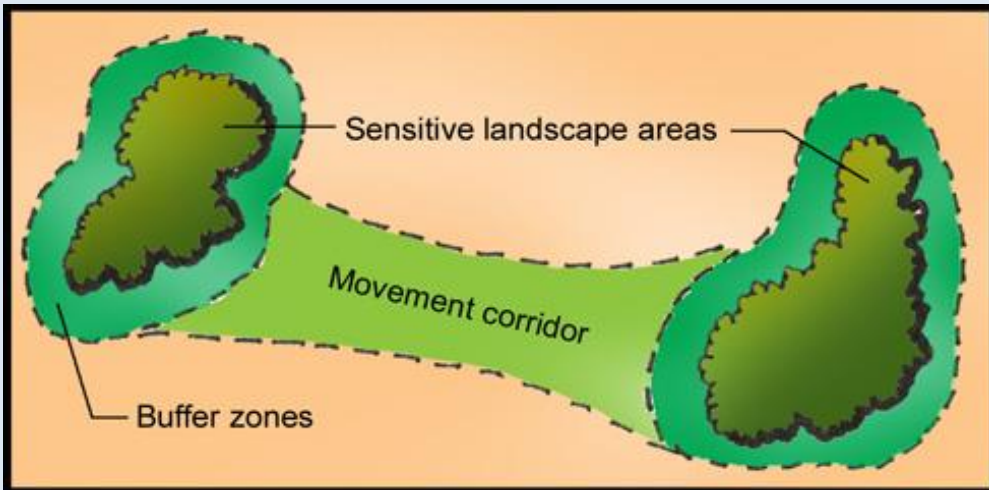
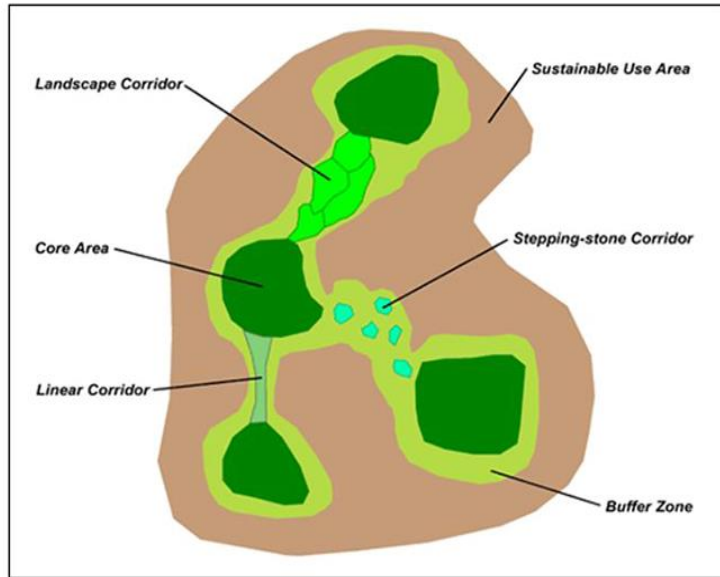
Occurs due to the random sampling of genes from the original population





# Habitat (Movement) Corridors:

-strips or clumps of habitat that connect small isolated habitats to larger, continuous habitats



This large illustration depicts a diverse landscape with various habitat types and their interactions. Key features and their functions are highlighted in text boxes:
 

- Large patches of native vegetation provide core habitat:** A large green mountain peak.
- Floodplain inundation triggers plant regeneration and provides habitat for aquatic species:** A blue river and its surrounding wetlands.
- Long distance movement of migratory species:** A flock of birds flying across the sky.
- 'Buffers' around natural areas protect them from external threats:** Yellow dashed lines surrounding a natural area.
- Native grasslands provide habitat and pasture:** A field with cows grazing.
- Fauna moving through the landscape disperse pollen and seed:** Birds and insects near a field.
- Migratory bird species rely on important wetland and shore habitats:** A wetland area near a body of water.
- Linear strips of roadside and fence line vegetation form movement corridors:** A road with trees and a fence line.
- 'Stepping stones' of native vegetation such as paddock trees help connect patches:** Small trees scattered in a field.
- Sensitively designed urban parks and gardens contribute habitat for native species:** A residential area with green spaces.
- Free-flowing rivers transport nutrients and sediments to the sea:** A river flowing towards the ocean.
- Fish travel between fresh and saltwater environments at different life cycle stages:** A boat on the ocean.



# Ecological crisis

- According to its degree of endemism, a **local crisis will have more or less significant consequences, from the death of many individuals to the total extinction of a species.** Whatever its origin, **disappearance of one or several species often will involve a rupture in the [food chain](#)**, further impacting the survival of other species.
  - Gharial mortality in Chambal
- **In the case of a global crisis**, the consequences can be much more significant; **some extinction events showed the disappearance of more than 90% of existing species at that time.** However, it should be noted that the disappearance of certain species, such as the **dinosaurs, by freeing an ecological niche, allowed the development and the diversification of the mammals.** An ecological crisis thus paradoxically favored biodiversity.
  - Decline in Tiger population

## Challenges- Development vs conservation

- **Advocating actions and policies for nature conservation.**
- Reduction and clean up of pollution, (Green house gases) : **Green India Mission**
- Reducing societal consumption of non-renewable fuels; development of alternative, green, low-carbon or renewable energy sources;
- Conservation and sustainable use of scarce resources such as water, land, and air;
- Protection of representative or unique or pristine ecosystems;
- Preservation of threatened and endangered species;

# Challenges

- Establishment of [nature](#) and biosphere reserves;
- Man animal conflicts
- Protection of [biodiversity](#) and ecosystems upon which all human and other life on earth depends
- [Megaprojects](#) - pose special challenges and risks to the natural environment
- Disaster management – drought, flood, fire, land slides, avalanches
- Weed eradication and invasive alien species
- Climate change and migration of species



Thank you