Forest Ecology

LESSON PLAN FOR FOREST ECOLOGY

Learning Unit	Contents		Sessions
1- Introduction	Definition, Scope		1
2- Ecological Factors	Climatic Factors	Solar Radiation - Light, Heat, Temperature	3
		Moisture	
		Wind	
	Edaphic Factors	Soil Formation	
		Soil Profile	
		Soil Properties	
		Soil Structure	
		Soil Water, Soil Air, Relationship	
		Soil Organic Matter	

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Learning Unit	Contents		Sessions
2- Ecological Factors	Physiographic Factors	Configuration of Land Surface	
		Altitude	
		Slope	
		Aspect and Exposure	
	Biotic Factor	Weeds	
		Parasites	
		Grazing	
		Fire	
		Man Animal Conflict	
3- Ecosystem	Component of Ecosystem	Concept of Ecosystem	2
		Ecosystem Energetic - Primary & Secondary Production, Food Chains	
		Biogeochemical Cycles	
	Major Ecosystems	Terrestrial	
		Aquatic	

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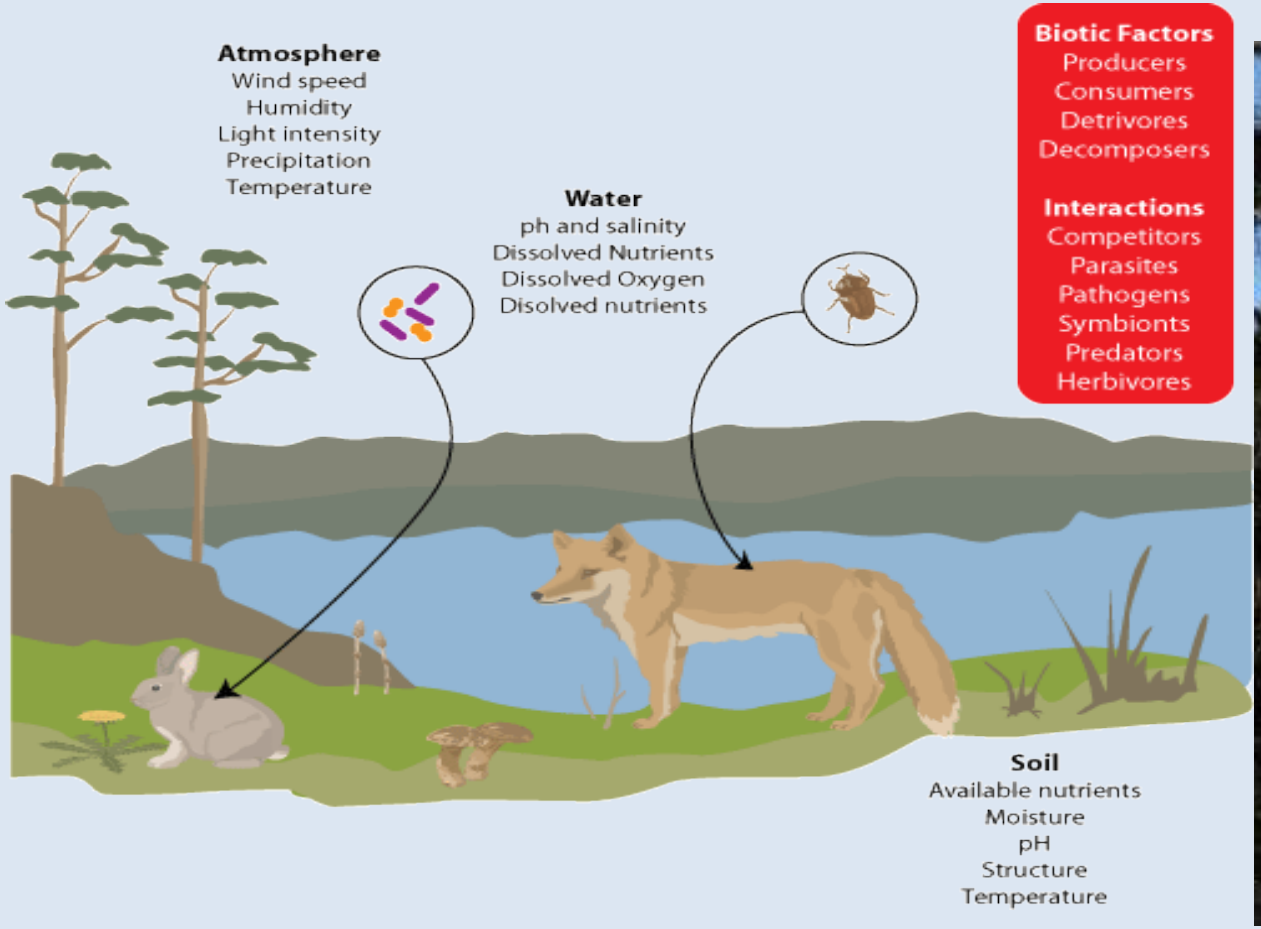
Learning Unit	Contents		Sessions
4-Forest biomes	Introduction, Types	Deserts Cold & Hot	1
		Grass Land	
		Tidal Forest	
		Wetlands	
		Climatic Climax Forest	
		Secondary Forest	
5- Basic Components of Ecosystems	Communities	Communities Structure, Disturbance	2
	Population	Properties, Growth, Regulation, Competition	

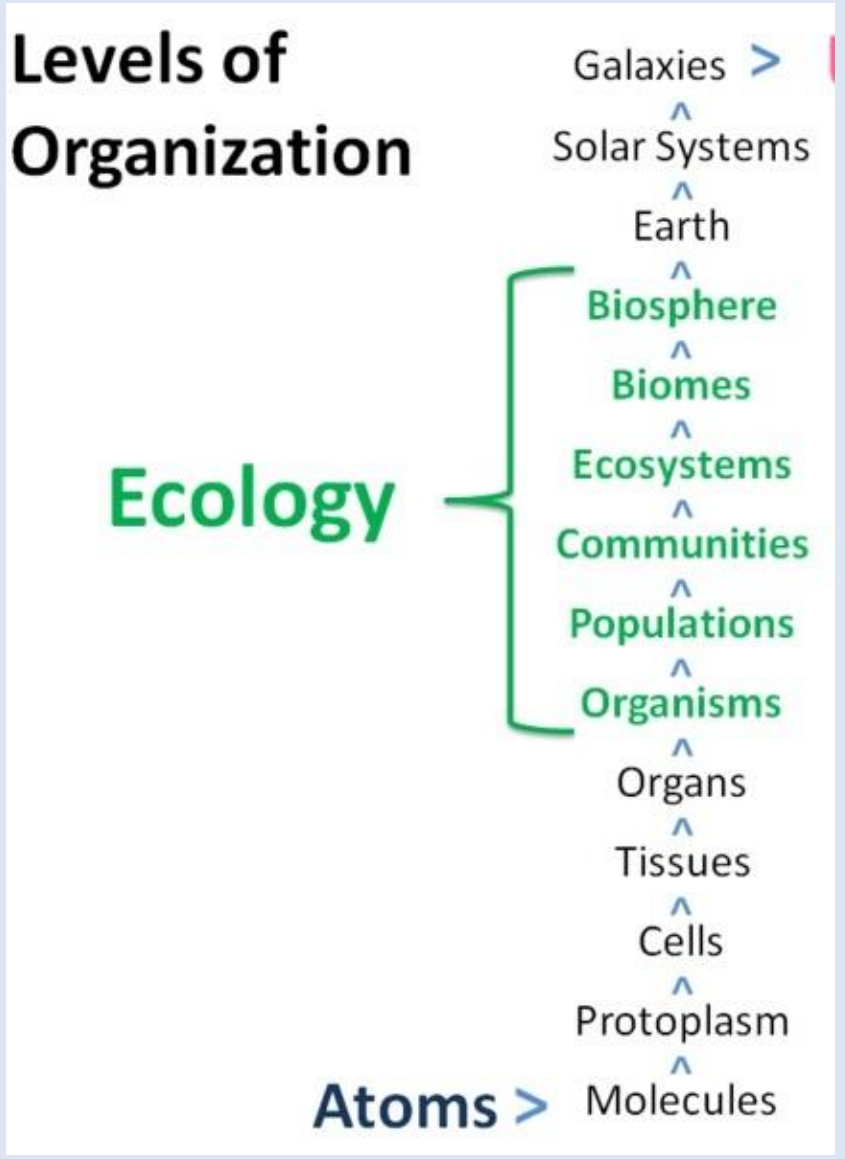
LESSON PLAN FOR FOREST ECOLOGY

Learning Unit	Contents		Sessions
6- Succession	Introduction, Kinds	Mono-climax Theory	1
		Poly-climax Theory	
		Kinds of Succession	
7- Adaptations	Plants		1
	Animals		
8- Ecological Indicators	Ecological Indicators		
9- Invasive Alien Species	Invasive Alien Species		1
10- Phytogeographical Zones	Phytogeographical Zones		1
11- Zoogeographical Zone	Zoogeographical Zone		1
12- Classification of Forests	Introduction & Types		4
	Champion & Seth's		

Ecology (from Greek: οἶκος, *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

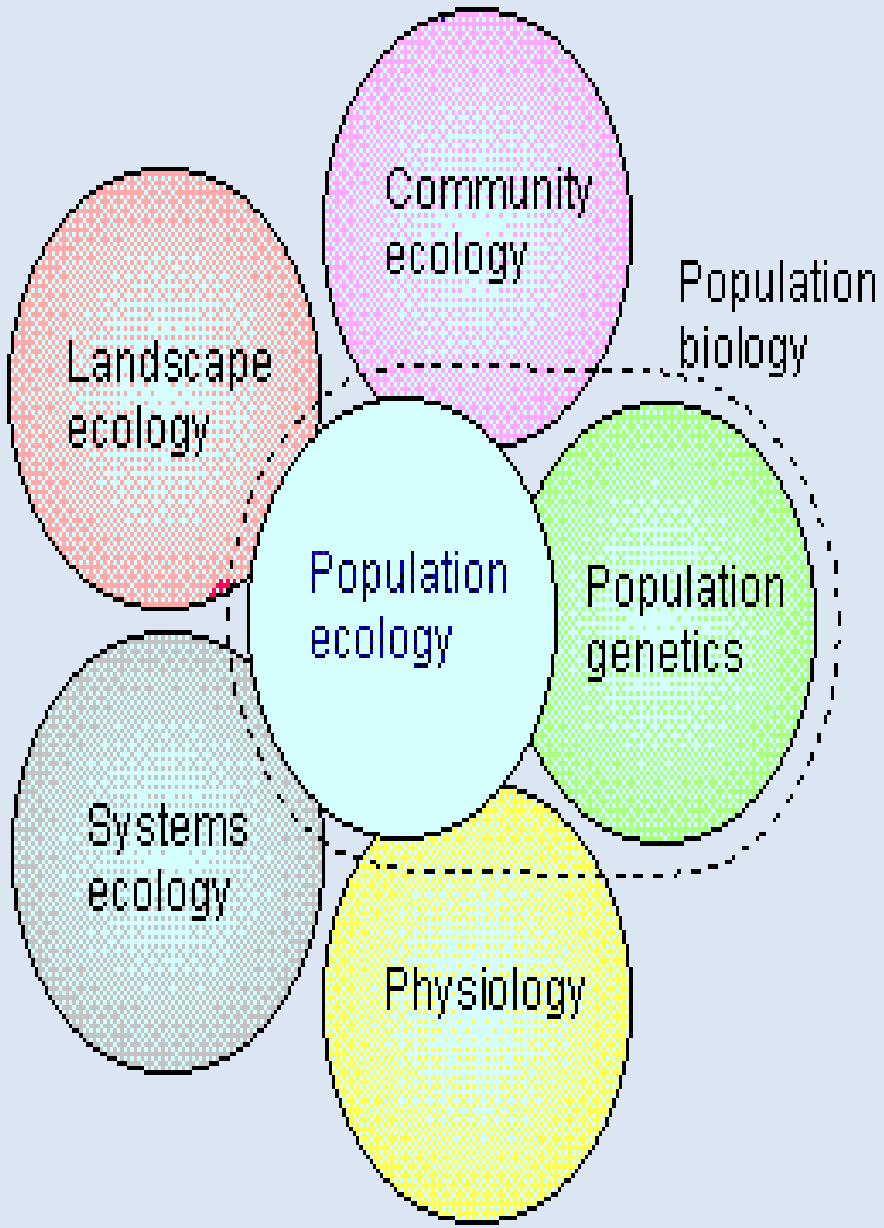
Living (Bio) + Component		(=) Resultant Bio-system	Discipline Concerned with the enquiry
Genes	Abiotic environment	Genetic Systems	Genetics
Cells		Cell System	Cytology
Tissues		Tissue System	Histology
Organs		Organ System	Anatomy, Physiology
Organisms		Organismic System	
Populations		Population System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

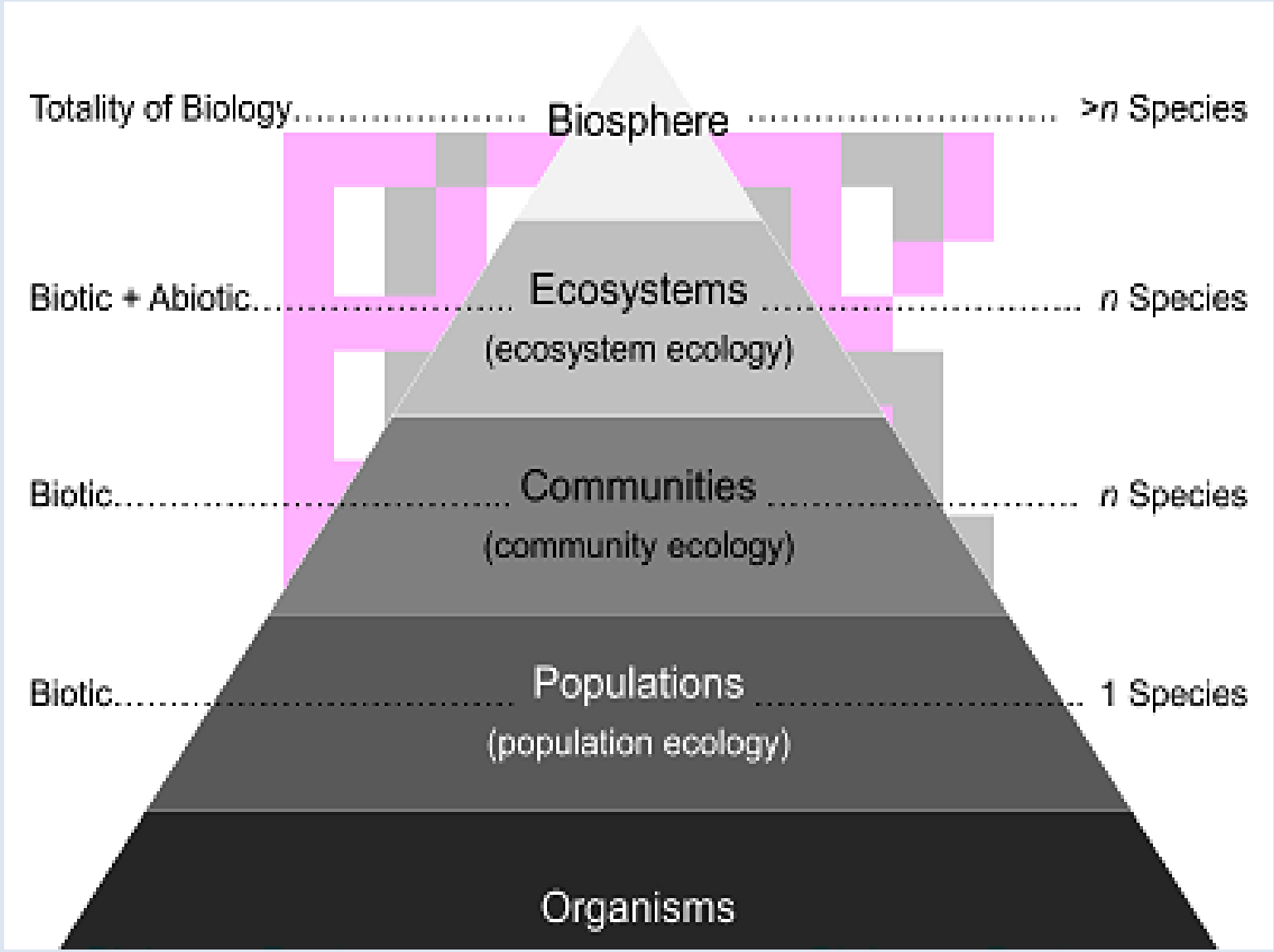
S. No.	Level	Description
1	Organism	An individual plant or animal
2	Population	A group of individuals of one species
3	Community	The sum of populations of different species within a given area
4	Ecosystem	The sum of the communities and the non-living environment in an area
5	Biosphere	The sum of all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

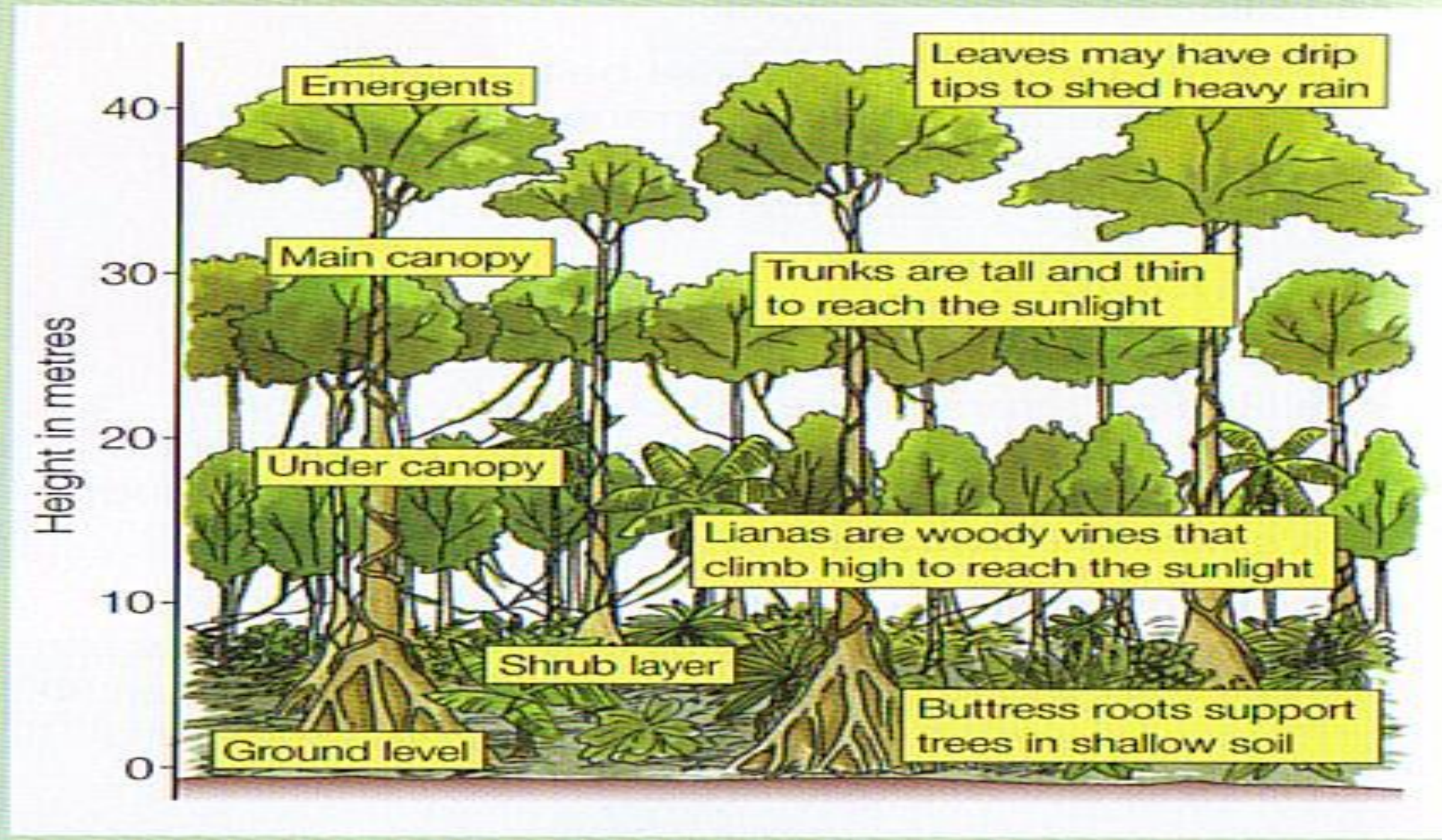
Disciplines of ecology

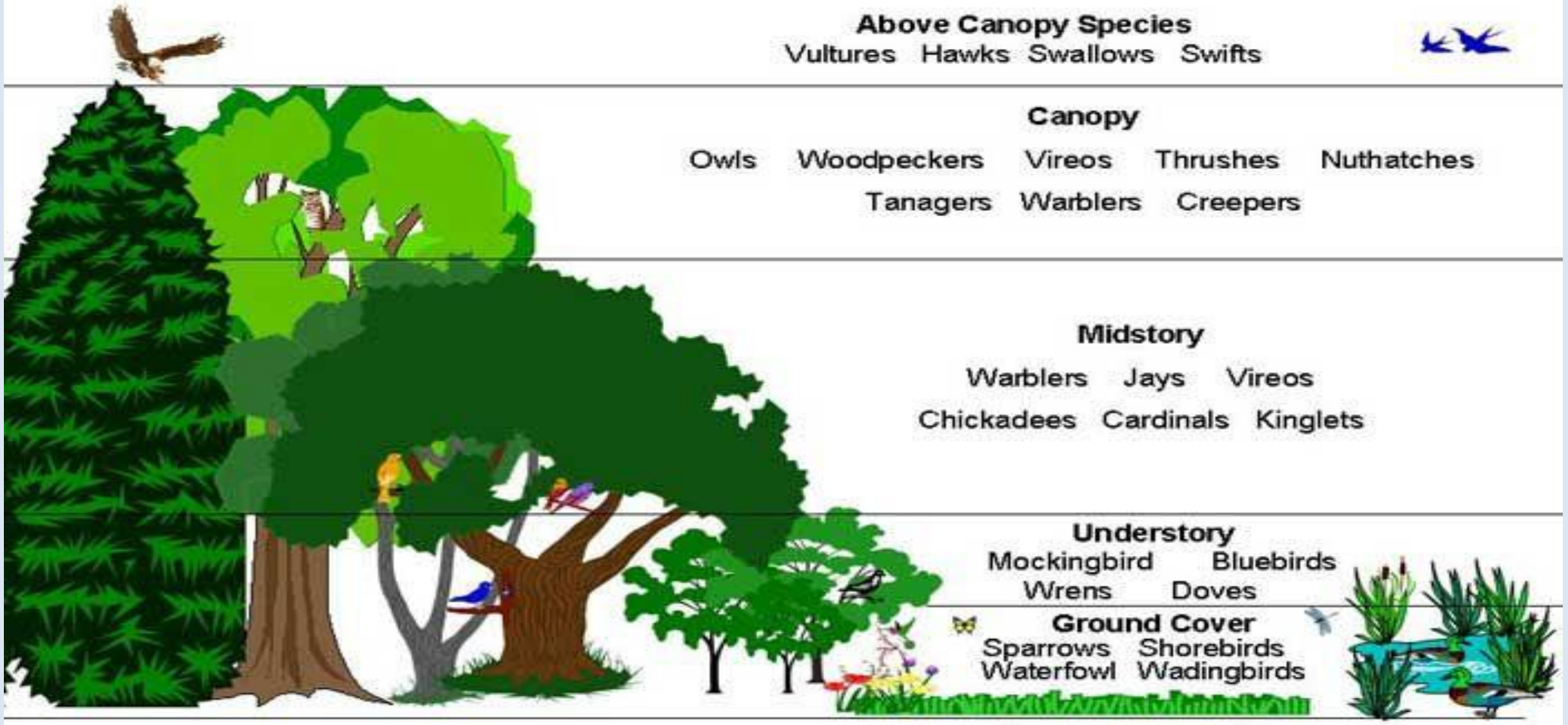




Forest Ecology

- **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.

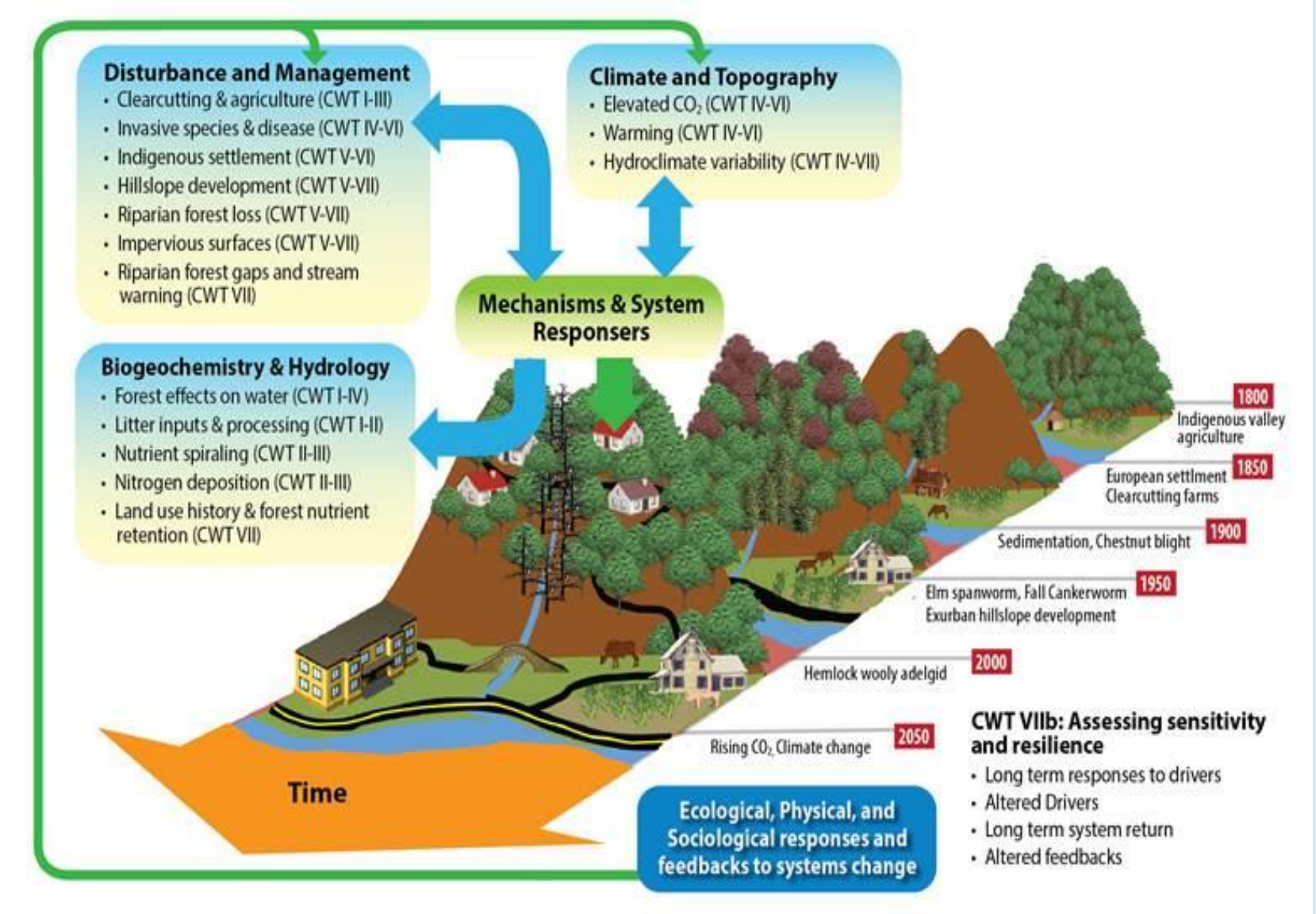

Emergents
Leaves may have drip tips to shed heavy rain
Main canopy
Trunks are tall and thin to reach the sunlight
Under canopy
Lianas are woody vines that climb high to reach the sunlight
Shrub layer
Buttress roots support trees in shallow soil
Ground level
Height in metres
40
30
20
10
0



Canopy		Midstory	Understory		Ground Cover	
Junipers	Hickories	Ash	**Tall Shrubs**	**Low Shrubs**	**Prairie**	**Wetland**
Pines	Oaks	Maples	Dogwoods	Agaritas	Gramas	Sedges
Cedars	Elms	Sweetgum	Viburnums	Yaupons	Bluestems	Rushes
Maples	Pecans	Hackberries	Hawthorne	Wax Myrtles	Paspalums	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

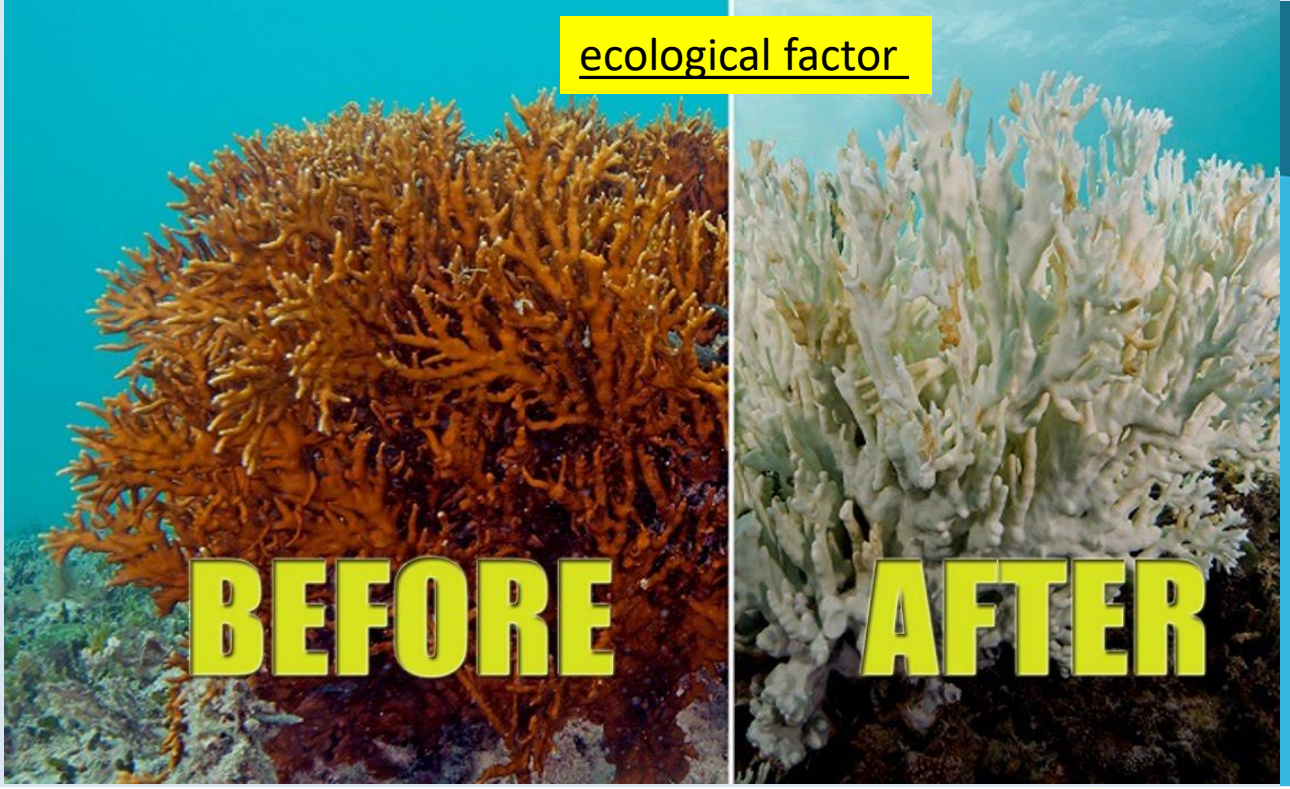
PLANNING APPLICATIONS

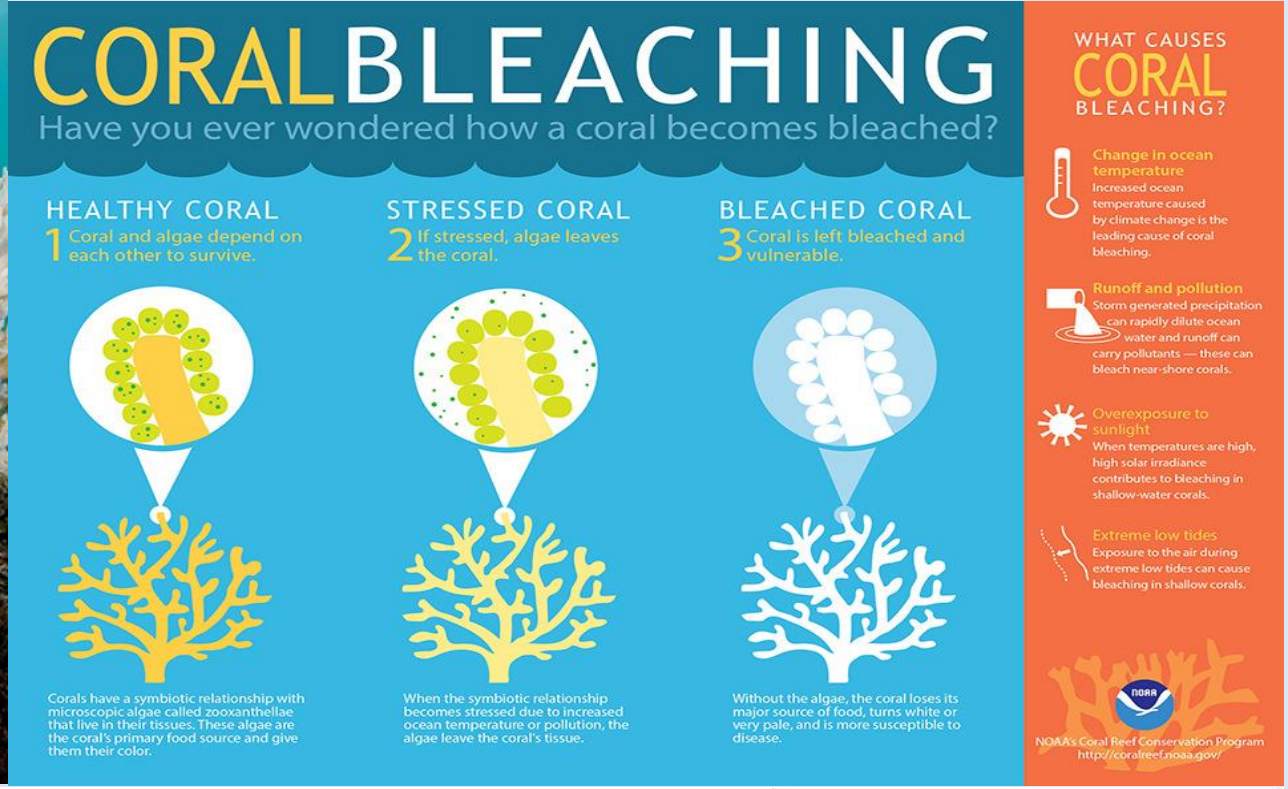
- Set objectives and targets for biodiversity in plans
- Manage biodiversity at multiple levels of biological organization and multiple time and spatial scales
- Incorporate spatial and temporal approaches to land use that are compatible with an area's natural potential
- Avoid land uses that convert 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

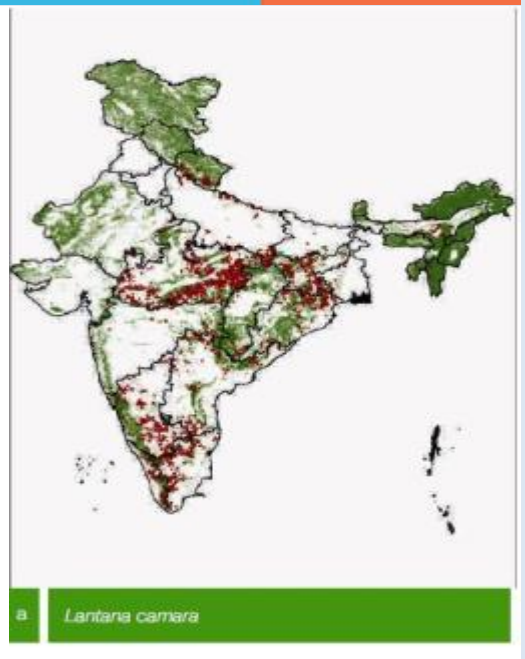




Invasive African cat fish *Clarias gariepinus* were posing threat to birds and other wildlife especially aquatics of the Park.

Predation

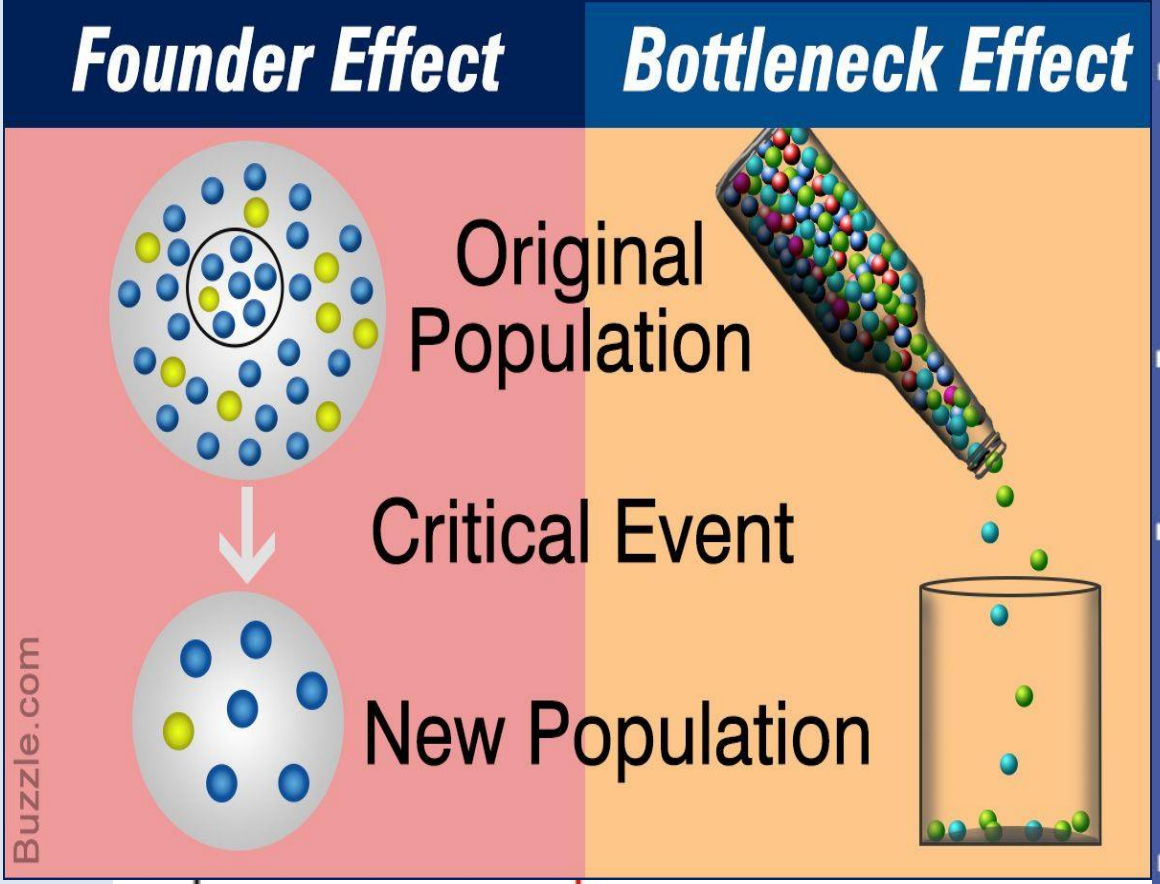
Over Population

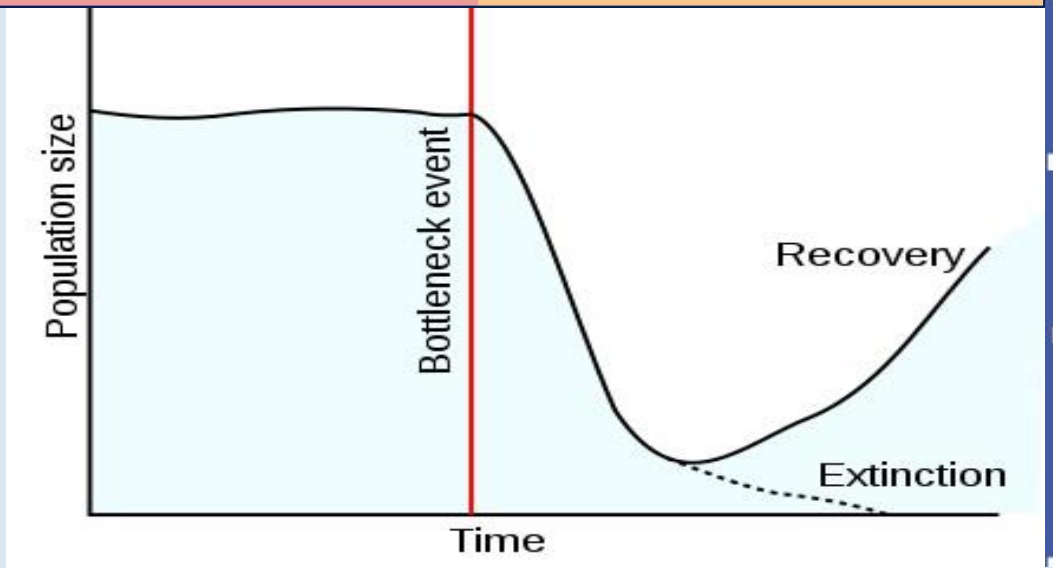



Fire storm

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

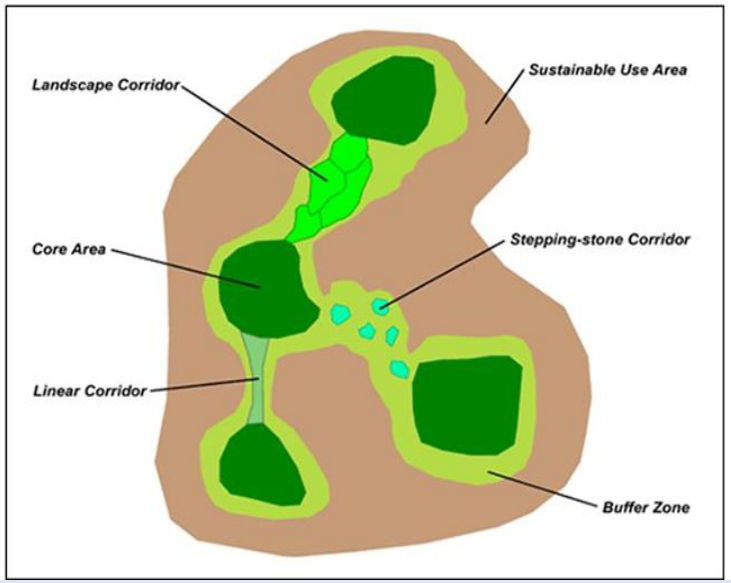


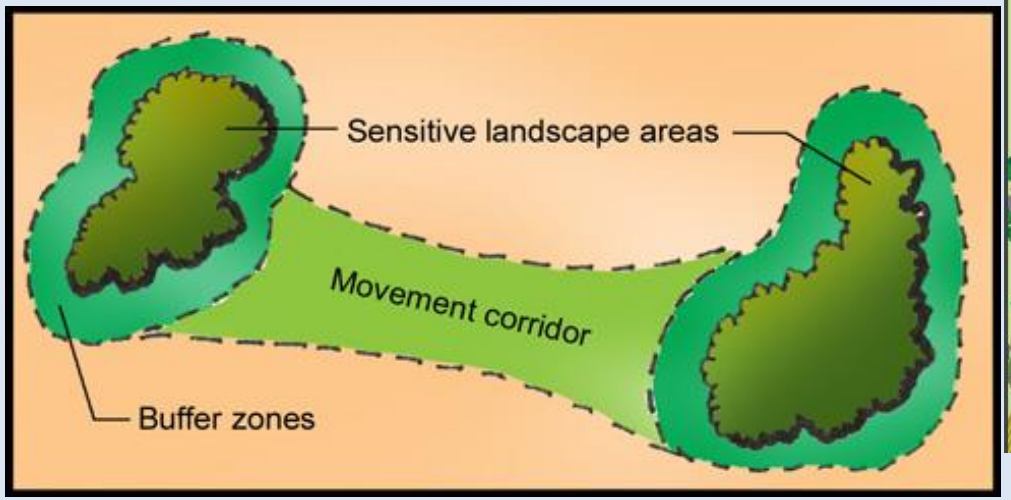


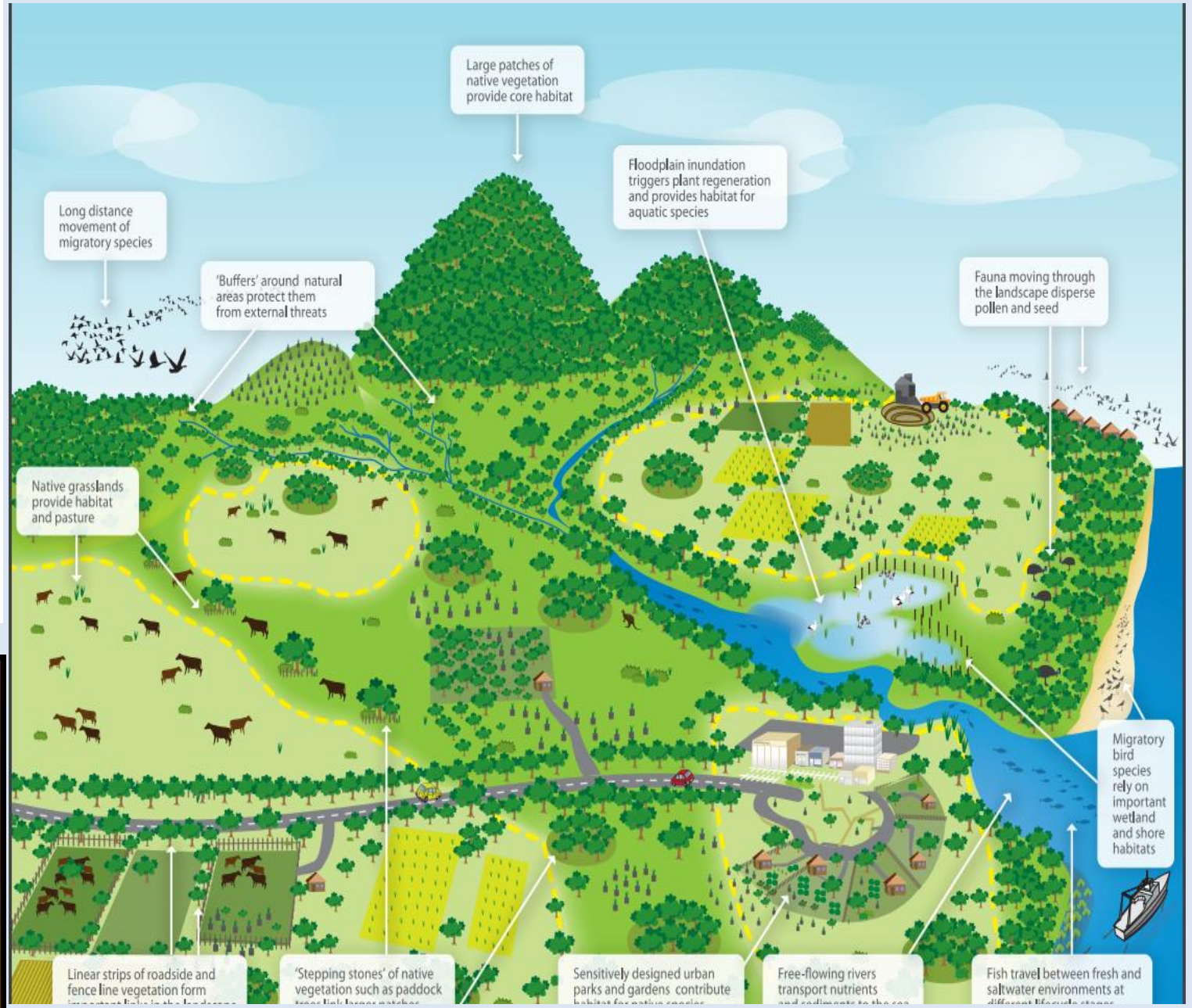
FOUNDER EFFECT	BOTTLENECK EFFECT
The phenomenon, which occurs when a small group of individuals becomes isolated from a large population	The phenomenon, which occurs when a population rapidly decreases in size
One origin of the bottleneck effect	Can have different origins
Causes: Migration of very small individuals from the main population	Causes: A sharp reduction of the population size by environmental events such as droughts, floods, fires, earthquakes, diseases, etc.
Does not affect the original population	Affects the original population
Probability of Inbreeding: High	Probability of Inbreeding: Very high
Produces a population with a non-random sample of genes of the original population	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







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