Forest Ecology, Biodiversity and Management (FRM-512)

Practical Manual

For

M. Sc. (Forestry) Silviculture and Agroforestry



Dr. Swati Shedage



College of Horticulture and Forestry Rani Lakshmi Bai Central Agricultural University, Jhansi (UP) - 284003. India

Content

Sl. No.	Торіс	Page No.
1.	Study of forest succession	
2.	Study of the forest community structure	
3.	Study of the forest population and dynamics	
4.	Study of forest productivity estimation methods	
5.	Study of vegetation analysis	
6.	Study of CVP Index for forest vegetation	
7.	Study of forest biomass	
8.	Study of quantification of litter production in the forest	
9.	Visit of national park	
10.	Visit of wildlife sanctuary	
11.	Visit of botanical garden	
12.	Visit of arboretum	
13.	Collection and preservation of plant specimen	

Study of forest succession

Introduction: Succession is a fundamental process in ecology in which ecosystems recover after disturbances. Understanding the mechanisms that determine how young tropical forests change during succession is crucial because approximately half of the world's tropical forests are regenerating after farmland abandonment, and succession forests are now expected to supply the vast majority of ecosystems services that were provided by old growth forests (e.g. carbon sequestration). Edaphic factors, initial conditions, and competition have been proposed to be key drivers that influence tropical forest succession; however, how these drivers alter succession remains poorly understood. For my doctoral dissertation research, I used census data from a young tropical dry forest, and a large-scale field experiment in a tropical moist forest to examine the combined effects of edaphic factors and initial conditions on forest succession, as well as the effect of lianas on trees, an intense form of plant competition, on forest succession.

Objectives: The goal of the study of ecological succession is to understand the mechanisms responsible for changes in species' density, diversity, and ecosystem processes

What are the different stages of ecological succession?

						•••••
						•••••
•••••					• • • • • • • • • • • • • • • • • • • •	• • • • • • • • • • • • • • • • • • • •
•••••	•••••	• • • • • • • • • • • • • • • • • • • •	••••••	• • • • • • • • • • • • • • • • • • • •	• • • • • • • • • • • • • • • • • • • •	• • • • • • • • • • • • • • • • • • • •
•••••	•••••	• • • • • • • • • • • • • • • • • • • •	•••••	• • • • • • • • • • • • • • • • • • • •	• • • • • • • • • • • • • • • • • • • •	•••••
•••••	•••••	•••••	•••••	•••••	•••••	•••••
•••••	•••••	• • • • • • • • • • • • • • • • • • • •	••••••	• • • • • • • • • • • • • • • • • • • •	• • • • • • • • • • • • • • • • • • • •	•••••
						•••••
•••••	•••••	•••••	•••••	• • • • • • • • • • • • • • • • • • • •	•••••	•••••
••••••••	••••••	• • • • • • • • • • • • • • • • • • • •	••••••	• • • • • • • • • • • • • • • • • • •	•••••	••••••
						•••••
•••••						• • • • • • • • • • • • • • • • • • • •
			••••••			•••••

.....

.....

Review the cases on ecological succession in tropical forests

Study of the forest community structure

Introduction: Structure is a fundamental notion referring to patterns and relationships within a more or less well-defined system. "Forest structure" usually refers to the way in which the attributes of trees are distributed within a forest ecosystem. The structure of a forest is the result of natural processes and human disturbance. Important natural processes are species-specific tree growth, mortality and recruitment and natural disturbances such as fire, wind or snow damage. In addition, human disturbance in the form of clearfellings, plantings or selective tree removal has a major structuring effect.

Objectives: To study forest structure and diversity with particular reference to CCF methods of ecosystem management.

•••••	•••••••••••••••••••••••••••••••••••••••	•••••	•••••
	••••••	••••••	
	•••••••••••••••••••••••••••••••••••••••	••••••	
••••••	••••••	•••••	
••••••	••••••	•••••	••••••
•••••••••••••••••••••••••••••••••••••••	•••••••••••••••••••••••••••••••••••••••	•••••	•••••
••••••	••••••	••••••	•••••
	•••••••••••••••••••••••••••••••••••••••	•••••	
	••••••	•••••	
••••••	••••••	•••••	•••••
••••••	•••••••••••••••••••••••••••••••••••••••	•••••	•••••
••••••	••••••	•••••	•••••
••••••	••••••	••••••	•••••
		•••••	•••••

What are the different methods used to measure forest community structure?

Review the cases on forest community structure

•••••••••••••••••••••••••••••••••••••••

Study of the forest population and dynamics

Introduction: Forest dynamics encompass changes in stand structure, species composition, species interactions with disturbance type and severity, and disturbance interactions with landform, over a range of spatial and temporal scales. The changes start with forest development and succession, which sets the stage for discussions of species-disturbance interactions, integration of neighborhood effects into cross-scale dynamics, and categories of landscape dynamics. Stand development is directional change in structure over time, whereas succession is directional change in species composition, where early-successional species are replaced by late-successional species

Objectives: To study forest population dynamics

What are the different developmental stages of forest population dynamics?

_____

.....

Activities: Estimate Population dynamics of tree species of nearby forest

Study of forest productivity estimation methods

Introduction: Forest productivity is often defined as the standing forest volume at a given time t, V_t , which is the cumulative increase of stand volume since the stand was initiated (at $t=t_0$). It is referred to as yield in studies of forest growth and yield. Typically, the term productivity is used to account for the accumulation of aboveground stem wood in standing trees, although it may also include below-ground accumulation. Productivity distinguishes between primary productivity (the rate at which energy is stored by photosynthetic and chemosynthetic activity of producer organisms, chiefly green plants) and secondary productivity (the rate at which the carbon stored by primary producers is assimilated by animals or decomposers). Primary productivity is further divided into gross primary productivity, "the total rate of photosynthesis including the organic matter used up in respiration during the measurement period," and net primary productivity (NPP), "the rate of storage of organic matter in plant tissues in excess of the respiratory utilization by the plants during the period of measurement." In the context of a forest, NPP includes not only the biomass in trees, but also that in herbs and shrubs, although the biomass of herbs and shrubs is usually negligible compared with that of trees. These definitions have become standard in the ecological literature. Thus, the net productivity of trees (the items of interest to most foresters) usually closely approximate the NPP. The term "productivity" is noteworthy because it is a rate and involves acquisition of photosynthate per unit time.

Objectives: To study forest productivity and different methods used for its estimation

What are the different methods used to measure forest productivity?

				••••••
•••••••	•••••••	••••••••••	•••••••	• • • • • • • • • • • • • • • • • • • •
	•••••••••	•••••••••••	• • • • • • • • • • • • • • • • • • • •	• • • • • • • • • • • • • • • • • • • •

Review the cases on forest productivity estimation

••••••
••••••
••••••
••••••
•••••••••••••••••••••••••••••••••••••••

Study of vegetation analysis

Introduction: Vegetation analysis is the way to study species composition and structure of plant community. Vegetation analysis is also known as phytosociological analysis. The following considerations should be taken into account before starting analysis: Too little or too much data and a lack or excess of data must be avoided. Vegetation data must be selective since it would be impractical to undertake total recording or description of vegetation. Time and expenses should be considered. Most useful information with the least amount of time and money is desired. The nature of the vegetation must be assessed. If it is homogenous then quantitative data will be collected because observable difference will be slight. If the vegetation is heterogeneous in nature then there might be qualitative differences. Therefore, it is important to know the type of data to collect and the spatial location of the sampling points

Objectives: To study different method of vegetation analysis

What are the different methods used to estimate vegetation data?

•••••	•••••	•••••	•••••	•••••	•••••		•••••	•••••	•••••
•••••	•••••	•••••	•••••	•••••	•••••			• • • • • • • • • • • • • • • •	•••••
•••••									•••••
•••••								• • • • • • • • • • • • • •	
									•••••
•••••	•••••	•••••	•••••	•••••	•••••		•••••	•••••	•••••
•••••	•••••	•••••	•••••	•••••	•••••		•••••	• • • • • • • • • • • • • • •	•••••
•••••	•••••	•••••	•••••	•••••	•••••	•••••	•••••	• • • • • • • • • • • • • • •	•••••
•••••	•••••	•••••	•••••	•••••	•••••	•••••	•••••	• • • • • • • • • • • • • • •	•••••
									•••••
•••••	• • • • • • • • • •	• • • • • • • • • • • •	•••••	•••••	•••••		•••••	• • • • • • • • • • • • • • •	••••
•••••	• • • • • • • • • •	• • • • • • • • • • • •	•••••	•••••	•••••			• • • • • • • • • • • • • • •	•••••
••••	• • • • • • • • • •	• • • • • • • • • • • •	• • • • • • • • • • • • •	•••••	• • • • • • • • • • • • •	• • • • • • • • • • • • • • • • • • • •	•••••	• • • • • • • • • • • • • • • •	•••••
•••••	• • • • • • • • • • •	•••••	• • • • • • • • • • • • • •		•••••				•••••

.....

Activities: Estimate phytosociological characters of given area by using quadrates method

Study of CVP Index for forest vegetation

Introduction: Climate is the prime factor that influences forest growth, composition and distribution. There are many ways to determine forest productivity in terms of climatic factors like temperature, precipitation, length of growing season, effective sun hour etc. When edaphic and topographic factors remain constant, climatic factors become more prominent for forest growth and productivity. Among many methods of assessment of forest productivity, Paterson's Climate Vegetation Productivity (CVP) index-requires less efforts and fieldwork to determine productive potential of any forest land. The index is not stand and species specific; hence, it can be put in use for overall assessment of the forest and vegetation productivity in any country, region and continent or even for the globe. This index may be used for comparison of forest lands, even non-forested lands with higher index value that may be established as a productive forest

Objectives: To study Paterson's Climate Vegetation Productivity (CVP) Index

Review the application of CVP index used for establish forest productivity

•••••	• • • • • • • • • • • • •	•••••	 • • • • • • • • • • • • • • • • •	•••••	•••••	•••••	•••••
•••••						•••••	
						•••••	
•••••						•••••	• • • • • • • • • • • • • • •
••••	• • • • • • • • • • • • •	• • • • • • • • • • • • • • • • •	 	••••	• • • • • • • • • • • • • • • • •	• • • • • • • • • • • • • • • • • • •	• • • • • • • • • • •
••••	• • • • • • • • • • • • •	• • • • • • • • • • • • • • • • •	 	••••	• • • • • • • • • • • • • • • • •	• • • • • • • • • • • • • • • • • • • •	• • • • • • • • • • • • • •
						••••••	
						••••••	
••••			 				
• • • • • • • • •			 				
•••••			 			•••••	
•••••			 		• • • • • • • • • • • • • • •	•••••	• • • • • • • • • • • • •
• • • • • • • • •			 				

Study of forest biomass

Introduction: Biomass is the living (and sometimes including recently dead) organic material synthesized by plants and other organisms. The accumulation of biomass in forests is greater than in other Earth biomes because trees must effectively lift their leaves above their neighbors in order to compete for the light resource; hence, forest biomass provides the structural material that allows the plants to grow tall. The use of a suitable and rigor method to accurately estimate forest biomass is significant. Moreover, the world is increasingly facing the conflicting pressures of economic growth and environmental protection. Improving energy structure and vigorously developing biomass energy has become the development trend of energy utilization in the future. As energy plant is characterized by a large net accumulation of biomass. Therefore, the scientific evaluation of the size and potential of energy from plant also requires a suitable method for estimating biomass

Objectives: To study the methods to estimate forest biomass

What are different methods used to estimate forest biomass

• • • • • • • • • • • • • • • • • • • •		• • • • • • • • • • • • • • • • • • • •	• • • • • • • • • • • • • • • • • • • •	• • • • • • • • • • • • • • • • • • • •
•••••	• • • • • • • • • • • • • • • • • • • •	•••••	•••••	• • • • • • • • • • • • • • • • • • • •
• • • • • • • • • • • • • • • • • • • •		• • • • • • • • • • • • • • • • • • • •	•••••	• • • • • • • • • • • • • • • • • • • •
•••••		•••••	•••••	•••••
			• • • • • • • • • • • • • • • • • • • •	• • • • • • • • • • • • • • • • • • • •
		•••••	•••••	••••••
••••••		••••••	•••••	• • • • • • • • • • • • • • • • • • • •
••••••				• • • • • • • • • • • • • • • • • • • •

•••••••••••••••••••••••••••••••••••••••
Activity: Estimate the tree biomass of given area by using biomass expansion factor method
Activity: Estimate the tree biomass of given area by using biomass expansion factor method
Activity: Estimate the tree biomass of given area by using biomass expansion factor method
Activity: Estimate the tree biomass of given area by using biomass expansion factor method
Activity: Estimate the tree biomass of given area by using biomass expansion factor method
Activity: Estimate the tree biomass of given area by using biomass expansion factor method
Activity: Estimate the tree biomass of given area by using biomass expansion factor method
Activity: Estimate the tree biomass of given area by using biomass expansion factor method
Activity: Estimate the tree biomass of given area by using biomass expansion factor method
Activity: Estimate the tree biomass of given area by using biomass expansion factor method
Activity: Estimate the tree biomass of given area by using biomass expansion factor method
Activity: Estimate the tree biomass of given area by using biomass expansion factor method
Activity: Estimate the tree biomass of given area by using biomass expansion factor method

Study of quantification of litter production in the forest

Introduction: Litter and litter fall are used to refer to all organic material that falls from forest vegetation greater than 2 m in height. This includes leaves, woody debris, fruits, berries, lichens, flowers, and other organic matter. Leaves, leaf litter, and leaf-litter fall refer only to the leaf component of litter, excluding all non-leaf material. Production (or productivity) refers specifically to litter or leaf litter; it is that component of primary production that actually results in substance that falls from the vegetation to the forest floor. Production that is incorporated in growth or otherwise reabsorbed or grazed before it is released as litter fall is not included in this component. Litter represents an important link between forest community composition, productivity and biomass, and ecosystem processes

Objectives: To study quantification of litter production

Write the procedure of leaf litter quantification

••••	•••••	•••••	• • • • • • • • • • • • • • • • • • • •	•••••	• • • • • • • • • • • • • • •	•••••	•••••	• • • • • • • • • • • • • • • • • •	•••••
•••••	•••••		•••••		•••••	•••••	•••••	• • • • • • • • • • • • • • • • • • • •	•••••
•••••	•••••				• • • • • • • • • • • • • •			• • • • • • • • • • • • • • •	•••••
•••••	•••••	•••••••		•••••••	• • • • • • • • • • • • • • •	•••••	••••••	• • • • • • • • • • • • • • • • • • • •	•••••
•••••	•••••				• • • • • • • • • • • • •			• • • • • • • • • • • • • •	
•••••	•••••								
•••••									
•••••									•••••
•••••	•••••				• • • • • • • • • • • • • •	•••••	•••••	• • • • • • • • • • • • • • • •	•••••
•••••	•••••	••••••	•••••	•••••	• • • • • • • • • • • • • • •	•••••	•••••	•••••	• • • • • • • •
•••••	•••••				• • • • • • • • • • • • • •	•••••	••••••	• • • • • • • • • • • • • • • • • • • •	•••••

•••••••••••••••••••••••••••••••••••••••
•••••••••••••••••••••••••••••••••••••••
Activity: Quantify leaf litter production of given tree species
•••••••••••••••••••••••••••••••••••••••
•••••••••••••••••••••••••••••••••••••••
•••••••••••••••••••••••••••••••••••••••
•••••••••••••••••••••••••••••••••••••••
•••••••••••••••••••••••••••••••••••••••
•••••••••••••••••••••••••••••••••••••••
•••••••••••••••••••••••••••••••••••••••
•••••••••••••••••••••••••••••••••••••••
••••••
•••••••••••••••••••••••••••••••••••••••
•••••••••••••••••••••••••••••••••••••••
•••••••••••••••••••••••••••••••••••••••
••••••

Visit of national park

Objectives: To study ecology and biodiversity of national park

Q.1	Where did you visit?
Q.1	where did you visit?
Q.2	Write forest characteristics
x	
Q.3	Write species diversity (Trees, animals, birds)
Q.4	Estimate species density, abundance, frequency by using quadrate method

Visit of wildlife sanctuary

Objectives: To study ecology and biodiversity of wildlife sanctuary

Q.1	Where did you visit?
V •1	
Q.2	Write forest characteristics
Q.3	Write species diversity (Trees, animals, birds)
_	
Q.4	Estimate species density, abundance, frequency by using quadrate method
×.	

Visit of Botanical garden

Objectives: To study ecology and biodiversity of Botanical garden

Q.1	Where did you visit?
V •1	
Q.2	Write forest characteristics
Q.3	Write species diversity (Trees, animals, birds)
_	
Q.4	Estimate species density, abundance, frequency by using quadrate method
C	

Visit of arboretum

Objectives: To study ecology and biodiversity of arboretum

01	Whore did you visit?
Q.1	Where did you visit?
Q.2	Write forest characteristics
Q.2	while forest characteristics
Q.3	Write species diversity (Trees, animals, birds)
Q.4	Estimate species density, abundance, frequency by using quadrate method
Q.4	Estimate species density, abundance, nequency by using quadrate method
L	

Collection and preservation of plant specimen

Introduction: Preserved plant specimens provide us with important information about plant diversity and distribution, in a relatively permanent and verifiable form that serves as evidence of a plant's existence in time and space. If these specimens are properly preserved and maintained, they can last for well over 200 years. In a time where we are experiencing rapid habitat loss, herbaria provide important repositories for these sorts of data, and ensure their availability for future research. It is particularly important that plant collections be made in such a manner as to increase their longevity as preserved herbarium specimens, as well as optimize their usefulness for future research.

Objectives: To collect and preserve plant specimen (herbarium preparation)

Write steps involved in collection and preservation of plant specimen

..... _____

• • • • • • • • • • • • • • • • • • • •		 •••••		• • • • • • • • • • • • • • • • • • • •
• • • • • • • • • • • • • • • • • • • •	• • • • • • • • • • • • • • • • • • • •	 •••••		• • • • • • • • • • • • • • • • • • • •
• • • • • • • • • • • • • • • • • • • •	• • • • • • • • • • • • • • • • • • • •	 •••••	• • • • • • • • • • • • • • • • • • • •	• • • • • • • • • • • • • • • • • • • •

GLOSSARY

Biodiversity- Biodiversity—short for biological diversity—means the diversity of life in all its forms—the diversity of species, of genetic variations within one species, and of ecosystems.

Biome- A major portion of the living environment of a particular region (such as a fir forest or grassland), characterised by its distinctive vegetation and maintained largely by local climatic conditions.

Carrying capacity The maximum number of people, or individuals of a particular species, that a given part of the environment can maintain indefinitely.

Co-management- The sharing of authority, responsibility, and benefits between government and local communities in the management of natural resources.

Conservation- The management of human use of nature so that it may yield the greatest sustainable benefit to current generations while maintaining its potential to meet the needs and aspirations of future generations.

Conservation of Biodiversity- The management of human interactions with genes, species, and ecosystems so as to provide the maximum benefit to the present generation while maintaining their potential to meet the needs and aspirations of future generations; encompasses elements of saving, studying, and using biodiversity.

Co-management- The management of a specific resource (such as a forest or pasture) by a well-defined group of resource users with the authority to regulate its use by members and outsiders.

Cultural diversity- Variety or multiformity of human social structures, belief systems, and strategies for adapting to situations in different parts of the world. Language is a good indicator of cultural diversity, with over 6,000 languages currently being spoken.

Ecology- A branch of science concerned with the interrelationship of organisms and their environment; the study of ecosystems.

Ecosystem- Ecosystems are self-regulating communities of plants and animals interacting with each other and with their non-living environment—forests, wetlands, mountains, lakes, rivers, deserts and agricultural landscapes.

Ecosystem diversity- The variety of ecosystems that occurs within a larger landscape, ranging from biome (the largest ecological unit) to microhabitat.

Eco Tourism -Travel undertaken to witness sites or regions of unique natural or ecologic quality, or the provision of services to facilitate such travel that have the least impact on biological diversity and the natural environment.

Endangered species- A technical definition used for classification referring to a species that is in danger of extinction throughout all or a significant portion of its range. IUCN The World Conservation Union defines species as endangered if the factors causing their vulnerability or decline continue to operate.

Evolution- Any gradual change. Organic evolution is any genetic change in organisms from generation to generation.

Ex situ conservation- A conservation method that entails the removal of germplasm resources (seed, pollen, sperm, individual organisms, from their original habitat or natural environment. Keeping components of biodiversity alive outside of their original habitat or natural environment.

Extinction- The evolutionary termination of a species caused by the failure to reproduce and the death of all remaining members of the species; the natural failure to adapt to environmental change.

Fauna- All of the animals found in a given area.

Flora- All of the plants found in a given area.

Gene- The functional unit of heredity; the part of the DNA molecule that encodes a single enzyme or structural protein unit.

Gene bank- A facility established for the ex situ conservation of individuals (seeds), tissues, or reproductive cells of plants or animals.

Genetic diversity The variety of genes within a particular populaton, species, variety, or breed.

Grassroots (organizations or movements) People or society at a local level, rather than at the center of major political activity.

Habitat- A place or type of site where an organism or population naturally occurs.

Habitat loss- The outcome of a process of land use change in which a 'natural'; habitat-type is removed and replaced by another habitat-type, such as converting natural areas to production sites. In such process, flora and fauna species that previously used the site are displaced or destroyed. Generally this results in a reduction of biodiversity.

Hotspot- An area on earth with an unusual concentration of species, many of which are endemic to the area, and which is under serious threat by people.

Indicator species- A species whose status provides information on the overall condition of the ecosystem and of other species in that ecosystem.

Indigenous people- People whose ancestors inhabited a place or country when persons from another culture or ethnic background arrived on the scene and dominated them through conquest, settlement, or other means and who today live more in conformity with their own social, economic, and cultural customs and traditions than with those of the country of which they now form a part. (also: 'native peoples' or 'tribal peoples')

In situ conservation- A conservation method that attempts to preserve the genetic integrity of gene resources by conserving them within the evolutionary dynamic ecosystems of the original habitat or natural environment.

Intellectual property rights- Rights enabling an inventor to exclude imitators from the market for a certain period of time.

Invasive species- Invasive species are those that are introduced—intentionally or unintentionally—to an ecosystem in which they do not naturally appear and which threaten habitats, ecosystems, or native species. These species become invasive due to their high reproduction rates and by competing with and displacing native species, that naturally appear in that ecosystem. Unintentional introduction can be the result of accidents (e.g. when species escape from a zoo), transport (e.g. in the ballast water of a ship); intentional introduction can be the result of e.g. importing animals or plants or the genetic modification of organisms.

Inventory- On-site collection of data on natural resources and their properties.

Land use- Land use refers to how a specific piece of land is allocated: its purpose, need or use (e.g. agriculture, industry, residential or nature).

Native species Flora and fauna species that occur naturally in a given area or region. Also referred to as indigenous species.

Overexploitation- Overexploitation occurs when harvesting of specimens of flora and fauna species from the wild is out of balance with reproduction patterns and, as a consequence, species may become extinct.

Patent- A government grant of temporary monopoly rights on innovative processes or products.

Protected Areas- An area of land and/or sea especially dedicated to the protection and maintenance of biological diversity, and of natural and associated cultural resources, and managed through legal or other effective means. A protected area can be under either public or private ownership.

Red List- The IUCN Red List of Threatened Species provides taxonomic, conservation status and distribution information on taxa that have been globally evaluated using the IUCN Red List Categories and Criteria. This system is designed to determine the relative risk of extinction, and the main purpose of the IUCN Red List is to catalogue and highlight those taxa that are facing a higher risk of global extinction (i.e. those listed as Critically Endangered, Endangered and Vulnerable). The IUCN Red List also includes information on taxa that are categorized as Extinct or Extinct in the Wild; on taxa that cannot be evaluated because of insufficient information (i.e. are Data Deficient); and on taxa that are either close to meeting the threatened thresholds or that would be threatened were it not for an ongoing taxon-specific conservation programme (i.e. are Near Threatened)

Rehabilitation- The recovery of specific ecosystem services in a degraded ecosystem or habitat.

Restoration- The return of an ecosystem or habitat to its original community structure, natural complement of species, and natural functions.

Seedbank- A facility designed for the ex situ conservation of individual plant varieties through seed preservation and storage.

Species- A group of organisms capable of interbreeding freely with each other but not with members of other species.

Species diversity- The number and variety of species found in a given area in a region.

Succession- The more or less predictable changes in the composition of communities following a natural or human disturbance.

Sustainable development- Development that meets the needs and aspirations of the current generation without compromising the ability to meet those of future generations.

Sustainable use- The use of components of biological diversity in a way and at a rate that does not lead to the long-term decline of biological diversity, thereby maintaining its potential to meet the needs and aspirations of present and future generations.

Taxonomy- The classification of animals and plants based upon natural relationships.

Threatened species- A technical classification referring to a species that is likely to become endangered within the foreseeable future, throughout all or a significant portion of its range.

Wild species- Organisms captive or living in the wild that have not been subject to breeding to alter them from their native state

Wild life- Living, non-domesticated animals. Some experts consider plants also as part of wildlife.