**Some current trends: Forest biodiversity**

Forest biodiversity is being lost at an alarming rate. Key publications such as the Millennium Ecosystem Assessment and the Red List of Threatened Species indicate that a large and increasing number of forest ecosystems, populations and species are threatened globally or being lost due to the loss and degradation of forest habitats, and that this reduction of forest biodiversity will be aggravated by the effects of climate change. Tropical moist forests are home to the largest number of threatened species of any biome. It is assumed that numerous, but not yet scientifically described, species are presently being lost together with their tropical forest habitats.

The percentage of forest area designated for the conservation of biological diversity has increased significantly between 1990 and 2005, with an estimated 11.2% of total forest area having this objective as its primary function. This positive trend was observed in all regions with the exception of Northern, Eastern and Southern Africa (FAO 2006b). However, it is often unclear how effective the protection of these areas is, and different forest types are represented very unequally in the total area of protected forests. The aim of the CBD to achieve effective protection of at least 10% of all forest types by 2010 will presumably not be met.

Forested wetlands represent a particularly vulnerable forest type. Forested wetlands are highly biodiversity-rich and provide significant ecosystem services, such as carbon sequestration, and they underpin productive fisheries. A significant proportion of Ramsar Sites include forested areas, although a lack of data constrains estimates of the extent of coverage of this forest type under existing protected area systems. Forested wetlands are vulnerable not only to excessive direct use, but also to the added threat of unsustainable water use.

Areas under agriculture and pasture are expanding, often at the expense of forest. The Millennium Ecosystem Assessment reports that agricultural land is expanding in approximately 70% of the countries examined. The impact of agricultural expansion has been particularly severe in tropical forest regions, where pasture and crop land is expected to continue to increase over the next 30 to 50 years.

**Growing pressure on forest in India**

Growing pressure on forest in India Due to various monogenetic reasons, the pressure on natural forest is increasing throughout the world. The forests today have at least five times more pressure than what they can withstand. Like many other developing countries, forests in India are also under tremendous pressure mainly as a result of increased demand for forest produce viz. fuel, fodder, timber, non timber forest produce, etc. by ever exploiting population of the country. Presently a major chunk of forest area in the country is under illegal encroachment. The collection of fuel wood is considerably higher than what can sustainably be removed from the forests. Forests also contribute major percentage of the fodder requirement for the cattle, including 178 million tons of green fodder and 145 million tons of dry fodder. It has been estimated that half of the livestock population i.e. 270 millions graze in forests. This demand gets accentuated due to the extraction of green fodder to the tune of 175-200 million ton annually.

Currently people occupy around 1.5 million hectares of forestland for agricultural purposes. The trend of diversion of forestlands for non forestry purposes though arrested after the Forest Conservation Act, 1980 came into force, still continues. These effects cumulatively cause loss of ecological stability and bio-diversity, reduction in carbon sink capability, climate change, floods, droughts, desertification, damages to watersheds, silting of reservoirs, estuarine & river beds, changes in hydrological regimes, etc. According to World Bank, approximately 10 million hectares of land mass is reported to be under shifting cultivation, involving several million people spread over 16 states in India. According to Forest Survey of India estimate 53-54% of the forest area is annually affected by forest fires incidence (mostly due to practices such as agriculture and shifting cultivation).

The maximum forest loss in India has been estimated between 1950 and 1980, just before the enactment of Forest Conservation Act. During this period, a huge forest area was allotted to various sectors in the name of development. The non-forestry uses, for which forest area was converted during the period included agriculture, river valley projects, industries/ townships, transmission, roads, etc.

**Flora and Fauna of Indian Forests**

Forest consists of two major components i.e. flora and fauna. As far as flora is concerned, a number of detailed ethno-botanical explorations have been conducted in different parts of the country and more than 800 plant species of ethno-botanical interest have been collected and identified. As per Botanical Survey of India, the country can be divided into eight distinct floristic regions namely: Western Himalayas, Eastern Himalayas, Assam and North-East, the Gangetic plain, Indus plain, Deccan, Malabar and Andaman.

(i) The Western Himalayan region extending from Kashmir to Kumaon and characterized by the temperate zone is rich in forests of spruce, fir, cedrus, chir pine, other conifers and broad-leaved trees. The higher altitude area of this region named Alpine Zone extends from the upper limit of the temperate zone to about 4,750 meter elevation or even higher.

The characteristic trees of the zone are the silver fir, birch, juniper and dwarf willows.

(ii) The Eastern Himalayan region extends from Sikkim eastwards and embraces Darjeeling, Kurseong and the adjacent tracts. The temperate zone of the region has forests of oak, laurel, maple, rhododendrons, alder and birch; different types of conifers, juniper and dwarf willows.

(iii) The Assam and northeastern region comprising of the valleys of Brahmaputra and Surma and the intervening hill regions is rich and luxurious with evergreen forests, occasional thick clumps of bamboo, and tall grasses.

(iv) The Gangetic plain region covers the area from the Aravalli ranges to Bengal and Orissa. A large part of the area is alluvial plain and is under cultivation for wheat, sugar cane and rice. Only small area of the region supports forests of different types.

(v) The Indus plain region comprises of the plains of Punjab, western Rajasthan and northern Gujarat. The region is dry and hot and supports scanty natural vegetation.

(vi) The Deccan region, characterized by the entire tableland of the Indian peninsula supports vegetation of various kinds from scrub areas to mixed deciduous forests.

(vii) The Malabar region covers the excessively humid belt of mountain running parallel to the southwest coast and contains evergreen and moist deciduous forests. This region, besides being rich in forest vegetation, produces important commercial crops like coconut, betel nut, pepper, coffee and tea. Rubber, cashew nut and eucalyptus trees have also been successfully introduced in some parts of this region.

**Ecosystem services provided by forests**

Ecosystems generate numerous benefits or “ecosystem services”. River systems provide freshwater, recreation, power, and food supply. Coastal wetlands help mitigate against flooding, filter waste, and serve as nurseries for fisheries. Forests provide us a wide variety of ecosystem services, including provisioning, regulating, cultural, and supportive services. These ecosystem services not only deliver the basic material needs for survival, but also underlie other aspects of well-being, including health, security, good social relations and freedom of choice.

Forests are amongst the most biologically-rich terrestrial systems. Together, tropical, temperate and boreal forests offer diverse sets of habitats for plants, animals and micro-organisms, and harbour the vast majority of the world’s terrestrial species. In the past, timber production was regarded as the dominant function of forests. However, in recent years this perception has shifted to a more multi-functional and balanced view. Today, it is understood that forest biodiversity underpins a wide ranges of goods and services for human well-being. Ecologically intact forests store and purify drinking water, they can mitigate natural disasters such as droughts and floods, they help store carbon and regulate the climate, they provide food and produce rainfall, and they provide a vast array of goods for medicinal, cultural and spiritual purposes. The health of forests and the provision of these and further forest ecosystem services depend on the diversity between species, the genetic diversity within species, and the diversity of forest types.

The Millennium Ecosystem Assessment (MEA), a scientific undertaking involving over 1300 experts working in 95 countries, indicates that a large and increasing number of forest ecosystems, populations and species are threatened globally or being lost due to the loss and degradation of forest habitats, and that this reduction of forest biodiversity will be aggravated by the effects of climate change. Tropical moist forests are home to the largest number of threatened species of any biome. It is assumed that numerous, but not yet scientifically described, species are presently being lost together with their tropical forest habitats.

Conserving forest biodiversity is a prerequisite for the long-term and broad flow of forest ecosystem services.

**WILDFIRE**

A wildfire or wildland fire is an uncontrolled fire in an area of combustible vegetation that occurs in the countryside area. Other names such as brush fire, bush fire, forest fire, desert fire, grass fire, hill fire, peat fire, vegetation fire, and veldfire may be used to describe the same phenomenon depending on the type of vegetation being burned. A wildfire differs from other fires by its extensive size, the speed at which it can spread out from its original source, its potential to change direction unexpectedly, and its ability to jump gaps such as roads, rivers and fire breaks. Wildfires are characterized in terms of the cause of ignition, their physical properties such as speed of propagation, the combustible material present, and the effect of weather on the fire.

Bushfires in Australia are common; because of the generally hot and dry climate, they pose a great risk to life and infrastructure during all times of the year, though mostly throughout the hotter months of summer and spring.

In the United States, there are typically between 60,000 and 80,000 wildfires that occur each year, burning 3 million to 10 million acres (12,000 to 40,000 square kilometres) of land per year. Fossil records and human history contain accounts of wildfires, as wildfires can occur in periodic intervals. Wildfires can cause extensive damage, both to property and human life, but they also have various beneficial effects on wilderness areas. Some plant species depend on the effects of fire for growth and reproduction, although large wildfires may also have negative ecological effects.

Strategies of wildfire prevention, detection, and suppression have varied over the years, and international wildfire management experts encourage further development of technology and research. One of the more controversial techniques is controlled burning: permitting or even igniting smaller fires to minimize the amount of flammable material available for a potential wildfire.

Wildfires differ from other fires in that they take place outdoors in areas of grassland, woodlands, bushland, scrubland, peatland, and other wooded areas that act as a source of fuel, or combustible material. Buildings may become involved if a wildfire spreads to adjacent communities. While the causes of wildfires vary and the outcomes are always unique, all wildfires can be characterized in terms of their physical properties, their fuel type, and the effect that weather has on the fire. Wildfire behaviour and severity result from the combination of factors such as available fuels, physical setting, and weather.

**FORESTRY**

Forestry is the science and craft of creating, managing, using, conserving, and repairing forests and associated resources to meet desired goals, needs, and values for human and environment benefits. Forestry is practiced in plantations and natural stands. The science of forestry has elements that belong to the biological, physical, social, political and managerial sciences.

Modern forestry generally embraces a broad range of concerns, including the provision of timber, fuel wood, wildlife habitat, natural water quality management, recreation, landscape and community protection, biodiversity management, watershed management, erosion control, and preserving forests. A practitioner of forestry is known as a forester.

Forestry is an important economic segment in various industrial countries. For example, in Germany, forests cover nearly a third of the land area, wood is the most important renewable resource, and forestry supports more than a million jobs.

Foresters work for the timber industry, government agencies, conservation groups, local authorities, urban parks boards, citizens' associations, and private landowners. The forestry profession includes a wide diversity of jobs, with educational requirements ranging from college bachelor's degrees to PhDs for highly specialized work. Industrial foresters plan forest regeneration starting with careful harvesting. Urban foresters manage trees in urban green spaces. Foresters work in tree nurseries growing seedlings for regeneration projects. Foresters improve tree genetics. Forest engineers develop new building systems. Professional foresters measure and model the growth of forests with tools like geographic information systems. Foresters may combat insect infestation, disease, forest and grassland wildfire. Increasingly, foresters participate in wildlife conservation planning and watershed protection. Foresters have been mainly concerned with timber management, especially reforestation, maintaining forests at prime conditions, and fire control.

*Forestry as a science*

Over the past centuries, forestry was regarded as a separate science. With the rise of ecology and environmental science, there has been a reordering in the applied sciences. In line with this view, forestry is a primary land-use science comparable with agriculture. Forests or tree plantations, those whose primary purpose is the extraction of forest products, are planned and managed utilizing a mix of ecological and agroecological principles.

**FOREST**

A forest is a large area dominated by trees. Hundreds of more precise definitions of forest are used throughout the world, incorporating factors such as tree density, tree height, land use, legal standing and ecological function.

Forests are the dominant terrestrial ecosystem of Earth, and are distributed across the globe. Forests account for 75% of the gross primary productivity of the Earth's biosphere, and contain 80% of the Earth's plant biomass.

Forests at different latitudes and elevations form different ecozones: boreal forests near the poles, tropical forests near the equator and temperate forests at mid-latitudes. Higher elevation areas tend to support forests similar to those at higher latitudes, and amount of precipitation also affects forest composition.

Human society and forests influence each other in both positive and negative ways. Forests provide ecosystem services to humans and serve as tourist attractions. Forests can also affect people's health. Human activities can negatively affect forest ecosystems.

*Definition*

There is no universally recognised precise definition, with more than 800 definitions of forest used around the world. Although a forest is usually defined by the presence of trees, under many definitions an area completely lacking trees may still be considered a forest if it grew trees in the past, will grow trees in the future, or was legally designated as a forest regardless of vegetation type.

There are three broad categories of forest definitions in use: administrative, land use, and land cover. Administrative definitions are based primarily upon the legal designations of land, and commonly bear little relationship to the vegetation growing on the land: land that is legally designated as a forest is defined as a forest even if no trees are growing on it. Land use definitions are based upon the primary purpose that the land serves. For example, a forest may be defined as any land that is used primarily for production of timber. Under such a land use definition, cleared roads or infrastructure within an area used for forestry, or areas within the region that have been cleared by harvesting, disease or fire are still considered forests even if they contain no trees. Land cover definitions define forests based upon the type and density of vegetation growing on the land. Such definitions typically define a forest as an area growing trees above some threshold. These thresholds are typically the number of trees per area (density), the area of ground under the tree canopy (canopy cover) or the section of land that is occupied by the cross-section of tree trunks (basal area).

**TYPES AND LAYERS OF FORESTS**

A forest is made up of many layers.

Each layer has a different set of plants and animals depending upon the availability of sunlight, moisture and food.

Forest floor contains decomposing leaves, animal droppings, and dead trees. Decay on the forest floor forms new soil and provides nutrients to the plants. The forest floor supports ferns, grasses, mushroom and tree seedlings.

Understory is made up of bushes, shrubs, and young trees that are adapted to living in the shades of the canopy.

Canopy is formed by the mass of intertwined branches, twigs and leaves of the mature trees. The crowns of the dominant trees receive most of the sunlight. This is the most productive part of the trees where maximum food is produced. The canopy forms a shady, protective "umbrella" over the rest of the forest.

Emergent layer exists in the tropical rain forest and is composed of a few scattered trees that tower over the canopy.

*Classification*

Forests can be classified in different ways. One such way is in terms of the biome in which they exist, combined with leaf longevity of the dominant species (whether they are evergreen or deciduous). Another distinction is whether the forests are composed predominantly of broadleaf trees, coniferous trees, or mixed.

Boreal forests occupy the subarctic zone and are generally evergreen and coniferous.

Temperate zones support both broadleaf deciduous forests (e.g., temperate deciduous forest) and evergreen coniferous forests (e.g., temperate coniferous forests and temperate rainforests). Warm temperate zones support broadleaf evergreen forests, including laurel forests.

Tropical and subtropical forests include tropical and subtropical moist forests, tropical and subtropical dry forests, and tropical and subtropical coniferous forests.

Forests can also be classified more specifically based on the climate and the dominant tree species present, resulting in numerous different forest types (e.g., Ponderosa pine/Douglas-fir forest).

The number of trees in the world, according to a 2015 estimate, is 3 trillion, of which 1.4 trillion are in the tropics or sub-tropics, 0.6 trillion in the temperate zones, and 0.7 trillion in the coniferous boreal forests. The estimate is about eight times higher than previous estimates, and is based on tree densities measured on over 400,000 plots. It remains subject to a wide margin of error, not least because the samples are mainly from Europe and North America.

**Coniferous forest**

Coniferous forest refers to vegetation composed primarily of cone-bearing needle-leaved or scale-leaved evergreen trees, found in areas that have long winters and moderate to high annual precipitation. The northern Eurasian coniferous forest is called the taiga, or the boreal forest. Both terms are used to describe the entire circumpolar coniferous forest with its many lakes, bogs, and rivers. Coniferous forests also cover mountains in many parts of the world. Pines, spruces, firs, and larches are the dominant trees in coniferous forests. They are similar in shape and height and often form a nearly uniform stand with a layer of low shrubs or herbs beneath. Mosses, liverworts, and lichens cover the forest floor.

The light-coloured, usually acidic soils of coniferous forests are called podzols (podsols) and have a compacted humus layer, known as mor, which contains many fungi. These soils are low in mineral content, organic material, and number of invertebrates such as earthworms.

Mosquitoes, flies, and other insects are common inhabitants of the coniferous forest, but few cold-blooded vertebrates, such as snakes and frogs, are present because of the low temperatures. Birds include woodpeckers, crossbills, warblers, kinglets, nuthatches, waxwings, grouse, hawks, and owls. Prominent mammals include shrews, voles, squirrels, martens, moose, reindeer, lynx, and wolves.

Eurasian coniferous forest is dominated in the east by Siberian pine, Siberian fir, and Siberian and Dahurian larches. Scots pine and Norway spruce are the important species in western Europe. North American coniferous forest is dominated throughout by white spruce, black spruce, and balsam fir, although lodgepole pine and alpine fir are important species in the western section.

A distinct subtype of the North American coniferous forest is the moist temperate coniferous forest, or coast forest, which is found along the west coast of North America eastward to the Rocky Mountains. This subtype is sometimes called temperate rain forest (see temperate forest), although this term is properly applied only to broad-leaved evergreen forests of the Southern Hemisphere. Warm temperatures, high humidity, and often misty conditions encourage the development of a mossy, moisture-loving plant layer under the giant trees of Sitka spruce, western red cedar, western hemlock, Douglas fir, and coast redwood.

Other subtypes of coniferous forest occur at various elevations in the Rocky Mountains of North America, in Central America, and in eastern Asia. They are known as subalpine and montane forests and are dominated by combinations of pine, spruce, and fir.

**Deciduous forest**

Deciduous forest refers to vegetation composed primarily of broad-leaved trees that shed all their leaves during one season. Deciduous forest is found in three middle-latitude regions with a temperate climate characterized by a winter season and year-round precipitation: eastern North America, western Eurasia, and northeastern Asia. Deciduous forest also extends into more arid regions along stream banks and around bodies of water.

Oaks, beeches, birches, chestnuts, aspens, elms, maples, and basswoods (or lindens) are the dominant trees in mid-latitude deciduous forests. They vary in shape and height and form dense growths that admit relatively little light through the leafy canopy. Shrubs are found primarily near clearings and forest edges, where more light is available, and herbaceous flowering plants are abundant within the forest in the spring, before the trees come into full leaf.

The soils upon which deciduous forests thrive are gray-brown and brown podzols. They are slightly acidic and have a granular humus layer known as mull, which is a porous mixture of organic material and mineral soil. Mull humus harbours many bacteria and invertebrate animals such as earthworms.

Snails, slugs, insects, and spiders are common inhabitants of the deciduous forest, and many cold-blooded vertebrates, such as snakes, frogs, salamanders, and turtles, are also present. Birds are represented by warblers, flycatchers, vireos, thrushes, woodpeckers, hawks, and owls. Prominent mammals include mice, moles, chipmunks, rabbits, weasels, foxes, bears, and deer.

Differences in temperature, moisture, and elevation may cause the formation of distinct plant associations within the deciduous-forest pattern. The dominance of beeches and maples in the northern part of the eastern North American deciduous forest and that of oaks and hickories along the southern extension of this vegetation are typical examples.

*Deciduous forest of tropical regions*

*Monsoon forest*, also called dry forest or tropical deciduous forest, refers to open woodland in tropical areas that have a long dry season followed by a season of heavy rainfall. The trees in a monsoon forest usually shed their leaves during the dry season and come into leaf at the start of the rainy season. Many lianas (woody vines) and herbaceous epiphytes (air plants, such as orchids are present. Monsoon forests are especially well developed in Southeast Asia and are typified by tall teak trees and thickets of bamboo.