Bolivia, western Mexico, and southern Africa, and explicitly include benefits for local citizens.

See also: **Biodiversity**: Plant Diversity in Forests. **Ecology**: Natural Disturbance in Forest Environments. **Environment**: Environmental Impacts; Impacts of Elevated CO_2 and Climate Change. **Operations**: Small-scale Forestry. **Soil Development and Properties**: Nutrient Cycling. **Tree Physiology**: Mycorrhizae; Stress. **Tropical Ecosystems**: Acacias; Dipterocarps; Eucalypts. **Tropical Forests**: Combretaceae; Tropical Moist Forests.

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Tropical Moist Forests

L G Saw, Forest Research Institute Malaysia, Kepong, Kuala Lumpur, Malaysia

Distribution of the Tropical Moist Forests

The tropical moist forests are limited by the tropics of Cancer and Capricorn (**Figure 1**). However, the distribution is not evenly dispersed across the Americas, Africa, and Asia, often being restricted by the climatic conditions surrounding the land area. The largest area of tropical forest is found in the Neotropics (4×10^6 km^2). The neotropical forests occur in three parts: the Amazon and Orinoco basins are the largest area, followed by a block which lies across the Andes on the Pacific coasts of Ecuador and Colombia, extending northwards through Central America as far as Veracruz in southernmost Mexico. The Atlantic coast of Brazil has a third area of rainforest, a strip less than 50 km wide on the coastal mountains, extending from Bahia in the north to Rio Grande do Sul in the south. The area has now been reduced to about 12% of its original extent.

The second largest block of tropical moist forests occurs in eastern tropics and is estimated to cover 2.5×10^6 km^2. Centered in the Malay archipelago, it includes all of the Southeast Asian countries into the Pacific islands and in a narrow coastal strip in Queensland, Australia. In Australia, the forest extends in small pockets into New South Wales but is mainly restricted to the wettest sites with most fertile soils. In the Malay peninsula, the forests extend into Myanmar, Thailand to the southern Himalayas in upper Myanmar, Assam, and southern China. Africa has the smallest block of the tropical moist forests, with an area of about 1.8×10^6 km^2. Centered in the Congo basin, this block extends from the high mountains at its eastern limit westwards to the Atlantic ocean, with outliers in East Africa. It extends as a coastal strip into West Africa and woodlands reach the coast at the Dahomey Gap. There are tiny patches of rainforest on the east coast of Madagascar and in the Mascarenes.

Environment of the Tropical Moist Forests

A number of interacting environmental features influence the distribution of vegetation, e.g., climate, temperature, and moisture. Tropical moist forests occur in climates where the mean temperature of the coldest month is more than 18°C. This excludes some tropical montane areas, although an alternative definition includes forests where the difference between the mean temperatures of the warmest and the coldest months is less than 5°C. Another important characteristic of tropical climates is that the diurnal range of mean daily temperature exceeds the annual range. The amount of rainfall and its distribution through the year defines different tropical climates. Rainforests develop where monthly rainfall exceeds 100 mm and short dry spells last only a few days or weeks. Where there are regular dry periods (60 mm rainfall or less), monsoon forests or tropical seasonal forests develop. Superficially, both forest formations appear similar but they have very different species compositions: tropical moist forests are species-rich with a heterogeneous physiognomy, whereas monsoon forests are relatively species-poor and have a simple structure, often containing

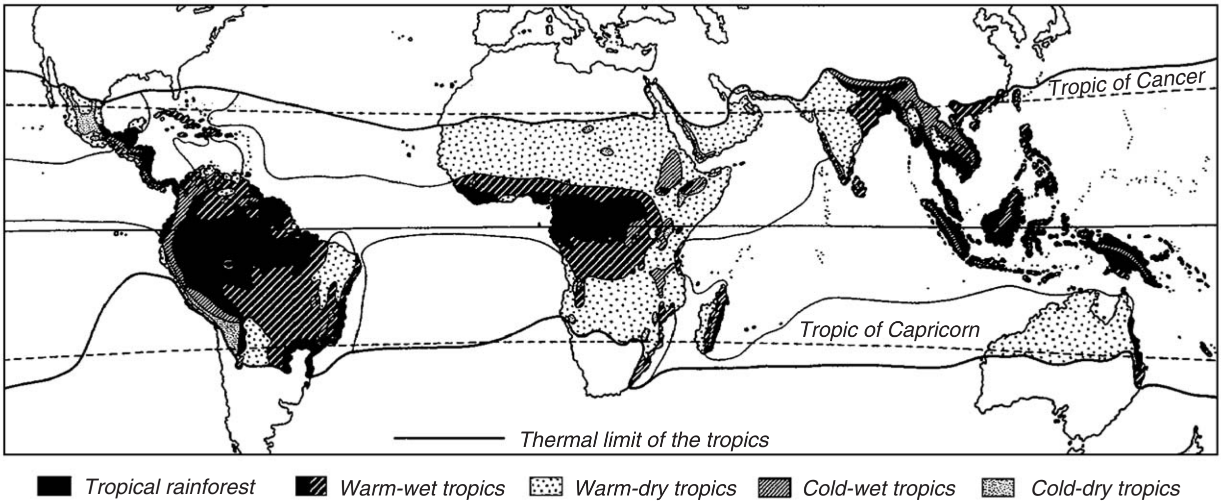

Figure 1 Distribution of tropical rainforest within hygrothermal zonations. Modified, with permission, from Lauer W (1989) Climate and weather. In: Lieth H and Werger MJA (eds) *Ecosystems of the World*, vol. 14B, *Tropical Rain Forest Ecosystems*. Amsterdam: Elsevier.

deciduous canopy trees. Tropical moist forests occur in ever-wet or perhumid climates.

Forest Formations

The structure and the species physiognomy of the major tropical moist forests are similar. This has often been described as forest formations. A forest formation is recognized by a particular combination of vegetation structure and physiognomy regardless of flora. Different species in the three areas have evolved similar responses to particular environments. The forest formations occupy different physical habitats, which are mostly sharply bounded; where this is not so there is a merging zone.

The formations develop from three interacting environmental factors: climatic, edaphic, and soil water influences (**Table 1**). Temperature regimes are more-or-less constant throughout the year in the tropical moist forests; the amount and distribution of rainfall in a region often determine the kind of major formation that develops. Seasonality of rainfall patterns has a tremendous demarcating effect on the type of formation developing. For example, in the extreme north of peninsular Malaysia in the states of Perlis and Kedah, a pronounced 2–3-month dry period results in a semievergreen rainforest that is predominantly Myanmarese and Thai. Here, deciduous trees form a good proportion of the forest. A short distance south in the state of Perak, the vegetation is lowland evergreen rainforest. Similarly, in the African rainforests, the percentage of contribution of deciduous trees rises as the climate becomes drier, as one moves north or south of the equator. A further factor that influences climate is the change in temperature regimes as elevation changes. Lowland evergreen rainforest is often restricted to elevations below 1200 m above sea level; beyond that, montane and subalpine forests develop. After climate, the substrate upon which the vegetation develops defines other forest formations. For example, soil water availability will restrict the type of plant community. In dryland areas, the climatic forest types develop in normal (mainly oxisols and ultisols) soils. However, with different availability of nutrients, other very distinctive formations develop. In podzolized sands, heath forest develops and other specialized formations are found over limestone, ultrabasic rocks, and quartzite rocks.

Where the water table is high and under maritime influence (i.e., salt water, swells) beach, mangrove, and brackish water forests may develop. Under inland freshwater swamp, depending on the degree of inundation, freshwater swamp and freshwater periodic swamp forests develop. An example of the kind of forest formations developing in Borneo indicates the dominance of particular species (**Figure 2**).

Dryland Forests

Tropical Lowland Evergreen Rainforest

This is the most luxuriant of all plant communities, and is dense evergreen forest 45 m or more tall, characterized by large numbers of tree species. Gregarious dominants are uncommon and usually two-thirds or more of the canopy individuals and two-thirds or more of the upper-canopy trees are of

Table 1 Forest formations of tropical moist forests. Reproduced with permission from Whitmore TC (1990) *An Introduction to Tropical Rainforest*. Oxford University Press

Climate	*Soil water*		*Soils*	*Elevation*	*Forest formation*
Seasonally dry	Strong annual shortage				Monsoon forests (various formations)
	Slight annual shortage				Semievergreen rainforest
Ever-wet (perhumid)	Dryland		Zonal (mainly oxisols, ultisols)	Lowlands	Lowland evergreen rainforest
				Mountains	
				(750) 1200–1500 m	Lower montane forest
				(600) 1500–3000 (3350) m	Upper montane rainforest
				3000 (3350) to treeline	Subalpine forest
			Podzolized sands	Mostly lowlands	Heath forest
			Limestone	Mostly lowlands	Forest over limestone
			Ultrabasic rocks	Mostly lowlands	Forest over ultrabasics
	Water table high (at least periodically)	Coastal saltwater			Beach vegetation
					Mangrove forest
					Brackish water forest
		Inland fresh water	Oligotropic peats		Peat swamp forest
			Eutropic (much and mineral) soils	±Permanently wet	Freshwater swamp forest
				Periodically wet	Freshwater periodic swamp forest

species individually contributing no more than 1% of the total number in the Neotropics and Asian blocks of the lowland rainforest. This formation is conventionally regarded as having three tree layers, although the layers may grade into each other: (1) upper layer of individual or grouped giant emergent trees sometimes >70 m; (2) main stratum at about 24–36 m; and (3) smaller, shade-tolerant trees below that. Ground vegetation is often sparse, and mainly of small trees and understory palms; herbs are uncommon. Some of the biggest trees have a clear bole of 30 m and reach 4.5 m girth, and may be deciduous or semideciduous, without affecting the evergreen nature of the canopy as a whole. Boles are usually cylindrical. Buttresses are common. Cauliflory and ramiflory are common. Leaves are often large and pinnate or variously dissected. Big woody climbers are frequent. Shade and sun epiphytes are occasional to frequent. Among the three regions of tropical lowland rainforests, the African block is less typical, as described above. Although the great majority of understory trees in the African forests are evergreen, a substantial proportion of the taller trees can be deciduous. Further, there can be a dominance of a single species in the canopy.

In this formation, tree diversity is the richest in the world. It is usual in this formation for tree diversity exceeding 150 species for trees (≥10 cm diameter at breast height) per hectare. In one particularly rich forest in Yanamomo, Peru, over 280 species per hectare have been recorded. More recently, large ecological plot studies have shown diversity of 817 species per 50 ha and 1171 species per 52 ha recorded for trees ≥1 cm diameter at breast height, in Malaysia. In comparison in more seasonal forest areas of India, Panama, and Thailand, the diversity was less than half of the Malaysian totals, ranging from 68 species to 305 species per 50-ha plot.

Floristic Composition of Lowland Evergreen Rainforests

Among the three blocks of evergreen rainforests, the African forest is less diverse, for example, the tree

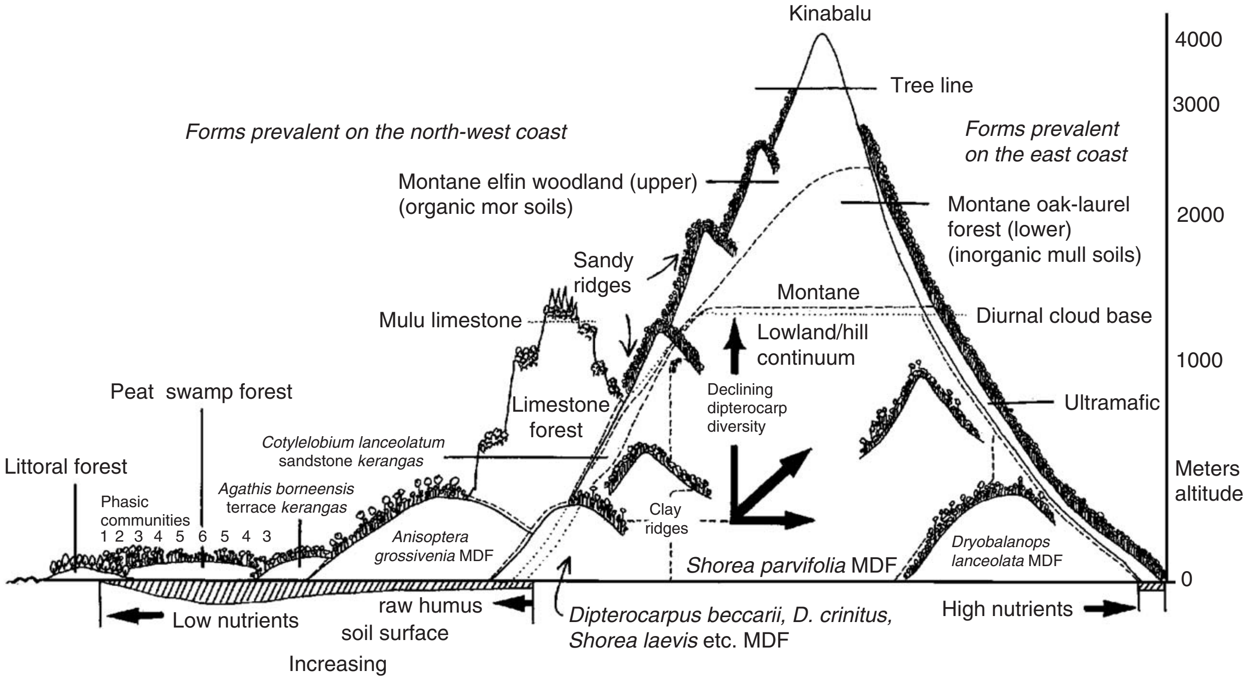

Figure 2 Diagram of the major floristic associations in Bornean forests. MDF, mixed Dipterocarp forest. The bold arrows indicate declining dipterocarp diversity with changes in nutrients levels in the soil, and altitude. Reproduced with permission from Ashton PS (1995) Biogeography and ecology. In: Soepadma E and Wong KM (eds) *Tree Flora of Sabah and Sarawak*, vol. 1. Kuala Lumpur, Malaysia: Forest Research Institute Malaysia.

diversity of the various lowland evergreen forests in the Ivory Coast is much lower than that in Malaysia and Surinam. By African standards, these Ivory Coast forests are floristically rather rich, yet they contain about a quarter of the number of tree species per unit area found in Malaysia. There have been many speculations over the poverty of the African forest flora. It has been suggested that forest flora was once much richer than today but has been reduced by progressive aridity since the Miocene, and especially by a series of severe dry episodes during the Quaternary. The African rainforest shares similar richness in legume species with the South American and in the absence of Dipterocarpaceae, a family so typical of Southeast Asian forests. However, it is particularly poor in palm species in its understory species. In contrast with rich bromeliad flora of South America, Africa has only one bromeliad species (*Pitcairnia feliciana*). Major families shared with South America include Euphorbiaceae, Meliaceae, Moraceae, and Sapotaceae. These probably represented old families which were present on both continents before rifting. A number of leguminous trees, including *Brachystegia laurentii*, *Cynometra alexandri, Gilbertiodendron dewevrei*, *Michelsonia microphylla*, and *Scorodophloeus zenkeri* may dominate the canopy of the lowland African forests as single species.

The flora of the eastern block, in particular, the Malesian region is rich with about 42 000 species of vascular plants. The flora of the Malesian region is also not homogeneous. There are marked differences from island to island. However, there are two floristic elements, one centered on the Sunda shelf and the other on the Sahul shelf. A strong zoogeographical boundary runs through these shelves, sometimes called Wallace's line. Dipterocarpaceae is probably the most important single distinction between the forests west and east of Wallace's line. Dipterocarpaceae west of Wallace's line dominates the rainforests in Malesia as upper-canopy or emergent trees like no other tree families. Species are also very diverse, particularly on the island of Borneo. Other groups that are centered on the Sunda shelf include some palm genera such as *Daemonorops*, *Iguanura*, and *Pinanga*, Magnoliaceae, and *Artocarpus* (Moraceae). Conifers are more abundant east of Wallace's line, more in the mountains, but some species may form dense stands in lowland forests. These conifers all belong to two families, Araucariaeae and Podocarpaceae. Among the palms, *Gronophyllum*, *Gulubia*, *Hydriastela*, *Metroxylon*, and *Siphokentia*, are confined to the east side of Wallace's line. The family Proteaceae is centered on the Sahul shelf, except for *Heliciopsis* which has a Sundaic focus. Other plant groups, e.g., *Syzygium* (Myrtaceae), are equally abundant on both sides of Wallace's line. The north eastern Australian rainforests have similar affinity to New Guinea Island and with floristic composition of the Sahul shelf. With its present drier climate, some genera endemic to this rainforest include *Backhousia*, *Blepharocarya*, *Buckinghamia*, *Cardwellia*, *Castanospermum*, *Ceratopetalum*, *Doryphora*, *Flindersia*, *Musgravea*, and *Placosperma*.

As in the eastern block of rainforest, the neotropical rainforest is complex and not homogeneous. Floristic composition varied with the different forest types. Principally, in the *terra firme* forest Leguminosae is the most abundant family in terms of genera and species and the Lecythidiaceae in numbers of individuals. Other important families with larger-sized trees include Burseraceae, Celestraceae, Meliaceae, Myrtaceae, and Sterculiaceae. The understory, may include Euphorbiaceae, Myrtaceae, Palmae, and Rubiaceae. Some common genera include *Bertholletia*, *Eschweilera*, *Goupia*, *Parkia*, *Tabebuia*, *Tetragastris*, and *Vouacapoua*. The absence or presence of palms and lianas is sometimes indicative of the forest type in the rainforests of the Neotropics. Some of the common palms found in the forest include *Euterpe precatoria*, *Jessenia batuaua*, *Maximiliana regia*, *Oenocapus distichus*, and *Orbignya barbosioana*.

Heath Forest

Heath forest occurs on soils developed from siliceous parent material, which are inherently poor in bases and highly acidic, and of coastal alluvium or weathered sandstone origin. Such soils become podzolized. In some substrate, particularly those under sandstones, the soils become temporarily waterlogged, particularly during the rainy season. The streams draining from such forests are tea-colored owing to the presence of organic colloids that leached out from the soils. They are usually acid (pH <5.5), and with a low oxygen content. The most extensive heath forests are found in the upper reaches of Rio Negro and Rio Orinoco in South America. In Brazil, they are known as campina, campinarana, caatinga Amazonica, or campina rupestre. In the Far East, there are also large areas of heath forest in Borneo (called kerangas), less extensively in peninsular Malaysia, Sumatra, and New Guinea. African heath forests are less extensive areas and are found in coastal sands in Gabon, Cameroon, and Ivory Coast.

This forest is strikingly different from the lowland evergreen forest in having a very different flora, structure, and physiognomy. Depending on the depth of the heath soils and variability of water supply, the vegetation varies from low scrublands comprising sedges, grasses, and stunted gnarled trees to near-lowland rainforest formation. Characteristically, the forest is dominated by pole-sized trees, where the main story is formed by large saplings and small poles and forms a tidy and orderly stand. The canopy is low, uniform, and usually densely closed with no trace of layering. Single emergents may occur but often in areas with deeper soils. There are more trees with small leaves, many species with sclerophyllous leaves; deciduous species are absent. Big woody climbers are rare, but slender, wiry, independent climbers are frequent. Myrmecophytes are abundant, especially in the more open and stunted heath. Amongst the herbs are insectivorous plants, e.g., *Drosera, Nepenthes,* and *Utricularia*.

When the sandstone formation extends into higher elevations, the montane flora extends to the lower elevations. In many respects, the upper montane and heath forest have many features of structure and physiognomy in common.

Limestone Forest

The total extent of limestone is small and is often found in the lowlands. The largest areas are found in the Far East. They are absent in the humid tropics of Africa and are rare in Latin America, except in the Caribbean region. A distinctive feature of the limestone hills is the karst landscape. In the Far East, it occurs in Central Sumatra, peninsular Malaysia, Borneo (mainly in Sarawak and in small areas in Sabah), Java, the Lesser Sunda Islands, Celebes, the Moluccas, and New Guinea.

There are a diversity of habitats and soils within the limestone hills that sometimes support very specific animal and plant species. The alluvial soils at the base of the limestone hills, although derived from other rocks, are under the influence of run-off water and erosion from the limestone. The soils are often more fertile and more base-rich and often the vegetation is an extension of the adjacent forest. The second zone is the base of cliffs and ravines in the hills, sometimes with small scree slopes of limestone boulders. Here a few species may dominate, for example, in peninsular Malaysia the palm *Arenga westerhoutii* sometimes completely dominates the slope. The third zone is the limestone slope with its dense, irregular forest with trees clinging precariously, their roots penetrating to great depths in crevices. Sheer cliffs may bear scattered shrubs and a characteristic herb flora. In peninsular Malaysia and Borneo, Gesneriaceae with species adapted to desiccation are prominent, and *Cycas* and some *Pandanus* are often seen clinging to crevices of cliffs. The final zone is the summits of the limestone hills. It is a peculiar habit. It has a deep mat of peat-like humus, held together by tree roots and anchored to the limestone pinnacles underneath. It often contains many epiphytic plants and plants specializing in the drier and harsher environment; orchids and ferns may be common.

Limestone flora often contains many endemic plants. For example, the palm genus *Maxburretia* is completely restricted to the limestone hills of the Malay peninsula, each species being endemic to specific limestone hills. Similar examples, although not as restrictive, can be seen in many genera of Gesneriaceae, e.g., *Boea*, *Chirita*, *Monophyllaea*, and *Paraboea*.

Beach Vegetation

Two kinds of beach vegetation are recognized. One occurs on accreting coasts where new sand is deposited and plant cover is often of low herbaceous creeping plants (the *pes caprae* association). Species found in this habitat are often pantropical. At the inland margin of the sand beach, the second vegetation forms; in the Far East, for example, the *Barringtonia* association is found here. Inland it merges with the lowland rainforest. Its composition is very uniform throughout Malesia and many species extend from the coast of Africa through Malesia far into the Pacific. Many species have seeds or fruits adapted to water dispersal. The trees are sometimes loaded with epiphytes, particularly orchids, ferns and asclepiads (*Hoya* and *Dischidia*).

Swamp Forests

Mangrove Swamp Forest

Mangrove forest develops where there is coastal sedimentation of mud; mangroves are the usual initial colonizers. The mud is invaded by the tide twice daily, but the pneumatophore shoots of pioneer species of *Avicennia*, followed at a later stage by the many-stemmed stools of *Rhizophora*, trap sediment very efficiently (sometimes up to several meters a year). The vegetation is simple in structure, 5–25 m in height depending on the community, with comparatively even and unbroken canopy, a very poor understory layer which is frequently absent, and poor in species. The principal tree species are restricted to such habitats, and are frequently characterized by special root formations such as stilt roots (*Rhizophora*) and pneumatophores (*Avicennia*, *Bruguiera*, *Sonneratia*, and *Xylocarpus*). The vegetation is often very simple, with few species dominating the whole stand. There is also a distinct succession from the seaward front to the landward side. Mangrove forest is found throughout the tropics. The mangroves of Madagascar and eastern shores of Africa have a strong Asian affinity while those of the Atlantic shores of the USA and West Africa share similar floristic affinities.

In the Far East, on the edge of the mangrove and the upper tidal limit of estuaries, there is a forest with a number of distinctive species, amongst which *Nypa fruticans* is important and forms extensive pure stands, mainly along water courses in river estuaries.

Peat Swamp Forest

In parts of Sumatra, Malaya, Borneo, and west New Guinea a physiological setting exists which favored the formation of peat. Since sea level rose at the end of the last Ice Age, rivers deposit silt as levees and on flood plains. Swamps form behind the levees and became less saline and over time under anaerobic conditions peat develops from the accumulated litter. The process continues until the present day. Peat is semiliquid and low in nutrients because the only input is from rainfall. Peat reaches 13 m thick in the most developed domes, a formation that is better understood in Southeast Asia where the domes occur in large areas, particularly in east Sumatra, Malaya, Borneo, and New Guinea. Less in extent are the peat swamp forests found in the USA and Africa.

Structurally and floristically, the peat swamp forest is not a uniform formation. In Borneo, for example, there exists a catena of at least six types of phasic communities which are moderately sharply distinct in structure, physiognomy, and flora. In general, the forest has a three-layered tree structure. Most of the tree families of the lowland forest are found in the peat swamp forest. However, there are species that specialize in such environments. Palms are poorly represented; those that occur are either swamp specialists or species restricted to this formation (e.g., *Cyrtostachys renda*, *Korthalsia flagellaris*).

Freshwater Swamp Forest

The soil surface of land covered by the freshwater swamp forest formation is regularly to occasionally inundated with mineral-rich fresh water of fairly high pH (nonacidic). There may be peat present in the soil but one key difference of this formation from the peat swamp forest is that in the latter, rain is the only source of water reaching this forest, which is nutrient-poor. Freshwater swamp occurs throughout the tropics, where the river system runs into low-lying areas and regular flooding produces the condition for this formation to develop. As with the peat swamp forest formation, this is a varied formation, often dependent on the degree of inundation and the kind of parent material in which the vegetation develops. The Amazon, which has annual floods and is influenced by tides to some 600 km inland, has very extensive and diverse freshwater permanent and periodic swampy forests. Igapó is applied to black and clear water areas and várzea muddy water inundation. Várzea is formed by flooding with muddy water rivers such as the Amazonas and the Madeira, and igapós on sandy soil and clear water. The várzeas have soils that are more fertile. The Zaire basin is about one-third occupied by swamp forests. The greatest extent of this formation in Asia is where the biggest rivers are, e.g., in Indo-China, Thailand, and Myanmar (Mekong and Irrawaddy), and in New Guinea (Fly and Sepik). In recent years, much of this habitat has been destroyed due to conversion to agriculture.

Global Trends in Rainforest Areas

Increasing human population in the last hundred years has had a profound impact on the tropical rainforests. In many tropical societies, land-use patterns have shifted from a low-impact traditional use of forestlands to a more intensive industrial use. Tropical forests are being altered at a rapid pace in one of two different ways. Some areas are converted to other uses; others are logged but left to regenerate. Land conversion poses the greatest threat. There are major differences between regions in the rate at which tropical moist forests are disappearing. In Southeast Asia, the major conversion has been from planned conversion of forest areas to industrial agriculture plantation crops such as rubber and oil palm. More recently, areas have also been converted to tree plantation crops to produce pulp. Most often *Acacia mangium* is planted. In the neotropics, large areas have been converted to pastures for cattle farming. Industrial tree crops are also planted in large areas, often using species of *Acacia mangium*, *Eucalyptus*, and tropical pines. These are examples of planned conversion often initiated by government policies. Forest conversion also comes about that is not centrally planned. In many countries, peasant farmers moved into rainforest, usually to practice shifting cultivation, and often illegally. These people often moved into new forest areas following commercial logging. Forests are also destroyed for dams and mines.

Harvesting timber from the forest will alter the nature and dynamics of the rainforests. Commercial logging in tropical rainforests can take a number of forms, almost all of which involve the removal of selected trees rather than the clear felling of whole stands. This is different from temperate forestry operations where clear felling is much more common. In the past, such practices, i.e., selective felling, were not intensive and often forests regenerated. In peninsular Malaysia, for example, under the Malayan Uniform System, it was possible to return to harvest a forest area after about 60 years of first harvesting. Changing market forces and more mechanized logging operations in recent years have now increased logging intensities. This has resulted in the slow recovery of logged-over forests. However, many countries are now considering better ways of managing the forests. Studies have indicated that when properly managed, forests, can provide both services and products for the present and the future.

To conserve the rainforests, increasingly, many tropical countries are looking into sustainable forest management (SFM) practices. Tropical rainforests are a renewable resource, which can be utilized while retaining their diversity and richness. Bringing such principles into forest management has become a strong challenge for many developing countries in the tropics.

See also: **Tropical Ecosystems**: Bamboos, Palms and Rattans; Dipterocarps; *Ficus* spp. (and other important Moraceae); Mangroves. **Tropical Forests**: Monsoon Forests (Southern and Southeast Asia); Tropical Montane Forests.

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Tropical Montane Forests

M Kappelle, Utrecht University, Utrecht, The Netherlands

Introduction

Mid and high-elevation regions near the equator such as are found in the Andes and on Papua New Guinea support tropical montane forests (TMF), which range from relatively dry woodlands to extremely wet forests. TMF forms a major component of several of the world's biodiversity hotspots (e.g., Meso-America and the northern Andes), as it represents an extremely species-rich system, which is highly endangered due to human interference. The most important and diverse of all TMF types is the tropical montane cloud forest (TMCF). This conspicuous ecosystem filters global air masses in such a way that they seize and incorporate water and nutrients from mist and fog into their cycles. It may be even richer than the tropical lowland rainforest (TLRF) when diversity is measured as species density on a per-unit-area basis. TMCF is well known for its important fresh-water resources, which feed the many rivers passing through major mountain cities in the Andes such as Bogotá and Quito, which in turn depend on these resources to supply their human populations with sufficient drinking water. However, today these fragile forests are among the most endangered ecosystems worldwide, due to destructive anthropogenic forces causing forest loss and habitat fragmentation, ultimately leading to species extinction and loss of environmental goods and services which are vital to the regional and local human populations.

The present article presents a brief overview of TMF, emphasizing its most important representative, the TMCF type. A bioclimatic definition is presented and its overall aspects are discussed. Subsequently, its geographic distribution and main determinants are treated. Details on climate, soils, and topography are elaborated. Furthermore, past trends in forest cover are dealt with. This is followed by a detailed discussion of the TMF structure, species composition, dominance, and dynamics as a result of disturbances. Regional subtypes and boundaries with other forest types are listed. Next, the ecological/environmental and sociocultural importance of this specific forest ecosystem is analyzed. Past and current TMF use practices are assessed and some sustainable forest management systems identified. Finally, threats to the survival of species and the integrity of the ecosystem as a whole are evaluated and current and future conservation strategies discussed. Such an analysis ultimately permits the setting of priorities in conservation and sustainable development for the benefit of the peoples living in and depending on TMF systems.

Definition

Forests on Tropical Mountains

TMF is latitudinally restricted to the tropics and may only be found, in its strict sense, at northern and southern latitudes between the tropics of Cancer and Capricorn. In a wider sense, TMF reaches a northern latitude of 23° in Mexico and a southern latitude of 25° in Argentina. Within this latitudinal range, TMF is altitudinally restricted to montane elevations. This is the most difficult part of the elaboration of a concise definition, for scholars have not been able to define the altitudinal limits of the montane belt unanimously. In general, as a rule of thumb, it is assumed that montane forests occur between 500 and 4000 m above sea-level. However, there are places on earth, especially on volcanic islands, where montane forests may occur at 300 m elevation (e.g., in the Caribbean), while there are sites in certain tropical mountain chains such as in the South American Andes where small pockets of montane forests occur in wind-protected valleys at elevations over 4000 m. In the latter case, these montane forests are better known as tropical subalpine forests (TSF) as they often occur just below – or amongst – the treeless, tropical alpine grasslands and shrublands.

Tropical Montane Cloud Forests

In contrast, TMCF – the cloudy version of TMF – was well defined a decade ago. Specialists now agree