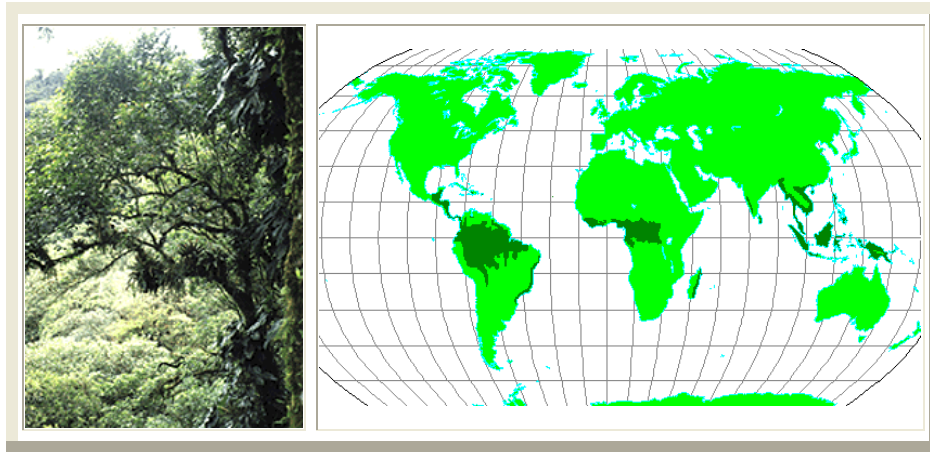


## Tropical Broadleaf Evergreen Forest: The Rainforest



**Introduction.** The tropical rainforest is earth's most complex biome in terms of both structure and species diversity. It occurs under optimal growing conditions: abundant precipitation and year round warmth. There is no annual rhythm to the forest; rather each species has evolved its own flowering and fruiting seasons. Sunlight is a major limiting factor. A variety of strategies have been successful in the struggle to reach light or to adapt to the low intensity of light beneath the canopy.

**Climate:** (Koeppen's Af and Am climate types.) Mean monthly temperatures are above 64 ° F; precipitation is often in excess of 100 inches a year. There is usually a brief season of reduced precipitation. In monsoonal areas, there is a real dry season, but that is more than compensated for with abundant precipitation the rest of the year.

**Vegetation:** A vertical stratification of three layer of trees is apparent.. These layers have been identified as A, B, and C layers:

- A layer: the emergents. Widely spaced trees 100 to 120 feet tall and with umbrella-shaped canopies extend above the general canopy of the forest. Since they must contend with drying winds, they tend to have small leaves and some species are deciduous during the brief dry season.
- B layer: a closed canopy of 80 foot trees. Light is readily available at the top of this layer, but greatly reduced below it.
- C layer: a closed canopy of 60 foot trees. There is little air movement in this zone and consequently humidity is constantly high.
- Shrub/sapling layer: Less than 3 percent of the light intercepted at the top of the forest canopy passes to this layer. Arrested growth is characteristic of young trees capable of a rapid surge of growth when a gap in canopy above them opens.
- Ground layer: sparse plant growth. Less than 1 percent of the light that strikes the top of the forest penetrates to the forest floor. In such darkness few green plants grow. Moisture is also reduced by the canopy above: one third of the precipitation is intercepted before it reaches the ground.

**Growthforms:** Various growthforms represent strategies to reach sunlight:

1. **Epiphytes:** the so-called air plants grow on branches high in the trees, using the limbs merely for support and extracting moisture from the air and trapping the constant leaf-fall and wind-blown dust. Bromeliads (pineapple family) are especially abundant in the neotropics; the orchid family is widely distributed in all three formations of the tropical rainforest. As demonstration of the relative aridity of exposed branches in the high canopy, epiphytic cacti also occur in the Americas.
2. **Lianas:** woody vines grow rapidly up the tree trunks when there is a temporary gap in the canopy and flower and fruit in the tree tops of the A and B layers. Many are deciduous.
3. **Climbers:** green-stemmed plants such as philodendron that remain in the understory. Many climbers, including the ancestors of the domesticated yams (Africa) and sweet potatoes (South America), store nutrients in roots and tubers.
4. **Stranglers:** these plants begin life as epiphytes in the canopy and send their roots downward to the forest floor. The fig family is well represented among stranglers.
5. **Heterotrophs:** non-photosynthetic plants can live on the forest floor.
  - **Parasites** derive their nutrients by tapping into the roots or stems of photosynthetic species. *Rafflesia arnoldi*, a root parasite of a liana, has the world's largest flower, more than three feet in diameter. It produces an odor similar to rotting flesh to attract pollinating insects.
  - **Saprophytes** derive their nutrients from decaying organic matter. Some orchids employ this strategy common to fungi and bacteria.

**Common characteristics of tropical trees.** Tropical species frequently possess one or more of the following attributes not seen in trees of higher latitudes.

- **Buttresses:** many species have broad, woody flanges at the base of the trunk. Originally believed to help support the tree, now it is believed that the buttresses channel stem flow and its dissolved nutrients to the roots.
- **Large leaves** are common among trees of the C layer. Young individuals of trees destined for the B and A layers may also have large trees. When they reach the canopy new leaves will be smaller. The large leaf surface helps intercept light in the sun-dappled lower strata of the forest.
- **Drip tips** facilitate drainage of precipitation off the leaf to promote transpiration. They occur in the lower layers and among the saplings of species of the emergent layer (A layer).

Other characteristics that distinguish tropical species of trees from those of temperate forests include

- Exceptionally **thin bark**, often only 1-2 mm thick. Usually very smooth, although sometimes armed with spines or thorns.

- **Cauliflory**, the development of flowers (and hence fruits) directly from the trunk, rather than at the tips of branches.
- **Large fleshy fruits** attract birds, mammals, and even fish as dispersal agents.

**Soil: Oxisols**, infertile, deeply weathered and severely leached, have developed on the ancient Gondwanan shields. Rapid bacterial decay prevents the accumulation of humus. The concentration of iron and aluminum oxides by the laterization process gives the oxisols a bright red color and sometimes produces minable deposits (e.g., bauxite). On younger substrates, especially of volcanic origin, tropical soils may be quite fertile.

**Subclimaxes:** Distinct communities (varzea) develop on floodplains. Jungles may line rivers where sunlight penetrates all layers of the forest. Where forests have long been cleared and laterites have developed to cause season waterlogging of the substrate, tropical grasslands and palm savannas occur.

**Fauna:** Animal life is highly diverse. Common characteristics found among mammals and birds (and reptiles and amphibians, too) include adaptations to an arboreal life (for example, the prehensile tails of New World monkeys), bright colors and sharp patterns, loud vocalizations, and diets heavy on fruits.

**Distribution of biome:** The tropical rainforest is found between 10 ° N and 10 ° S latitude at elevations below 3,000 feet. There are three major, disjunct formations:

- Neotropical (Amazonia into Central America)
- African (Zaire Basin with an outlier in West Africa; also eastern Madagascar)
- Indo- Malaysian (west coast of India, Assam, southeast Asia, New Guinea and Queensland, Australia).

The species composition and even genera and families are distinct in each. They also differ from species of temperate forests. Species diversity is highest in the extensive neotropical forest; second in the highly fragmented Indo-Malaysian formation; and lowest in Africa. Where 5 to a maximum of 30 species of tree share dominance in the Temperate Broadleaf Deciduous Forest, there may be 40 to 100 different species in one hectare of tropical rainforest. Tropical species of both plants and animals often have very restricted distribution areas.

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**Alpine expressions of the biome:** A simplification of the tropical rainforest in species composition and in stratification occurs as elevation exceeds 3000 ft. Distinct communities are found at higher elevations, communities that do *not* replicate latitudinal changes in vegetation as do alpine communities in temperate zones. For more information, see [Tropical Life Zones](#).