TROPICAL DRY FOREST STRUCTURE, DISTRIBUTION AND DYNAMICS

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Summary

Dry tropical forests are perhaps the most extensive vegetation type in the tropics, originally covering more than 40% of the tropical landmass. They are characterized by a prolonged and severe drought for several months and rainy, humid conditions for the remainder of the year. Plants within this forest type include deciduous and evergreen trees that have specialized water-retention traits such as stem-succulence to help tolerate the stress of the prolonged dry season. Except along rivers, trees are short with broad crowns; the closed-canopy forest has few layers. Leaf fall, flowering, and dry-fruit

production usually peak during the dry season. Vegetative growth is highest in the wet season, with some flowering and fleshy-fruit production also occurring then. The growth-limiting dry season means that one can often use tree growth rings to study the population dynamics of these forests. Germination is confined to the early wet season to ensure adequate water throughout the first growth stages. Diversity is high, and endemism is pronounced. Globally, dry forest has been altered to a great extent and only a small portion of the original forest remains. Human population density is greater in this ecosystem than in other tropical systems due to the more clement climate and more fertile soils. The largest threats to dry tropical forest include anthropogenic fire, livestock grazing, and the low proportion that has been conserved.

1. Introduction

1.1. Distribution and Climate

While all tropical forests tend to have at least one period in the year with lowered water availability, tropical dry forests (TDFs) are the subset where the dry season is both prolonged and severe. More generally, they can be defined as areas within the tropics where there is a drought (<30 mm of rain per month for at least four months) during the low sun period, and a rainy season of several months duration when the sun is highest in the sky and there is more than 100mm of monthly rain. The fact that the drought is in the period of minimum evapotranspiration permits a forest rather than shrub-dominated vegetation, as occurs more poleward in Mediterranean climates. Annual precipitation is in the range of 400-1700 mm. Further, a TDF is defined as having a continuous cover of trees; thus, we exclude savannas as they are too open. It is estimated that about 1 million km^2 of TDF remains today with about half of that in South America (Figure 1). Other regions with substantial areas of TDF include India and Southeast Asia, Australia, the Caribbean and Central America, and two parallel belts in Africa.

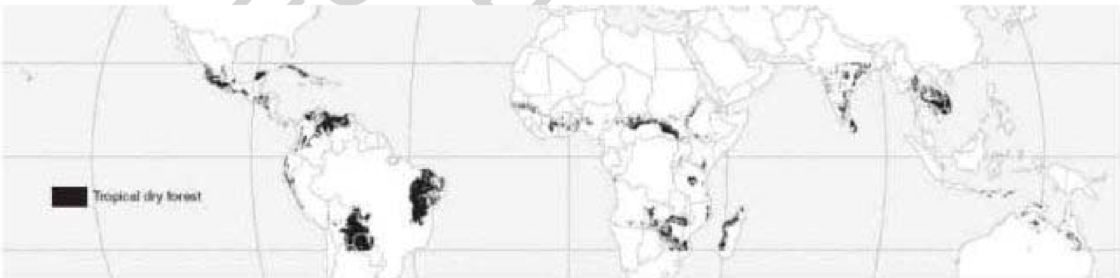

Figure 1. The extant of dry tropical forest (taken from Miles et al (2006)). The map is based on 10 km cells containing at least 40% forest.

Broadly, there are two mechanisms for the development of a tropical climate regime characterized by drought in the low sun season and rain in the high sun season. On the west side of continents, the subtropical high pressure system will dominate during the low sun season bringing dry subsiding air, clear skies, and stable conditions. During the high sun season this high pressure shifts more poleward and is frequently replaced by the **Inter-tropical Convergence Zone** which is associated with convective storms. A second mechanism, more typical of the east sides of continents, is a monsoonal regime whereby winter conditions are dominated by cool, dry air drawn from a source area deep within continental interiors. In summer the flow is reversed, and now moist, warm air (the monsoon) flows in from tropical oceanic source areas. Regionally, the presence of mountains can complicate these mechanisms by inducing orographic precipitation and rain shadows.

1.2. Overview of Dry Forest Structure and Origin

The most distinctive characteristic of TDF is the loss of leaves by the majority of trees during the long dry season with its characteristically low relative humidity. This is especially common away from valley bottoms. In consequence, there is a pulse of biological activity concentrated in the wet season (in much the same way as activity is limited to the period when soils are thawed in the vegetation of higher latitudes). TDFs are quite different from either wet tropical forests or mid-latitude forests, and should not be regarded as transitional between those vegetation types. For one thing, the trees are only about half the size (measured as diameter or height), and heavily draped with lianas. The characteristic shape of these trees is different from mid-latitude and wet tropical forests: the crown being quite wide relative to the height. The canopy height is less homogenous, and, as one discovers when trying to walk through TDF, there is a well-developed understory of shrubs.

The origins of this vegetation type are unclear. Two reasons for the lack of knowledge are that (1) the great majority of the tree species are animal-pollinated, and therefore there is a paucity of pollen grains in lake sediments to permit delineation of past plant assemblages. Second, it is hard to discern a TDF community using macrofossils (e.g. fossilized leaves); these will be preferentially preserved in wet sites, but the characteristic genera of TDFs will be found on the interfluves while genera more typical of (or shared with) the wet tropical forests will tend to be found along water margins. For Central America, elements of the present TDF appear in the mid to late Eocene. One study used the diversification rate of the genus *Bursera*, which is a common genus in Neotropical dry forests, to argue that the TDF appeared around 25 million years ago in western Mexico, perhaps as a result of aridity associated with the most recent uplift of the Sierra Madre Occidental.

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Biographical Sketches

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