

Structure of Tropical Rain Forests

Identify physical features of tropical forests

Provide a preview of measuring biodiversity

Structure of Tropical Rain Forests

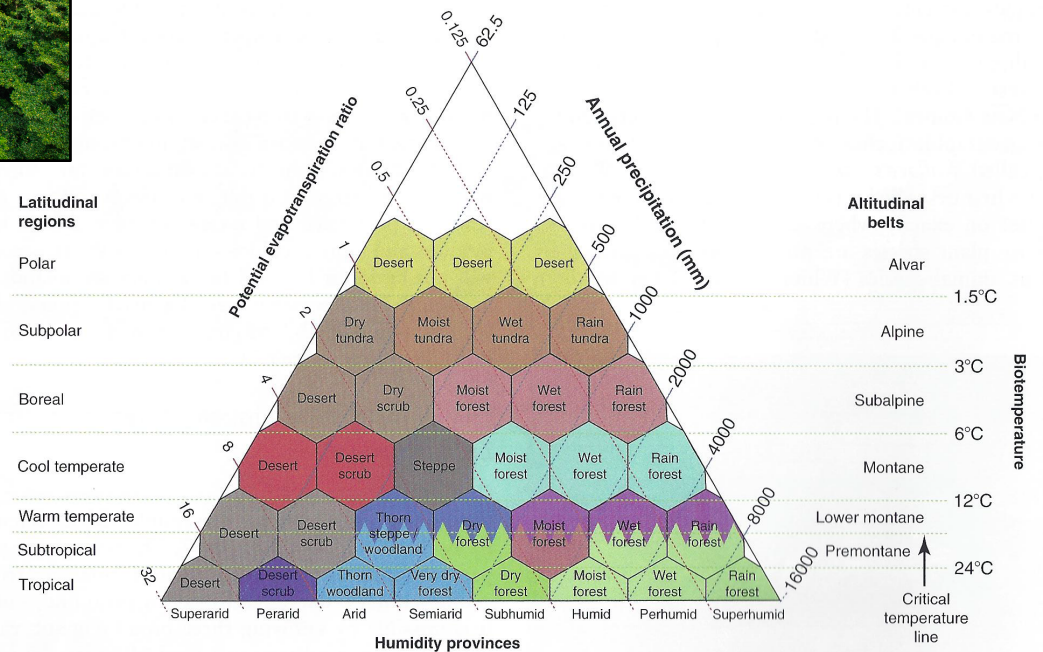
“It is a world in which man seems an intruder, and where he feels overwhelmed by the contemplations of the ever-acting forces which, from some simple elements of the atmosphere, build up the great mass of vegetation which overshadows and almost seems to oppress the earth.”

– Alfred Russel Wallace 1895

Rainforests: A complex physical structure



Tropical rain forest represents a biome determined by climates that remain warm and wet throughout the year



Rainforests: A complex physical structure



Two broad characteristics are evident in rain forests:

Complex physiognomy (physical structure)

- Tall canopy (30-35 m)
- High volume and biomass
- Multiple forest strata

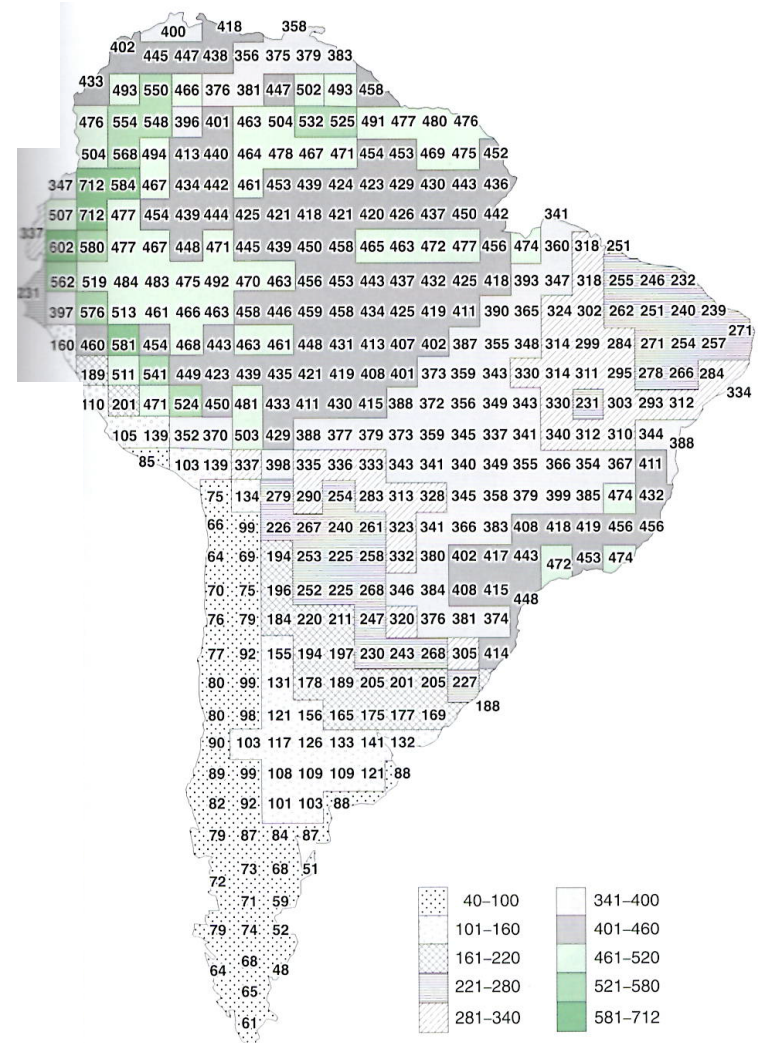
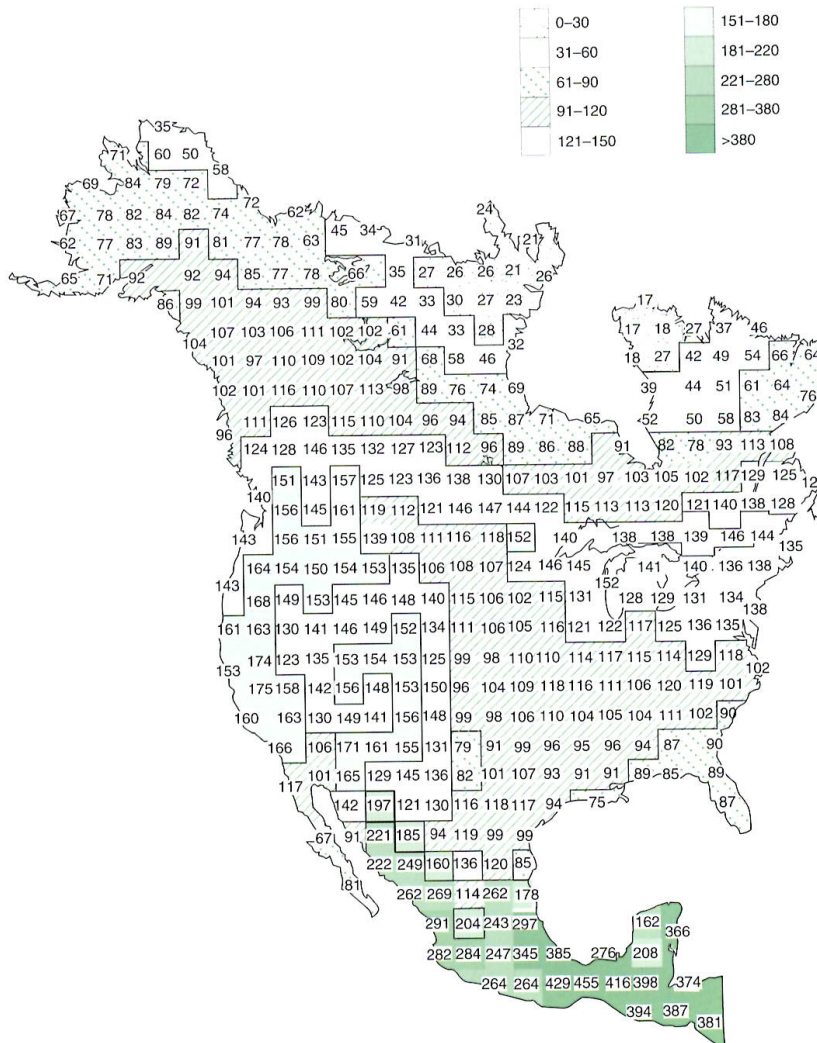
Biodiversity

- Species richness
- Species evenness

High diversity across most taxonomic groups: trees, bromeliads, orchids, mammals, birds, reptiles, amphibians, arthropods

Species richness trends in birds

Tropical regions are centers of biodiversity: compare numbers of species in area cells across North and South America



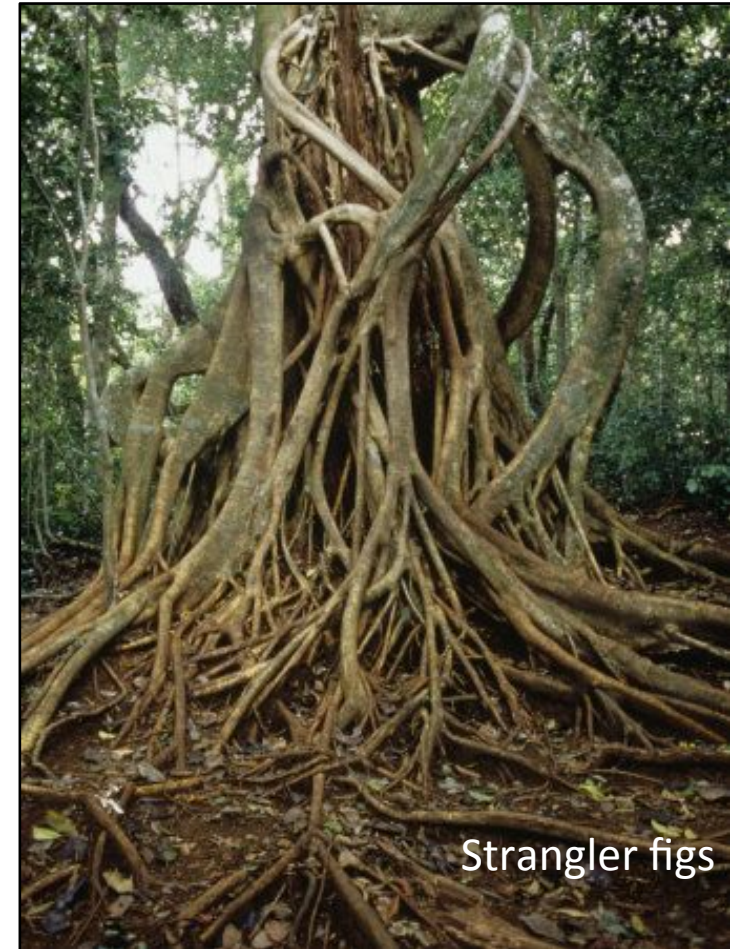
Rainforests: A complex physical structure



These two characteristics, complex structure and biodiversity, may contribute causally to each other:

Structural complexity is a function of diverse growth forms (trees of different heights, vines, epiphytes)

Recall structural features of forests



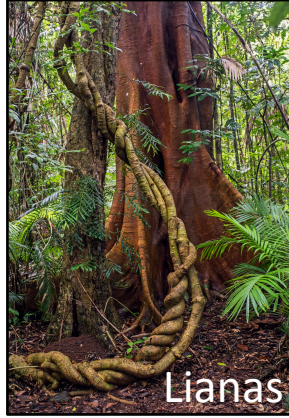
Structural complexity promotes further diversity

Provides numerous varied energy resources for animals and plants:

- Epiphytes are habitats for insects, frogs, foraging substrates for birds
- Palm and figs provide food resources for numerous birds and mammals
- Lianas and strangler figs are supported by large canopy trees



Epiphytes



Lianas



Palms



Tree ferns



Strangler figs

Gaps in Tropical Forest

Gaps are natural disturbances within tropical forests, generated by localized forces (e.g., treefall or lightning strike)

These disturbances are a major force affecting rain forest dynamics (to be discussed later...)

Gaps allow high light penetration to the forest floor, and are colonized by heliophilic fast-growing plant species

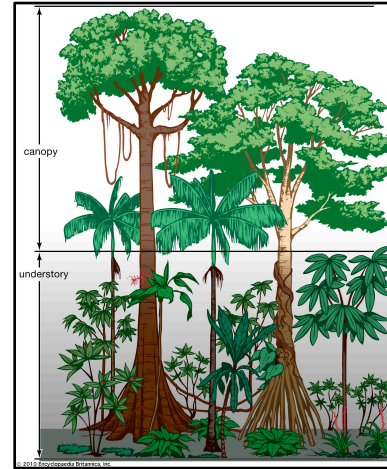
These are gradually replaced by slow-growing shade tolerant species through ecological succession



Features of Tropical Forest

Common structural 'field marks' of most rain forests include:

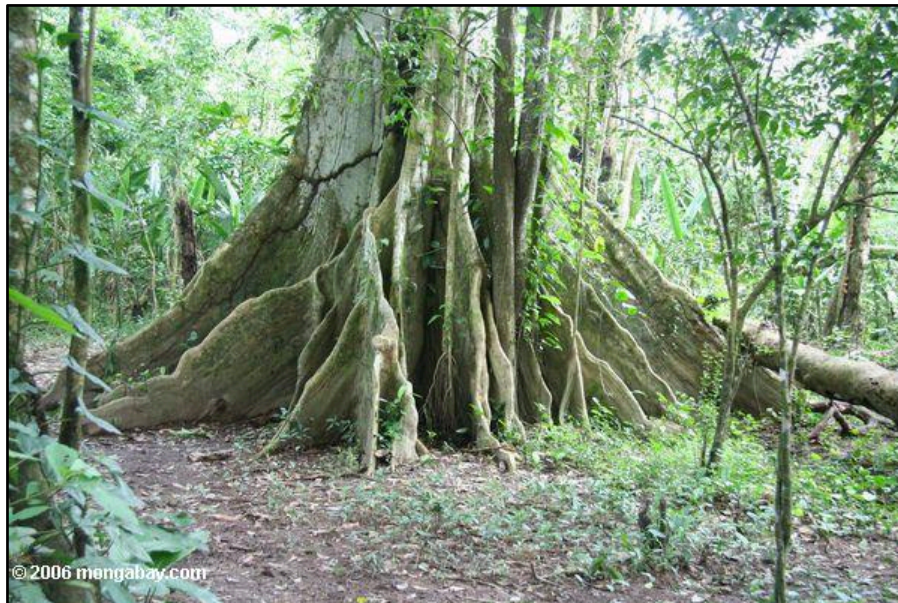
- Tall canopy
- Scattered emergent trees
- Small understory trees and palms
- Forest gaps
- Umbrella branching of canopy trees
- Animal pollinated flowers (sometimes synchronized)
- Buttressed roots of trees
- Epiphytes, vines, lianas
- Thin leaf litter (decays quickly)
- Typically acidic, clay-based soils many of which are nutrient poor



Features of Tropical Forest

Common structural 'field marks' of most rain forests include:

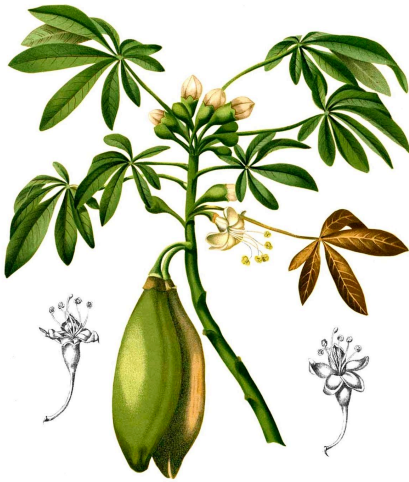
- Broad leaved trees (few gymnosperms)
- Buttresses: roots that flare from the trunk
- Surface or prop roots radiating from the base of the trunk, in some palms



Features of Tropical Forest

Common structural 'field marks' of most rain forests include:

- Many tropical trees show a characteristic called *cauliflory* (flowers and fruits grow directly from trunk)
- Tropical leaves are often non-lobed, waxy with drip tips



Ceiba pentandra



Castilla leaves



Theobroma cacao

Fruits of Tropical Forest

Animal-facilitated seed dispersal is a prevailing feature of tropical forests



Cocos nucifera



Lecythidaceae



Durio zibethinus



Artocarpus altilis



Crescentia alata



Hymenaea courbaril



*Enterolobium
cyclocarpum*



Theobroma cacao

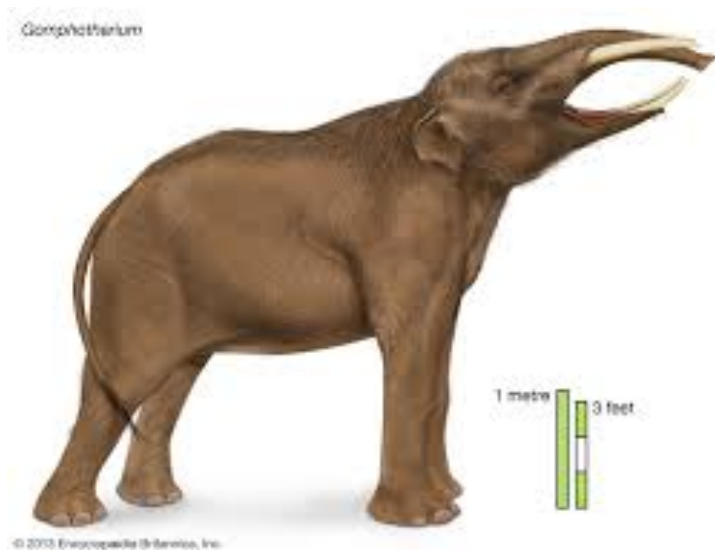
Fruits of Tropical Forest

Neotropical mammals are common consumers (and dispersers) of tropical fruits



Fruits of Tropical Forest

Some extinct mammals (e.g., Giant ground sloths, Gompothères) were probably important seed dispersers for large-seeded tropical plants



When large mammals (Pleistocene megafauna) became extinct, many trees lost their primary dispersers

Features of Tropical Forest

Palms – occur worldwide, among the most distinctive tropical plants, with ~1500 species

Abundant in forest understory, and some reaching the canopy, many protected with spines



Features of Tropical Forest



Palms are an important food source for mammals (e.g., peccaries, agoutis)

Seed predation influences diversity and local distribution of trees (Janzen – Connell effects)



Features of Tropical Forest

Lianas are woody vines that generally invade forest gaps

A growth form found in many plant families (Cucurbitaceae, Smilacaceae)

Pervasive in canopy and understory



(one hectare in Panama supported 1600 lianas)



Features of Tropical Forest

Hemiepiphytes – among the most unusual plant growth forms. They begin their life cycle as epiphytes and eventually become rooted in the ground

Best known group is the stranglers:
Ficus spp.



Features of Tropical Forest

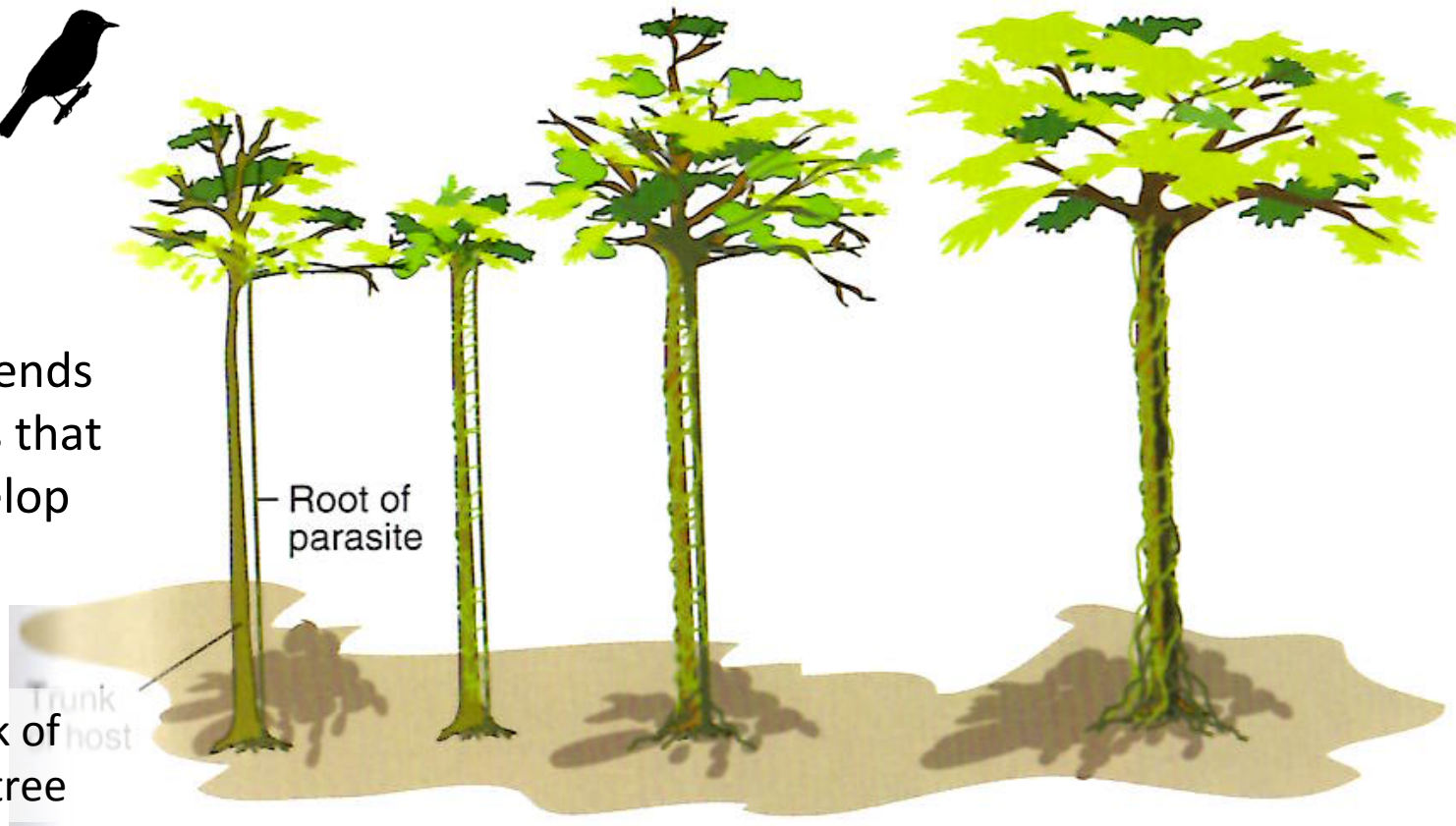
Growth strategy of *Ficus* spp.

Fig seeds are deposited by dispersers in a host tree



The seedling sends down air roots that gradually envelop the host tree

Trunk of host tree



Features of Tropical Forest

Growth strategy of *Ficus* spp.



The host tree eventually dies and the fig remains as a fully grown canopy tree

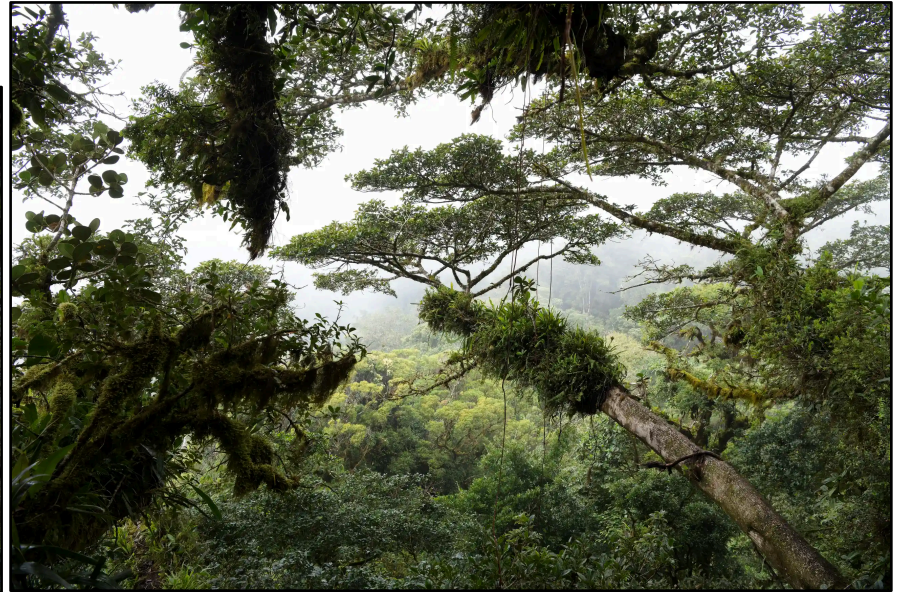


Figs are keystone resources for animals



Features of Tropical Forest

Epiphytes – grow on other plants and contribute to forest canopy structure



Highest biomass of epiphytes is found in cloud forest, where they are important for hydrological and nutrient cycles
(Epiphytes are less abundant and less diverse in drier forests)

Features of Tropical Forest

~200 species of birds use epiphytes in foraging



Other species use it for nesting substrate

Nadkarni & Matelson 1989

Features of Tropical Forest

Estimated 15,500 species
in Central and South
America

Epiphytes attach to
branches and trap soil
particles, developing
epiphyte mats



Many epiphytes have root systems that contain mycorrhizae,
which aid in uptake of minerals

Features of Tropical Forest

Bromeliads (Bromeliaceae): 3,000 described species

Overlapping leaves form a 'tank'
that holds water and detrital material



Features of Tropical Forest

Bromeliads are home to various frogs, mosquitoes, snail and others, that complete all or part of their life cycle there.

Three frog species found in *Aechmea* bromeliads



Features of Tropical Forest

Common understory plants include members of diverse families:

Melastomataceae, Rubiaceae, Piperaceae, palms, Heliconias and ferns, plus many slow-growing, shade-tolerant saplings

