

# Tropical Rainforest Biome

## Structure of the vegetation: **Leaves**

- canopy leaves exposed to recurrent dry periods - evergreen, thick cuticle, leathery



*Ficus* - fig (Moraceae)



*Syzygium* (Australia)

# Tropical Rainforest Biome

## Structure of the vegetation: Leaves

- compound leaves common



*Ceiba* - kapoc (Malvaceae)

*Sterculia* - (Malvaceae)

- new leaves with anthocyanin flush to prevent photo-oxidation



# Tropical Rainforest Biome

## Structure of the vegetation: **Leaves**

- interior forest more stable (dark and humid)
- drip tip leaves common



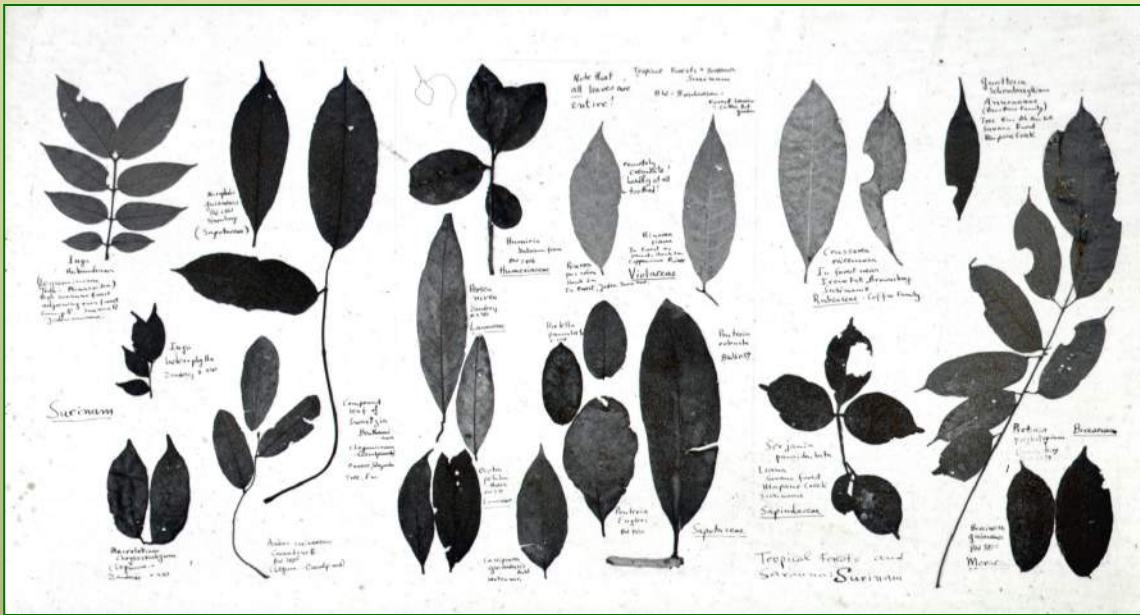
*Ficus* - fig



# Tropical Rainforest Biome

## Structure of the vegetation: Leaves

- Ghana undergrowth study with 90% drip tips



- *Nepenthes* (Asian pitcher plant) drip tip converted into carnivorous trapping structure



# Tropical Rainforest Biome

## Structure of the vegetation: **Herbs**

- 70-90% of species are trees
- low light levels discourage herbs
- some common families



Gesneriaceae - African  
violet family



Melastomataceae -  
melastome family



## Tropical Rainforest Biome

### Structure of the vegetation: **Herbs**

- 70-90% of species are trees
- low light levels discourage herbs
- other common families



Begoniaceae -  
begonia family

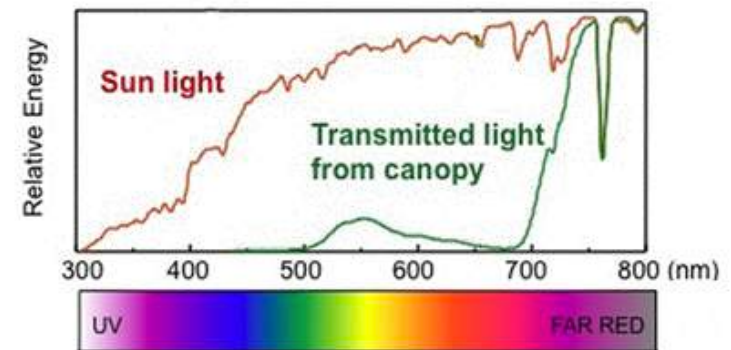


Commeliniaceae -  
spiderwort family

# Tropical Rainforest Biome

## Structure of the vegetation: **Herbs**

- velvety, variegated, or metallic shimmer leaves
- adaptive in low light conditions



**Figure 1.** Comparison of full sunlight spectrum to that beneath a canopy of trees.

# Tropical Rainforest Biome

## Structure of the vegetation: **Herbs**

- **coarse herbs** common in riparian (river edge) or gap habitats
- order Zingiberales (banana families: heliconias, gingers, etc.)



*Heliconia* (Heliconiaceae)



*Costus* (Costaceae)



## Tropical Rainforest Biome

### Structure of the vegetation: **Herbs**

- **mycorrhizal parasites** common
- adaptation to low nutrients (mycorrhizal) and low light (non-photosynthetic)



*Voyria* (Gentianaceae)



*Triuris* (Triuridaceae)

# Tropical Rainforest Biome

## Structure of the vegetation: **Herbs**

- **parasites** common
- adaptation to low nutrients (parasitize plants) and low light (non-photosynthetic)



*Rafflesia* (Rafflesiaceae)



*Heliosis* (Balanophoraceae)

# Tropical Rainforest Biome

## Structure of the vegetation: **Herbs**

- **fungi** common
- non-photosynthetic



Stinkhorn



Bracket fungus

## Tropical Rainforest Biome

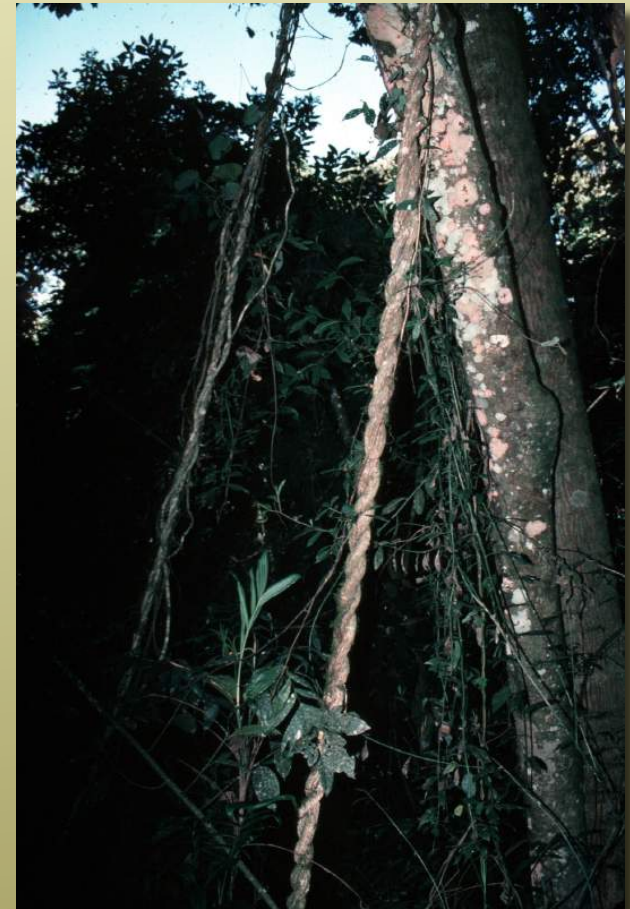
Structure of the vegetation: **Lianas** — a cost effective method in struggle for light

- exploit tree as support for rapidly growing flexible stem and branch in canopy



*Combretum* (Combretaceae)

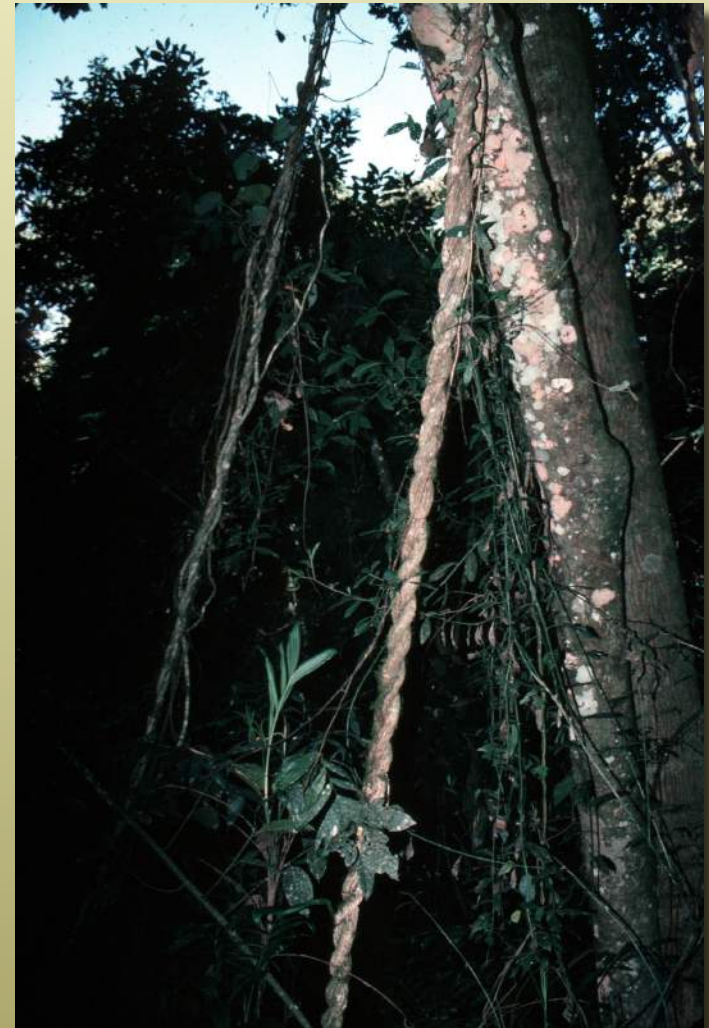
*Ficus* - fig (Moraceae)



## Tropical Rainforest Biome

Structure of the vegetation: **Lianas** — a cost effective method in struggle for light

- 90% of all lianas confined to wet tropical rainforests - why?
- rope-like (20cm, 8in) but with pliable secondary thickenings



*Ficus* - fig (Moraceae)

# Tropical Rainforest Biome

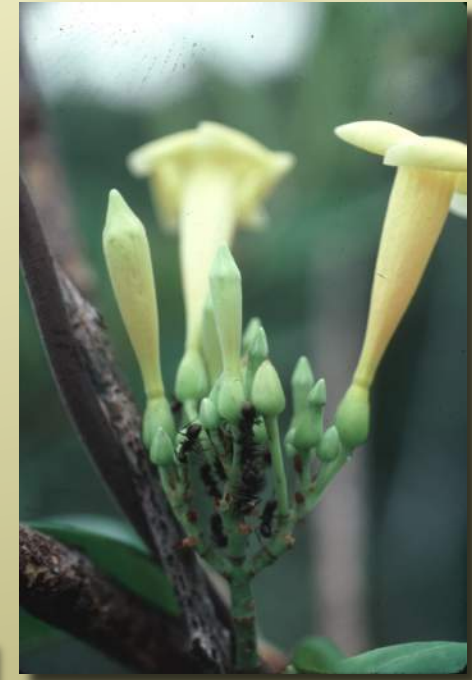
## Structure of the vegetation: **Lianas**

- other common liana families



*Bignoniaceae -  
catalpa family*

*Apocynaceae -  
dogbane family*



*Cucurbitaceae -  
gourd family*



*Gurania* and other  
cucurbit flowers are  
sole source of nectar  
for adult heliconid  
butterflies

# Tropical Rainforest Biome

## Structure of the vegetation: **Lianas**

- other common liana families



*Passifloraceae - passion  
flower family*

*Passiflora* leaves are sole  
source of food for heliconid  
butterfly larvae



## Tropical Rainforest Biome

Structure of the vegetation: **Epiphytes** — a cost effective method in struggle for light

- germination in top most branches of host tree
- host solely as means of physical support



Epiphytes in Costa Rica canopy walk

- flowering plants, ferns, mosses, liverworts, lichens, algae (**epiphylls**)





## Tropical Rainforest Biome

Structure of the vegetation: **Epiphytes** — a cost effective method in struggle for light

- the study and collection of epiphytes one of the most challenging in science



Alec Barrow - Barro Colorado Island

Scott Mori - NY Bot Gard in Guyana

## Tropical Rainforest Biome

Structure of the vegetation: **Epiphytes** — a cost effective method in struggle for light

- dominant angiosperm epiphytes:

Orchidaceae - orchids



Cactaceae - cacti



## Tropical Rainforest Biome

Structure of the vegetation: **Epiphytes** — a cost effective method in struggle for light

- dominant angiosperm epiphytes:



Piperaceae - peperomias



Araceae - aroids

## Tropical Rainforest Biome

Structure of the vegetation: **Epiphytes** — a cost effective method in struggle for light

- dominant angiosperm epiphytes:



Gesneriaceae -  
African violets



Bromeliaceae - pineapples

## Tropical Rainforest Biome

Structure of the vegetation: **Epiphytes** — adaptations to epiphytic condition — *the problem of obtaining and storing water*



**water tanks** (water storage)  
- Bromeliaceae

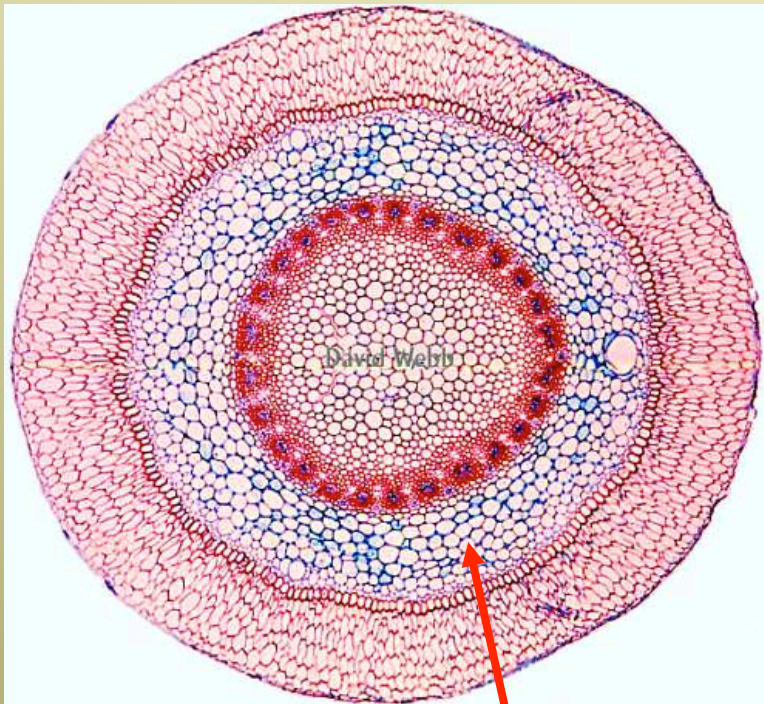


**Scales** (water & nutrient uptake)  
- Bromeliaceae



## Tropical Rainforest Biome

Structure of the vegetation: **Epiphytes** — adaptations to epiphytic condition — *the problem of obtaining and storing water*



**leaf tubers** (water storage) - Orchidaceae

Orchid root **velamen** (water storage)

# Tropical Rainforest Biome

Structure of the vegetation: **Epiphytes** — adaptations to epiphytic condition — *the problem of obtaining and storing water*



**Succulence & CAM**  
photosynthesis - Cactaceae



**“trash baskets” & aerial roots** - staghorn ferns (above) and Araceae (right)



## Tropical Rainforest Biome

Structure of the vegetation: **Stranglers** — a cost effective method in struggle for light

- start as epiphytes and grow roots down host tree



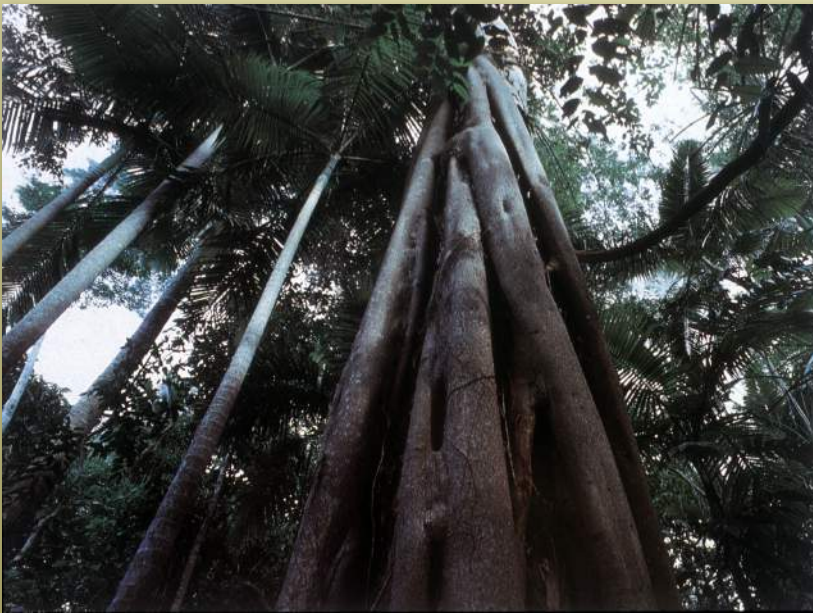
*Ficus* (strangler fig - Moraceae)



## Tropical Rainforest Biome

Structure of the vegetation: **Stranglers** — a cost effective method in struggle for light

- start as epiphytes and grow roots down host tree
- shoot elongates and roots thicken, coalesce



*Ficus* (strangler fig - Moraceae)



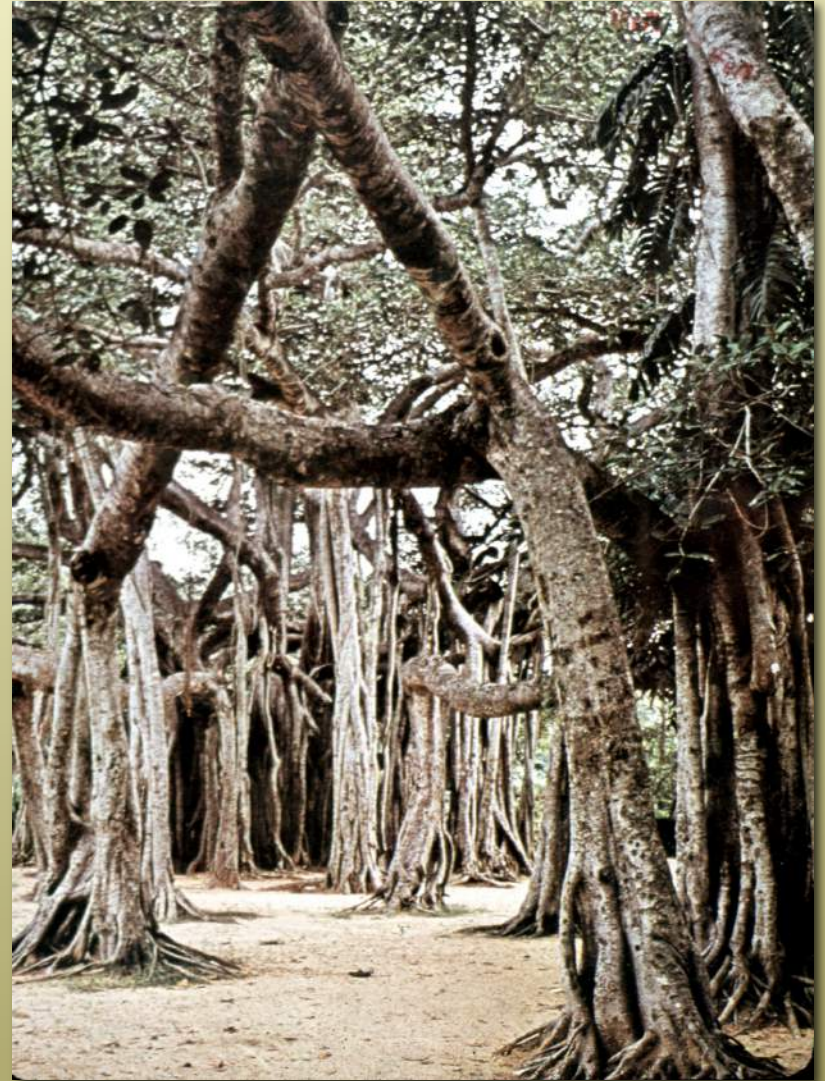
## Tropical Rainforest Biome

Structure of the vegetation: **Stranglers** — a cost effective method in struggle for light

- strangulation of host via “root” stem



*Ficus* (strangler fig - Moraceae)



## Tropical Rainforest Biome

Structure of the vegetation: **Stranglers** — a cost effective method in struggle for light

- other stranglers



*Clusia*  
(Clusiaceae)



## Tropical Rainforest Biome

Structure of the vegetation: **Stranglers** — a cost effective method in struggle for light

- other stranglers



*Metrosideros robusta* -  
Northern rata (Myrtaceae)

# Tropical Rainforest Biome

## Structure of the vegetation: **Hemi-epiphytes**

- germinate on ground, grow up as lianas (root climbers)
- bottom dies, becomes epiphytes
- “walk” through forest looking for light



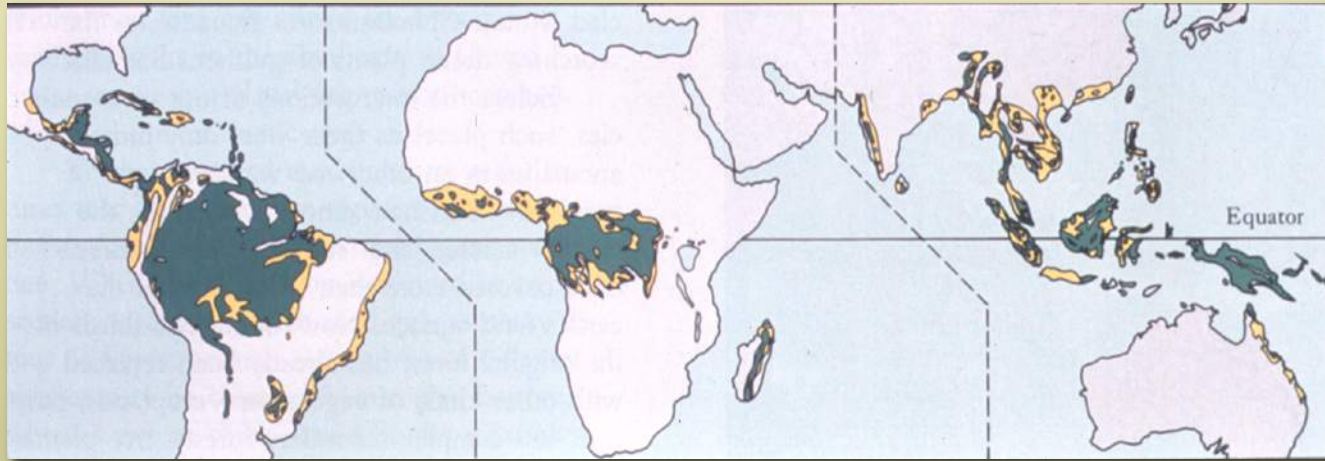
*Anthurium & Philodendron* (aroid - Araceae)



*Philodendron* (aroid -  
Araceae)

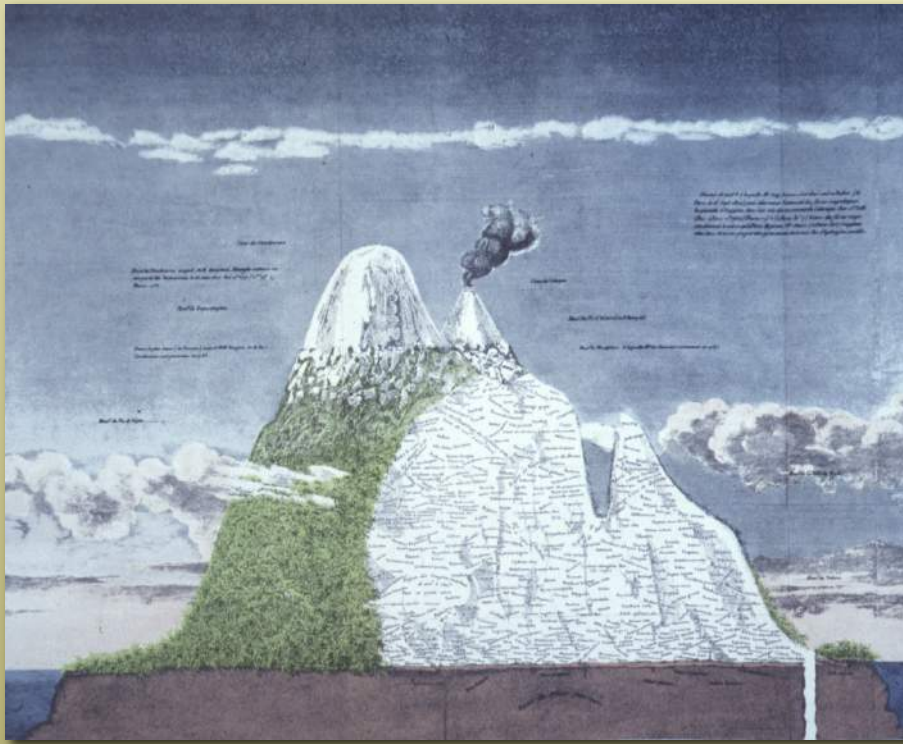
## Cloud Forest or Tropical Montane Biome

- Form when moisture laden winds encounter mountains



## Cloud Forest or Tropical Montane Biome

- Form when moisture laden winds encounter mountains
- Elevation and humidity related - not precise location



Panamanian cloud forests lower

Andean cloud forests higher



## Cloud Forest or Tropical Montane Biome

- epiphytes most abundant here
- trees smaller, lianas rare





## Cloud Forest or Tropical Montane Biome

- characteristic groups of cloud forests



- tree ferns

*Cyathea*



## Cloud Forest or Tropical Montane Biome

- characteristic groups of cloud forests



*Hymenophyllum* - filmy fern

- filmy ferns  
(Hymenophyllaceae)
- club mosses, spike mosses, true mosses



*Selaginella* - spike moss

## Cloud Forest or Tropical Montane Biome

- characteristic groups of cloud forests



- *Gunnera*  
(Gunneraceae)



- Rubiaceae (coffee family)

- Ericaceae (blueberry family)



## Above Tropical Montane Forests



Elfin forest - Costa Rica

Ruwenzoris



Costa Rica  
- Cerro de  
la Muerte



Tropical subalpine, paramo

## Above Tropical Montane Forests



Sierra Nevada del Cocuy  
National Park, Colombia  
[4,638 m]

*Lupinus alopecuroides*  
growing with *Senecio*  
*niveoaurus* in a superparamo

Photo: Mauricio Diazgranados

# Reproductive Strategies in Tropical Forests

## Pollination biology

- outcrossing mechanisms in trees, usually animal-mediated
- e.g., dioecy - separate male and female plants

## Level of dioecy

Costa Rica

20% tall trees

12% small trees

Sarawak

26% trees

Nigeria

40% trees



dioecious *Clusia*

# Reproductive Strategies in Tropical Forests

## Pollination biology

- wind pollination rare in mature rain forests
- common in early seral stages (light gaps, cut-over forests)

- wind pollination dropped from 38% to 8% in two years after light gap formed in Costa Rica



Wind pollinated *Cecropia*

# Reproductive Strategies in Tropical Forests

## Pollination biology

- animal pollination involves bats, birds, bees, moths, beetles



Carrion insect/bat pollinated  
*Aristolochia*



Hummingbird pollinated  
*Fuchsia*



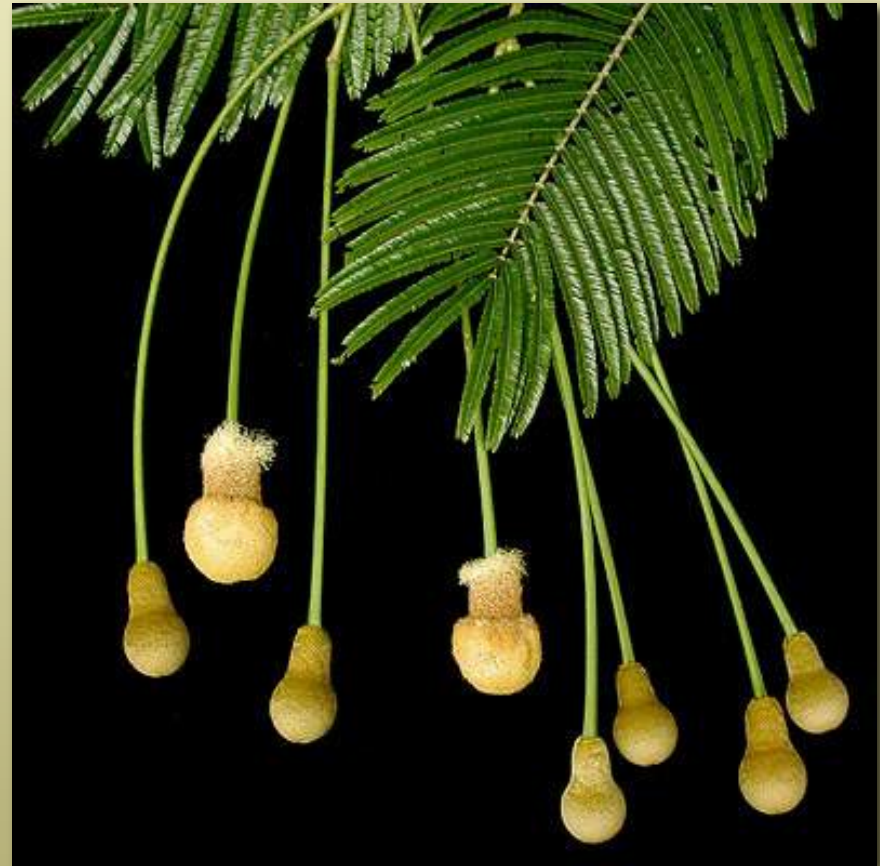
# Reproductive Strategies in Tropical Forests

## Pollination biology

- animal pollination involves bats, birds, bees, moths, beetles



many bat-pollinated trees are **cauliflorous** - flowers on stem



or with pendant flowers (*Parkia* - Fabaceae)

# Reproductive Strategies in Tropical Forests

## Seed or fruit dispersal

- fleshy fruits dominate (90% +)
- wind dispersal (5-10%)
- water dispersal (1-2%)



bat-dispersed figs



frugivorous  
birds



primate dispersed durian

# Major Animal Radiations in Tropical Forests

- ca. 45% of land plant species occur here
- ca. 50% of land animal species
- here are a number of significant animal radiations in tropical settings – many of which we will discuss biogeographically later



# Major Animal Radiations in Tropical Forests



ants



spiders



euglossine bees

## Lepidoptera



## Coleoptera



# Major Animal Radiations in Tropical Forests



snakes



mongabay.com



frogs

# Major Animal Radiations in Tropical Forests



toucans



parrots



Quetzal



hummingbirds



Bird-of-paradise

# Major Animal Radiations in Tropical Forests

