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

  - new leaves with anthocyanin flush to prevent photo-oxidation

*Ceiba* - kapoc (Malvaceae)

*Sterculia* - (Malvaceae)
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.
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

- **Apocynaceae** - dogbane family
- **Cucurbitaceae** - gourd family
- **Bignoniaceae** - catalpa 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

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

*Passifloraceae* - passion flower family
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

- 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*

Orchid root *velamen* (water storage) - Orchidaceae

Leaf tubers (water storage) - Orchidaceae
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

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*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
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

Andean cloud forests higher

Panamanian cloud forests lower
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 niveoaureus* 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

<table>
<thead>
<tr>
<th>Location</th>
<th>Tall Trees (20%)</th>
<th>Small Trees (12%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Costa Rica</td>
<td>20%</td>
<td>12%</td>
</tr>
<tr>
<td>Sarawak</td>
<td>26%</td>
<td></td>
</tr>
<tr>
<td>Nigeria</td>
<td>40%</td>
<td></td>
</tr>
</tbody>
</table>

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%)

frugivorous birds

bat-dispersed figs

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
- Frogs
Major Animal Radiations in Tropical Forests

toucans
parrots
hummingbirds
Bird-of-paradise
Quetzal
Major Animal Radiations in Tropical Forests

monkeys, other primates, bats, cats