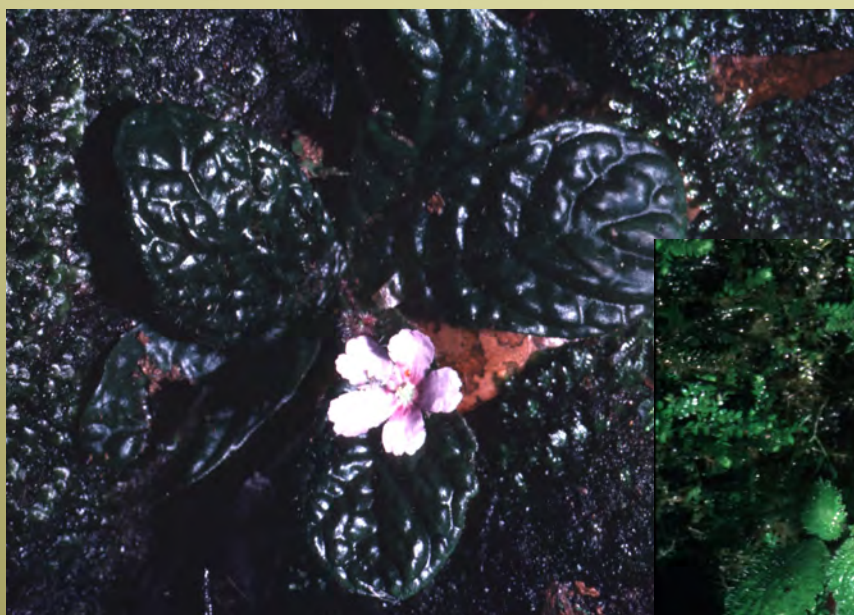
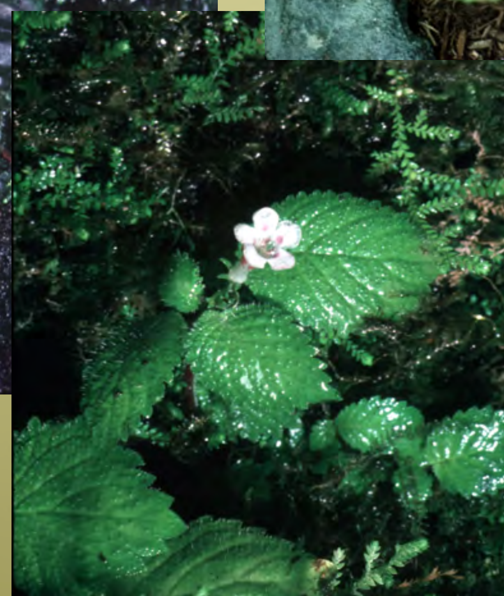
Tropical Rainforest Biome

Structure of the vegetation: **Herbs**

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

Melastomataceae - melastome family





Gesneriaceae - African violet family

Tropical Rainforest Biome

Structure of the vegetation: Herbs

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

- other common families

Commeliniaceae - spiderwort family

Begoniaceae - begonia family

Tropical Rainforest Biome

Structure of the vegetation: **Herbs**

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

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**

- **saprophytes** (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)

Mitrastemma (Mitrastemmaceae)

Tropical Rainforest Biome

Structure of the vegetation: **Herbs**

- **fungi** common
- non-photosynthetic

Stinkhorn

Bracket fungus

Tropical Rainforest Biome

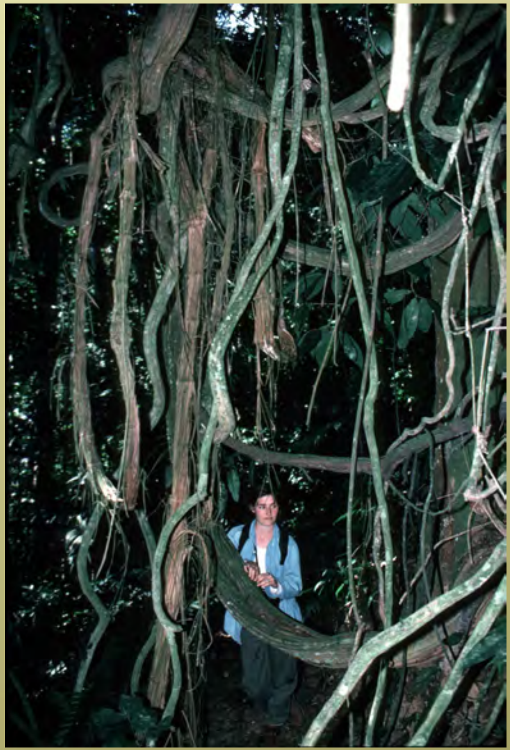
Structure of the vegetation: **Lianas —** a cost effective method in struggle for light

- exploit tree as support for rapidly growing flexible stem

Ficus - fig (Moraceae)

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

Combretum (Combretaceae)



Bauhinia (Fabaceae)

Tropical Rainforest Biome

Structure of the vegetation: **Lianas**

- other common liana families

Apocynaceae - dogbane family

Bignoniaceae - catalpa 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 - Princeton U in 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 —** a cost effective method in struggle for light

- adaptations to epiphytic condition — *the problem of obtaining and storing water*

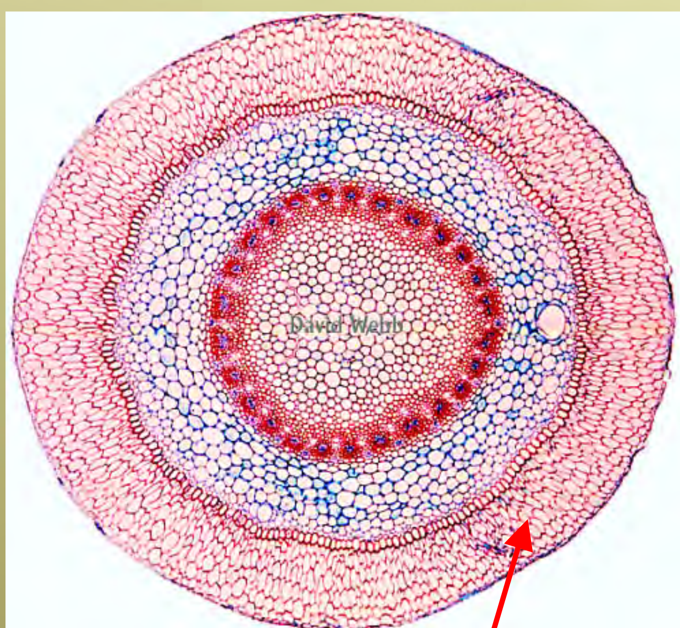
water tanks (water storage) - Bromeliaceae

Scales (water & nutrient uptake) - Bromeliaceae

Tropical Rainforest Biome

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

- adaptations to epiphytic condition — *the problem of obtaining and storing water*



Orchid root velamen (water storage)

leaf tubers (water storage) - Orchidaceae

Tropical Rainforest Biome

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

• 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

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

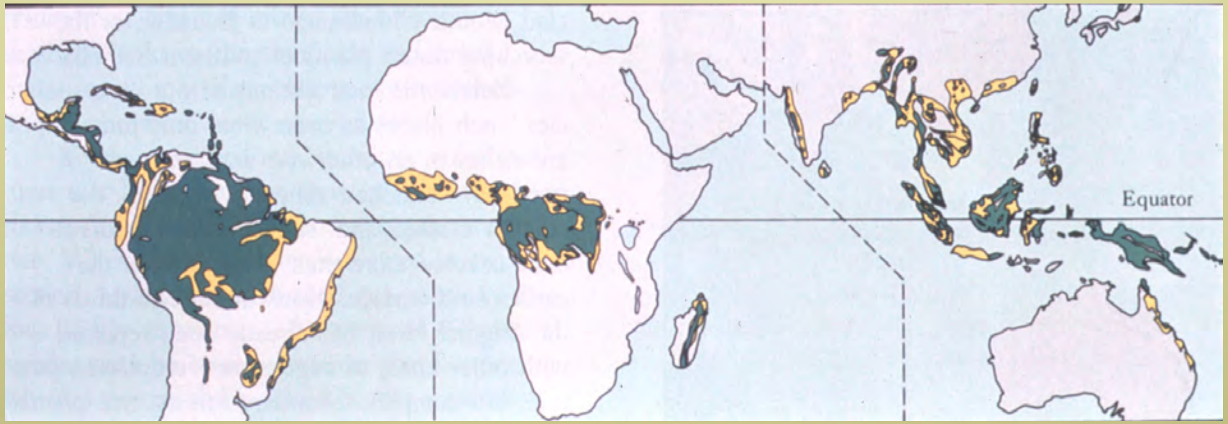
- germinate on ground, grow up as lianas (root climbers)
- bottom dies, becomes epiphytes
- “walk” or “snake” through forest looking for light

Anthurium & Philodendron (aroid - Araceae)

Philodendron (aroid - Araceae)

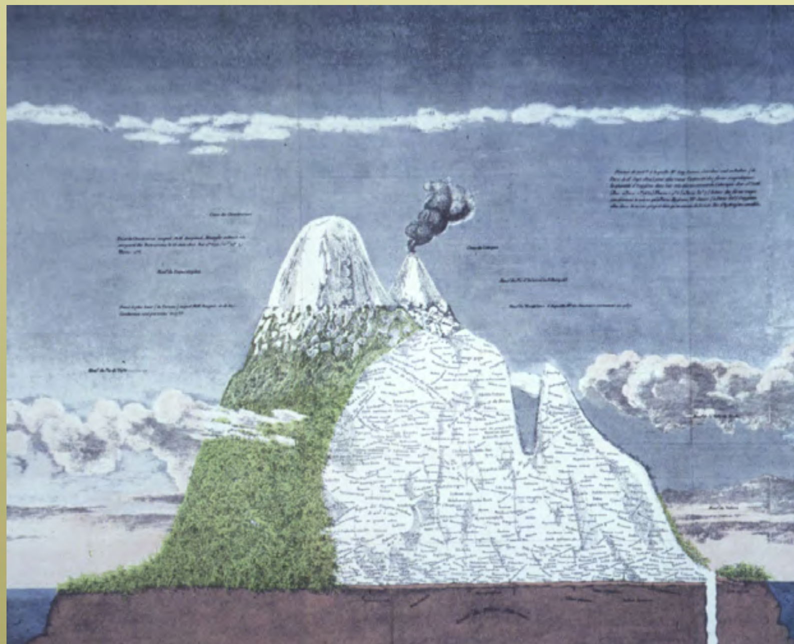
Cloud Forest or Tropical Montane Biome

- 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



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 well developed, 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%)

frugivorous birds

bat-dispersed figs

primate dispersed durian

Tropical Coastal Communities

Relationships to other tropical forest systems
— specialized swamp forests:

Mangrove and **beach forests**

- confined to tropical and subtropical zones at the interface of terrestrial and saltwater

Mangrove Forests

- confined to tropical and subtropical ocean tidal zones
- water temperature must exceed 75° F or 24° C in warmest month
- unique adaptations to harsh environment seen around the world and in different families of plants - convergent

Queensland, Australia

Moluccas

Venezuela

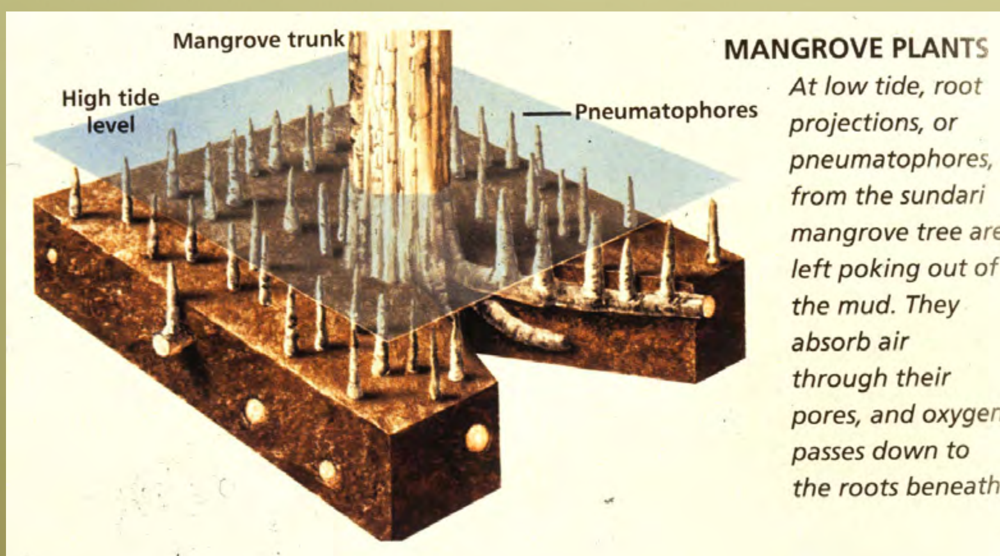
Mangrove Forests

- stilt roots - support

Rhizophora mangle - red mangrove

Mangrove Forests

- stilt roots - support
- pneumatophores - erect roots for O_2 exchange
- salt glands - excretion



Rhizophora mangle - red mangrove

Mangrove Forests

- stilt roots - support
- pneumatophores - erect roots for O_2 exchange
- salt glands - excretion
- viviparous seedlings

Rhizophora mangle - red mangrove

Xylocarpus (Meliaceae) & *Rhizophora*

Mangrove Forests

- 80 species in 30 genera (20 families)
- 60 species Old World & 20 New World

(Rhizophoraceae - red mangrove - most common in Neotropics)

Rhizophora mangle - red mangrove

Xylocarpus (Meliaceae) & *Rhizophora*

Mangrove Forests

- 80 species in 30 genera (20 families)
- 60 species Old World & 20 New World

Avicennia - black mangrove; inner boundary of red mangrove, better drained

Avicennia nitida (black mangrove, Acanthaceae)

Mangrove Forests

- 80 species in 30 genera (20 families)
- 60 species Old World & 20 New World

Four mangrove families in one Neotropical mangrove community

Avicennia - Acanthanceae

Rhizophora - Rhizophoraceae

Laguncularia - Combretaceae

Maytenus - Celastraceae

Beach Forests

- salt and sand - species often seen in mangrove community

Hibiscus tiliaceus

Cocos nucifera

Terminalia catappa

Beach Forests

- salt and sand - species often seen in mangrove community

Hippomane (Euphorbiaceae) - machaneel

Beach Forests

- woody climbers or runners

Coccoloba uvifera
(Polygonaceae) - seaside grape

Beach Forests

- woody climbers or runners

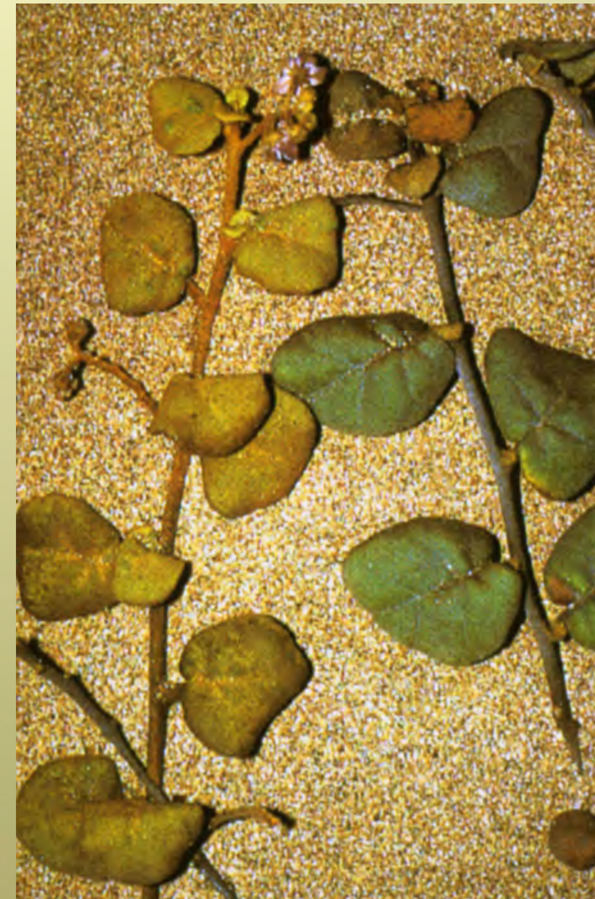
Ipomoea pes-caprae (Convolvulaceae) - morning glory

Beach Forests

- woody climbers or runners

Scaevola (Goodeniaceae)

Chamaesyce (Euphorbiaceae)



Solanum (Solanaceae)