



EPIPHYTES
Epífitas

Definition:
Plants which spend all or part of their lives NOT rooted in the ground.



EPIPHYTES

Grow on a variety of substrates:

- twigs, branches and bark
- cavities, croches and knots
- on leaves (**epiphylls**)
- on rock (**lithophytes**), roofs, utility wires

EPIPHYTE DISTRIBUTION

- **Largely a tropical phenomenon**
 - Mostly montane – 35% of plant species!
 - "air plants" can't tolerate frost
- **More in the New World**
 - New World endemics: Bromeliaceae and Cactaceae
 - Andes = most extensive tropical mountains
- **High diversity**
 - >25,000 vascular plant spp. (84 families)
 - Non-vascular epiphytes increase with elevation
 - Mosses, liverworts, lichens



EPIPHYTE DIVERSITY

CATEGORIES:

1. Accidentals
2. Facultative
3. True epiphytes



Many shrubby Gesneriads can survive as epiphytes.



Some epiphytic Aroids grow just fine in the ground after falling from a tree.



Many orchids and bromeliads are obligate epiphytes. They die if they fall off the tree.

EPIPHYTE DIVERSITY

CATEGORIES:

4. Hemi-epiphytes

- 1° hemiphytes – start in canopy
- 2° hemiphytes – start on ground



Hemiepiphytes festoon trees in Carcavado, Costa Rica

EPIPHYTE DISTRIBUTION

TROPICAL

Frost-intolerant

Abundance depends on **MOISTURE**

Low-Mid Montane

- zone of cloud formation

Within Canopy...

Horizontal stratification

- outer branches vs. inner branches

Vertical stratification

- upper canopy vs. lower canopy



EPIPHYTE ECOLOGY

Conditions in the canopy

- Lots of light
- Dry and windy
- No soil
- Discontinuous habitat

Epiphyte Adaptations

1. Overcoming water stress
2. Overcoming nutrient limitation
3. Efficient dispersal mechanisms



EPIPHYTE ECOLOGY

Overcoming Water Stress

1. Drought Tolerance

- POIKILOHYDROUS
 - e.g. "resurrection" fern, epiphytic mosses and algae



The Resurrection fern *Polypodium polypodioides* - DESSICATED



The Resurrection fern *Polypodium polypodioides* - HYDRATED

EPIPHYTE ECOLOGY

Overcoming Water Stress

2. Drought Avoidance

- Establishment in humid microsites



EPIPHYTE ECOLOGY

Overcoming Water Stress

2. Drought Avoidance

- Morphological adaptations for **water capture**
 - Phytotelmata (e.g., tank bromeliads)
 - Succulence = water storage tissue
 - Spongy roots and specialized hairs
 - High surface area



EPIPHYTE ECOLOGY

Overcoming Water Stress

2. Drought Avoidance

Morphological adaptations to **avoid water loss**

- trichomes: create boundary layer
- waxy roots and leaves
- sunken stomates



From left to right: Orchid pseudobulb; trichomes on *Tillandsia*; succulent leaves of epiphytic cactus *Rhytidocactus*

EPIPHYTE ECOLOGY

Overcoming Water Stress

2. Drought Avoidance

Physiological adaptations to reduce water stress

- CAM photosynthesis: stomates open at night
- C3-CAM switchers



EPIPHYTE ECOLOGY

In the Canopy...

- no large nutrient reservoir
- shallow rooting stratum
- aridity limits nutrient uptake

Sources of Canopy Nutrients

1. Atmospheric Inputs
 - Dry and wet deposition
 - N-fixation
 - Stemflow
 - Throughfall



EPIPHYTE ECOLOGY

Sources of Canopy Nutrients

2. Solid Inputs
 - Bark
 - Litterfall
 - Canopy soil
 - Ant nests

Formation of "canopy soil"



Nalini Nadkarni, one of the pioneers of canopy research, measures canopy soil in Costa Rica

EPIPHYTE ECOLOGY

Epiphyte Adaptations for Nutrient Capture

- same as for water capture
- marcescence
- mycorrhizae
- hemi-epiphytism
- protection from herbivory
- carnivory
- symbioses with other organisms
 - ant "gardens"
 - phytotelmata



TANK BROMELIADS

Arboreal aquaria!

phytotelmata

EPIPHYTE ECOLOGY

Other Adaptations

- abundant wind or bird dispersed seeds
- vegetative reproduction

Specific adaptations depend on environment and species

Guzmania monostachia seeds

vegetative reproduction in orchids

SOME EPIPHYTE GROUPS

ORCHIDACEAE – orchids, vanilla

- second largest vascular plant family - > 19,000 spp.
- epiphytic, lithophytic or terrestrial herbs
- some have **pseudobulbs**
- strap like leaves, some ± succulent
- roots with **velamen**

pseudobulbs

velamen

strap-like leaves

ORCHIDACEAE

Orchids, Vanilla

- flowers with 3 sepals, 3 petals
 - one is modified "lip" petal
- specialized pollination
- fruit a capsule with many dust-like seeds
- require fungi to germinate

BROMELIACEAE

Spanish moss, Pineapple

- exclusively **neotropical**
- epiphytic or terrestrial herbs
- strap-like leaves in **rosette**
- bulbous base or **tanks**
- some spiny and/or colorful
- trichomes** to capture water
- often CAM photosynthesis

water is adsorbed under trichomes by capillary action

trichomes

Leaf surface

BROMELIACEAE

Spanish moss, Pineapple

- flowers in colorful structures
- bird or wind dispersed
- ornamentals, pineapples

Cantelropala bilbergioides

ARACEAE

Elephant ears, philodendrons, taro, Jack-in-the-Pulpit, "aroids"

- epiphytic, hemi-epiphytic or terrestrial herbs
- leaves large, often heart-shaped, variegated
- calcium oxylate crystals
- **spadix** (flower spike) and **spathe** (hood)
- bird or bat dispersed
- many ornamentals, houseplants

PTERIDOPHYTES

FERNS

- primitive vascular plants
- tropical and temperate
- epiphytes, lithophytes, terrestrial
- feather-like or simple leaves
- some poikilohydrous
- reproduce by spores
- require water for fertilization (no pollen)

BRYOPHYTES

MOSSES

- small, non-vascular plants
- some poikilohydrous
- reproduce by spores
- restricted to moist habitats
- frost resistant
- very abundant in upper montane forests
