

## Commelinids

4 main groups:

- Acorales - sister to all monocots
- Alismatids
  - inc. Aroids - jack in the pulpit
- Lilioids (lilies, orchids, yams)
  - non-monophyletic
  - petaloid
- Commelinids
  - Arecales - palms
  - Commelinales - spiderwort
  - Zingiberales - banana
  - Poales
    - pineapple
    - grasses & sedges

Monocot Phylogeny  
APG III 2009

## Commelinids

- theme: reduction of flower, loss of nectar, loss of zoophily, evolution of bracts

pickeral weed

rapatead

heliconia

## Commelinales + Zingiberales

- 2 closely related tropical orders
- primarily nectar bearing but with losses
- bracted inflorescences

pickeral weed  
nectar

spiderwort  
pollen only

heliconia  
bracts

## Commelinaceae - spiderwort



*Commelina erecta* - Erect dayflower

*Tradescantia ohiensis* - spiderwort



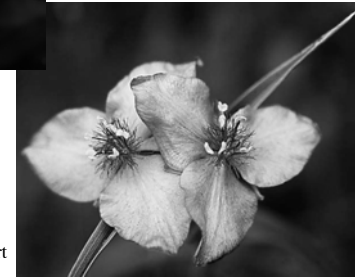
Family of small herbs with succulent stems, stems jointed; leaves sheathing. Family does not produce nectar, but showy flowers for insect pollen gathering.

## Commelinaceae - spiderwort



*Rhoen* - Moses in a cradle

Inflorescence often bracted



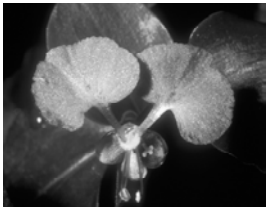
*Tradescantia ohiensis* - spiderwort

## Commelinaceae - spiderwort

Flowers actinomorphic or zygomorphic

CA 3 CO 3 A 6 G(3)

*Commelina communis* - day flower



*Tradescantia ohiensis* - spiderwort



## Commelinaceae - spiderwort



- species rich in pantropics, especially Africa
- floral diversity is enormous



*Zehneria pendula?*  
Comelinaceae  
Gerald D. Carr

## Pontederiaceae - pickerel weed

Aquatic family of emergents or floaters.  
Water hyacinth (*Eichhornia*) from tropical America is invasive species in subtropical areas of the world.



*Eichhornia crassipes*  
Water hyacinth  
invading Florida



## Pontederiaceae - pickerel weed

Pickerel weed has glossy heart-shaped leaves,  
superficially like *Sagittaria* but without net venation.  
Flowers are in congested showy purple inflorescences.



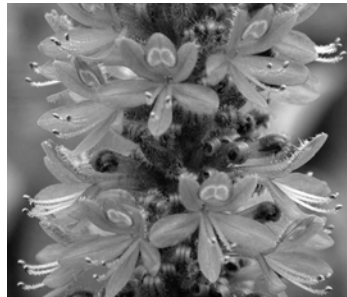
*Pontederia cordata* - Pickerel weed

## Pontederiaceae - pickerel weed

Flowers are showy, insect  
pollinated with nectar glands -  
previously placed in Liliales!



*Pontederia cordata* - Pickerel weed



## Haemodoraceae - kangaroo paw



*Anigozanthus* - kangaroo paw

Small family with floral nectar,  
species radiations in Australia and  
South Africa

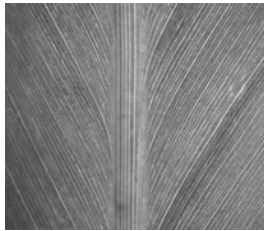
## Zingiberales

- strongly supported group of 8 tropical families

- rhizomatous monocots with showy, nectared, but highly bracted flowers

- 3 shared features:

1. Parallel-pinnate leaves, often distichous



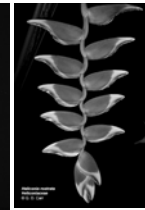
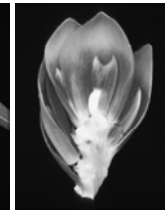
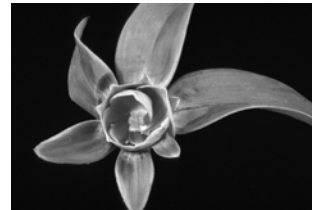
## Zingiberales

- strongly supported group of 8 tropical families

- rhizomatous monocots with showy, nectared, but highly bracted flowers

- 3 shared features:

2. Bracted flowers and inflorescences



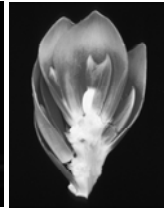
## Zingiberales

- strongly supported group of 8 tropical families

- rhizomatous monocots with showy, nectared, but highly bracted flowers

- 3 shared features:

3. Inferior ovary



## Zingiberales

- order fairly well known based on DNA and morphology
- show interesting trends in (1) fusion of perianth and (2) stamen loss and staminode development

*Costus* floral pattern



- 3 fused sepals
- 3 separate petals
- 5 fused sterile anthers (labellum)
- 1 fertile anther

DNA-based Zingiberales "rhizogram" by John Kress

## Zingiberales

Musaceae - banana

- robust herbs with spiralled phyllotaxy
- fleshy fruits

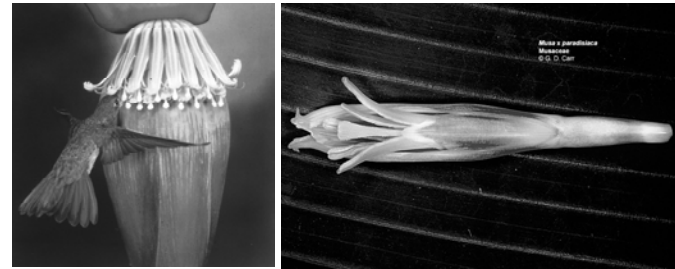
*Musa X paradisiaca*  
(sterile triploid)  
cultivated banana



## Zingiberales

Musaceae - banana

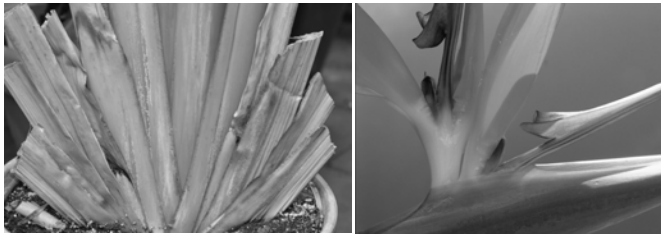
- unisexual flowers
- “tubular” flowers [3 sepals + 2 petals]
- 5 fertile stamens



## Zingiberales

Strelitziaceae - bird of paradise

- woody trunks (usually) with distichous leaves
- 2 fused petals (elaborated flowers for different pollination systems: bird, marsupial, bat)
- 5 or 6 fertile stamens



## Zingiberales

Strelitziaceae - bird of paradise

- 3 genera of Gondwanan distribution



*Phenakospermum*  
Guayana Shield

*Ravenala*  
Madagascar

*Strelitzia*  
South Africa

## Zingiberales

Lowiaceae - orchidantha

- 1 genus
- perianth tube = 3 sepals
- 1 petal = “labellum”
- 5 fertile stamens



*Orchidantha* of SE Asia  
and Pacific

## Zingiberales

Heliconiaceae - heliconia

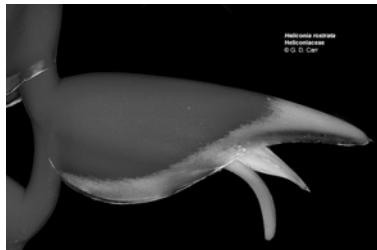
- primarily Neotropical
- robust herbs with distichous phyllotaxy
- showy bract system



## Zingiberales

Heliconiaceae - heliconia

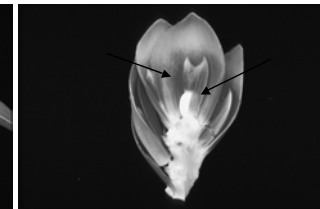
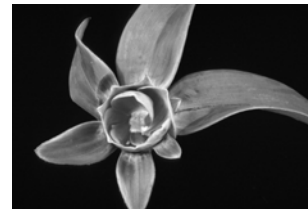
- flowers inverted (resupinate)
- 5 stamens + staminode
- flower mites



## Zingiberales

Costaceae - costus

- robust herbs with spiral phyllotaxy
- double bracted flowers



## Zingiberales

Costaceae - costus

- two major groups - insect pollinated and bird pollinated
- “labellum” formed from 5 sterile stamens



## Zingiberales

Zingiberaceae - ginger

- robust herbs with distichous phyllotaxy
- ethereal aromatic (ginger)



## Zingiberales

Zingiberaceae - ginger

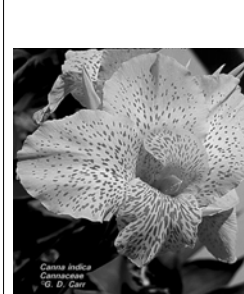
- striking floral diversity and pollinators



## Zingiberales

Cannaceae - canna

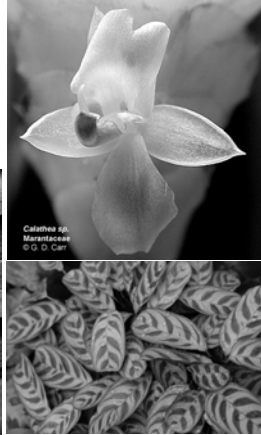
- only *Canna* of Neotropics
- asymmetrical flowers



## Zingiberales

Marantaceae - prayer plant

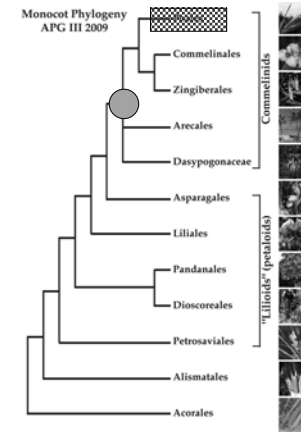
- pantropical, petiolate leaved
- pairs of asymmetrical flowers



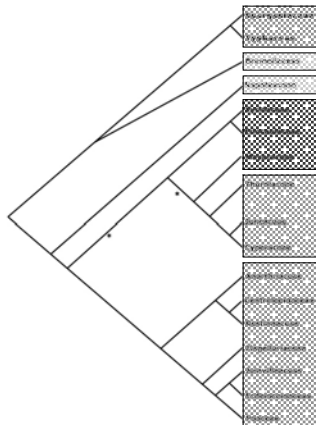
## Poales I - showy flowers

4 main groups:

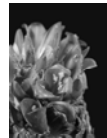
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    - pineapple
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## Poales I - showy flowers



• showy flowers, insect or bird pollinated



• +/- reduced flowers, insect or wind pollinated



• reduced flowers, wind pollinated



## \*Bromeliaceae - pineapples

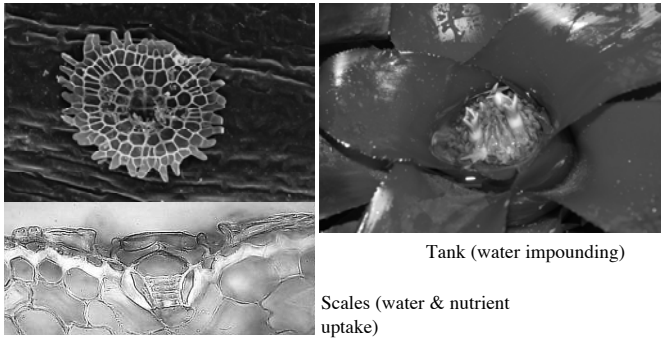
- mainly epiphytic, but terrestrial as well in inhospitable regions





## \*Bromeliaceae - pineapples

- key adaptations: CAM photosynthesis, modified trichomes or scales, “tank” formation



Tank (water impounding)

Scales (water & nutrient uptake)

## \*Bromeliaceae - pineapples

- key adaptations: CAM photosynthesis, modified trichomes or scales, “tank” formation

- scales very visible in Spanish moss



*Tillandsia usneoides* in South Carolina live oaks

## \*Bromeliaceae - pineapples

- preadaptations to carnivory in *Brocchinia* and *Catopsis*



Amino acids radioactively labeled being incorporated into the scales of *Brocchinia*

## \*Bromeliaceae - pineapples

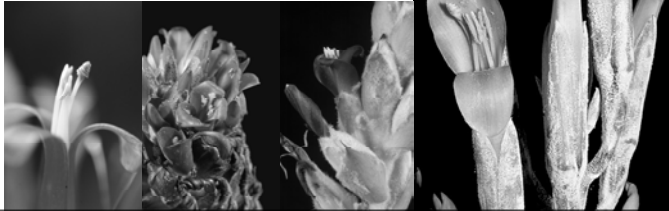
- inflorescence heavily bracted and often the attractant



## \*Bromeliaceae - pineapples

CA 3 CO 3 A 6  $\underline{G}$  (3) or  $\overline{G}$  (3)

- petals showy, but not the sepals
- 2 sets of 3 stamens
- superior or inferior ovary, with twisted styles
- berry or capsule



## \*Bromeliaceae - pineapples

- bromeliads are an American family: 2600 species, 56 genera



## \*Bromeliaceae - pineapples

- pineapple not native to Hawaii - along with two other ingredients of Hawaiian Punch



## \*Bromeliaceae - pineapples

- classification traditionally had three subfamilies

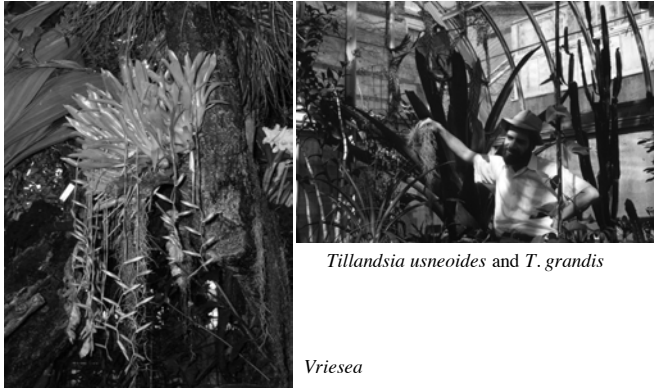
tillandsioids      pitcairnioids      bromelioids



Incan ceremonial dance

## \*Bromeliaceae - pineapples

- tillandsioids



*Tillandsia usneoides* and *T. grandis*

*Vriesea*

## \*Bromeliaceae - pineapples

- bromelioids



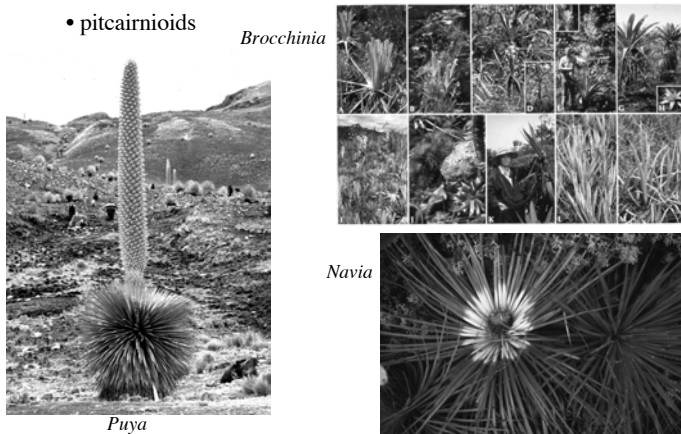
*Achmea*

*Ananas* -  
pineapple

*Neoregelia*

## \*Bromeliaceae - pineapples

- pitcairnioids



*Brocchinia*

*Navia*

*Puya*

## \*Bromeliaceae - pineapples

- 2 subfamilies natural based on DNA
- pitcairnioids broadly paraphyletic
- *Brocchinia* sister to rest of family
- origin of family in Guayana Shield of South America



## \*Bromeliaceae - pineapples

Guayana Highlands of southern Venezuela and adjacent areas of Brazil and Colombia - the higher elevation "tepuis" are rain drenched and extremely nutrient poor

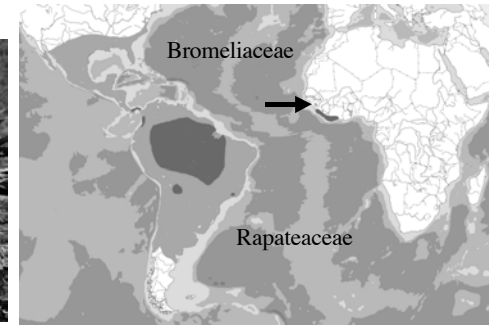


## \*Bromeliaceae - pineapples

When did the Atlantic disjunction occur?



*Picairnia saxicola*  
Costa Rica



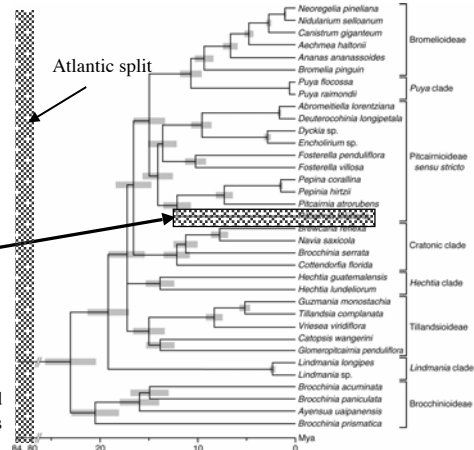
*Picairnia feliciani* in west Africa

## \*Bromeliaceae - pineapples

When did the Atlantic disjunction occur?

Long distance dispersal to Africa!  
African species divergence is 15-13 mya

DNA tree calibrated with monocot fossils



## \*Bromeliaceae - pineapples

Where did the African species come from?

• African species originated from Andes!



## Rapateaceae - a tepui family

- 16 genera and nearly 100 species from the Guayana Shield



## Rapateaceae - a tepui family

- most species are pollinated by pollen-gathering bees
- hummingbird pollination has evolved once in a clade of two genera



## Rapateaceae - a tepui family

- most species in the Guayana Shield but one in west Africa



Is the African *Mascolocephalus* a product of Atlantic vicariance with closest Guayana Shield relatives, or a product of long distance dispersal?

## Rapateaceae - a tepui family

Recent long distance dispersal to Africa!  
African species divergence is 8-6 my  
whereas Atlantic separation is 80+ mya

