



Asterales

- 11 families and nearly 26,000 species - Australasia appears to be center of diversity
- no iridoids, latex common, inferior gynoecium, pollen presentation

bellflower - Campanulaceae chikory - Asteraceae

*Asteraceae - composites

One of the most successful of all flowering plant families with over 1,500 genera and 23,000 species

- composites found throughout the world but most characteristic of the grassland biomes

*Asteraceae - composites

One of the most successful of all flowering plant families with over 1,500 genera and 23,000 species

- but also diverse in arctic to tropical and subtropical regions

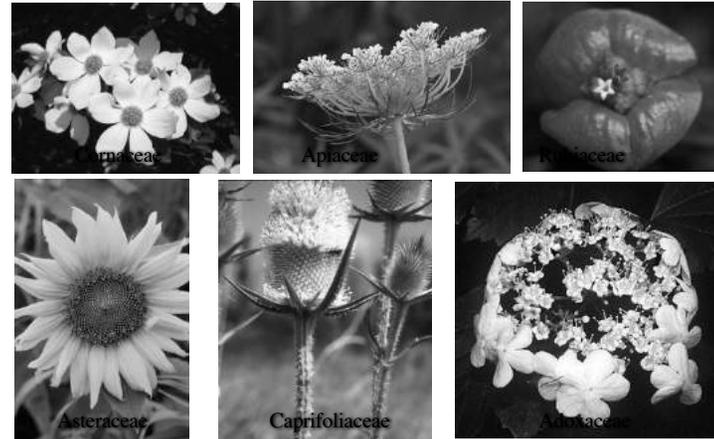
*Asteraceae - composites

Family has 4 specialized features important in this radiation:

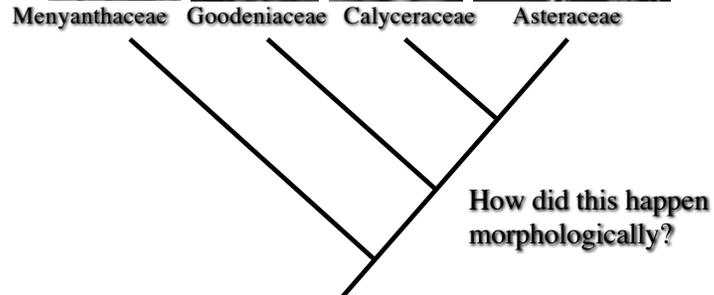
1. Special inflorescence "head" - pseudanthia
2. Pollen presentation
3. Diverse secondary chemistry
4. Whole genome duplication



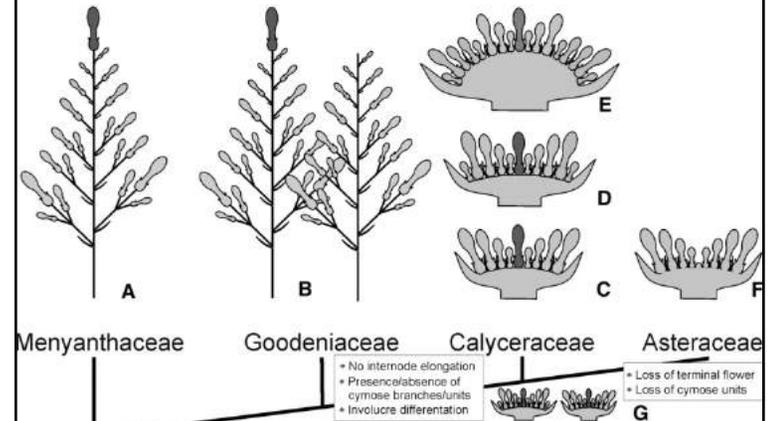
Pseudanthia in the Asterids



Pathway to Asteraceae Head?

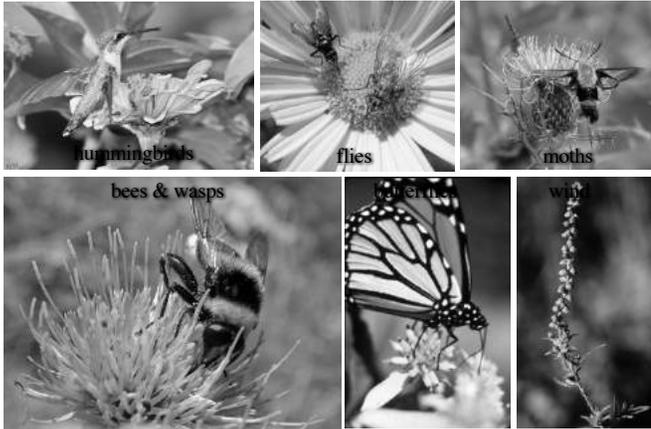


Pathway to Asteraceae Head?

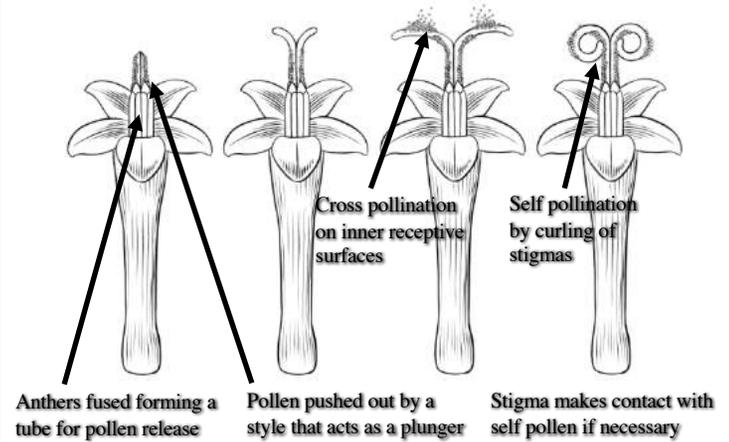


Pozner et al. 2012 (Amer J Bot)

Pollination Syndromes



Pollen Presentation

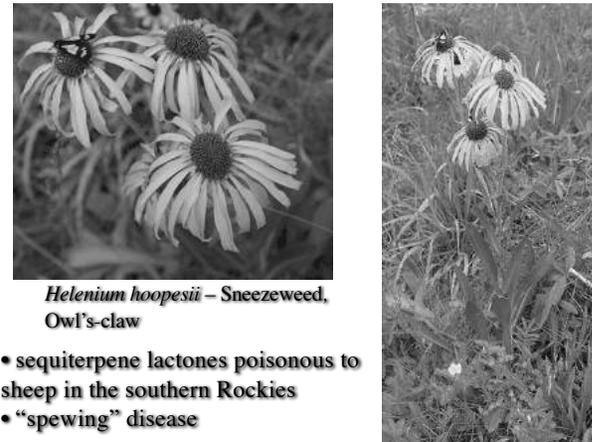


Chemical Diversity



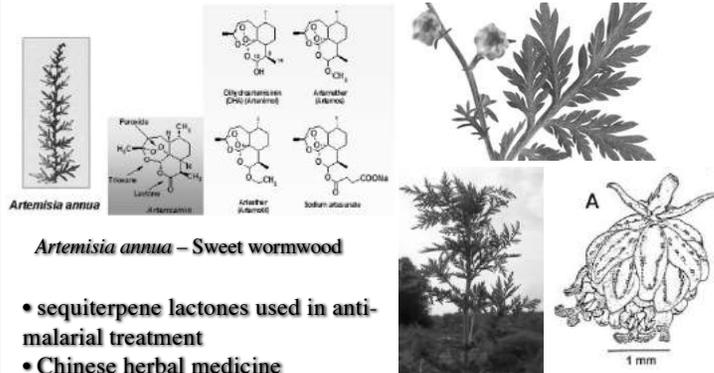
- polyacetylenes, sesquiterpene lactones, terpenes, alkaloids, latex

Chemical Diversity



- sesquiterpene lactones poisonous to sheep in the southern Rockies
- “spewing” disease

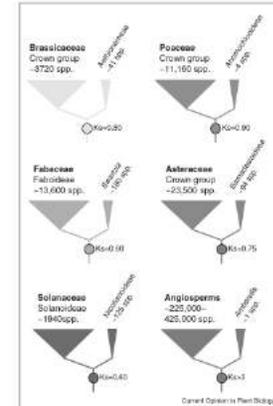
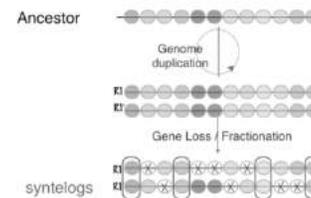
Chemical Diversity



Whole Genome Duplication

- all Asteraceae have genome doubling – not in other Asterales
- species radiation associated with the WGD shows a “time lag”

Fractionation and diploidization:



Schranz et al. 2012 – Ancient whole genome duplications, novelty and diversification: the WGD Radiation Lag-Time Model.

Asteraceae - composites



The head or capitulum is a cluster of 1 or 2 distinct flower types. The family is also called “Compositae” referring to this clustering.

The head is surrounded by special bracts called the involucre or phyllaries.

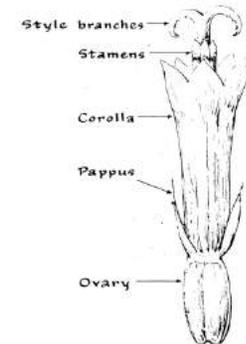
The involucre is important in the classification and identification within the family.



Asteraceae - floral diversity

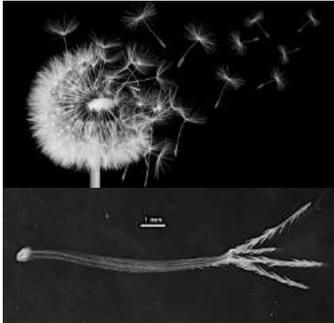


CAX CO(5) A(5) G(2)

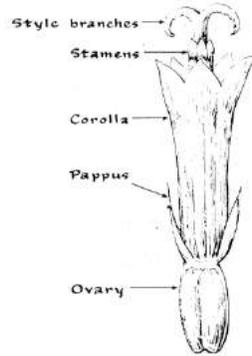


- Calyx is reduced to a pappus of scales, awns, bristles, or absent
- Corolla has 5 petals but variously fused or zygomorphic
- Anthers (only) fused in a ring

Asteraceae - floral diversity

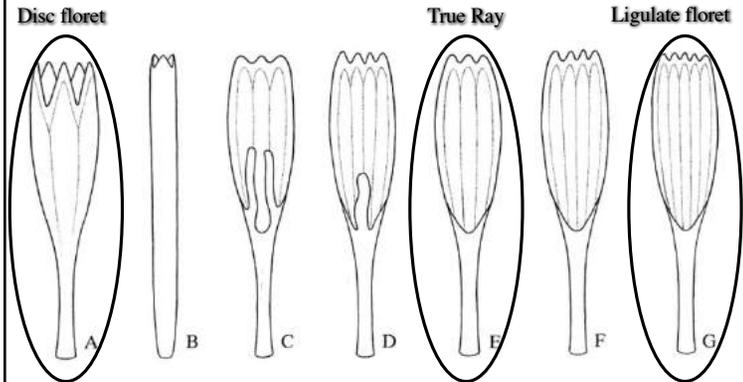


CAX CO(5) A(5) G(2)



The fruit is a one-seeded achene with the pappus serving as the fruit disperser (e.g., barbs for animal dispersal, hairs for wind dispersal)

Asteraceae - floral diversity



- the family exhibits a diverse array of floral types
- these three corolla types are seen in Wisconsin

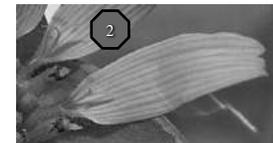
Asteraceae - floral diversity



Main floret types

1. Disk or tubular florets are actinomorphic

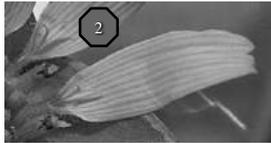
Asteraceae - floral diversity



Main floret types

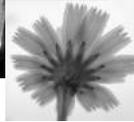
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2. Ray florets are usually 3 long fused petals + 2 obsolete petals

Asteraceae - floral diversity



Main floret types

1. Disk or tubular florets are actinomorphic
2. Ray florets are usually 3 long fused petals + 2 obsolete petals
3. Ligulate florets are 5 fused petals but split open



Asteraceae - head diversity

These various types of florets combine to form a number of different looking heads

Radiate head: disk florets in the center, ray florets along the edge (these usually pistillate)



Symphyotrichum - aster

Asteraceae - head diversity

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Radiate head: disk florets in the center, ray florets along the edge (these usually pistillate)

Discoid head: only disk or tubular florets comprise the entire head



Liatris - blazing star

Asteraceae - head diversity

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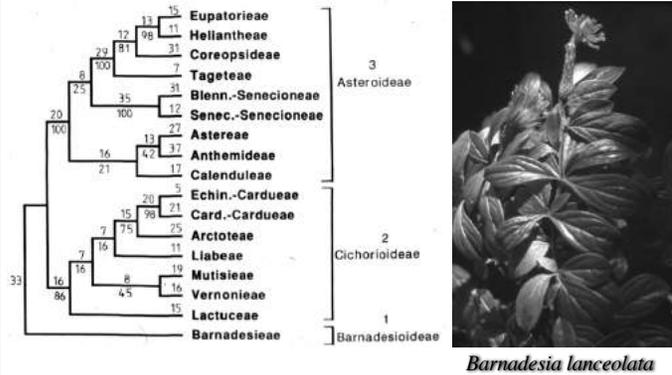
Ligulate head: only ligulate florets comprise the entire head



Cichorium - chickory

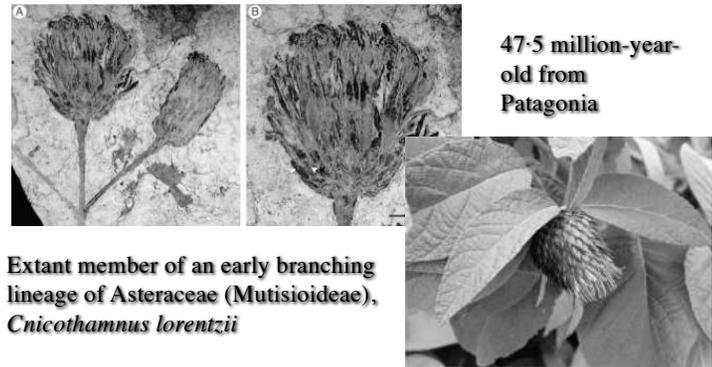
Asteraceae - phylogeny

- early DNA based work surprisingly placed a small group of South America genera as sister to the rest of the family and recognition of 3 subfamilies and many tribes



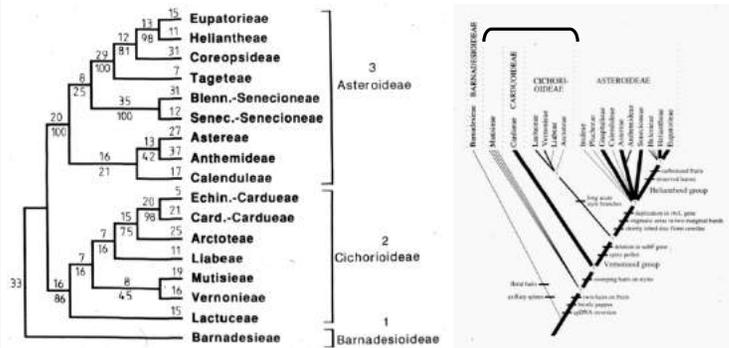
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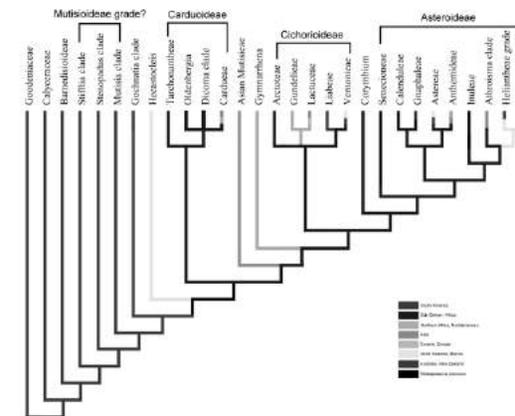
Asteraceae - phylogeny

- later DNA based work questioned the monophyly of subfamily Cichorioideae - classification still in progress



Asteraceae - phylogeny

- family originated in South America



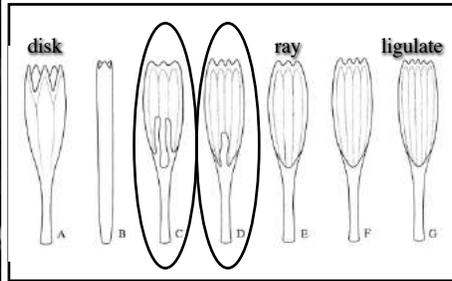
Asteraceae - tribes

Tribe Barnadesiinae



Barnadesia lanceolata

Small South American tribe with bilabiate (C) or pseudolabiate (D) corolla - similar to some other families of Asterales



Asteraceae - tribes

Tribe Mutisieae

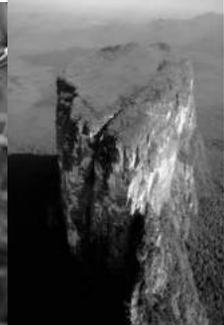
South American tribe usually with bilabiate flowers; characteristic of tepuis in northern South America



Stomochaeta



Duidaea



Cerro Autana

Asteraceae - tribes

Tribe Lactuceae (Cichorieae)



Only have ligulate heads, milky latex in vegetative parts, pappus of filaments

Dandelion, goat's beard, chickory, hawkweed



Taraxacum - dandelion



Asteraceae - tribes

Tribe Lactuceae (Cichorieae)



Cichorium intybus - chickory

Eurasian weed - totally naturalized and distributed widely even to Botany 400 plant collections



Asteraceae - tribes

Tribe Lactuceae (Cichorieae)



Sonchus asper – sow thistle



Hieracium -
hawkweeds



Asteraceae - tribes

Tribe Cardueae (Cynareae)



Cirsium -
thistles



- spiny phyllaries and often leaves and stems
- heads never radiate
- petals white or cyanic colors (blues, purples)
- thistle, knapweed, burdock

Asteraceae - tribes

Tribe Cardueae (Cynareae)



Centaurea maculosa - Spotted knapweed



Arctium - burdock

Asteraceae - tribes

Tribe Vernoniae

Alternate leaves
Purple flowers generally



Vernonia fasciculata - ironweed

Hesperomannii
Hawaii



Asteraceae - tribes

Tribe Inuleae (Gnaphalieae)

Plants usually covered with white hairs, pappus of bristles or hairs

Pussy toes, cudweed, pearly everlasting



Antennaria plantaginifolia - pussy toes

Asteraceae - tribes

Tribe Inuleae (Gnaphalieae)



Anaphalis margaritacea - pearly everlasting

Asteraceae - tribes

Tribe Astereae

Conspicuous rays in radiate head, pappus of plumose bristles; asters, goldenrods, fleabanes



Symphyotrichum pilosus – frost aster
(Botany 400 plant collections)



Symphyotrichum novae-angliae
- New England aster

Asteraceae - tribes

Tribe Astereae



Solidago rigida -
stiff goldenrod



Erigeron annuus –
daisy fleabane

Asteraceae - tribes

Tribe Anthemideae

Aromatic plants, with dissected, alternate leaves; pappus of awns or scales or missing

Ox-eye daisy, yarrow, wormwood, tansy, dog fennel



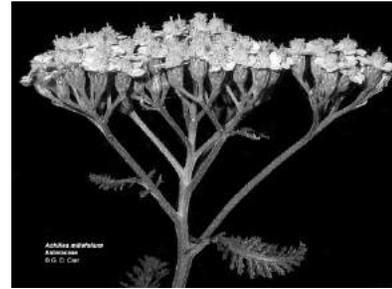
Leucanthemum vulgare
Ox-eye daisy, chrysanthemum



Tanacetum bipinnatum –
Lake Huron tansy

Asteraceae - tribes

Tribe Anthemideae



Achillea millefolium – yarrow
(Botany 400 plant collections)



Matricaria discoidea - pineapple weed

Asteraceae - tribes

Tribe Senecioneae

Alternate or basal leaved, phyllaries in 1 row, capillary pappus; ragwort, Indian plantain



Packera aureus - golden ragwort



Asteraceae - tribes

Tribe Helenieae

Alternate leaved, radiate heads, 3-lobed ray flowers always widest at tip



Helenium autumnale –
common sneezeweed



Gaillardia aristata –
common blanket-flower

Asteraceae - tribes

Tribe Heliantheae



Ratibida pinnata - coneflower

Large tribe with radiate, multi-layered phyllaries, rays mostly yellow, tendency for opposite leaves

Coneflower, sunflower, rosinweed, ox-eye, black-eyed Susan, prairie dock, coreopsis, Peruvian daisy



Helianthus annuus - sunflower

Asteraceae - tribes

Tribe Heliantheae



Biden cernuus - bur marigold



Echinacea pallida - purple coneflower

Asteraceae - tribes

Ambrosia artemisiifolia
ragweed



Tribe Ambrosieae

(or Heliantheae)

Unisexual and wind pollinated, rays absent, stamens not fused

Ragweed, cocklebur

Male florets

Female florets

Asteraceae - tribes

Tribe Eupatorieae

(or Heliantheae)

Opposite or whorled leaves

Discoid heads

Corolla never yellow

Joe-pye weed,
boneset,
snakeroot,
blazing star



Eutrochium maculatum
Joe-pye weed



Eupatorium perfoliatum
Boneset