

Core Asterids

- will examine the second of the two well supported lineages of the core asterids
- 'lamiid' or Asterid I group
- 'campanulid' or Asterid II group

Core Asterids

- will examine the second of the two well supported lineages of the core asterids
- 'lamiid' or Asterid I group
- 'campanulid' or Asterid II group

○ = NOT fused corolla tube

- Asterids gained fused corolla several times
- 2 separate origins of fused petals in "core" Asterids (plus several times in Ericales; Cornales start fused)

Early vs. Late Sympetaly

euasterids II - campanulids

Calendula, Asteraceae

early

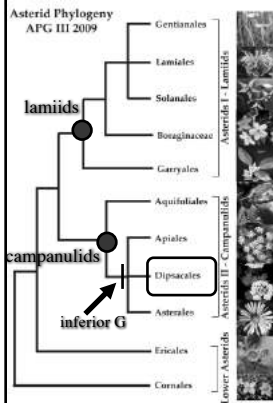
euasterids I - lamiids

Anchusa, Boraginaceae

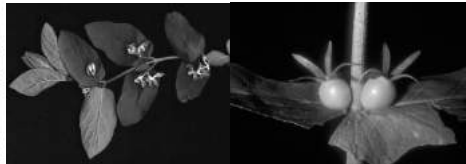
late

also in Cornaceae of "basal asterids"

Dipsacales

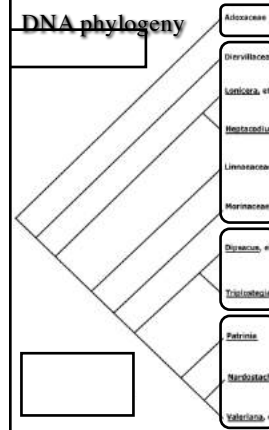


- order within 'campanulids or Asterid II group'
- 2 (or 7) families and nearly 1,100 species of herbs and shrubs largely from North Hemisphere
- iridoids, opposite leaves, inferior gynoecium



"Caprifoliaceae" - what is it ?

DNA phylogeny



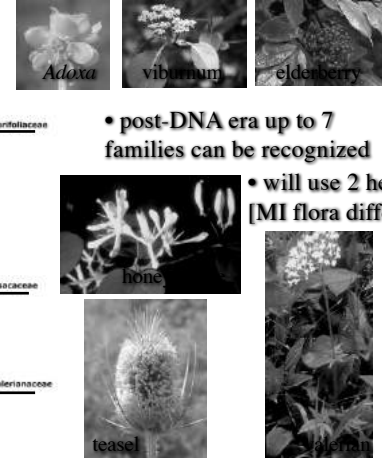
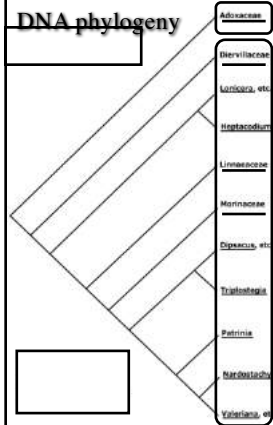
- Adoxaceae *Adoxa*
- Diervillaceae
- Umbelliferae, etc.
- Caprifoliaceae – paraphyletic!
- Linnaeaceae
- Moraceae
- Dipsacaceae
- Valerianaceae



• pre-DNA era four families were recognized (as in Gleason/Cronquist)

"Caprifoliaceae" - what is it ?

DNA phylogeny

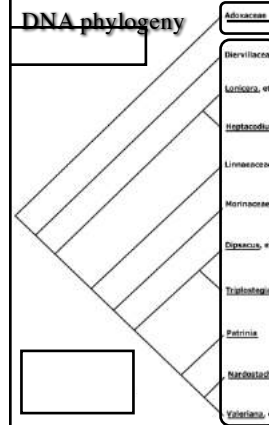


• post-DNA era up to 7 families can be recognized

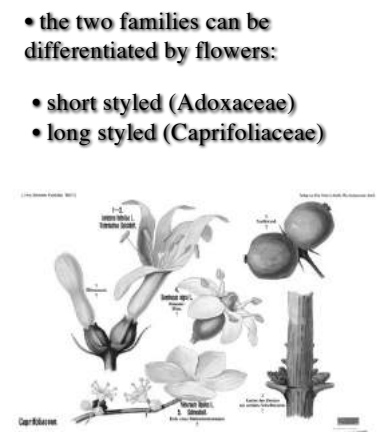
• will use 2 here [MI flora differs!]

"Caprifoliaceae" - what is it ?

DNA phylogeny



- Adoxaceae
- Diervillaceae
- Umbelliferae, etc.
- Caprifoliaceae
- Linnaeaceae
- Moraceae
- Dipsacaceae
- Valerianaceae



• the two families can be differentiated by flowers:

- short styled (Adoxaceae)
- long styled (Caprifoliaceae)

“Caprifoliaceae” - what is it ?



Viburnum - viburnum

• the two families can be differentiated by flowers:

- short styled (Adoxaceae)
- long styled (Caprifoliaceae)



Lonicera - honeysuckle

Adoxaceae - viburnums

5 genera and 200 species of opposite leaved shrubs and some herbs - mainly North Temperate



Sambucus canadensis - Common elder

- flowers small and usually in flat-topped cymes
- 5 merous with up to 5 fused carpels and short style
- berry or drupaceous fruits



Adoxaceae - viburnums



Sambucus racemosa - red-berried elder



- elder-berries are opposite, compounded leaved shrubs



Adoxaceae - viburnums

- viburnums are simple leaved shrubs, but often lobed, or coarsely toothed



Viburnum davidii

Adoxaceae - viburnums



• note enlarged, sterile flowers on edge of 'head' inflorescence for pollinator attraction



Viburnum opulus (trilobum)
high-bush cranberry

another "pseudanthium" or false flower

Adoxaceae - viburnums



Viburnum acerifolium
maple-leaved viburnum

• many viburnums have glands on petioles

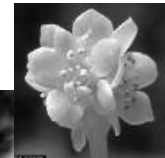


Viburnum lentago
honeyberry



Viburnum rafinesquianum
arrowwood

Adoxaceae - viburnums



• unusual reduced woodland herb with musky scent and trifoliate, spiralled leaves

Adoxa moschatellina - muskroot

*Caprifoliaceae - honeysuckles

Northern hemisphere family (and tropical mountains) of 43 genera and about 900 species of shrubs, subshrubs, vines and herbs



Lonicera - honeysuckle



Linnaea - twinflower



Dipsacus - teasel

*Caprifoliaceae - honeysuckles

CA (5) CO (5) A 4-5 G (2-5)



Lonicera - honeysuckle

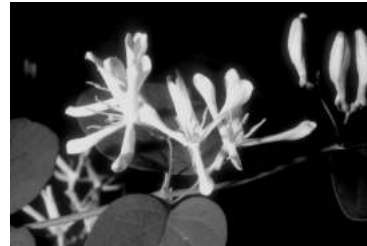
- 5 merous, long styled, and bell-shaped or strongly zygomorphic
- inferior ovary forms berry (or reduced to achenes)



horse gent

*Caprifoliaceae - honeysuckles

- honeysuckles include native (right) and introduced aggressive shrubs (below) or vines



Lonicera tatarica - tartarian honeysuckle



Lonicera canadensis - fly honeysuckle

*Caprifoliaceae - honeysuckles



Lonicera reticulata - grape honeysuckle

natives



Lonicera dioica - red honeysuckle

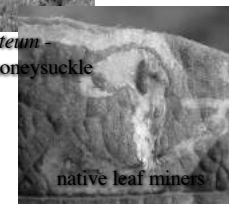


*Caprifoliaceae - honeysuckles

invasives



Lonicera xylosteum - European fly honeysuckle



native leaf miners



Lonicera X bella - pretty honeysuckle

*Caprifoliaceae - honeysuckles



Diervilla lonicera -
bush honeysuckle



Triosteum perfoliatum
Horse gentian



*Caprifoliaceae - honeysuckles

Linnaea borealis - twinflower

- Characteristic subshrub of (circum)boreal forests where it forms large colonies. Two flowers form per inflorescence.



*Caprifoliaceae - honeysuckles

- many cultivated ornamentals



Abelia



Kolkwitzia

*Caprifoliaceae - honeysuckles

• the old 'Valerianaceae' and 'Dipsacaceae' exhibit features that will be seen in Asteraceae ["pseudanthium" or head]

- congested inflorescences
- bracted inflorescences



Valeriana uliginosa -
marsh valerian



Valeriana edulis -
edible valerian



Knautia
blue-buttons

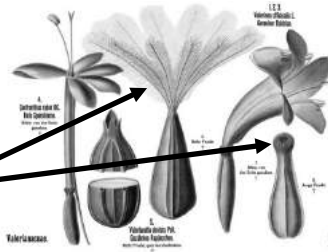
*Caprifoliaceae - honeysuckles

• the old 'Valerianaceae' and 'Dipsacaceae' exhibit features that will be seen in Asteraceae ["pseudanthium" or head]



Knautia

- reduced calyx - pappus
- one seeded achene



pappus

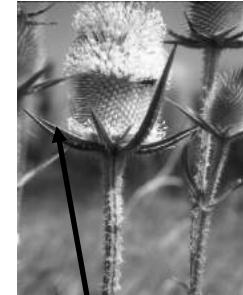
*Caprifoliaceae - honeysuckles

• the old 'Valerianaceae' and 'Dipsacaceae' exhibit features that will be seen in Asteraceae ["pseudanthium" or head]



Dipsacus fullonum - teasel
Introduced and adventive

- involucre bracts



Involucre bracts

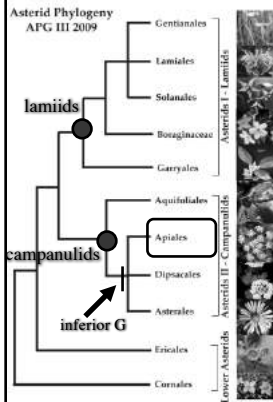


pappus

Apiales

• 7 families and nearly 5,500 species of herbs and shrubs - Australasia appears to be center of diversity

• iridoids, aromatic, alternate compound leaves, umbels, corolla separate, inferior gynoecium



ginseng - Araliaceae

parsnip - Apiaceae

Araliaceae - ginseng



Aralia hispida - bristly sarsaparilla

- tropical family of trees, shrubs, or herbs (temperate)
- leaves divided or up to 3 times or more compound
- distinctive aroma and chemicals



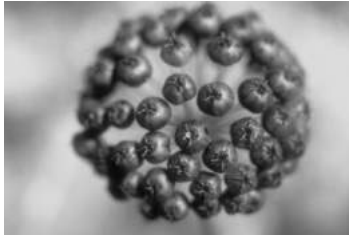
Aralia nudicaulis - wild sarsaparilla

Araliaceae - ginseng

CA 5 CO 5 A 5 $\overline{G(5)}$



- umbels
- flowers small, non-asterid like (no corolla tube)
- 5 merous, with 5 fused carpels forming inferior ovary & berries



Aralia hispida - bristly sarsaparilla : note 5 styles

Araliaceae - ginseng



Aralia elata
Hercule's club, Devil's walking stick



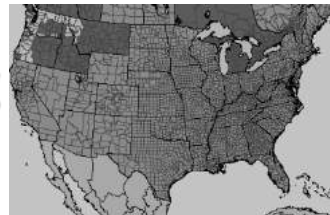
Aralia racemosa
spikenard

Araliaceae - ginseng



Oplopanax horridus
Devils club

Western N Am. – Great Lakes disjunction
only Isle Royale in Lake Superior



Araliaceae - ginseng



Panax quinquefolius - American ginseng

Rich woods; leaflets are stalked. Heavily collected woodland species for roots.



Araliaceae - ginseng



Hedera helix
English ivy

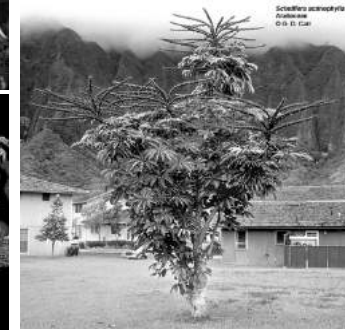
Eurasia - N. Africa; invasive in U.S.



Araliaceae - ginseng



Tetrapanax papyrifera -
rice paper



Schefflera - umbrella plants

*Apiaceae - umbels

Large family of 430 genera and over 3700 species most common in north temperate regions. Economically important (carrot, parsnip, parsley, celery, dill, caraway).



parsnip



carrot

*Apiaceae - umbels



- aromatic herbs with hollow stems
- dissected or compound leaves
- leaves strongly sheathing



sheath

Heracleum lanatum - cow parsnip

*Apiaceae - umbels

CA 5 CO 5 A 5 $\overline{G(2)}$

- flowers small in umbels, often compound
- female flowers often along edge of each umbellet

common feature in Asterids
with the formation of a 'head'



*Apiaceae - umbels

CA 5 CO 5 A 5 $\overline{G(2)}$

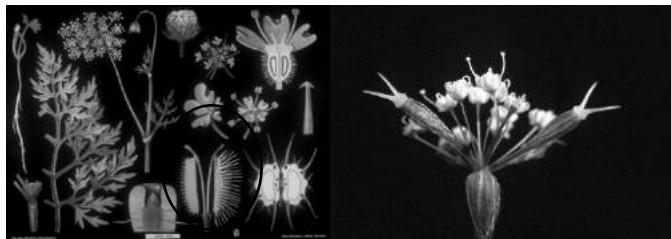
- flowers small in umbels, often compound
- female flowers often along edge of each umbellet
- 5 merous with no corolla tube
- inferior gynoeceium of 2 carpels separating at maturity



*Apiaceae - umbels

CA 5 CO 5 A 5 $\overline{G(2)}$

- fruit dehiscent and splitting - schizocarp
- 2 dry, 1-seeded mericarps held together by carpophore
- fruits 5-ribbed separated by oil canals - taxonomic character for separating genera



*Apiaceae - umbels



Angelica atropurpurea - great angelica

- Large coarse herb of wetter areas

*Apiaceae - umbels



Cicuta bulbifera
Bulblet water hemlock

Cicuta maculata
spotted water hemlock



Although containing nasty compounds, *Cicuta* is not the hemlock that Socrates took (*Conium*). Common species of marshes and streams.

*Apiaceae - umbels



Cryptotaenia canadensis - honewort



Osmorhiza longistylis - sweet cicely

*Apiaceae - umbels

Daucus carota - wild carrot, Queen Anne's lace

Note umbel with involucre bracts; larger female flowers along edge of umbel; the progenitor of cultivated carrot (same species); common weed



*Apiaceae - umbels



Eryngium yuccifolium
Rattlesnake master



Dry prairie species with sword-shaped leaves with spiny edge. Umbels has become literally a "head" as in Asteraceae.

*Apiaceae - umbels

The mystery plant from Abilene, Texas

Eryngium leavenworthii *Dipsacus fullonum* – teasel (*Caryophyllaceae*) *Cifolium*



*Apiaceae - umbels

Heracleum lanatum
American cow-parsnip
Our most robust species in Wisconsin



*Apiaceae - umbels

Pastinaca sativa - wild parsnip
Introduced and spreading along roadsides.
Dermatitic reaction from leaves is rapid
but only in presence of UV light which
causes precursor to change to phototoxin.



*Apiaceae - umbels

Torilis japonica- hedge parsley

Introduced and spreading in forests. If
collected, mount it!

Torilin - effective blocker of testosterone
to DHT conversion (5 alpha-reductase)
["pseudo-hermaphroditism", no male
pattern baldness, no prostate cancer]



Pittosporaceae

“The secretory canals and some of the chemical features, notably the presence of polyacetylenes, have led some authors to propose a close relationship between the Pittosporaceae and the Araliales [Apiales]. The ovular structure would also be consistent with such a relationship.” Cronquist, 1981



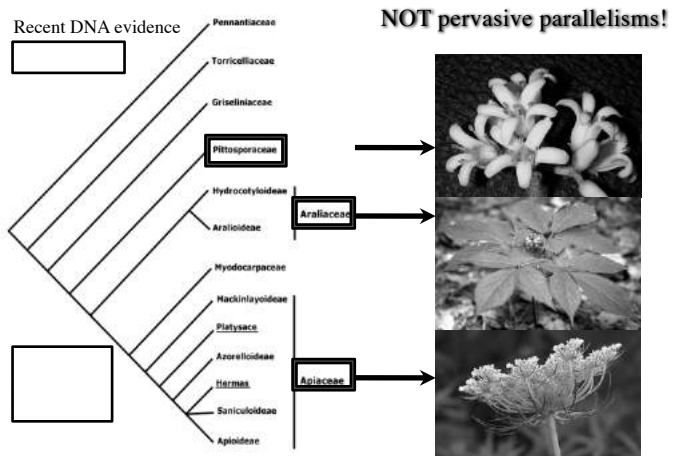
Pittosporaceae

“Rather we must suppose that the anatomical and chemical similarities between the Pittosporaceae and Araliales illustrate the pervasive parallelism that besets efforts to establish phylogenetic relationships among the angiosperms”

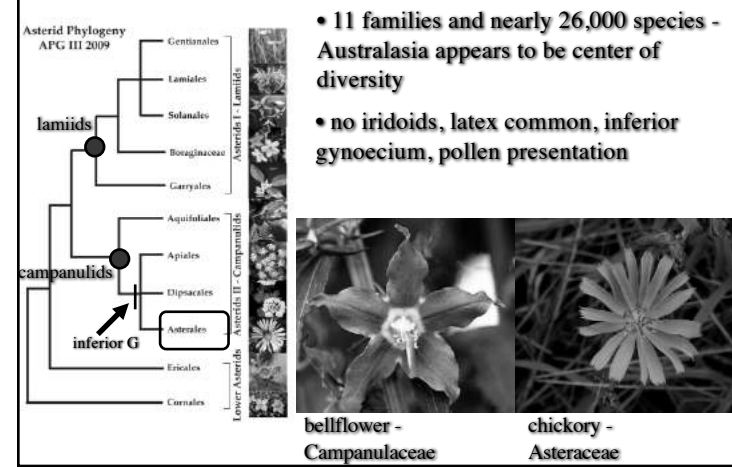
Cronquist, 1981



Pittosporaceae



Asterales



Asterales

Asterid Phylogeny
APG III 2009

lamiids

campanulids

inferior G

Secondary pollen presentation in *Campanula*

bellflower -
Campanulaceae

chikory -
Asteraceae

*Campanulaceae - bellflowers

A family mostly of herbs, but some secondarily woody, widely distributed in the temperate regions and in the montane tropics. Contains 65 genera and over 2200 species, with half belonging to *Campanula* and *Lobelia*.

- alternate leaves
- milky latex
- 5 merous with inferior ovary

*Campanulaceae - bellflowers

The family is divided into two distinct subfamilies - Campanuloideae and Lobelioideae - distinguished by floral symmetry, staminal fusion, and carpel number

Campanula - bellflower
Subfamily Campanuloideae

Lobelia - lobelia
Subfamily Lobelioideae

*Campanulaceae - bellflowers

Subfamily Campanuloideae

CA (5) CO (5) A 5 G (3-5)

Campanula and relatives have actinomorphic flowers, stamens not fused, and 3-5 fused carpels. Note the 3 styles of *Campanula* to the left.

This is a 5 carpellate species

***Campanulaceae - bellflowers**



Campanula americana - tall bellflower

***Campanulaceae - bellflowers**



Campanula rotundifolia
Bluebell - circumboreal



Campanula rapunculoides
European bellflower

***Campanulaceae - bellflowers**



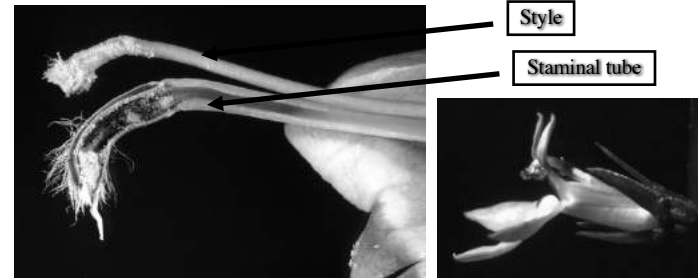
Triodanis perfoliata - Venus looking glass

***Campanulaceae - bellflowers**

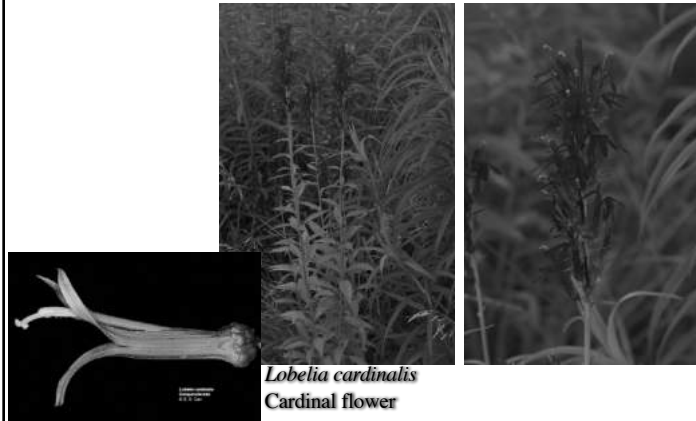
Subfamily Lobelioideae

CA (5) COZ (5) A (5) \overline{G} (2)

Lobelia and relatives have zygomorphic flowers, stamens fused into a tube in which the pollen is shed, and 2 fused carpels. Style pushes pollen out through the tube.

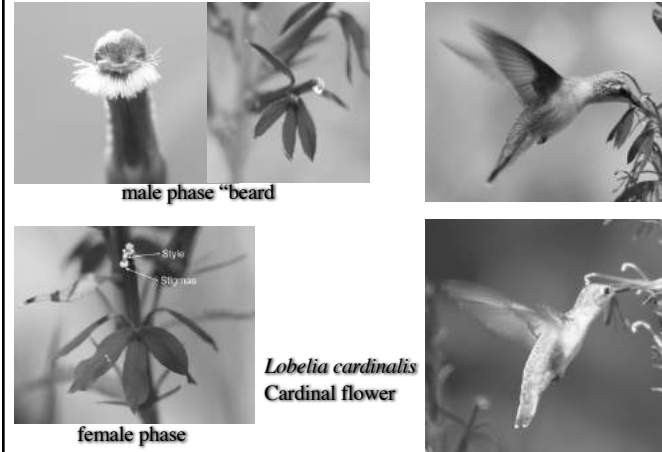


*Campanulaceae - bellflowers



Lobelia cardinalis
Cardinal flower

*Campanulaceae - bellflowers



male phase "beard"

Lobelia cardinalis
Cardinal flower

female phase

*Campanulaceae - bellflowers

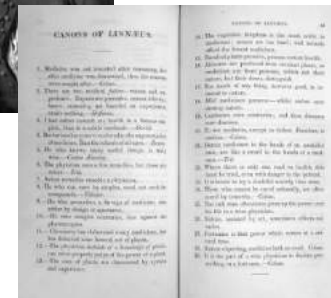


Long considered a cure
for syphilis – but probably
not true



Lobelia siphilitica L. - Great blue lobelia

*Campanulaceae - bellflowers



Lobelia siphilitica L. - Great blue lobelia

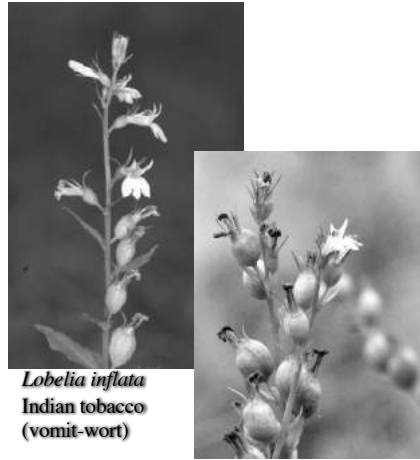
*Campanulaceae - bellflowers

Indian tobacco

- asthma
- muscle disorders
- food poisoning
- nicotine replacement

- piperidine alkaloids
- lobeline primarily

Nicocure



Lobelia inflata
Indian tobacco
(vomit-wort)

*Campanulaceae - bellflowers



Lobelia - Mt. Kenya

Centropogon - Andes

Lobelia - Hawaii

Menyanthaceae - bog buckbean

Aquatic, or semi-aquatic family. Flowers 5 merous with fringed petals.
Gynoecium of 2 fused superior carpels. – long placed in Gentianaceae!



Menyanthes trifoliata
Bog buckbean

Menyanthaceae - bog buckbean

Aquatic, or semi-aquatic family. Flowers 5 merous with fringed petals.
Gynoecium of 2 fused superior carpels.



Nymphaoides - convergence!



The DNR forced the Botany Dept in 2010 to dig up the Botany Garden pond that had *Nymphaoides*

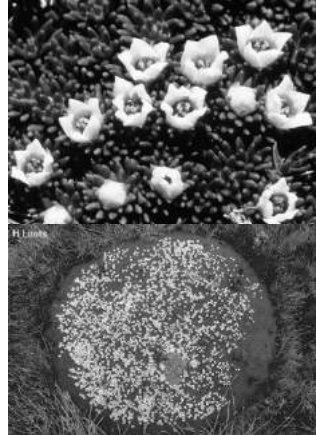
Stylidiaceae - trigger flowers



Australasian and South American



Stylidium



Donatia

Goodeniaceae



Australasian – and beaches!



Scaevola - note opened corolla tube



Calyceraceae



South American only



• closest family to Asteraceae - the composites; note biogeography



Acicurpha tribuloides
photo by Derek Woodhead
University of Wisconsin