Diversity and Evolution of Asterids

... morning glories, mints, and snapdragons...

two resources for keying out “hard” families

Poaceae

Solanaceae – Bot400 link

Asteraceae

Solanales

• order within ‘lamiids’ or Asterid I group
• 5 families and nearly 5,000 species dominated by Solanaceae (nightshade) and Convolvulaceae (morning glory)
• no iridoids, alternate leaves, plicate corolla, calyx persistent in fruit

*Solanaceae* - morning glory

Largely tropical family of 57 genera and 1600 spp. Twining herbs or woody with alternate leaves.

*Calyx* *sepium*

Hedge bindweed

*Ipomoea* *purpurea*

Morning-glory
Cuscuta (Cuscutaceae) is actually part of the Convolvulaceae!

Twining habit (for support) has gone one step further and species are now parasitic (support + food + water; no chlorophyll)

Cuscuta spp. - dodder

Cuscuta gronovii
Common dodder

Cuscuta glomerata
Rope dodder

Calystegia sepium
Hedge bindweed

Convolvulus

Flowers strongly funnelform with plicate corolla tube (with fold lines). Calyx often unfused.

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

Calystegia sepium
Hedge bindweed

Note: 2 large bracts

Convolvulus arvensis
Field bindweed

Note: no floral bracts
**Convolvulaceae - morning glory**

*Ipomoea - morning glory*  
*Ipomoea pes-caprae*  
*Ipomea batatus - sweet potato*

**Lamiales**

- Large order (23,000+ species) within ‘lamiid’ or Asterid I group - 12% of all eudicots
- 22 families - dominated by the mints - Lamiaceae
- Iridoids, opposite leaves common, zygomorphic bilabiate flowers common, 4 stamens common

**Lamiales**

- Many small, isolated families

**Oleaceae - olive and ash**

Cosmopolitan family of opposite-leaved shrubs and trees

- 4 merous flowers
- Only 2 stamens

*CA (4) CO (4) or 0 A 2 G (2)*

*Syringa vulgaris - Lilac*
Oleaceae - olive and ash

- Olives are one-seeded drupes

*Laurus nobilis* - olive

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Oleaceae - olive and ash

*Forsythia suspensa*
Goldenbell, forsythia

*Ligustrum vulgare*
European privet

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Oleaceae - olive and ash

- Ashes have compound leaves and diamond-furrowed bark
- Ashes are usually unisexual, other genera are bisexual

*Fraxinus pennsylvanica*
- Red, green ash

*Fraxinus americana*
- White ash
- Ashes have 1-seeded samaras

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**Lamiaceae - mints**

Huge cosmopolitan family of 267 genera and nearly 7000 species of herbs and sometimes shrubs or trees.

- major family of Mediterranean climate regions
- strongly aromatic (mint, peppermint, sage, rosemary, thyme)
- square stems, opposite leaves
- flowers often congested in verticils or terminal heads.

*Satureja* in Greece  
*Mentha longifolia*

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**Lamiaceae - mints**

*Satureja* in Greece  
*Mentha longifolia*

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**Lamiaceae - mints**

*Stachys palustris* - hedge nettle

**Lamiaceae - mints**

*Salvia* - sage

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**Lamiaceae - mints**

*Stachys palustris* - hedge nettle

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**Lamiaceae - mints**

*Galeopsis*

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**Lamiaceae - mints**

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**Lamiaceae - mints**

*Galeopsis*

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**Lamiaceae - mints**

*Galeopsis*
*Lamiaceae - mints

*Prunella vulgaris - selfheal

Glechoma hederacea - creeping charlie

Botany 400 collections species!

Nepeta cataria - catnip

*Leonurus cardiaca - motherwort

Lycopus americanus - Water horehound

Monarda punctata - horsemint

Monarda fistulosa - wild bergamot

Botany 400 collections species!

Salvia - giant polyphyletic genus which has evolved 3 separate times
**Lamiaceae - mints**

*Salvia* - giant polyphyletic genus which has evolved 3 separate times

Formation of staminal lever

- anther connective

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**Verbenaceae - vervains**

34 genera and 1175 species of aromatic herbs, vines, trees

- square stems
- opposite, serrate leaves
- flowers not lipped
- fruit often 1-2 seeded drupe, not gynobasic

- *Clerodendrum*
- *Vitex*
- *Tectona grandis - teak*
- *Lantana camara - sage*
- *Verbena gracilens*
Verbenaceae - vervains

Verbenae hastata - Blue vervain
Verbenae stricta - Hoary vervain

* “Scrophulariaceae”

The ‘old’ family is similar to mints, but . . .
- alternate or opposite leaved
- round or squarish stems
- terminal style, many seeds, capsules

Aureolaria - false foxglove

Bellardia

Pedicularis canadensis - wood betony
Castilleja coccinea - Indian paintbrush

* “Scrophulariaceae”

. . . and included normal as well as hemiparasitic species (green but with attachment to plants for additional food)

Castilleja - paintbrush

Status of 3 “old” unrelated families
1. Plantaginaceae – wind pollinated
2. Orobanchaceae – holoparasites
3. Scrophulariaceae – the rest + hemiparasites

Plantago - plantain
Conopholis - squaw-root
Verbasca - mullein
Linaria - buttercups
Castilleja - paintbrush
* “Scrophulariaceae”

Status of 3 “new” unrelated families – DNA story!
1. Plantaginaceae – wind pollinated + most genera
2. Orobanchaceae – holoparasites + hemiparasites
3. Scrophulariaceae – only Scrophularia + Verbascum

Plantago – plantain
Linaria – buttercups
Conopholis – squawroot
Castilleja – paintbrush
Verbascum – mullein

Scrophulariaceae - figworts

Verbascum thapsus - mullein
New Scrophulariaceae is small with 24 genera but retains type genus
Scrophularia marilandica - figwort, carpenter's-square

Plantaginaceae - plantains

Plantago lanceolata - English plantain
Plantaginaceae includes Plantago (plantains) - wind pollinated derivatives of snapdragons . . .

Verbascum thapsus - common mullein - weedy biennial (1st year as a rosette)
Commonly collected in Botany 400 plant collections!
Plantaginaceae - plantains

Plantaginaceae includes *Plantago* (plantains) - wind pollinated derivatives of snapdragons . . .

*Plantago major* - common plantain

but also most of non-hemiparasitic members of former Scrophulariaceae

*Plantago patagonica* - wooly plantain

*Chelone glabra* - turtlehead

*Veronicastrum virginicum* - Culver’s-root

*Antirrhinum* - snapdragon

*Linaria* - butter&eggs

*Digitalis* - foxglove

*Veronica* persica – Bird’s-eye speedwell

... a petition to ICBN has been made to conserve the name *Antirrhinaceae* (*Veronicaceae* has been rejected)
Orobanchaceae - broomrape

Orobanchaceae contains holo-parasites (non-green)

*Conopholis americana* (squaw-root)

Orobanchaceae - broomrape

Orobanchaceae contains holo-parasites

*Epifagus virginiana* - beech drops

haustoria

Orobanchaceae - broomrape

... and hemi-parasites of old Scrophulariaceae

*Orobanche fasciculata* - fascicled broomrape

obligate host: *Artemisia campestris* - wormwood

*Orobanche uniflora* - one-flowered broomrape

Orobanchaceae - broomrape

Castilleja sessiflora - downy paintbrush

*Pedicularis lanceolata* - swamp lousewort
**Lentibulariaceae - bladderworts**

Cosmopolitan (3 genera/320 species) - vegetatively diverse, *insectivorous* herbs of wetlands

- *Pinguicula* - butterwort
- *Utricularia* - bladderwort

**Bignoniaceae - catalpa**

Tropical (some temperate) trees and lianas with opposite, compound leaves and large flowers (bat, bird, bee)

- *Campsis radicans* - trumpet creeper
- *Spathodea campanulata* (Camellia)  
- *Jacaranda*

**Acanthaceae - acanths**

Tropical (some temperate) herbs, shrubs, lianas with opposite, simple leaves and thick nodes

- *Aphelandra*  
- *Acanthus ilicifolius* (Mistletoe)

- *Catalpa*

- Elongated capsules appearing like legumes

- Showy bracts
- Explosively dehiscent capsules
**Acanthaceae - acanths**

1 endangered species in Wisconsin prairies

*Ruellia humilis* - hairy ruellia

**Gesneriaceae - African violets**

Pantropical herbs and epiphytes or weak shrubs

\[ CA (5) \quad CO (2+3) \quad A 2+2 \quad G (2) \]

- ovary inferior or superior
- anthers fuse at maturity

**Gesneriaceae - African violets**

Pantropical herbs and epiphytes or weak shrubs

\[ CA (5) \quad CO (2+3) \quad A 2+2 \quad G (2) \]

- ovary inferior or superior
- anthers fuse at maturity

**Boraginaceae - borage**

- unplaced family within ‘lamiid’ or Asterid 1 group
- large family of herbs to trees, 148 genera and 2740 species

**Cordia - geiger tree**

*Myosotis - forget me not*
**Boraginaceae - borage**

- Typically hairy plants
- Scirpoid cyme inflorescences - compound monochasium

- **Borago**

- **Mertensia virginica** - Eastern bluebells

- **Lithospermum** (puccoon) - classic dimorphic heterostyly

- **Myosotis** - forget me not

- **Echium**

- **Botany 400 collections species!**
**Boraginaceae - borage**

- *Lithospermum canescens* - Hoary puccoon
- *Lithospermum incisum* - Fringed puccoon

**Boraginaceae - borage**

- *Mertensia virginica* - Eastern bluebells

**Boraginaceae - borage**

- *Hydrophyllum virginianum* - Common waterleaf
  - formerly Hydrophyllaceae