Classification

Tzetal classification of biota

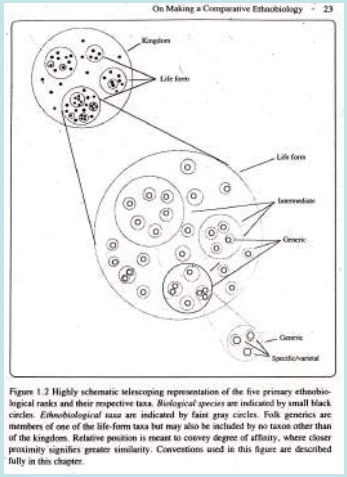
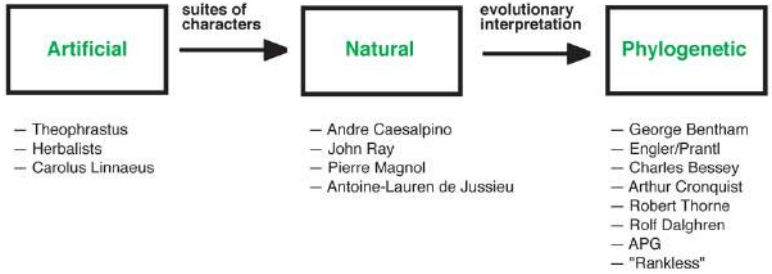


Figure 1.2 Highly schematic telescoping representation of the five primary ethnobiological ranks and their respective taxa. *Biological species* are indicated by small black circles. *Ethnobiological taxa* are indicated by faint gray circles. Folk generics are members of one of the life-form taxa but may also be included by no taxon other than of the kingdom. Relative position is meant to convey degree of affinity, where closer proximity signifies greater similarity. Conventions used in this figure are described fully in this chapter.

Classification

Three main systems of classifications in western civilization



- Theophrastus
- Herbalists
- Carolus Linnaeus

- Andre Caesalpino
- John Ray
- Pierre Magnol
- Antoine-Lauren de Jussieu

- George Bentham
- Engler/Prantl
- Charles Bessey
- Arthur Cronquist
- Robert Thorne
- Rolf Dalghren
- APG
- "Rankless"

Classification

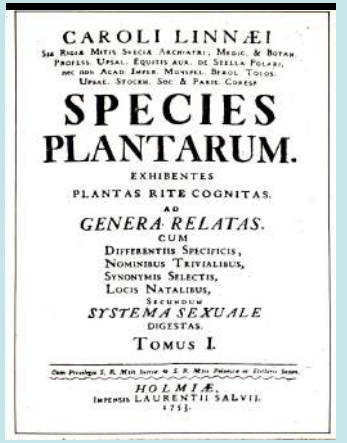
Carolus Linnaeus (1707-1778) - Swedish taxonomist

- good example of an "artificial" system of classification

Classification

Carolus Linnaeus (1707-1778) - Swedish taxonomist

- greatest achievement - *Species Plantarum* in 1753 arranged as *Systema Sexuale*
- classification based on reproductive features chosen *a priori* simply on workability

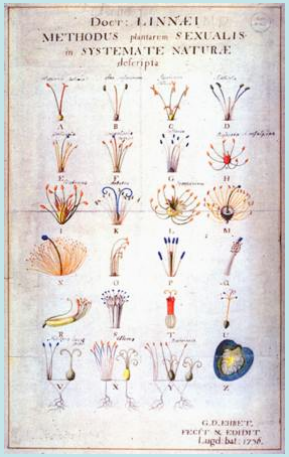


CAROLI LINNÆI
SPECIES PLANTARUM.
EXHIBENTES
PLANTAS RITE COGNITAS.
AD
GENERA RELATAS.
CUM
DIFFERENTIIS SPECIFICIS,
NOMINIBUS TRIVIALIBUS,
SYNONYMIS SELECTIS,
LOCIS NATALIBUS,
SECUNDUM
SYSTEMA SEXUALE
DIGESTAS.
TOMUS I.
HOLMIÆ,
IMPENSIS LAURENTII SALVII.
1753.

Classification

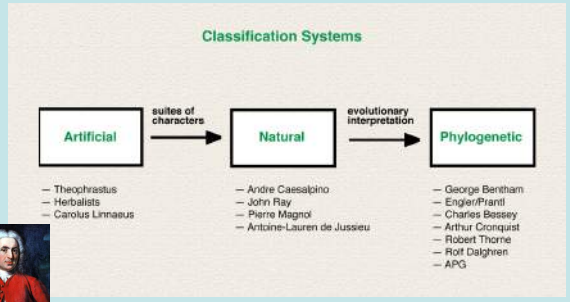
Take a closer look inside *Species Plantarum*

- prime divisions based on number of stamens
- secondary divisions based on number of pistils



Classification

The shift from "**artificial**" systems of classification to "**natural**" systems basically involved the departure away from reliance on a single or few characters used to "pigeon-hole" a plant (e.g., habit, medicinal property, # of stamens). Instead, large numbers - or "suites" - of characters were later used.



Classification

This switch from artificial to natural systems of classification was aided by a fad in the 18th and 19th centuries - laying out botanical gardens to reflect the current classification scheme in vogue.

Shown here is the famous Linnaean Gardens in Uppsula, Sweden, in which the plants are arranged by stamen number as in Carolus Linnaeus' "Sexual System of Classification"

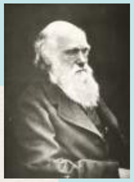
Classification

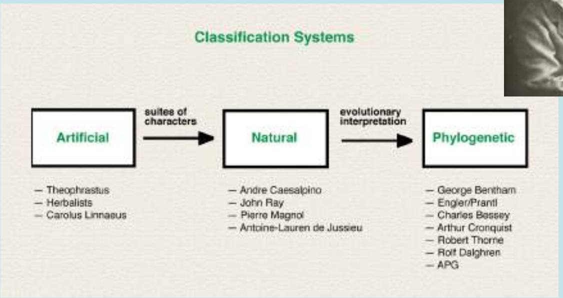
The de Jussieau family of systematists and ecologists at the Paris Herbarium experimented by replanting the species so that those most "similar" looking on the basis of many features would be in proximity.

Antoine de Jussieau later developed the first "natural" system of classification of flowering plants - aspects of which are still in use today.

Classification

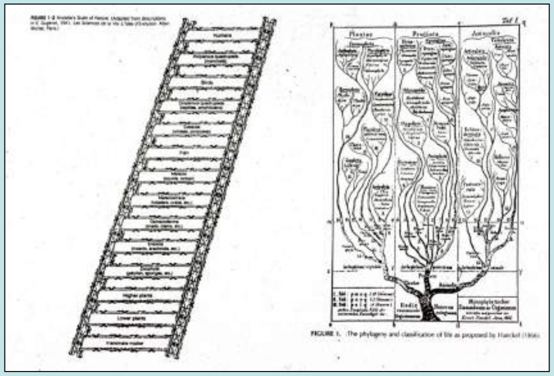
The shift from "**natural**" systems of classification to "**phylogenetic**" systems required the concept from Charles Darwin that organisms are tied together by genealogical descent - one of the two basic evolutionary paradigms.





Classification

It is important to realize that evolution predicts a "**tree**"- like pattern to life; not the Greek "**ladder of life**" pattern. This confusion is the basis of a lot miscommunication in the "evolution-creationist" debate.



Classification

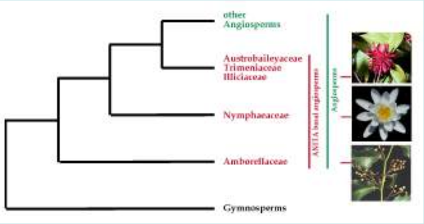
PHYLOGENETICS OF SEED PLANTS: AN ANALYSIS OF NUCLEOTIDE SEQUENCES FROM THE PLASTID GENE *rbc*L[1]

Mark W. Chase,[2] Douglas E. Soltis,[3] Richard G. Olmstead,[4] David Morgan,[5] Donald H. Les,[6] Brent D. Mishler,[7] Melvin R. Duvall,[2] Robert A. Price,[8] Harold G. Hills,[2] Yin-Long Qiu,[2] Kathleen A. Kron,[2] Jeffrey H. Rettig,[8] Elena Conti,[10] Jeffrey D. Palmer,[8] James R. Manhart,[9] Kenneth J. Sytsma,[10] Helen J. Michaels,[11] W. John Kress,[12] Kenneth G. Karol,[10] W. Dennis Clark,[13] Mikael Hedrén,[14] Brandon S. Gaut,[2] Robert K. Jansen,[15] Ki-Joong Kim,[15] Charles F. Wimpee,[2] James F. Smith,[16] Glenn R. Furnier,[20] Steven H. Strauss,[17] Qiu-Yun Xiang,[3] Gregory M. Plunkett,[3] Pamela S. Soltis,[3] Susan M. Swensen,[18] Stephen E. Williams,[19] Paul A. Gadek,[20] Christopher J. Quinn,[20] Luis E. Eguiarte,[2] Edward Golenberg,[21] Gerald H. Learn, Jr.,[2] Sean W. Graham,[22] Spencer C. H. Barrett,[22] Selvadurai Dayanandan,[23] and Victor A. Albert[2]

ABSTRACT

We present the results of two exploratory parsimony analyses of DNA sequences from 475 and 499 species of seed plants, respectively, representing all major taxonomic groups. The data are exclusively from the chloroplast gene *rbc*L, which codes for the large subunit of ribulose-1,5-bisphosphate carboxylase/oxygenase (RuBisCO or RuBPCase). We used two different state-transformation assumptions resulting in two sets of cladograms: (i) equal-weighting for the 499-taxon analysis; and (ii) a procedure that differentially weights transversions over transitions within characters and codon positions among characters for the 475-taxon analysis. The degree of congruence between these results and other molecular, as well as morphological, cladistic studies indicates that *rbc*L sequence variation contains historical evidence appropriate for phylogenetic analysis at this taxonomic level of sampling.

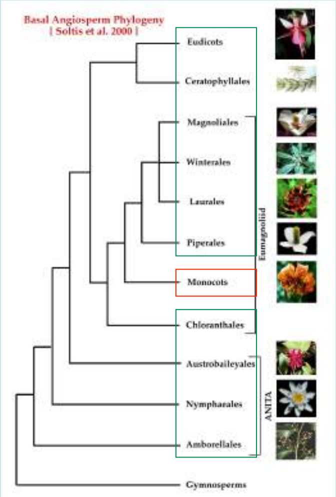
ANN. MISSOURI BOT. GARD. 80: 528–580. 1993.



Most modern phylogenetic studies depict their results in the form of a **tree** or **phylogeny**

Major surprises were uncovered including the recognition of the first diverging flowering plants - which include the water lilies.

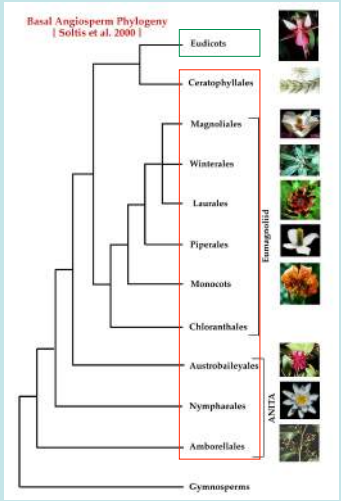
Magnoliophyta - Flowering Plants



Angiosperms have traditionally been divided into two classes: the **dicotyledons** and the **monocotyledons**.

As demonstrated here, monocots are imbedded within the dicots - thus, the separation of flowering plants into two classes of dicotyledons and monocotyledons is no longer recognized.

Magnoliophyta - Flowering Plants



Angiosperms have traditionally been divided into two classes: the **dicotyledons** and the **monocotyledons**. As demonstrated here, monocots are imbedded within the dicots - thus, the separation of flowering plants into two classes of dicotyledons and monocotyledons is no longer recognized.

The basal angiosperms are those groups that are now shown to be the oldest diverging. They include some primitive dicots and all monocots.

All other angiosperms - the bulk of the dicots - are called the "**eudicots**" and considered more advanced.

Nymphaeales - water lily order

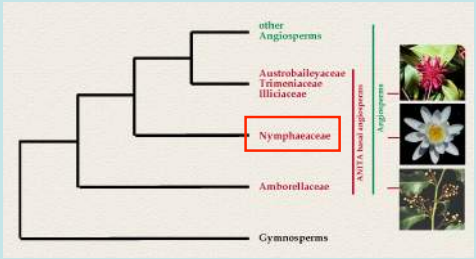
Nymphaea - water lily

Nelumbo - lotus lily

- Floating or submersed leaves
- Air cavities in tissue
- Mucilaginous coverings
- Lack of vessels

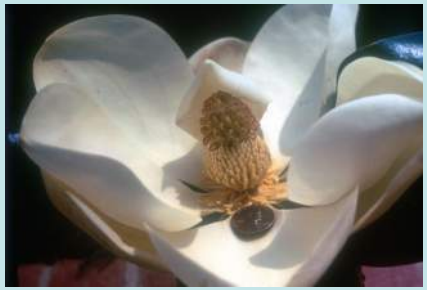
Convergence [unrelated plants with similar adaptations] common

The order is almost the first flowering plants that split off after the rise of angiosperms - only one monotypic family in New Caledonia is more basal.



Magnoliaceae - magnolia family

One species of *Magnolia* in the Great Lakes region, and part of the Alleghenian flora. Tropical trees with ethereal oils which leads to a strong scent. They typically have simple, alternate entire leaves.



Magnolia

Flowers are spiralled rather than whorled with elongated receptacle

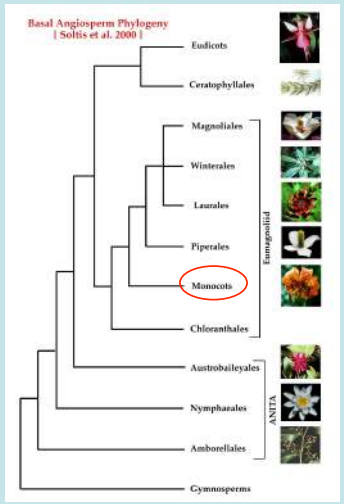
P ∞ A ∞ G ∞

Tepals, laminar stamens, apocarpic

Fruit = "cone" of **follicles**

Dehiscent fruit with one suture, derived from one carpel

The Monocots

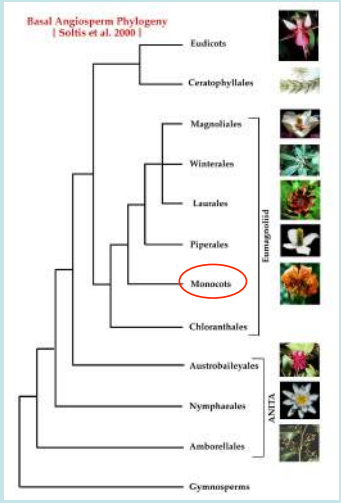


The remainder of the basal angiosperms are the **monocotyledons.**

The main features of the monocots separating them from all other flowering plants (and why they have long been separated out as a distinct group) are:

1. 3 merous flowers

The Monocots

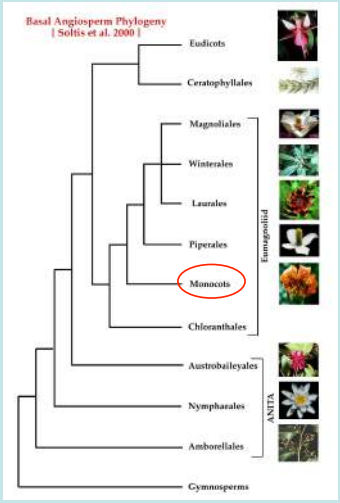


The remainder of the basal angiosperms are the **monocotyledons.**

The main features of the monocots separating them from all other flowering plants (and why they have long been separated out as a distinct group) are:

1. 3 merous flowers
2. Parallel-veined leaves

The Monocots

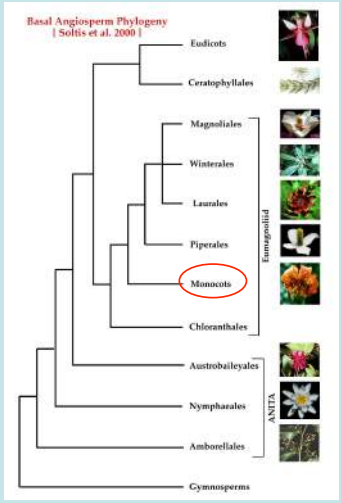


The remainder of the basal angiosperms are the **monocotyledons.**

The main features of the monocots separating them from all other flowering plants (and why they have long been separated out as a distinct group) are:

1. 3 merous flowers
2. Parallel-veined leaves
3. Absence of woody tissue

The Monocots



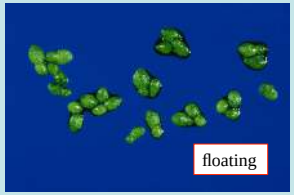
The monocots are comprised of 3 main groups:

1. Alismatids
2. Lilioids
3. Commelinids

Alismatids
- the aquatic monocots

Emergent, floating, or submerged aquatic group of monocots

These are the first diverging monocots



Alismatids
- the aquatic monocots

Showy flowers, insect-pollinated

Associated with the aquatic habit is the trend from insect-pollinated, showy flowers to water-pollinated, reduced flowers

The group shows increasing effort to vegetative reproduction over sexual reproduction

Reduced unisexual flowers, water-pollinated

Lilioid Monocots (Liliales + Asparagales)

The lilioid monocots represent two orders and contain most of the showy monocots such as lilies, tulips, blue flags, and orchids

They are defined by 3 features:

1. **Geophytes**: herbaceous above ground with bulbs, corms, rhizomes, tubers as modified, perennial stems below ground

Lilioid Monocots (Liliales + Asparagales)

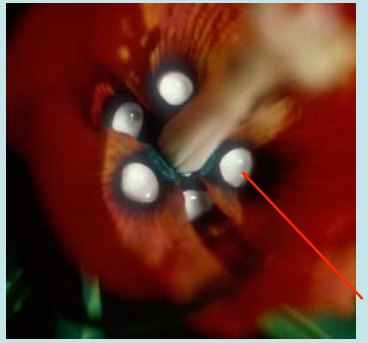
The lilioid monocots represent two orders and contain most of the showy monocots such as lilies, tulips, blue flags, and orchids

They are defined by 3 features:

1. **Geophytes**: herbaceous above ground with bulbs, corms, rhizomes, tubers as modified, perennial stems below ground

2. **Tepals**: showy perianth in 2 series of 3 each; usually all petaloid, or outer series not green and sepal-like

Lilioid Monocots (Liliales + Asparagales)



The lilioid monocots represent two orders and contain most of the showy monocots such as lilies, tulips, blue flags, and orchids

They are defined by 3 features:

1. **Geophytes**: herbaceous above ground with bulbs, corms, rhizomes, tubers as modified, perennial stems below ground

2. **Tepals**: showy perianth in 2 series of 3 each; usually all petaloid, or outer series not green and sepal-like

3. **Nectaries**: usually well-developed nectar tissue at the base of ovary or stamens; insect or bird-pollinated

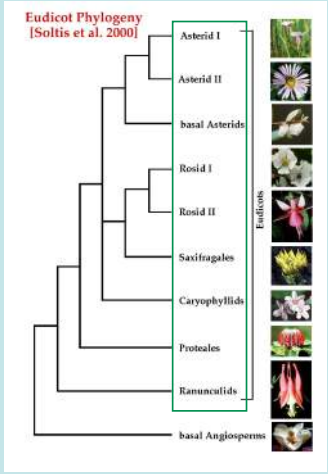
Commelinids

Carex pensylvanica
Pennsylvania sedge

The commelinid monocots show continual progression to loss of most floral parts and specialization of reduced florets for wind pollination. The inflorescence - **spikelet** - becomes the most important structure ecologically.

The sedges and grasses are the most important families of this large group.

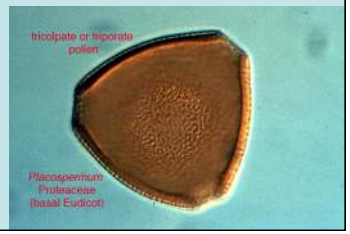
Eudicots



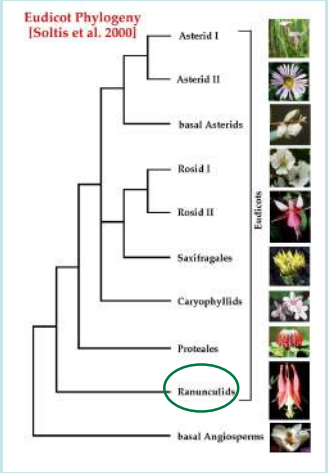
The true dicots = **eudicots** all have 3-pored pollen.

They are the largest group of angiosperms, and are quite diverse
The main groups include:

Ranunculids
Caryophyllids
Rosids
Asterids



Ranunculids

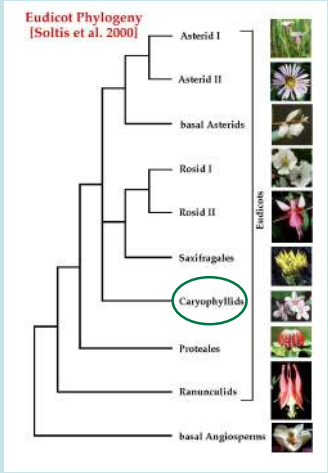


The first diverging group of true dicots or **eudicots**

The largest family is the Ranunculaceae or buttercup family. Flowers are primitive looking with many parts and no fusion.

Anemone canadensis - anemone

Caryophyllids



The caryophyllid group is a strange mixture of plants including cacti, carnations, and some carnivorous families.

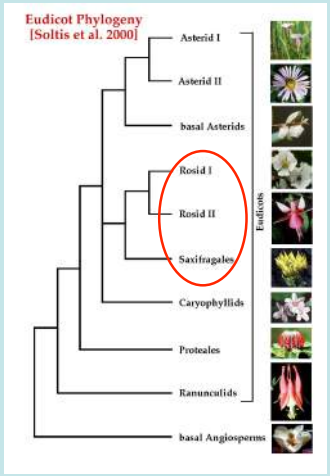
Many of them are found in marginal habitats - deserts, salt environments, nutrient poor sites, and weedy areas. This distribution is accompanied by unusual physiological or morphological adaptations.

Caryophyllids

Many of the species are **introduced** (either by Native Americans or Europeans or later) and either **naturalized** – well-established, often widespread plant that is not originally in our flora – or **adventive** – only casually established, not persistent.

Gypsophila paniculata
Baby's-breath
Caryophyllaceae

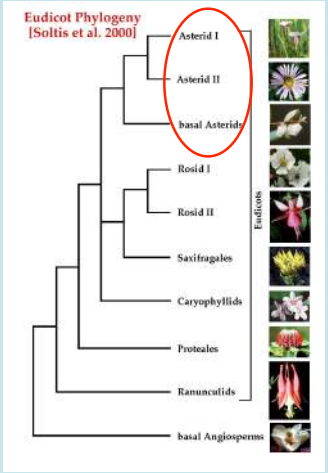
Rosids



Rosids are one of the two large groups of eudicots

Separate petals

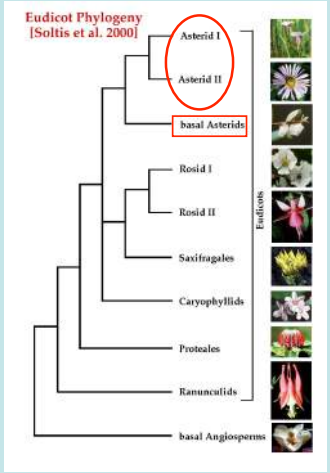
Asterids



Asterids is the second of the two large groups of dicots.

Fused petals

Asterids



The basal asterids include blueberries and dogwoods and relatives

The rest of asterids have the typical asterid flowers - (1) fused petals, (2) stamens = or less than number of petals, (3) stamens fused to petals