

ANGIOSPERMS: The flowering plants

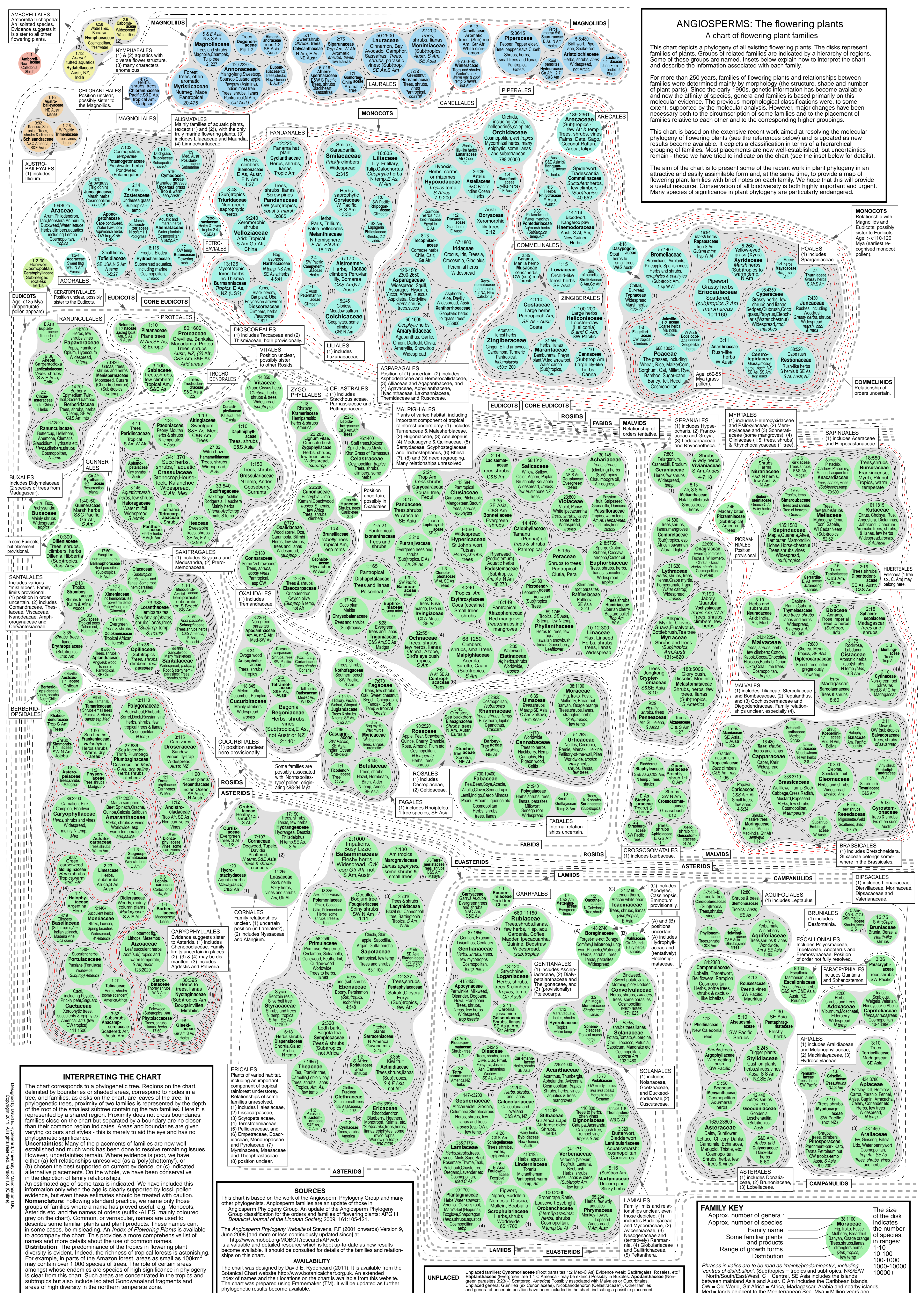
A chart of flowering plant families

This chart depicts a phylogeny of all existing flowering plants. The disks represent families of plants. Groups of related families are indicated by a hierarchy of regions. Some of these groups are named. Insets below explain how to interpret the chart and describe the information associated with each family.

For more than 250 years, families of flowering plants and relationships between families were determined mainly by morphology (the structure, shape and number of plant parts). Since the early 1990s, genetic information has become available and now the affinity of species, genera and families is based primarily on this molecular evidence. The previous morphological classifications were, to some extent, supported by the molecular analysis. However, major changes have been necessary both to the circumscription of some families and to the placement of families relative to each other and to the corresponding higher groupings.

This chart is based on the extensive recent work aimed at resolving the molecular phylogeny of flowering plants (see the references below) and is updated as new results become available. It depicts a classification in terms of a hierarchical grouping of families. Most placements are now well-established, but uncertainties remain - these we have tried to indicate on the chart (see the inset below for details).

The aim of the chart is to present some of the recent work in plant phylogeny in an attractive and easily assimilable form and, at the same time, to provide a map of flowering plant families with brief notes on each family. We hope that this will provide a useful resource. Conservation of all biodiversity is both highly important and urgent. Many species of significance in plant phylogeny are particularly endangered.



INTERPRETING THE CHART

The chart corresponds to a phylogenetic tree. Regions on the chart, delimited by boundaries or shaded areas, correspond to nodes in a tree, and families, as disks on the chart, are leaves of the tree. In phylogenetic trees, proximity of two families is represented by the depth of the root of the smallest subtree containing the two families. Here it is represented by a shared region. Proximity does not cross boundaries: families close on the chart but separated by a boundary are no closer than their common region indicates. Areas and boundaries are given varying colours and styles - this is merely to aid the eye and has no phylogenetic significance.

Uncertainties: Many of the placements of families are now well-established and much work has been done to resolve remaining issues. However, uncertainties remain. Where evidence is poor, we have either (a) left relationships unresolved (as a poly(chotomy)), or (b) chosen the best supported on current evidence, or (c) indicated alternative placements. On the whole, we have been conservative in the depiction of family relationships.

An estimated age of some taxa is indicated. We have included this information only when the age is clearly supported by fossil pollen evidence, but even these estimates should be treated with caution.

Nomenclature: Following standard practice, we name only those groups of families where a name has proved useful, e.g. Monocots, Asterids etc. and the names of orders (suffix -ALES, mainly coloured grey on the chart), common, vernacular, names are used to describe some familiar plants and plant products. These names are, in some cases, misleading. An *Index of Flowering Plants* is available to accompany the chart. This provides a more comprehensive list of names and more details about the use of common names.

Distribution: The predominance of the tropics in flowering plant diversity is evident. Indeed, the richness of tropical forests is astonishing. For example, in parts of the Amazon forest, areas as small as 100km² may contain over 1,000 species of trees. The role of certain areas amongst whose endemics are species of high significance in phylogeny is clear from this chart. Such areas are concentrated in the tropics and sub-tropics but also include the northern temperate zone.

SOURCES

This chart is based on the work of the Angiosperm Phylogeny Group and many other phylogenists. Angiosperm families are an update of those in Angiosperm Phylogeny Group. An update of the Angiosperm Phylogeny Group classification for the orders and families of flowering plants: APG III. *Botanical Journal of the Linnean Society*, 2009, 161:105-121.

The *Angiosperm Phylogeny Website* of Stevens, PF (2001 onwards) Version 9, June 2008 (and many or less continuously updated since) at <http://www.mobot.org/MOBOT/research/APweb> is a valuable and detailed resource which is kept up-to-date as new results become available. It should be consulted for details of the families and relationships on this chart.

The chart was designed by David E. Rydeheard (2011). It is available from the Botanical Chart website <http://www.botanicalchart.org.uk>. An extended index of names and their locations on the chart is available from this website. The chart was prepared using Framemaker (TM). It will be updated as further phylogenetic results become available.

UNPLACED

Unplaced families: **Cynomorpha** (Root parasites 12 Med-CAS) Evidence weak; **Saxifragales**, **Rosales**, etc? **Utriculariaceae** (Evergreen tree 11 C America - may be extinct possibly in Buxales); **Subulariaceae** (Non-green parasitic 3.23+ Scattered, America) Possibly associated with Malvales or Cucurbitales. **Parasitales** (Non-green parasitic 10 Cucurbitales, Nicotianales, Solanales, etc.) Other families and genera of uncertain position have been placed on the chart, indicating a possible placement.

FAMILY KEY

Approx. number of genera: 38,100
 Approx. number of species: 311,000
 Family name: Moraceae
 Some familiar plants: Fig, lily, mulberry, breadfruit, banana, orange, papaya, mango, guava, kiwifruit, etc.
 Range of growth forms: Tree, shrub, climber, etc.
 Distribution: World-wide
 The size of the disk indicates the number of species, in ranges: 1-10, 10-100, 100-1000, 1000+.