

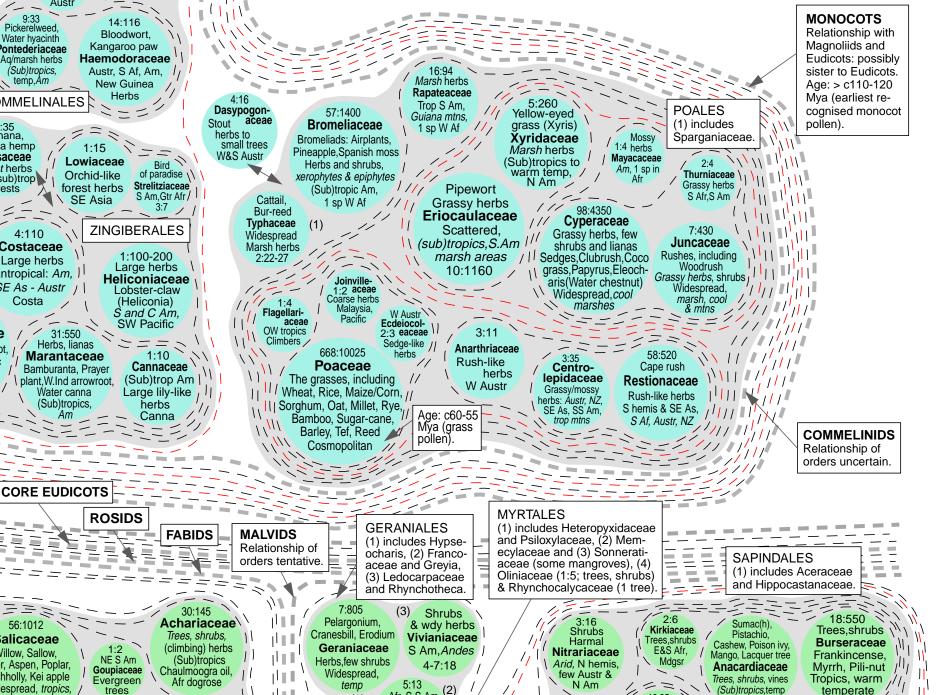
## **ANGIOSPERMS:** The flowering plants A chart of flowering plant families

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.

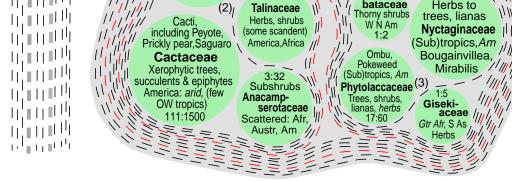
For more than 250 years, families of flowering plants and relationships between families were determined mainly by morphology (the structure, shape and number of plant parts). Since the early 1990s, genetic information has become available and now the affinity of species, genera and families is based 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.



(2 species of trees from Madagascar).	Resurrection plants 1:2 aceae 8:145 Widespre S Afr, M	ead, / 33:540 Gooseberry, ///	6:280 Position Souari tree, /	Pantropical Widespread, tropics, / tropics / trees	temp 5:13 (2) / // / 1 N Afr, S S Am (2) /	19:95 (Sub)tropics,temp temperate
	1:40 EQ	/ Saxifrage, Astilbe,	phia,Ulmo, Coachwood Trop Afr possibly in 3:15 Pequi	Gamboge,Pitchapple, 3:35 Trees 23:800 Passion- fruit, Stripese	eed.	eae 1 ( Simaroubaceae
4:70 Box, Pachysandra	Gunneraceae	, / / Mainly herbs //// Tropic	Africa Shrubs, trees Oxalidales. Africa Shrubs, trees Oxalidales.	Trees, shrubs, C&S Am		As I Trees and shrubs Trees, T
Image: Image and the second	S&C Pacific, Gtr Afr, / Widespread, Tetracarp- aeaceae	La contraction and contraction	mbers 2:3 / W Africa to 1:1 SE Asia / Liana	Bonnetiaceae / Trees, shrubs, vines, Evergreen	temp, 1/1 Picramniaceae	Meliaceae Mahogany, Omu, Citrus, Choisya, Rue, 11, 11, 14, 14, 14, 14, 14, 14, 14, 14
Videspread, tropics	SAm	Sweetspire (2) Oxalidaceae	4-5:21 Lophopyxid	9:560 shrubs / Calophyllaceae Widespread, (1) shrubs,tree 26:932	es /// Trees,shrubs, lianas,mangroves	135:1580 Toon, Sapele, Jaborandi, Cneorum 1111 Sapindaceae WI Cedar, Neem Aromatic trees, shrubs, 11111
	300 Heshy herbs //	Vivio Sorrei, Oca, Vivio Serrei, Oca, Vivio Sorrei,	In Brunelliaceae Woolly trees	Widespread Tamanu (Punnai) oil	Combretaceae (Sub)tropics, esp	Maple, Guarana, Akee, (Sub)tropics & lianas, few herbs ///// Bambutan Mamoncillo, 52:621 Widespread, <i>tropics</i> , ///////
but placement Trees,		Herbs, tew shrubs, trees and lianas	/// Tropical Am, /// Trees and / Putranjivaceae / /// esp mtns //	St John's wort, Tutsan Tutsan Tutsan	African savannah // 22:656 NIALES	Lichee, Horse-chestnut (1) S Af, Austr
Dillenia,	Libbortio Fulle-like	AXIFRAGALES ) includes Soyauxia and Connaraceae (sub)trop ///	1:1 Ganbalot	Herbs, shrubs, Riverweed (Podostemum) Stats (8) Rubber, Cass. Jatropha,Casto	Sava, Evening primrose, A provisional	Widespread,
	Balanophoraceae (1) = = = : Me	edusandra, (2) Ptero- emonaceae.	aceae	Aquatic herbs // Shrubs to trees Euphorbiac Podostemaceae // Pantropical Trees, shrubs, h	herbs (1) 31:620 Herbs, shrubs, trees // 1 1, 1, 1	(sub)tropics
SANTALALES	(Sub)tropics, (Sub)tropics E Asia			aceae (Sub)tropics: // Clutia, Pera lianas, succul Widespread	d /   <sup>1</sup>     Herbs, shrubs, trees W N Am /       /	1:2 Tapisciaceae Dipentodont- Petenaea (1 tree
Includes various "mistletoes". Family		1:10 11 esp OW / // Trees & shrub	Sw Pacific WAI,	48:270 / Picrodendr- (9) Stem and tropics	Henna, Crape myrtle, (3)	E Af aceae Scrambling China SE As, Austr, / belong here.
limits provisional. ( (1) position in order	Strombosi- aceae // Ximeniaceae 3:c58/ Aeri	sodendr- rial aceae OXALIDALES	Poisonleaf aceae / Trees	/ Tropics, Am	50 (Water caltrop) Widespread, 7:190 (Widespread, 7:190)	shrubs C&S Am
uncertain. (2) includes Comandraceae, Thes-	Shrubs to trees / Inc hemparasites Kulim & Afina / Trop-warm temp Vellow/Mog alum? / Tog-transformed (on State)	hiparasitic      , (1) includes hishrubs      , (1) Tremandraceae. (Sub)trop & terr	p, // / 17:460 1:1-2 3:10 Coco plum, // Euphro- Trees: Bush	Coca (cocaine) - 16:149 (Sub)tropics Rafflesia / Trees, Expose SE Asia / Humiri	riaceae	Daphne, $= = = = = = = =$
iaceae, Viscaceae,	(Ximenia) / Hemiparasites		Makita / Guyana mtns / mango, Dika nut I Chrysobalanaceae / Trees //	Small trees, shrubs	n cherry, <b>Vochysiaceae With subshrul</b> d bullet <b>Wochysiaceae With subshrul</b> <b>Tropic Am</b> , W Af	205 / Thymelaeaceae Bixaceae 37 2:18 2:18 2:18 2:19 2:19 2:19 2:19 2:19 2:19 2:19 2:19
Nanodeacae, Amph- orogynaceae and	/ Iropical trees / Evergreen (Stituds, lianas, liees s	3:c50 Root parasites Schoepfiaceae	Trees and shrubs // 5:28 // SE As	(3) Red mangrove Trees shrubs inc /   S temp, few N temp	Afr, Merce, Afr. Myrtle, Cloves, Cloves, few	a, / lianas and herbs / Rose imperial sepalaceae // /// d / (a) Widespread. Trees to herbs Madagascar // ////
	Huambula / trees & shrubs (Sub)trop, temp, ITre	ees, shrubs, herbs)	(Sub)tropics / trees and lianas   32:551 (4)	mangroves / Phyllanthaceae 10-12:300 Herbs to trees, few Linaceae	///////// Guava,Eucalyptus, ////////////////////////////////////	(2) Shemis & Afr / (Sub)trop, Trees and // ///
	bs, trees, Tropical African forests	E Asia ////////////////////////////////////	C&S Am,SE As // Trees, shrubs,	68:1250 Climbers, 2:25 Hawaiian Gooseberry, / Flax, Linseed Indian Gooseberry, / Herbs, shrubs,	I // II , I' Shrubs and trees , I' I' I' Malv	$\frac{1225+}{1200} = \frac{1}{17680} = -\frac{8:175}{17680}$
(Sub	opalaceae / 8:c33 / Opiliaceae 44.99	4:34 // Coryno- wood ///////////////////////////////////	Madgsr / few herbs, lianas Ochna, Azobe,	/ shrubs, small trees Waterwort Leafflower (2) Widespread	(Sub)tropics, / // Trees, shru Am,Austr /        // few climbe	bs, herbs, / Shorea, Meranti Labdanum , / Muntingi-
	Aptandraceae // (Sub)tropics Many main Aptandraceae // (Sub)tropics Many main Angueuk wood, // (Sub)tropics Santala	titetees'  /// / Ovoga wood / Shrubs,trees Warm te aceae     / / / / Anisophylle- (sub)trop       / / / / Anisophylle- (sub)trop       / / / / / / / / / / / / / / / /	Bird's eye bush Tropics,	Acerola, Aq herbs, shrubs	// 🚺 // 🔨 131:4620 / 👘 👘 📊 📊 Kapok,Coco	
	Isano oil Partropical, parasites (2) Root & ster	Troop shruba	bs// Nothofagaceae 2:6	Surette, Caapi (Sub)tropics, tropics	Trees (2) 188:5005	Lime trees gregariously N temp (Med), / (4)
	extoxic- -1 aceae	Irepics	Southern beech SW Pacific, 7:670		Crypter- Dissotis, Medinilla	East / Non-green root
Berberid-	Chilean	118:845 Tetramel- aceae Tall he S&F As	bs Trees few shrubs	38:1100 Moraceae	MALVALES	iaceae, Sterculiaceae
Vines, shrubs Austr,Chile	Athel //, tree, Tamarisk	Cucumber, Pumpkin \ Austr Med-CA Med-CA W USA		52:925 Cosmonolitan Ulmaceae // Fig, Iroko, Fustic, Mulberry, Breadfruit,	and Bombaca	spermaceae and 8:60 Madagascar
BERBERID-	Tamaricaceae	Mainly climbers Begonia	/// // Walnut, Wingnut Tanoak, Cork /// // Juglandaceae Temp & tropical	(sub)tropics / Trees,shrubs / Banyan, Osage orange	Lill Heathy S America // /// Diegodendrace	eae. Family relation-
OPSIDALES Rhabdo- dendrace	Eurasia & Africa, / Sorrel,Dock,Russian vine	Widespread, Begoniaceae tropics Herbs, shrubs,	Trees & shrubs	Sea buckthorn Trees, shrubs, lianas C Am: Zelkova, stranglers, herbs ////	Penaeaceae Trees ///////////////////////////////////	
Trop S A		(Sub)tropics,E As, /	1 <u>C&amp;S Am</u> 3:57 Bog myrtle, 90:2520	Elaeagnaceae Buckthorn,Jujube, I Elin, read I (Sub)hopics, I	Afr, St Helena, Alzateaceae	$= = -\frac{1}{3} = -\frac{1}$
	Sea heaths (/ Frankeniaceae) N temp 3:11	15 NO Austr or NZ	Wax myrtie Myricaceae Widcorreae	Eurasia 1:1 Worldwide Utricaceae	1:2? /// / // / / / / / / / / / / / / / /	Anithaceae Koeberlini- Mexico (1:1 aceae Bataceae Shrubs (1) (1) Anith Nam Anithaceae (1) (1)
	Carnin Carnin Carnin Carnin Carnin Carnin Carnin Carnin Carnin		Widespread I Quince, Cherry, Bramble SE Asia, Trees, shrubs: I Rose, Almond, Plum etc Indian Ocean Cosmopolitan.	1:2 Tree aceae Trees to herbs		s, shrubs, anthaceae Bolivia Coasts of savannah
SW N Jojot	Am Warm, dry / Thrift, Plumbago Vonue' f	dew,	N temperate	(Tree aceae NE Af NE Af Cannabis Hop Pellitory-of-the-wall, Pilea	Garden	and lianas Meadowfoam araceae
		pread,	6:145 Betulaceae	NE Af Pigeon wood, Wolldwide, <i>itopics</i> //// // Celtis	Bladdernut Guam-	er, Karir 2:8 10:300 1:1 Viny shrub
	Astero- Physen- Paiaceae Physen- Herbs, shrubs,	1:90 http://with 'Normanolles	d III Ticodendr- aceae Hazel Hornbeam	730:19400	Staphyleaceae atelaceae S& S&E Asia,C&S Am, Brambly S&E Asia,C&S Am, Brambly Shrub 1:1 , 1:95	pics 338:3710 Cleome, Pentadipl- Spectacle fruit Wafr
	Addgscr aceae (Climbers // Droso- Madgscr // Droso- phyllaceae	Nepenthaceae     ROSIDS   type' pollen, origin	C Am Birch, Alder III Corropiaceae	Fabaceae       Pea,Bean,Soya,Acacia,       21:940	shrubs C Am Papaya \	Brassicaceae Herbs and shrubs
	Carnivores   W Med	Indian Ocean, II SE Asia, /// ASTERIDS	SE Asia (2) Celtidacea	Alfalfa,Clover,Senna,Lupin, Lentil,Indigo,Carob,Mimosa, Herbs,shrubs,trees, Small trace	Shrubs Shrubs SW N Am	/ Wallflower, Turnip, Stock, () Cabbage, Cress, Radish, <i>tropics, Am</i> <i>tropics, Am</i> <i>tropics, Am</i> <i>tropics, Am</i>
	86:2200 arnation, Pink, (1) Marsh samphire, (1) 1:12		FAGALES	Peanut,Broom,Liquorice etc lianas, parasites Quillajaceae Sis shrubs	Stachy- Unraceae Crossosomat-	Mustard,Rapeseed Herbs, few shrubs
	pion, Pearlwort /ophyllaceae Ancistro Quinoa, Celosia, Saltbush	ceae \\/// / iaceae \ 17:100	(1) includes Rhoiptel 1 tree species, SE As	a, I Concercity Iemp S Am (Sub)tropics.	Trees,1:5 Greasebush / 4-6:34	Cosmopolitan, few shrubs Gyrostem- N temperate
	shrubs and vines	$rac{1}{1}$ shrubs $rac{1}{3}$ Irees, shrubs,		FABALES = -	2:2 (1) Troop	s i i i i i Mignonette, Weld Subshrub Scattered Med
	Widespread, worldwide, esp /// /// Vines warm temperate, /// ///	Hydrangeaceae Hydrangea, Deutzia,		Internal relation- ships uncertain.	Strasburg- Trees, Xero Hill Ben nut, Morin Research Aphloiaceae Cational Moring Milling Gtr	iga Emblingi-
	Med Achato- carpaceae		2:1000		Trees E Gtr Afr 1:1 Semi-arid	W AUSI
	Trees,shrubs Warm Am		/ / Busy Lizzie 7:130	FABIDS	CROSSOSOMATALES	BRASSICALES (1) includes Bretschneidera.
	9:87 Green	N temp, S&E Asia	/   Balsaminaceae Am tropics	$\begin{bmatrix} \mathbf{V} \\ \mathbf{V} $	(1) includes Ixerbaceae.	Stixaceae belongs some- where in the Brassicales.
	arpetweed 2:23 C Am	Trees & shrubs, Creepers 14:265	<ul> <li>Widespread, OW</li> <li>Lianas, epiphytes, meristaceat</li> <li>cesp Gtr Afr, not</li> <li>some shrubs &amp; Cess Am.</li> </ul>	) └ <del>、 、</del> = = = = = = = = = = = = = = = =		
1 $1 $ $1 $ $1 $ $1 $ $1 $ $1 $ $1$	erbs, shrubs Herbs, popics, warm subshrubs Lophio- arid, Afr Lophio-	Stachydaceae Loasaceae	S Am, Austr small trees (5) Malaya			
	(4) Austr Corbichonia	Madagascar, C&S Afr (1)	18:385	2:17 <b>1:1</b> (C)		(1) includes Linnaeaceae, Diervillaceae, Morinaceae,
	Halophy-		Am, temp Eurasia Polemoniaceae Ocotillo, (3) 25:310 Trees & shrubs	Garrya,Aucuba Garrya,Aucuba Decid tree Garrya,Aucuba	Lemon thorn, Cassinopsis, Citronella-tree Shrubs & trees	AQUIFOLIALES Dipsacaceae and Valerianaceae.
	Argentina 9:140+ Woody, mainly 1:1 UII 1:1 UII Barbeu-		Phlox, Cobaea, Gilia, Polemonium Spiny shrubs	Evergreen trees China Ch	acinaceae provisionally.	
4:	19 Succulent herbs Madagascar, //// iaceae	CORNALES	Herbs, some SW N Am / Blazin Ind, Cannot Dati /	N&C Am, 660:11150 Tree,shrub Iree C&E As Rubiaceae	(Sub)tropics, SE As /	BRUNIALES (1) includes
	laceae Blinks, Lewisia,	unclear. (1) uncertain	lianas – – – Tropics, S'Am, / W Afr	Trees, shrubs, lianas,	E Asia (A) and (B) positions	a mate, Desfontainia. Shrubstrees Bruniaceae
'        ', <mark>\</mark>  ',\\ Madei	spinach, Widespread, Hottentot fig, CAR ra vine, W America (Lithons Mesembs) Evide	RYOPHYLLALES    (2) includes Nyssaceae	58:2590 Chicle, Star	87:1655 (2) Tew nerbs, 1 sp. aqu. (A) Boraginaceae Gentian, Exacum, Madder, Ipecacuanha, Forget-me-not,Borage	(B) 1:8 uncertain. / Phyllonom- Helwingi- aceae (A) includes (A) aceae Aquif	bliaceae
	quina ==== / / Aizoaceae \ to As	sterids. (1) includes	rimulaceae Argan Gutta-percha	/ Lisianthus, Centaury Quinine, Bedstraw Comfrey, Heliotrope, Lun	ng-Gtr Afr, India Hydrophyll- Trees, shrubs C&E Asia Irees, sh C&S Am Vo	rldwide, / Includes Polyosmaceae,
	Succulent herbs	s uncertain in places:	amen, Soldanella, Wood Featherfoil Pantropical, few temp	Gentianaceae Herbs, shrubs, trees, (sub)tropics Widespread, Herbs, shrubs, trees,	shrubs (tentatively)	SE Asia / Tribelaceae, Anopterus and Eremosynaceae. Position
	Purslane (Portulaca)	estis and Petiveria.	wood, Featherfoil, Pantropical, few temp // Sladeniaceae   Cudjoe-wood (7) Trees and shrubs // Evergreen / Worldwide (7)	few mycotrophs Cosmopolitan, 13:420 GENTIANALES Widespread	Hoplestig- mataceae. 84:2380 Campanulaceae	of order not fully resolved. 3:36 Paracryphi-
日 清 前 前 一 片碧池	Worldwide 1232020		rees to herbs, Trees 12:337 (4)	(1) includes Asclep- iadaceae, (2) Dialy-	Bindwood	9:130 Escallonia, Tasmanian laurel Includes Quintinia
	(2), Talinaceae	30:395 11111 Herbs to	(2) and (sub)shrubs	(1) (1) (1) (1) (1) (1) (1) (1)	Sweet potato, Jalap, orning glory, Dodder Bellflowers, Rampion Cosmopolitan Herbs, Some frees, Trees & vines	Tasmanian laurel Escalloniaceae Trees, shrubs, herbs

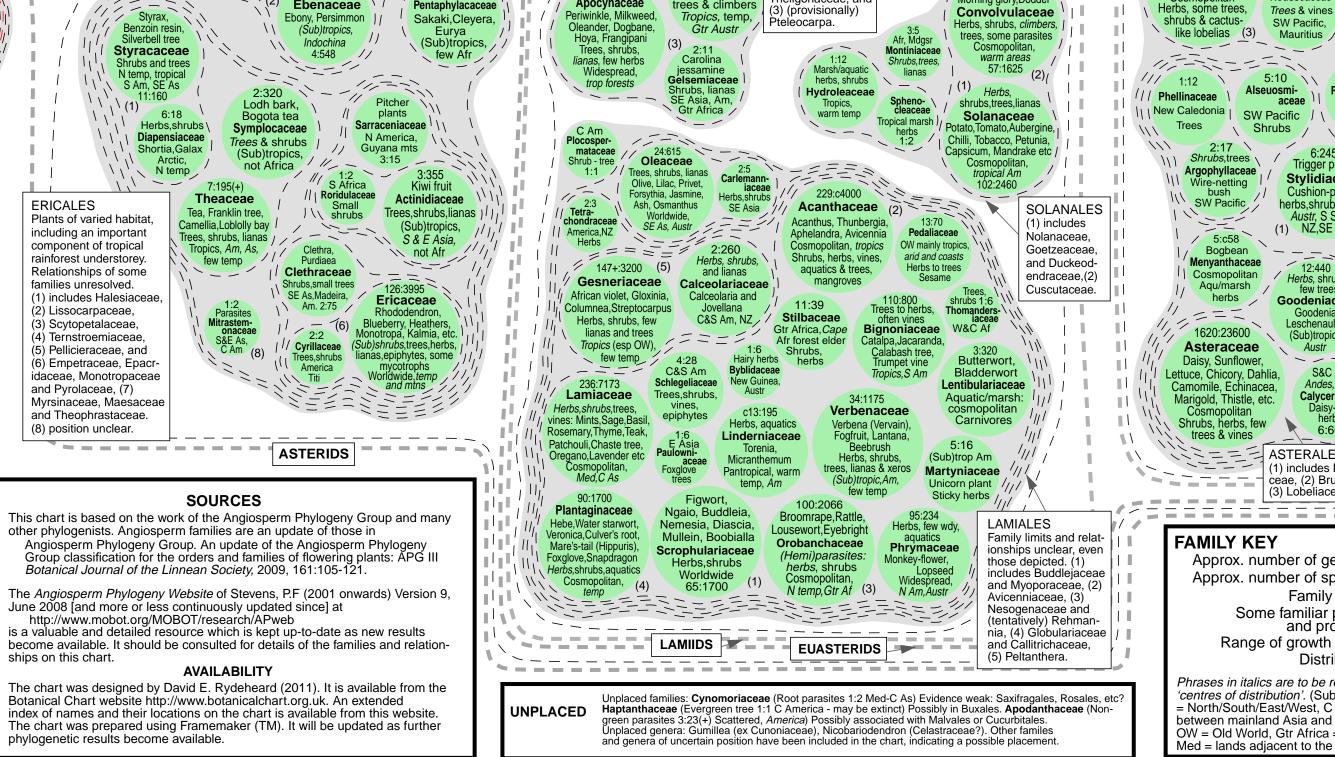


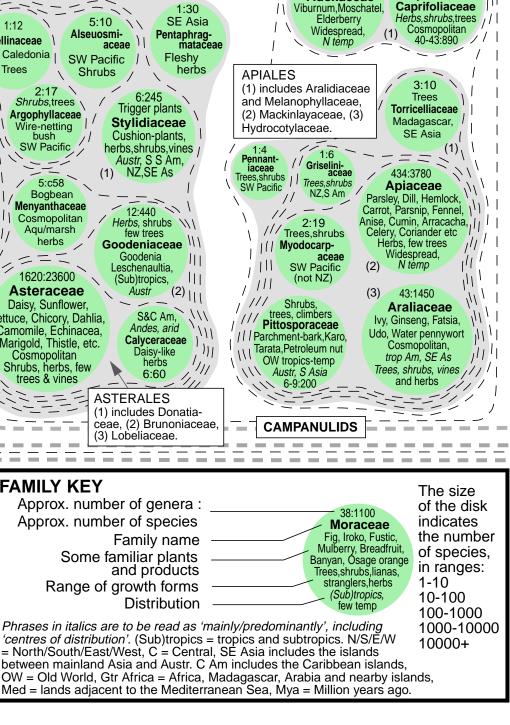
## **INTERPRETING THE CHART**

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(cho)tomy'), 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, or vernacular, names are used to describe some familiar plants and plant products. These names can, in some cases, be 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 100km<sup>2</sup> 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 subtropics but also include isolated Gondwanaland fragments and areas of high diversity in the northern temperate zone.





C&S Am C&F Asia

Austr. NZ.

11

5:200

shrubs and trees

Adoxaceae

rnum.Mosch

Scabious,

/eigela.Valeria

Honeysuckle, Abelia