Campanulidae M. J. Donoghue and P. D. Cantino in P. D. Cantino et al. (2007): 837 [M. J. Donoghue and P. D. Cantino], converted clade name

Registration Number: 248

Definition: The largest crown clade containing *Campanula latifolia* Linnaeus 1753 (*Asterales*) but not *Lamium purpureum* Linnaeus 1753 (*Lamiidae/Lamiales*) and *Cornus mas* Linnaeus 1753 (*Cornales*) and *Erica carnea* Linnaeus 1753 (*Ericales/Ericaceae*). This is a maximum-crown-clade definition. Abbreviated definition: max crown ∇ (*Campanula latifolia* Linnaeus 1753 ~ *Lamium purpureum* Linnaeus 1753 & *Cornus mas* Linnaeus 1753 & *Erica carnea* Linnaeus 1753).

Etymology: Derived from *Campanula* (name of an included taxon), which is Latin for "little bell" (Gledhill, 1989).

Reference Phylogeny: The primary reference phylogeny is Soltis et al. (2011: Figs. 1, 2e–g). See also Soltis et al. (2000: Figs. 1, 12), Kårehed (2001: Figs. 1, 2), Bremer et al. (2002: Fig. 1), Winkworth et al. (2008: Fig. 1), and Tank and Donoghue (2010: Figs. 1, 3).

Composition: *Apiidae* (this volume) and probably *Aquifoliales* sensu APG II (2003). There is a slight possibility that some or all of the taxa that are currently included in *Aquifoliales* are not part of *Campanulidae* (see Comments).

Diagnostic Apomorphies: We know of no unambiguous non-molecular synapomorphies. Stevens (2011) cited several characters for this clade, including vessel elements with scalariform perforations, small flowers, short styles, copious endosperm, and short embryos. Several of these characters are poorly sampled; others are ill-defined or highly variable both within and outside of this clade (e.g., flower size, style length). Erbar and Leins (1996) showed that "early sympetaly" is largely restricted to this clade, but its correlation with inferior ovary and reduced calyx should be explored further (Endress, 2001), and its placement on the tree remains uncertain. For example, it may be an apomorphy of the less inclusive clade *Apiidae* (defined in this volume), as suggested by Stevens (2011).

Synonyms: The informal names "asterid II", "euasterid(s) II", and "campanulids" are approximate synonyms (see Comments).

Comments: Until we published the name *Campanulidae* (Cantino et al., 2007), there was no preexisting scientific name for this clade, which is strongly supported in molecular analyses (Soltis et al., 2000; Bremer et al., 2002; Tank and Donoghue, 2010; Soltis et al., 2011) and in an analysis that combined molecular and morphological data (Kårehed, 2001). It has been referred to informally as "asterid II" (Chase et al., 1993), "euasterid(s) II" (APG, 1998; Olmstead et al., 2000; Savolainen et al., 2000; Soltis et al., 2000; Albach et al., 2001a,b; Lundberg, 2001; Judd et al., 2002; APG II, 2003), and "campanulids" (Bremer et al., 2002; Judd and Olmstead, 2004; APG III, 2009). The definition used here differs slightly from our earlier one (Cantino et al., 2007) in that we no longer use *Garrya elliptica* as an external specifier. With 100% boostrap support for the grouping of *Garryales* with the rest of *Lamiidae* (Soltis et al., 2011), there is no longer any need to include two external specifiers representing *Lamiidae*.

There is a slight possibility that *Ilex* (*Aquifoliaceae*) is a member of *Lamiidae* (as defined in this volume), rather than being closely related to *Apiidae* (this volume) as in the reference phylogeny. *Ilex* was linked with *Lamiidae* in an analysis of *RPB2* duplications (Oxelman et al., 2004) and in an analysis of *matK* sequences (Hilu et al., 2003). Because these studies did not include any members of *Helwingia*, *Phyllonoma*, *Cardiopteridaceae* or *Stemonuraceae*, which have been linked strongly with *Ilex* (Kårehed, 2001; Bremer et al., 2002; Tank and Donoghue, 2010; Soltis et al., 2011) in *Aquifoliales*, these taxa presumably could also be related to *Lamiidae*. Our definition of *Campanulidae* is designed to include *Ilex* and these relatives (*Aquifoliales*) if they are more closely related to *Apiidae* than to *Lamiidae* and to exclude them if that is not the case. If *Ilex* and its relatives were to be found to be more closely related to *Lamiidae* than to *Apiidae*, then *Campanulidae* and *Apiidae* would become synonyms. As we stated previously (Cantino et al., 2007), it is our intent that *Campanulidae* have precedence over *Apiidae* in the unlikely event that both names refer to the same clade.

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Apiidae M. J. Donoghue and P. D. Cantino in P. D. Cantino et al. (2007): E31 [M. J. Donoghue and P. D. Cantino], converted clade name

Registration Number: 247

Definition: The largest crown clade containing *Apium graveolens* Linnaeus 1753 (*Apiales*), *Helianthus annuus* Linnaeus 1753 (*Asterales*), and *Dipsacus sativus* (Linnaeus) Honckeny 1782 (originally described as *Dipsacus fullonum* var. *sativus* Linnaeus 1763) (*Dipsacales*), but not *Ilex crenata* Thunberg 1784 (*Aquifoliales*) or *Lamium purpureum* Linnaeus 1753 (*Lamiidae*). This is a maximum-crown-clade definition with multiple internal and external specifiers. Abbreviated definition: max crown ∇ (*Apium graveolens* Linnaeus 1753 & *Helianthus annuus* Linnaeus 1753 & *Dipsacus sativus* (Linnaeus) Honckeny 1782 ~ *Ilex crenata* Thunberg 1784 v *Lamium purpureum* Linnaeus 1753).

Etymology: Derived from *Apium*, the name of a subclade to which celery belongs and a name used by Pliny "for a celery-like plant" (Gledhill, 1989).

Reference Phylogeny: The primary reference phylogeny is Soltis et al. (2011: Figs. 1, 2e–g). See also Soltis et al. (2000: Figs. 1, 12), Kårehed (2001: Figs. 1, 2), Bremer et al. (2002: Fig. 1), Winkworth et al. (2008: Fig. 1), and Tank and Donoghue (2010: Figs. 1, 3).

Composition: The clade *Apiidae* includes three major subclades (*Apiales*, *Asterales* and *Dispsacales*) and three smaller ones (*Escalloniaceae*, *Paracryphiaceae* and *Bruniales*) (all taxa sensu Tank and Donoghue, 2010).

Diagnostic Apomorphies: There are no clear non-molecular synapomorphies. Possible synapomorphies cited by Stevens (2011) include early sympetaly (see Erbar and Liens, 1996; Leins and Erbar, 2003), a gynoecium of two or three carpels, and an inferior ovary. In addition, polyacetylenes are mentioned by Judd and Olmstead (2004). However, corolla tube development and polyacetylenes are still poorly sampled, and the gynoecial characters are widespread in *Asteridae* and may thus be plesiomorphic. A noteworthy tendency within *Apiidae* is the aggregation of small flowers into more conspicuous, head-like or umbellate inflorescences.

Synonyms: None.

Comments: Traditionally, the taxon *Apiales* was considered distantly related to *Asterales* and *Dipsacales*, and even to *Asteridae* (e.g., Cronquist, 1981, placed *Apiales* in *Rosidae*). However, recent analyses based on molecular data have indicated that *Apiales* (and several smaller taxa; see Composition) are closely related to *Asterales* and *Dipsacales*. To highlight the relationship of *Apiales* to *Asterales* and *Dipsacales*, Cantino et al. (2007) proposed the name *Apiidae* for a clade composed primarily of these three taxa.

Although the monophyly of *Apiidae* has very strong molecular support (Olmstead et al., 2000; Soltis et al., 2000; Albach et al., 2001; Lundberg, 2001; Bremer et al., 2002; Hilu et al., 2003; Tank and Donoghue, 2010; Soltis et al., 2011), basal relationships remain somewhat uncertain, and a minimum-clade definition would consequently require a long list of internal specifiers. We therefore prefer a maximum-crown-clade definition with two external specifiers. Two additional external specifiers that we used in our earlier, otherwise-similar definition (Cantino et al., 2007)—*Cardiopteris quinqueloba* and

Garrya elliptica—are excluded here because recent analyses (Tank and Donoghue, 2010; Soltis et al., 2011) have clarified their positions. Specifically, there is now strong support for the monophyly of *Aquifoliales*, eliminating the need to represent this clade by two external specifiers (*Ilex* and *Cardiopteris*). Similarly, the 100% boostrap support for the inclusion of *Garryales* within *Lamiidae* (Soltis et al., 2011) has eliminated the need to include species of both *Garrya* and *Lamium* as external specifiers.

A maximum-crown-clade definition normally has only one internal specifier, but three are used here to render the name inapplicable to any clade in the context of certain phylogenies. In the unlikely event that *Apiales*, *Asterales* and *Dipsacales* turn out not to be closely related, the name *Apiidae* may not apply to any clade.

Under any phylogenetic hypothesis in which *Campanulidae* and *Apiidae* are synonyms, we intend *Campanulidae* to have precedence; see *Campanulidae* (this volume).

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