TABLE S1.Description of fossils used in the calibrations and justification for their placement.

Order	Clade number (Table 1)	Justification for selection and placement.
Nympheales	A	The *Pluricarpellatia peltata* fossil from the Lower Cretaceous Crao Formation of northeastern Brazil was first described by Mohr et al. (Mohr et al. 2008). It is based on "several nearly complete specimens with roots, cordate, excentrically peltate to centrally peltate leaves, and flowering structures with in situ seeds". The fossil shows similarities to Cabombaceae including an apocarpous gynoecium, but differs in carpel morphology from the latter. Therefore Mohr et al. considered it to represent "an extinct member of the Nymphaeales, most likely branching off early in this lineage." This statement is supported by their cladistic analysis, indicating either a position of *Pluricarpellatia* as stem taxon in living Cabombaceae or as sister to Nymphaeales depending on the coding of the leaf type. We use it to calibrate the split between Hydatellaceae and Cabombaceae with an age of 118.5 mya.

	B	*Monetianthus mirus* is a fossil flower from the from the Vale de Agua locality Portugal (Barremian-Aptian) described by Friis et al. (2001). The single specimen is a structurally preserved coalified fossil flower reported to be radially symmetrical, perigynous and apparently bisexual. Friis et al. (2001) considered it to be related to Nymphaeaceae and a parsimony analysis within a reduced data set of extant Nympheales supports a position as sister to all extant Nymphaeaceae. The fossil was later named as *Monetianthus mirus* (Friis et al. 2009). Additional organizational features of the fossil, particularly on placentation, ovule number, and ovule size revealed by synchrotron radiation x-ray tomographic microscopy (SRXTM) revealed a strongly supported relationship to Nymphaeaceae. The age of the sediments of the Vale de Agua locality were reported as probable Late Aptian or Early Albian age (Friis et al. 2009). We therefore include *Monetianthus mirus* as a calibration point for the split between Nymphaeaceae and Cabombaceae with a minimum age of 106 mya and a mean age of 113 mya.
	C	*Microvictoria svitkoana* is a Turonian carbonized fossil flower collected at the Raritan Formation in New Jersey, U. S. A. first described by Gandolfo et al. (2004). The authors place the fossil, supported by a cladistic analysis, either as sister to *Victoria* or as sister to a clade of *Victoria* and *Euryale.* We therefore applied an age of 90 mya to calibrate the split between *Nymphaea* and the clade of *Victoria* and *Euryale*.

Austrobaileyales	D	*Anacostia* sp. is described by Friis et al. (1997) based on dispersed charcoalified or compressed fruitlets. The genus *Anacostia* comprises four species: *Anacostia marylandensis* and *Anacostia virginiensis* from the Patapsco Formation stratum (Potomac Group, Puddledock locality, U. S. A.) and therefore Early Cretaceous, most probably early or middle Albian age. As well as *Anacostia portugallica* and *Anacostia teixeirae* both found within the "Complexos gresosos de Nazaré e de Cos-Juncal" strata (Vale de Agua, Famalicão and Buarcos locality, Portugal) and therefore of Early Cretaceous, possibly Aptian age. In a phylogenetic analysis (Doyle et al. 2008) *Anacostia* was placed either as sister to *Illicium* and Schisandraceae s. s. or to Schisandraceae alone. A fossilized *Trimenia* seed from the early to late Albian Hikagenosawa Formation of the Yezo Group is described by Yamada et al. (Yamada et al. 2008). It is characterized by a remarkable high number of similarities to extant *Trimenia* seeds: "The fossil seed is not distinguishable from that of extant Trimenia in terms of shape, size, anatropy, bitegmy, endo and exostomic micropyle, crushed inner integument with an operculum, lignified multilayered exotesta composed of isodiametric cells, alveolate surface of the exotesta, or nonlignified multilayered mesotesta". Therefore the authors conclude: "Thus, to our knowledge, no other seeds can be compared to the fossil seed". We used 101.5 mya to calibrate the split between Trimeniaceae and Schisandraceae.
Chloranthales	E	*Asteropollis asteroides* (Walker and Walker 1984) is a Barremian-Aptian fossil pollen closely related to extant *Hedyosmum* and therefore the oldest record of Chloranthaceae (Friis et al. 2010). Morphological cladistic analysis indicated that *Asteropollis* can be assigned either as stem or crown of extant *Hedyosmum* (Doyle et al. 2003). However recent analyses suggest that the stem position of *Asteropollis* is more likely (Zhang et al. 2011) which we adopted with an age of 125 mya for Chloranthales.

	F, f	*Chloranthistemon* (Crane et al. 1989) fossils comprise Turonian flowers, fragments of inflorescences and pollen (Friis et al. 1994, 1999). Detailed morphological cladistic analysis suggest that *Chloranthistemon* is to be placed on the stem of extant *Chloranthus* (Doyle et al. 2003; Eklund et al. 2004). However, a previous molecular dating analysis suggests that it probably occurred before the *Chloranthus-Sarcandra* divergence (Zhang et al. 2011). We therefore test two possible positions within the cross calibration. First as stem of extant *Chloranthus* and second as split between *Ascarina* and the *Chloranthus-Sarcandra*. Cross validation gave a lower discrepancy for its position as stem age for *Chloranthus*.
Canellales	G	*Walkeripollis* was described as winteraceous pollen from the Early Cretaceous of Israel by Walker et al. (1983). Doyle et al. (1990a) assigned tetrad Walkeripollis gabonensis pollen from the Barremian/ Aptian of Gabon to the genus *Walkeripollis* (Doyle et al. 1990a, b). Both taxa, *Walkeripollis*. sp. A (Walker et al. 1983) and *W. gabonensis* Doyle et al. 1990a), differ from modern Winteraceae pollen by possessing calymmate instead of acalymmate tetrads (Van der Ham and van Heuven 2002). Nonetheless Doyle and Endress (2010) verified a sister group relationship between Winteraceae and Walkeripollis (Doyle and Endress 2010) through cladistic analyses and therefore the fossil most likely represents a stem lineage to Winteraceae. We used *Walkeripollis gabonensis* as a constraint for the stem age of Winteraceae applying a minimum age of 127.5 mya.
Piperales	H	*Lactoripollenites africanus* is the oldest unambiguously identified Lactoridaceae fossil. It is described by Zavada and Benson (1987) based on Turonian/Campanian pollen from the Orange Basin of South Africa. The pollen is characterized by its occurrence as tetrads with an ornament and saccus organization identical to the extant *Lactoris fernandeziana*, today endemic to Juan Fernandez Islands. We used *Lactoripollenites africanus* to constrain the stem age of Lactoridaceae employing a minimum age of 92 mya.

	I	*Saururus tuckerae* (Smith and Stockey 2007) is described based on a single inflorescence and numerous flowers and pollen out of the Middle Eocene Princeton Group of British Columbia (Smith and Stockey 2007). To date, it is the only unambiguously determined Saururaceae fossil record of mid Eocene age and could especially be assigned due to pollen features. The single most parsimonious tree in a morphological cladistic analysis of Piperales revealed the fossil as sister to extant *Saururus*. We applied a minimum age constraint of 48.5 mya for the node connecting *Gymnotheca* and *Saururus* following (Symmank et al. 2011).
Magnoliales	J	*Endressinia brasiliana* was described as “a branching axis with attached simple, narrowly ovate leaves and several terminal small flowers” from the Late Aptian–Early Albian Brazilian Crato Formation (Mohr and Bernardes-de-Oliveira 2004). It is possible the earliest flower of Magnoliales with similarities to extant Eupomatiaceae and Himantandraceae, but cannot be unambiguously assigned to any extant family (Friis et al. 2010, 2011). This is also supported by a cladistic analysis showing a relationship to a clade consisting of *Degeneria*, *Galbulimima*, *Eupomatia,* and Annonaceae (Doyle and Endress 2010). We used *Endressinia brasiliana* as a constraint for the minimum age of Magnoliales.

	K	*Archaeanthus linnenbergeri* is described as a multifollicular angiosperm fruit from the uppermost Albian-mid Cenomanian Dakota Formation of central Kansas (Dilcher and Crane 1984). The authors view it as a “basal magnoliid flower” with no further affiliation to extant taxa. Recently *Archaeanthus* was incorporated in a morphological cladistics analysis and unambiguously revealed a close relative to Magnoliaceae (Doyle and Endress 2010). The three most parsimonious positions are either as sister to Magnoliaceae as a whole or within the crown group as sister to either *Liriodendron* or Magnolioideae. The authors conclude that *Archeanthus* can be used for molecular dating as a stem group relative of Magnoliaceae “specifically, it provides a minimum age of latest Albian (ca. 100 MYA) for the node connecting Magnoliaceae with Degeneria, Galbulimima, Eupomatia, and Annonaceae”. We therefore employed a calibration age of 100 mya to this node.
	L	*Liriodendroidea* species. Knobloch & Mai is an extinct genus with affinity to extant *Liriodendron* L. described on the basis of fruits and seeds. The earliest report is *L. alata* Frumin & Friis from the Cenomanian-Turonian of Kazakhtan (Frumin 1996). It was also found in the Late Cretaceous of Germany (*L. germanica* and *L. protogea* (Knobloch and Mai 1986)) and in the Santonian-Campanian of North Carolina (*L. latirapha* Frumin & Friis, *L. occidentalis* Frumin & Friis) (Frumin 1996). The genus shows a high similarity to extant *Liriodendron* L. We applied the age of 93.5 mya to the split between *Liriodendron* and *Magnolia* and therefore as crown group age of Magnoliaceae.

	M	*Futabanthus asamigawaensis* is of early Coniacian to Late Cretaceous age and was described on the basis of a single fossil flower from the Kamikitaba locality in the Ashizawa Formation, Futaba Group of northeastern Honshu, Japan (Takahashi et al. 2008). The multipartite construction of the fossil flower, combined with the form of the stamens caused the authors to conclude that *Futabanthus* is the earliest record of the family Annonaceae. *Futabanthus* has been used for molecular dating analyses setting the date to 89 mya for the split between *Anaxagorea* and the remaining Annonaceae (Su and Saunders 2009). We adopted this position with 88.5 mya as the crown age of Annonaceae.
Laurales	N	*Virginianthus calycanthoides* was originally described as an Early or Middle Albian fossil flower from the Puddledock locality in the Patapsco Formation, Virginia and assigned to Calycanthaceae including *Ideospermum* (Friis et al. 1994). It was included in two morphological phylogenetic analyses, which support the position as stem Calycanthaceae or Laurales (Doyle et al. 2008; Doyle and Endress 2010). The authors conclude that *Virginianthus* can therefore serve as a minimum age constrain for the crown group Laurales, a position that was also applied by Crepet et al. (2004). In our study we used a minimum age constraint of 110 mya for the crown group of Laurales.

	O	*Jerseyanthus calycanthoides* is described from the Late Cretaceous (Turonian) Raritan Formation of New Jersey (Crepet et al. 2005). The fossil evidence consists of fossil flowers, pollen and a single seed, depicting phenotypic similarity to extant Calycanthaceae and especially to *Calycanthus*. The authors place the taxa as sister to *Calycanthus* and also state that *Jerseyanthus* is unambiguously more similar to modern genera and differs in several characters from more basal *Ideospermum* and *Sinocalycanthus*. Furthermore they included *Jerseyanthus* in a phylogenetic analysis previously done by Renner (1999), which supports the position as sister to *Calycanthus* as the most parsimonious position, (Crepet et al. 2005). We thus included *Jerseyanthus* as a minimum age constraint of 91.5 mya for the crown group constraint of *Chimonanthus* and *Calycanthus* including *Sinocalycanthus*.
	P	*Potomacanthus lobatus* is described based on a single charcoalified bisexual flower from the Puddledock locality in Prince George County, Virginia (von Balthazar et al. 2007). A character state reconstruction based on Bayesian analyses of *trnK* intron data from extant taxa and morphological data from both extant and fossil species. The overall morphology revealed a relationship to extant Lauraceae. Nevertheless *Potomacanthus* differs in details of the androecium and therefore an exact placement within the Lauraceae is difficult. Von Balthazar et al. (von Balthazar et al. 2007) conclude that the fossil most likely represents an extinct linage within or along the stem of Lauraceae. This position is also supported by Taylor (Taylor 2009) who mentioned that it might be the earliest evidence for Lauraceae. Conservatively we used an age of 103 mya for the stem of Lauraceae.

Monocots	Q	*Mayoa portugallica* consists of Cretaceous (Barremian-Aptian) fossil pollen of Torres Vedras, Portugal that was first described by Friis et al. (Friis et al. 2004). It is assigned to the tribe Spathiphylleae within the subfamily Monsteroideae. It has a striking similarity to extant *Holochlamys*, but the authors refrain from assigning it to this clade, because of the lack of other material. We use it as a calibration point for the stem group Alismatales with an age of 125 mya.
Eudicots	R	A determining attribute of eudicots in the context of angiosperm evolution is the appearance of tricolpate pollen. Records of tricolpate pollen are from the late Barremian to Early Aptian of different locations (Friis et al. 2010). The oldest one is a single grain of late Barremian age from southern England (Hughes and McDougall 1990). Tricolpate fossil pollen was also found in Israel (Brenner 1996), Egypt (Penny 1988), Equatorial Africa and North America (Doyle 1992) of similar age. We used the age of 125 mya to calibrate the eudicot crown group, which was also applied by (Magallon and Castillo 2009; Magallon 2010).
	S	*Teixeiraea lusitanica* is the oldest undoubtedly Ranunculales fossil record so far. It is described from a single staminate flower from the Vale de Agua flora (Late Aptian–Early Albian) (von Balthazar et al. 2005). We therefore employed a minimum age constrain of 112 mya for the crown group of Ranunculales.
	T	The earliest records of *Nelumbites* is described from the mid Albian of Quantico locality, Virginia, comprising mainly fossilized leaves (Upchurch 1994) and from the mid Albian of Kazakhstan based on foliage, receptacle and fruit (Vakhrameev 1952). *Nelumbites* is considered to be distinct from extant *Nelumbo*, but it shows enough similarity to support an affinity to Nelumbonaceae (Upchurch 1994; Friis et al. 2011). This is also supported by cladistic analyses with the most parsimonious positions as sister to *Nelumbo*. We thus used it as constrain for the stem group of Nelumbonaceae (106 mya). The same date was also used by (Anderson et al. 2005) in a basal eudicot study.

	U	*Platanocarpus brookensis,* was described by Crane et al. (1993) as one of the first records of the platanoid group with an early-middle Albian origin from the Potomac Group of eastern North America. *P. brookensis* consists of inflorescence axis with sessile inflorescences and infructescences. The fossil is evidence for the occurrence of Platanaceae stem relatives in the early to middle Albian and we therefore used a minimum age constraint of 110 mya for the stem group of Platanaceae.

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