Article title: Extending beyond Gondwana: Cretaceous Cunoniaceae from western North America

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Fig. S1 "Fan" shaped phyloscan tree for *Ceratopetalum suciensis* shows most parsimonious positions indicated by the black branches on the tree. Most parsimonious positions +1 are indicated by the green branches while a gradient from yellow to gray show subsequent parsimonious positions. The bar graph on the left shows the numbers of steps and color gradients of the most parsimonious positions. To get a better view of the results, the phyloscan output will need to be viewed at a greater magnification on a pdf reader (see separate file).

Fig. S2 "Long" shaped phyloscan tree for *Ceratopetalum suciensis* shows most parsimonious positions indicated by the black branches on the tree. Most parsimonious positions +1 are indicated by the green branches while a gradient from yellow to gray show subsequent parsimonious positions. The bar graph on the left shows the numbers of steps and color gradients of the most parsimonious positions. To get a better view of the results, the phyloscan output will need to be viewed at a greater magnification on a pdf reader (see separate file).

Fig. S3 "Fan" shaped phyloscan output for *Tropidogyne pentaptera* shows most parsimonious positions indicated by the black branches on the tree. Most parsimonious positions +1 are indicated by the green branches while a gradient from yellow to gray show subsequent parsimonious positions. The bar graph on the left shows the numbers of steps and color gradients of the most parsimonious positions. To get a better view of the results, the phyloscan output will need to be viewed at a greater magnification on a pdf reader (see separate file)..

Fig. S4 "Long" shaped phyloscan output for *Tropidogyne pentaptera* shows most parsimonious positions indicated by the black branches on the tree. Most parsimonious positions +1 are indicated by the green branches while a gradient from yellow to gray show subsequent parsimonious positions. The bar graph on the left shows the numbers of steps and color gradients

of the most parsimonious positions. To get a better view of the results, the phyloscan output will need to be viewed at a greater magnification on a pdf reader (see separate file)..

Fig. S5 "Fan" shaped phyloscan output for *Platydiscus peltatus* shows most parsimonious positions indicated by the black branches on the tree. Most parsimonious positions +1 are indicated by the green branches while a gradient from yellow to gray show subsequent parsimonious positions. The bar graph on the left shows the numbers of steps and color gradients of the most parsimonious positions. To get a better view of the results, the phyloscan output will need to be viewed at a greater magnification on a pdf reader (see separate file)..

Fig. S6 "Long" shaped phyloscan output for *Platydiscus peltatus* shows most parsimonious positions indicated by the black branches on the tree. Most parsimonious positions +1 are indicated by the green branches while a gradient from yellow to gray show subsequent parsimonious positions. The bar graph on the left shows the numbers of steps and color gradients of the most parsimonious positions. To get a better view of the results, the phyloscan output will need to be viewed at a greater magnification on a pdf reader (see separate file)..

Table S1 Living *Ceratopetalum* fruits that were µCT scanned and segmented for morphological comparison.

SPECIES	COLLECTOR	HERBARIUM	ACCESSION #
C. succirubrum	Schodde 2178	L.H. Bailey Hortorium	BH 95696
C. succirubrum	T.G. Hartley 10967	Harvard University Gray Herbarium	A00969699
C. succirubrum	B. Hyland 10185	Harvard University Gray Herbarium	A00969700
C. apetalum	F.A. Rodway 2668	Harvard University Gray Herbarium	A00969698
C. corymbosum	T.G. Hartley 14046	Harvard University Gray Herbarium	A00969697
C. gummiferum	R. Coveny 11751	Harvard University Gray Herbarium	A00969696
C. virchowii	R. Booth 2772	Harvard University Gray Herbarium	A00969701

Table S2 Scan parameters for extant *Ceratopetalum* fruits.

Species	**Collector**	**KV**	**Current (µA)**	**Effective pixel size (µm)**	**Filter**
C. succirubrum	Schodde 2178	78	87	6.81	None
C. succirubrum	T.G. Hartley 10967	92	130	12.03	None
C. succirubrum	B. Hyland 10185	92	130	12.03	None
C. apetalum	F.A. Rodway 2668	85	125	10.67	None
C. corymbosum	T.G. Hartley 14046	85	125	10.67	None
C. gummiferum	R. Coveny 11751	85	125	10.7	None
C. virchowii	R. Booth 2772	94	101	10.05	None

Table S3 GenBank accession numbers for *rbcL* and *trnL* sequences used in the phylogenetic analyses.

Family	**Species**	***rbcL***	***trnL c-d* (intron)**	***trnL e-F***
Brunelliaceae	*Brunellia colombiana*	AF291937.1	AF299181.1	AF299234.1
Brunelliaceae	*Brunellia oliveri*	AF291938.1	AF299182.1	AF299235.1
Cunoniaceae	*Ackama paniculosa*	AF291921.1	AF299161.1	AF299214.1
Cunoniaceae	*Ackama rosifolia*	-	AF299162.1	AF299215.1
Cunoniaceae	*Acrophyllum australe*	AF291926.1	AF299168.1	AF299221.1
Cunoniaceae	*Anodopetalum biglandulosum*	AF291932.1	AF299175.1	AF299228.1
Cunoniaceae	*Bauera rubioides*	L11174.2	AF299183.1	AF299236.1
Cunoniaceae	*Bauera sessiliflora*	-	AF299184.1	AF299237.1
Cunoniaceae	*Caldcluvia paniculata*	AF291922.1	AF299163.1	AF299216.1
Cunoniaceae	*Callicoma serratifolia*	AF291928.1	AF299170.1	AF299223.1
Cunoniaceae	*Ceratopetalum apetalum*	KM895900.1	-	-
Cunoniaceae	*Ceratopetalum gummiferum*	L01895.1	AF299176.1	AF299229.1
Cunoniaceae	*Codia discolor*	AF291929.1	AF299171.1	AF299224.1
Cunoniaceae	*Cunonia atrorubens*	AF291918.1	AF299154.1	AF299207.1
Cunoniaceae	*Cunonia capensis*	-	AF299156.1	AF299209.1
Cunoniaceae	*Davidsonia jerseyana*	-	AF299185.1	AF299238.1

Cunoniaceae	*Davidsonia johnsonii*	-	AF299186.1	AF299239.1
Cunoniaceae	*Davidsonia pruriens*	AF291934.2	-	-
Cunoniaceae	*Eucryphia cordifolia*	AF291931.1	AF299173.1	AF299226.1
Cunoniaceae	*Eucryphia lucida*	L01918.2	-	-
Cunoniaceae	*Eucryphia moorei*	-	AF299174.1	AF299227.1
Cunoniaceae	*Geissois superba*	-	AF299166.1	AF299219.1
Cunoniaceae	*Gillbeea adenopetala*	AF291927.1	AF299169.1	AF299222.1
Cunoniaceae	*Hooglandia ignambiensis*	AY549641.1	AY549639.1	AY549640.1
Cunoniaceae	*Pancheria engleriana*	-	AF299158.1	AF299211.1
Cunoniaceae	*Platylophus trifoliatus*	AF291933.1	AF299177.1	AF299230.1
Cunoniaceae	*Pseudoweinmannia lachnocarpa*	AF291925.1	AF299167.1	AF299220.1
Cunoniaceae	*Pullea glabra*	AF291930.1	AF299172.1	AF299225.1
Cunoniaceae	*Schizomeria ovata*	-	AF299178.1	AF299231.1
Cunoniaceae	*Schizomeria serrata*	JX236031.1	-	JX236028.1
Cunoniaceae	*Spiraeanthemum ellipticum*	AF291935.1	AF299179.1	AF299232.1
Cunoniaceae	*Spiraeanthemum samoense*	AF291936.1	AF299180.1	AF299233.1
Cunoniaceae	*Spiraeopsis celebica*	AF291923.1	AF299164.1	AF299217.1

Cunoniaceae	*Vesselowskya rubifolia*	AF291920.1	AF299160.1	AF299213.1
Cunoniaceae	*Weinmannia bangii*	AF291915.1	AF299145.1	AF299198.1
Cunoniaceae	*Weinmannia fraxinea*	-	AF299149.1	AF299202.1
Cunoniaceae	*Weinmannia madagascariensis*	AF291916.1	AF299152.1	AF299205.1
Cunoniaceae	*Weinmannia minutiflora*	-	AF299150.1	AF299203.1

Table S4 Augmented data table from Gandolfo and Hermsen (2017) for fossil species of *Ceratopetalum*. Additional data was collected from Holmes and Holmes (1992) and Barnes and Hill (1999).

Wing length (mm)	Wing width (mm)	Primary veins	Secondary veins	Petals	Nectary disk	Ovary diameter (mm)	Stamens on fruit	Age
7-10	**3-4**	4	**Diverge throughout wing**	Present	**Present**	**3-5**	Absent	Middle Miocene
6-9	1.8-2.2	3	**Diverge throughout wing**	**Absent**	Absent?	1-1.2	**Present**	Early - Late Miocene
5-5.5	~1.5-2	3	Diverge at distal half	**Absent**	Absent?	~2.1	Absent	Middle Eocene
~10	**4-5.5**	4	**Diverge throughout wing**	Present	**Present**	6.5	Absent	Late Eocene – Early Oligocene
10	2-4	3	Diverge at distal half	**Absent**	**Present**	**4-5**	Absent	Ypresian (Early Eocene)
11	**3-4**	**5**	**Diverge throughout wing**	**Absent**	**Present**	**3.62-4**	**Present**	**Campanian (Late Cretaceous)**

Species	No. of wings	Wing shape	Wing apex	Wing base
C. priscum	**5**	Narrow oblong	Obtuse	Not constricted
C. westermannii	**5**	Narrow obovate	Rounded	Not constricted
C. maslinensis	**5**-6	Narrow oblong	**Acute** to obtuse	Not constricted
C. wilkinsonii	**5**	Ovate to **elliptical**	Obtuse	Not constricted
C. edgardoromeroi	**5**	Narrow obovate	Rounded	**Constricted gradually**
C. suciensis	**4-5**	**Elliptic**	**Acute**	**Attenuate (gradual constriction)**

Table S1 Augmented data table from Gandolfo and Hermsen (2017) for extant species of *Ceratopetalum.* Additional data was collected from Rozefelds and Barnes (2002).

Primary veins	Petals	Disk height	Ovary diameter (mm)	No. of styles	Style branch length (mm)	Stamens on fruit	Stamen filament length (mm)
3	Present	~0.7	**3.4-4.8**	**2-3**	~1.5	**Present**	2.6-3.0
3	**Absent**	**0.4-0.5**	**3-4.4**	**2-3**	~1.5	**Present**	~2
3	**Absent**	**~0.4**	?	**2-3**	~1.5	?	**1.8-2.3**
3	**Absent**	**0.3-0.4**	**3.6-4**	**2**	0.6-1.0	**Present**	1.9
Many (>5)	**Absent**	**~0.4**	**3.6-4.2**	**2**	~1.5	**Present**	**0.6-1.4**
Many (>5)	**Absent**	**~0.6**	6.1-7.3	**2-3**	~1.5	**Present**	**1.5-2.3**
3	**Absent**	**~0.4**	6-8	**2**	~1.6	**Present**	**1.5**
3	**Absent**	**~0.4**	?	**2**	~1.5	**Present**	**~1.5**
3	**Absent**	0.04-0.08	5.4-5.9	**2**	1.1-2.1	**Present**	**1.5-3.0**
5	**Absent**	**0.38-0.60**	**3.62-4**	**2**	**2.47**	**Present**	**1.21-1.89**

	No. of wings	Wing shape	Wing apex	Wing base	Wing length (mm)	Wing width (mm)
C. gummiferum	**4**-6	Narrowly to broadly obovate	**Acute**	Not constricted	**9.8-16.1**	**2.7-6.7**
C. apetalum	**4**-6	Obovate to ovate	**Acute**	Slightly constricted	6.3-8.9	**2.1-4.3**
C. corymbosum	**4**-6	Obovate to ovate	**Acute**	Slightly constricted	At least 7	?
C. hylandii	**4**	Narrowly obovate to lanceolate	**Acute** to obtuse	Slightly constricted	**6.6-11.2**	2.2-3
C, succirubrum	**4**-5	**Elliptical** to obovate	**Acute**	Slightly constricted	**8.3-12.6**	2.4-4.1
C. virchowii	**4**-6	Obovate to lanceolate	**Acute**	Slightly constricted	11.5-13.5	**3.4-4.9**
C. tetrapterum	**4**	Ovate to obovate	**Acute**	Slightly constricted	**8.8-17**	**3.8-5.1**
C. iugumensis	**4**	Narrowly to broadly obovate	**Acute**	Not constricted	4.8-5	4.8-5
C. macrophyllum	**4-5**	Obovate to lanceolate	**Acute**	Constricted	**10-13**	**3.2-4.5**
C. suciensis	**4-5**	**Elliptic**	**Acute**	**Attenuate (gradual constriction)**	**11**	**~3-4**

Methods S1

Phyloscan scorings justifications

The floral characters for *Ceratopetalum gummiferum* were scored based on observations of the µCT scanned specimen and data from literature (Dickison, 1975; Dickison 1984; Rozefelds & Barnes, 2002; Bradford *et al*., 2004). Number of perianth parts, stamens, and carpels can vary as *C. gummiferum* can have up to six calyx lobes present. Individuals with six calyx lobes will have six petals, twelve stamens, and three carpels present. However, these individuals are rare within the species and genus (Rozefelds & Barnes, 2002) so this variation was not scored within the phyloscan. Instead, *C. gummiferum* was scored to have four to five calyx lobes, eight to ten stamens, and two carpels present to account for the typical variation seen within the genus.

Characters for *Ceratopetalum suciensis* were scored using preserved floral characters present on the specimens. The semi-inferior ovary was scored as inferior due to the limited options in the character matrix. Number of perianth parts and perianth whorls were scored as missing because the lack of petals may be due to preservation or natural dehiscence rather than the absence of petals in the species. Anthers were not preserved so anther and pollen characters were scored as missing. Additionally, internal structures were not preserved so ovule characters were scored as missing.

A majority of the floral characters for the fossil flowers *Platydiscus peltatus* (Schönenberger *et al*., 2001) and *Tropidogyne pentaptera* (Poinar & Chambers, 2017) were scored according to their published descriptions. All semi-inferior ovaries were scored as inferior ovaries in the character matrix. Data that was scored as missing for the flowers were due to lack of preservation or poor preservation making it difficult to accurately interpret the characters in the images of the specimens. Anther characters were scored according to a *P. peltatus* specimen in bud. However, anther dehiscence via a valve or slit could not be interpreted from the images and was not described so the anther dehiscence was scored as missing. For *T. pentaptera*, the number of perianth parts and whorls were scored as missing because the lack of petals may also be due to preservation or natural dehiscence rather than an absence in the species. The anther orientation of *T. pentaptera*, was scored as missing due to difficulty interpreting the image of the anther on the specimen. Due to the preservation in amber, internal structures could not be observed so the ovule characters were scored as missing. Pollen characters were scored as

missing because the characters were not described and could not be interpreted clearly from the image in the original publication.

Video S1 Digital scans showing cross sections of *Ceratopetalum suciensis.*

Video S2 Digital scans showing longitudinal sections of *C. suciensis.*

Video S3 *Ceratopetalum suciensis* three-dimensional reconstruction in rotation.

Video S4 *Ceratopetalum succirubrum* three-dimensional reconstruction in rotation.

Video S5 Both *C. suciensis* and *C. succirubrum* three-dimensional reconstructions in rotation side by side to show similarities.

Notes S1 Tree file with *Ceratopetalum gummiferum* grafted for the phyloscan method (see separate file).

Notes S2 Character list (Note S2a) and character matrices (Note S2b, S2c) used for the initial and secondary phyloscan analysis (see separate file).

Notes S3 Majority rules consensus tree files and .t files from MrBayes analyses (see separate file).

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