

## Supplementary material

### Extrafloral nectaries in Leguminosae: phylogenetic distribution, morphological diversity and evolution

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### Specimens studied and voucher information

List of taxa used in morpho-anatomical analyses and voucher information. For the respective subfamilies and tribes, see Table 1 in the main text. Abbreviations (except for herbaria codes): ADS, Alfonso Delgado Salinas; AMG, Ana Maria Gonzalez; BM, Brigitte Marazzi; DELEP, Desert Legume Program of the University of Arizona, Tucson, AZ, USA. Herbarium acronyms are included in parentheses (for herbarium codes see Index Herbariorum, see <http://sweetgum.nybg.org/science/ih/>).

1. *Ancistrotropis peduncularis* (Fawc. & Rendle) A. Delgado (= *Vigna peduncularis* Fawc. & Rendle). ARGENTINA, Corrientes. Paraje Tres Cerros. Cerro Nazareno. 29°06'37.2"S, 56°55'51.3"W. *BM 381* (CTES).
2. *Batesia floribunda* Spruce ex Benth. ARGENTINA, Corrientes, Departamento San Cosme. *AMG 517* (CTES).
3. *Bauhinia forficata* subsp. *pruinosa* (Vogel) Fortunato & Wunderlin. ARGENTINA, Corrientes, Capital. *BM 368–369* (CTES).
4. *Bauhinia macranthera* Benth. ex Hemsl. UNITED STATES, Arizona, Desert Botanical Garden, Phoenix. *BM 305* (ARIZ).
5. *Caesalpinia pulcherrima* (L.) Sw. ARGENTINA, Corrientes, Capital. *AMG 518* (CTES).
6. *Chamaecrista nictitans* Moench. ARGENTINA, Corrientes. Departamento San Martin, Paraje Tres Cerros, Cerro Nazareno. 29°06'27.7"S, 56°55'33.8"W. *BM 376* (CTES).

7. *Condylostylis candida* (Vell.) A.Delgado (= *Vigna candida* (Vell.) Maréchal, Mascherpa & Stainier). ARGENTINA, Corrientes, Departamento San Cosme, Reserva Privada Las Lomas. 27°23'24.6"S, 56°22'49.8"W. *BM 425* (CTES).
8. *Desmanthus acuminatus* Benth. ARGENTINA, Corrientes, Departamento San Martin, Paraje Tres Cerros, Cerro Nazareno. 29°06'25.6"S, 56°56'08.1"W. *BM 391* (CTES).
9. *Enterolobium contortisiliquum* (Vell.) Morong. ARGENTINA, Corrientes, Capital. *AMG 516* (CTES).
10. *Erythrina crista-galli* L. ARGENTINA, Corrientes, Capital. *AMG 515* (CTES).
11. *Erythrina dominguezii* Hassl. ARGENTINA, Corrientes, Capital. *AMG 504* (CTES).
12. *Galactia latisiliqua* Desv. ARGENTINA, Corrientes. Dpto San Martin, Paraje Tres Cerros, Cerro Nazareno. 29°06'38.6"S, 56°55'50.8"W. *BM 383* (CTES).
13. *Leucaena leucocephala* (Lam.) de Wit. UNITED STATES, Arizona, University of Arizona Campus Arboretum, Tucson. *BM 307* (ARIZ).
14. *Lysiloma divaricatum* (Jacq.) J.F.Macbr. ARGENTINA, Catamarca, Cuesta del Portezuelo. *AMG-BM 500* (CTES).
15. *Macroptilium gibbosifolium* (Ortega) A.Delgado. UNITED STATES, Arizona, Flower Tank, 31°30'21.81"N, 110°33'32.19"W. *BM 344* (ARIZ).
16. *Macroptilium prostratum* Urb. ARGENTINA, Corrientes, Dpto San Martin, Paraje Tres Cerros, Cerro Nazareno. 29°06'36.5"S, 56°55'55.2"W. *BM 396* (CTES).
17. *Phaseolus lunatus* L. var. *lunatus*. MEXICO, Jalisco, Autlán de Navarro, Puerto Los Mazos. *ADS 2799*. (MEXU).
18. *Prosopis alba* Griseb. ARGENTINA, Corrientes, Capital. *AMG 519* (CTES).
19. *Prosopis strombulifera* (Lam.) Benth. ARGENTINA, Catamarca, Cordobita. *AMG-BM 502* (CTES).
20. *Senegalia bonariensis* (Gillies) Seigler & Ebinger. ARGENTINA, Corrientes, Departamento San Cosme, Santa Ana. 27°26'52"S, 58°38'40.5"W. *BM 366* (CTES).
21. *Senna alata* (L.) Roxb. ARGENTINA, Corrientes, Capital. *BM 370* (CTES).
22. *Senna birostris* (Dombey ex Vogel) H.S.Irwin & Barneby. ARGENTINA, La Rioja, Anillaco. *BM 424* (CTES).
23. *Senna hirsuta* (L.) H.S.Irwin & Barneby. ARGENTINA, Corrientes, Dpto San Martin, Paraje Tres Cerros, Cerro Nazareno. 29°06'34.2"S, 56°55'35.8"W. *BM 389* (CTES).
24. *Senna martiana* (Benth.) H.S.Irwin & Barneby, L.P.de Queiroz *s.n.*, cultivation at HUEFS.
25. *Senna morongii* (Britton) H.S.Irwin & Barneby. ARGENTINA, Chaco, Las Breñas. *BM 223* (CTES).

26. *Senna mucronifera*, (Mart. ex Benth.) H.S.Irwin & Barneby. PARAGUAY, Caaguazú. *BM 019* (CTES).
27. *Senna occidentalis* (L.) Link. PARAGUAY, Caaguazú. *BM 060* (CTES).
28. *Senna pleurocarpa* (F.Muell.) Randell. UNITED STATES, Arizona, Desert Legume Program, Tucson. XDL 96-0088 cultivated at DELEP (ARIZ).
29. *Senna scabriuscula* (Vogel) H.S.Irwin & Barneby. ARGENTINA, Corrientes, Dpto San Cosme, Santa Ana. 27°26'52"S, 58°38'40.5"W. *BM 367* (CTES).
30. *Senna septemtrionalis* (Viv.) H.S.Irwin & Barneby. GERMANY, Bayern, Botanischer Garten München-Nymphenburg, München. *BM 140* (Z-ZT).
31. *Senna tonduzii* (Standl.) H.S.Irwin & Barneby. MEXICO, Chiapas, Piedra Parada. *BM 187* (MEXU).
32. *Vigna unguiculata* (L.) Walpers. ARGENTINA, Corrientes, Capital. *AMG 507* (CTES).

**Table S1. List of genera with unclear or unreliable reports of extrafloral nectaries (EFNs) in the Leguminosae family**

Genera ordered by subfamilies (sf): Ca, Caesalpinioideae; Ce, Cercidoideae; D, Detarioideae; P, Papilionoideae. Note that this is by no means an exhaustive list.

Sf	Genus	Description	Source(s)
Ca	<i>Adenantha</i> L.	Glandular hairs (not elevated nectary) between pairs of pinnae. No details about nectar secretion.	Pascal <i>et al.</i> (2000); this study
Ca	<i>Apuleia</i> Gaertn.	It is unclear what kind of EFN (if any) is reported.	Bentley (1977; Bentley cited Böhmker (1917), but this study found only <i>Acacia</i> cited by Böhmker)
Ca	<i>Bussea</i> Harms	Clavate to capitate glands on leaflet blade (perhaps resin producing?).	Lersten and Curtis (1996)
Ca	<i>Cenostigma</i> Tul.	Glandular trichomes on the leaf epidermis near a cavity inside the mesophyll that, according to Melo <i>et al.</i> (2010a, 2010b, their fig. 3C), is nectar secreting. According to them the trichomes are nectariferous and associated with the cavity.	Melo <i>et al.</i> (2010a, 2010b, as <i>Caesalpinia</i> ( <i>Poincianella</i> ) <i>bracteosa</i> = <i>Cenostigma bracteosum</i> )
Ca	<i>Cordeauxia</i> Hemsl.	Glands on leaflet blade (perhaps resin producing?).	Lersten and Curtis (1996)
Ca	<i>Stenodrepanum</i> Harms	Gland of discoid shape on leaflet blade (perhaps resin producing?).	Lersten and Curtis (1996)
Ca	<i>Tachigali</i> Aubl. (= <i>Tachigalia</i> )	No details found, despite many authors reporting EFN presence with no other details.	Böhmker (1917, cited in Bentley 1977); Fonseca (1994) study on mutualism with a <i>Pseudomyrmex</i> sp. but none found by Pascal <i>et al.</i> (2000)
Ca	<i>Zuccagnia</i> Cav.	Small capitate glands deeply embedded in leaflet blade (perhaps resin producing?).	Lersten and Curtis (1996)
Ce	<i>Gigasiphon</i> Drake	'Apical nectary' on sepals.	Wunderlin (2010)
Ce	<i>Parkinsonia</i> L.	Stipules of young branches are orange, but no secretion or ants have ever been observed.	This study (observed on <i>P. x sonorae</i> and <i>P. praecox</i> in the field in Sonora, Mexico)
D	<i>Aphanocalyx</i> D.Oliver	On the leaf, a gland on the leaflet lamina.	Léonard (1994, p. 373)
D	<i>Cryptosepalum</i> Benth.	Unclear if tiny and disc-shaped flat EFNs are present on the leaf lamina like other detarioids.	This study (observed on images of live material of <i>C. pellegrinianum</i> kindly provided by William Hawthorne)
D	<i>Elizabetha</i> [now in <i>Paloue</i> ] Schomburgk ex Benth. (only <i>E. grahmi</i> )	Disc-shaped on leaf lamina base, perhaps like the flat EFNs of other detarioids (or resin producing?). But see <i>Paloue</i> (in Table 1 of main text).	Redden and Herendeen (2006)
D	<i>Goniorrhachis</i> Taub.	Marginal glands on leaves (EFNs?).	Herendeen <i>et al.</i> (2003)
D	<i>Heterostemon</i> Desf.	Resin glands or EFNs? Not EFNs according to Redden and Herendeen (2006).	Bentley (1977; cited in M. G. Weber, L. D. Porturas, K. H. Keeler, see <a href="http://www.extrafloralnectaries.org">www.extrafloralnectaries.org</a> , accessed 11 January 2019)
D	<i>Intsia</i> Thouars	Leaflets with small crateriform (verrucose-like) glands on the basal part of lower leaf lamina surface: resin producing or EFNs?	Hou <i>et al.</i> (1996)

Sf	Genus	Description	Source(s)
D	<i>Macrolobium</i> Schreb.	Reported on leaves according to Mckey (1989), who cited Böhmker (1917) in which there is no mention of <i>Macrolobium</i> , and to Koptur (1992), who cited Schnell <i>et al.</i> (1963) in which there is no mention of <i>Macrolobium</i> either.	Böhmker (1917, cited in Bentley 1977); Koptur (1992)
D	<i>Schotia</i> Jacq.	Marginal glands on leaves (perhaps resin producing?).	Herendeen <i>et al.</i> (2003)
P	<i>Anthyllis</i> L.	Glands on bracts or bracts modified into glands.	Polhill (1981); Sokoloff <i>et al.</i> (2007)
P	<i>Antopetitia</i> A.Rich.	Lower leaflets modified into stipuliform glands or glands at the apex; bracts, glands on bracts or bracts modified into glands.	Polhill (1981); Sokoloff <i>et al.</i> (2007)
P	<i>Coronilla</i> L.	Lower leaflets modified into stipuliform glands or glands at the apex; bracts or bracts modified into glands	Polhill (1981); Sokoloff <i>et al.</i> (2007)
P	<i>Dipteryx</i> Schreb.	No details found (punctuated, possibly colleters?)	Morellato and Oliveira (1991)
P	<i>Dorycnopsis</i> Boiss.	Lower leaflets modified into stipuliform glands or glands at the apex; glands on bracts or bracts modified into glands.	Polhill (1981); Sokoloff <i>et al.</i> (2007)
P	<i>Dunbaria</i> Wight & Arn.	Leaf base; morphology description not available. [Note: this record is based on So (2004) who mentioned EFNs in pairs at the leaf base as ‘button-shape’ in three <i>Dunbaria</i> species, and describes this type of EFNs as ‘oval in shape with a flat or concave surface’. However, inspection of images of <i>Dunbaria</i> species available on the internet was unable to provide evidence for such structures. It also is noted that there are no swollen scar EFNs in this genus.]	So (2004)
P	<i>Dussia</i> Krug & Urb. ex Taub.	Glandular structures on bracts (communicated by Benjamin Torke), but these are not secretory and no ant activity ever observed according to Toby Pennington (pers. comm.).	Benjamin Torke and Toby Pennington (pers. comm.)
P	<i>Glycyrrhiza</i> L.	On leaves in Koptur (1992)’s list, citing Keeler (1979), but is considered as dubious by Keeler (1980).	Koptur (1992)
P	<i>Hammatolobium</i> Fenzl	Lower leaflets modified into stipuliform glands or glands at the apex; bracts, glands on bracts or bracts modified into glands.	Polhill (1981); Sokoloff <i>et al.</i> (2007)
P	<i>Hippocrepis</i> L.	Glands at the base of stipules; bracts, glands on bracts or bracts modified into glands.	Polhill (1981, citation therein); Sokoloff <i>et al.</i> (2007)
P	<i>Hosackia</i> Douglas ex Benth.	Glands on bracts or bracts modified into glands.	Polhill (1981); Sokoloff <i>et al.</i> (2007)
P	<i>Indigofera</i> L.	Sessile gland on the stipules. These are probably multicellular gland-tipped trichomes. [Note: the hydathode EFNs mentioned by Schrire (1995) and also in Schrire <i>et al.</i> (2009) are discussed in the main text, as they are here not considered as EFNs.]	Schrire (1995); Schrire <i>et al.</i> (2009)
P	<i>Kebirita</i> (Bonnet) Kramina & D.D.Sokoloff	Glands at the base of stipules.	Polhill (1981); Sokoloff <i>et al.</i> (2007)
P	<i>Lotus</i> L.	Glands at the base of stipules; glands on bracts or bracts modified into glands.	Polhill (1981); Sokoloff <i>et al.</i> (2007)
P	<i>Lupinus</i> L.	No details found.	M. G. Weber <i>et al.</i> , see <a href="http://www.extrafloralnectaries.org">www.extrafloralnectaries.org</a> (citing ‘Keeler unpublished’)
P	<i>Ornithopus</i> L.	Glands at the base of stipules.	Polhill (1981); Sokoloff <i>et al.</i> (2007)

Sf	Genus	Description	Source(s)
P	<i>Ottleya</i> D.D.Sokoloff	Glands at the base of stipules.	Polhill (1981); Sokoloff <i>et al.</i> (2007)
P	<i>Pseudolotus</i> Rech.f.	Glands at the base of stipules.	Polhill (1981); Sokoloff <i>et al.</i> (2007)
P	<i>Rhynchosia</i> Lour. (incl. <i>Cylista</i> )	Trichomes have been misinterpreted as EFNs (see Bhattacharyya and Maheshwari 1970; Melo <i>et al.</i> 2010a, 2010b), but perhaps these are oil glands (Lersten and Brubaker 1987); presence of swollen-scar EFNs was not confirmed.	Vargas <i>et al.</i> (2015)
P	<i>Scorpiurus</i> L.	Glands at the base of stipules.	Polhill (1981); Sokoloff <i>et al.</i> (2007)
P	<i>Sesbania</i> Scop. (incl. <i>Glottidium</i> )	According to Mckey (1989): On proximal leaflets, 'formless glands on underside of the midrib', but morphology not further described. In Lavin and Sousa (1995, p. 16, speaking of stipitate trichomes: 'It has been suggested that, among potentially several functions [...], glandular trichomes serve a function similar to extrafloral nectaries (Polhill 1994; A. Delgado, unpubl. data). Ants and certain other insects feed on the glandular exudate and indirectly reduce the herbivory of other insects on the inflorescence'.	Mckey (1989); Polhill (1994, cited in Lavin and Sousa 1995, p. 16)
P	<i>Sophora</i> L.	Leaves, gland between proximal pair of leaflets (Zimmermann (1932, p. 175, citing three spp. of <i>Sophora</i> : <i>S. uniflora</i> , <i>S. calycioides</i> , <i>S. stenocarpa</i> (two of them are in Martius Flora Brasiliensis), but these three names do not exist in Tropicos.org or in The Plant List (accessed 11 January 2019).	Zimmermann (1932, p. 175)
P	<i>Syrmatium</i> Vogel	Glands at the base of stipules.	Polhill (1981); Sokoloff <i>et al.</i> (2007)
P	<i>Trifolium</i> L.	Glandular hairs at the base of leaflets.	Retallack and Willison (1988)
P	<i>Tripodion</i> Medik.	Glands at the base of stipules.	Polhill (1981); Sokoloff <i>et al.</i> (2007)
p	<i>Weberbauerella</i> Ulbr.	Reported as on the base of leaflets. Although doubtful that EFNs exist in this genus, three species are very glandular (G. Lewis, Royal Botanic Gardens Kew, pers. comm.).	M. G. Weber <i>et al.</i> , see <a href="http://www.extrafloralnectaries.org">www.extrafloralnectaries.org</a> (citing 'Keeler unpubl. from herbarium specimen')

**Table S2. List of genera with reported absence of extrafloral nectaries (EFNs) in the Leguminosae family**

Genera ordered by subfamilies (sf): Ca, Caesalpinioideae; Ce, Cercidoideae; D, Detarioideae; P, Papilionoideae. This is by no means an exhaustive list. Full citations are found below

Sf	Genus	Description and source(s)
Ca	<i>Acaciella</i> Britton & Rose	Rico-Arce and Bachman (2006); B. Maslin, pers. comm.; this study, none seen on herbarium specimens of <i>Acaciella angustissima</i> available online on Tropicos.org (accessed 31 May 2016).
Ca	<i>Acrocarpus</i> Arn.	Thought to be on rachis between leaflets (Herendeen <i>et al.</i> 2003), but detailed examination of herbarium material at Kew excluded EFN presence (G. Lewis, Royal Botanic Gardens Kew, pers. comm.).
Ca	<i>Afrocalliandra</i> E.R.Souza & L.P.Queiroz	Originally thought to be present on the petiole; present or absent according to de Souza <i>et al.</i> (2013), but no detailed description available and no mention of nectaries in the species protologues of Thulin <i>et al.</i> (1981). In June 2018, Gwilym Lewis checked the herbarium specimens studied by Souza <i>et al.</i> and his analysis and conclusions are: '[...]It looks very like a reduced stipule in form and colour. Its dark reddish-brown colour develops with age, just as with the stipules. It is not a gland, in my opinion not even an incipient gland. The structure is not swollen, although on herbarium specimens it can appear to be so depending on how it has dried, sometimes squashed up against the intersection between the pinnae pair and thus appearing to be almost round. But it is not round; it is broadly lanceolate. And it is definitely on the underside of the leaf. [...] It might simply be the remnant of a once bipinnate leaf with more pairs of pinnae (or a single terminal pinna) and thus have no real function at all.'
Ca	<i>Amblygonocarpus</i> Harms	Not on leaves (Lewis and Elias 1981 cited in Mckey 1989); this study
Ca	<i>Aubrevillea</i> F.Pellegrin	Not on leaves (Lewis and Elias 1981 cited in Mckey 1989); this study
Ca	<i>Burkea</i> Hook.	Pascal <i>et al.</i> (2000)
Ca	<i>Calliandra</i> Benth.	According to Barneby (1998) and Macqueen and Hernández (1997), <i>Calliandra</i> lacks EFNs. Koptur (1992) cited Zimmermann (1932, p. 175) who cited Delpino, but we were unable to find this report. However, EFNs wrongly identified in the genus <i>Afrocalliandra</i> , segregated from <i>Calliandra</i> .
Ca	<i>Cassia</i> L. (s.str.)	Irwin and Barneby (1982); this study
Ca	<i>Chidlowia</i> Hoyle	Pascal <i>et al.</i> (2000)
Ca	<i>Delonix</i> Raf.	On petiole, below first leaflet pair, glandular hairs on rachis according to Zimmermann (1932; citing <i>D. regia</i> as <i>Poinciana regia</i> ), but it is not an EFNs according to Pascal 2000). Genus then reported in Koptur (1992) and Mckey (1989), probably based on Zimmermann (1932). This study also confirmed absence of nectar-secreting structures (observed multiple living specimens of <i>Delonix regia</i> ).
Ca	<i>Dimorphandra</i> Schott	Although Lersten and Curtis (1996) reported glandular hairs and 'tiny glands', these are not EFNs according to Pascal <i>et al.</i> (2000).
Ce	<i>Dialium</i> L.	No conspicuous glands on petiole or rachis according to Hou <i>et al.</i> (1996), but erroneously cited as EFNs present by Bentley (1977).
Ca	<i>Dinizia</i> Ducke	Not on leaves (Lewis and Elias 1981 cited in Mckey 1989).
Ca	<i>Diptychandra</i> Tul.	Pascal <i>et al.</i> (2000)
Ca	<i>Elephantorrhiza</i> Benth.	Not on leaves (Lewis and Elias 1981 cited in Mckey 1989); this study. Nested within <i>Entada</i>
Ca	<i>Erythrostemon</i> Klotzsch	This study (based on <i>Erythrostemon gilliesii</i> , voucher specimen AMG-BM503)
Ca	<i>Fillaeopsis</i> Harms	Pascal <i>et al.</i> (2000); this study
Ca	<i>Gleditsia</i> J.Clayton	Lersten and Curtis (1996); Pascal <i>et al.</i> (2000)

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Sf	Genus	Description and source(s)
Ca	<i>Gymnocladus</i> Lam.	Lersten and Curtis (1996); Pascal <i>et al.</i> (2000)
Ca	<i>Hoffmannseggia</i> Cav.	On leaflet blade according to Lersten and Curtis (1996), but non-nectariferous glandular trichomes all over the plant (this study, based on voucher specimen AMG-BM501).
Ca	<i>Melanoxylon</i> Schott in K.Sprengel	This study: no foliar structures observed on herbarium specimen of <i>Melanoxylon brauna</i> available online on tropicos.org
Ca	<i>Mora</i> Benth.	Pascal <i>et al.</i> (2000)
Ca	<i>Pachyelasma</i> Harms	Pascal <i>et al.</i> (2000)
Ca	<i>Peltophorum</i> (Vogel) Benth.	Clavate to capitate glands on leaflet blade (Lersten and Curtis 1996) that are not nectar-secreting (observed in <i>Peltophorum dubium</i> , this study)
Ca	<i>Piptadeniastrum</i> Brenan	Not on leaves (Lewis and Elias 1981 cited in Mckey 1989); this study
Ca	<i>Schizolobium</i> Vogel	Pascal <i>et al.</i> (2000)
Ca	<i>Stachyothyrsus</i> Harms	Dome-like protuberance along the rachis, between each pair of pinnae, but no secretory tissue found by Pascal <i>et al.</i> (2000).
Ca	<i>Sympetalandra</i> Stapf	Pascal <i>et al.</i> (2000)
Ca	<i>Tetrapleura</i> Benth.	Not on leaves (Lewis and Elias 1981 cited in Mckey 1989; this study).
Ca	<i>Tetrapterocarpon</i> Humbert	Pascal <i>et al.</i> (2000)
Ce	<i>Cercis</i> L.	This study
Ce	<i>Schnella</i> Raddi	Trethowan <i>et al.</i> (2015); de Souza <i>et al.</i> (2017, studied <i>Schnella outimouta</i> )
D	<i>Crudia</i> Schreb.	No 'knotted vein glands' observed on the leaf lamina like other detarioids.
D	<i>Detarium</i> Juss.	No 'knotted vein glands' observed on the leaf lamina like other detarioids.
D	<i>Ecuadendron</i> D.A.Neill	Redden and Herendeen (2006)
P	<i>Centrolobium</i> Mart. ex Benth.	According to Roth (1984) there are giant glands on the lower surface of leaflets, but this is incorrect, as no such glands were seen in herbarium specimens in this study.

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