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Supplementary Material

Pollination strategies are exceptionally complex in southwestern Australia – a globally significant ancient biodiversity hotspot

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Table S1. Estimated numbers of clades with transitions to different pollination syndromes allocated using phylogenetic or taxonomic data with references (see Table 2 for abbreviations and notes below).

Syndrome	Global clades	Order, Family or Genus with other origins	Minimum SWAFR clades	Max	Families or Genera with SWAFR origins (number of transitions)	Notes and phylogeny references
1. Wind pollination	12	Pinales, Poales, Dioscoreales, Juncaginaceae, Potamogetonaceae, Caryophyllales, Casuarinaceae, Plantaginaceae, Polygonaceae, Acaena, Dodonaea, Urticaceae	15	20	Lawrencia (1-3), Amperea, Euphorbiaceae s. l. (8), Gyrostemonaceae, Haloragaceae (1), Hydatellaceae, Proteaceae (Stirlingia 1), Opercularia, Stylobasium, Alectryon	Euphorbiaceae s. l. has very complex pollination Haloragaceae - Chen et al. 2014
2. Water pollination	7	Marine plants or hydrophytes			Marine plants beyond scope here	
3. Generalist insect pollination		Wind ancestral in SWAFR for Haloragaceae	2	2	Glischrocaryon (Haloragaceae), Diplopeltis (Sapindaceae)	Chen et al. 2014
		Buzz pollination ancestral	2	2	Thysanotus (Asparagaceae)	Reversion in 2 species with SWAFR origins - Sirisena et al. 2016
4. Specific insect pollination (SIP)			**76**	**207**		
4.1. Bee SIP (not buzz pollination)			**34**	**122**		
A Dicot bee SIP	4	Lamiaceae, Fabaceae, Polygalaceae, Scrophulariaceae	17	93	Goodeniaceae, Malvaceae, Myrtaceae (Verticordia, etc.) Pittosporaceae, Proteaceae, Rutaceae, etc. (93 genera in total)	Consistent trait for family or genus (17 families)
B. Monocot bee SIP	2	Xyridaceae, Iridaceae, etc.	7	29	Asparagaceae, Commelinaceae, Dasypogonaceae, Haemodoraceae, Hemerocallidaceae, Iridaceae, etc. (29 genera)	Most families have peak diversity in SWAFR
4.2. Buzz pollination	4	Solanaceae, Boraginaceae, Dilleniaceae, Hemerocallidaceae	10	33	Asparagaceae, Byblidaceae, Commelinaceae, Dasypogonaceae, Dilleniaceae, Elaeocarpaceae, Ericaceae (2), Fabaceae, Hemerocallidaceae, Malvaceae, Pittosporaceae (33 genera in total)	See Section III.4.c
4.3. Fly SIP	1	Aponogetonaceae	3	7	Hakea (6), Stylidium	see Section IIV.2
4.4. Butterfly SIP	1	Capparis	7	10	Isotoma, Stackhousia, Ericaceae (4), Scaevola (Diaspasis), Franklandia, Pimelea (most), Parsonsia	as above

4.5. Moth SIP			2	4	Boronia (1), Ericaceae (3)	
4.6. Beetle SIP	1	Macrozamia			Cycads since Mesozoic (Cai et al. 2018)	Toon et al. 2020
4.7. Orchidaceae					See autogamy also	See Section III.4.d
a. Sexual deception			21	21	Caladenia (15), Drakaea clade, Pterostylis, etc. (21 clades 8 genera in total)	
b. Nectar			5	5	Microtis + Prasophyllum, Eriochilus, Leptoceras, Lyperanthus + Pyrorchis, Gastrodia	
c. Visual mimicry	1	Basal trait in region (Weston et al 2014)			Diuris, Thelymitra, etc.	
d. Fungus mimicry		Requires further study	2	3	Corybas (gnat), Cyrtostylis (gnat), Rhizanthella (phorid fly)	
e. Small flies		As above	2	2	Microtis (some sp.), Corunastylis	
5. Relatively specific insect pollination (RSIP)			**30**	**41**		
5.1. RSIP with complex flowers	1	Cassytha	8	16	Goodeniaceae (1-6), Utricularia, Malvaceae (5), Calytrix, Conospermum (1-4)	Consistent trait for family or genus
5.2. RSIP with very small flowers			22	25	Asteraceae (<15), Pimelea (1-4), Rhamnaceae (1), Corynanthera (Myrtaceae), Rutaceae (4)	Asteraceae – Schmidt-Lebuhn et al. 2021, Pimelea and Rutaceae 4 sp. in each
5. Bird pollination			**133**	**179**		
5.1. Myrtaceae		Gondwanan family	41	50	Balaustion, Beaufortia, Callistemon, Corymbia*, Cheyniana, Calothamnus, Chamelaucium (3), Darwinia (7-14), Eucalyptus* (9-15), Kunzea (2), Lamarchea, Melaleuca (3-6), Regelia, Verticordia (9 -13)	Numbers for Eucalyptus are subseries, Darwinia and Melaleuca are morphotypes, Verticordia are sections – Thornhill et al. 2015, Rye et al. 2020
					*Bird & Insect	
5.2. Proteaceae		Gondwanan family	31	42	Banksia (4), Lambertia, Adenanthos, Grevillea (>12), Hakea (15-21) for bird and insect pollination	Mast et al. 2012, 2015, Lamont et al. 2016
5.3 Fabaceae		Also occurs in tropical genera such as Crotalaria (not counted here)	20	20	Bossiaea (3), Daviesia (2), Gastrolobium (11), Kennedia (4), Leptosema, Swainsona, Templetonia	10 clades in Toon et al. 2014 plus 10 more here
5.4. Scrophulariaceae		Family mostly bee pollinated globally	11	15	Eremophila (40 taxa) in 10 separate Sections	Sections from Chinnock 2007

5.5. Lamiaceae		Family relatively specialised globally and associated with bees (Westerkamp & Classen-Bockhoff 2007)	8	20	Chloanthes, Dasymalla (3), Hemiandra (6), Hemigenia (2), Hemiphora (4), Microcorys (3), Prostanthera (3), Quoya (1)	Conn et al. 2011, Wilson et al. 2017
5.6. Haemodoraceae		Gondwanan family	3	6	Anigozanthos & Macropidia, Blancoa, Conostylis (4 sp.)	3 shown in Hopper et al. 2009, plus 1-3 origins in Conostylis
5.7. Rutaceae		Global family most are insect pollinated. *Correa is primarily east Australian	4	7	Correa*, Diplolaena + Chorilaena, Drummondita + Muiriantha, Nematolepis, Philotheca (1-2)	Consistent in genera except Philotheca which has only 2 sp.
5.8. Ericaceae		Bee and fly pollination is also common in Australia (Johnson 2013)	9	13	Andersonia (3), Brachyloma (2), Cosmelia (1), Leucopogon (2), Stenanthera (1), Styphelia (4)	Multiple origins in some genera Puente-Lelievre et al. 2015
5.9. Others	1	Loranthaceae	6	6	Thymelaeaceae (1), Utricularia (1), Pittosporaceae (4)	Pittosporaceae Bentleya and 3 Marianthus sp.
6. Non-flying mammal pollination			3	5	Most common in the Dryandra, clade in Banksia but most are primarily bird or insect pollinated	Transitions probably underestimated in Banksia s.l.
7. Self-pollination / Autogamy			14	25	Apiaceae (5-13), Araliaceae (2-5), Brassicaceae (2), Orchidaceae (2-6), Goodeniaceae (2), Stylidiaceae (1-3), etc.	At least 84 taxa as 1 or more clades in 16 families (see Section IV.12)
TOTAL	**35**		**275**	**481**		

Methods

To investigate evolutionary trends for syndromes, pollination trait transition frequencies were estimated for all SWAFR plants by counting taxa in clades with uniform syndromes. Monophyletic clades of species were identified in available molecular phylogenies cited in the table. When phylogenetic data were lacking, we designated clades likely to have a common pollination syndrome origin based on their taxonomic hierarchy. These were groups within families that had consistent floral morphology and belonged to the same genus or recognised subgeneric group. In cases where numbers of transitions were unclear both conservative transitions (e.g. one per genus) and estimated maximum transitions (recognising taxonomic complexity) are provided.

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Table S2. Evolutionary trends (→) for pollination syndromes in southwestern Australia with associated floral features that are highly consistent (see Table 1).

Sequence	Floral features
1. General insect pollination → specialised nectar feeding insects → specialised nectar and pollen feeding insects → pollen feeding bees → buzz pollination	1, 2, 3, 4, 6
2. General insect pollination → specialised nectar feeding insects → specific insect type with specialised floral syndrome (flies, butterflies, moths, etc.)	3, 5, 6
3. Insect pollination → insects & birds → primarily nectar-feeding birds → birds that feed on nectar and pollen	2, 7, 8, 10, 11
4. Insect pollination → birds & insects → birds, insects & non-flying mammals (NFM) → primarily NFM	7, 8, 9, 10, 11
5. Insect pollination → insects and wind → wind (also reverse in Haloragaceae)	1, 2, 12, dioecy

*Floral specialisations: 1 loss of nectar; 2 limited scent; 3 specialised colour signals (for insects); 4 closed anthers with pores or slits; 5 specialised olfactory signals; 6 hidden nectaries; 7 abundant nectar; 8 large brush, cup or tubular inflorescence, often red; 9 large, hidden, dull coloured and musty scented flowers; 10 secondary pollen presentation; 11 flowering phenology cooperation extends throughout year; 12 floral reductions other than anthers and pistil, abundant shed pollen.