Pollen morphology of the Myrtaceae. Part 3: tribes Chamelaucieae, Leptospermeae and Lindsayomyrteae


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Abstract. The pollen morphology of 36 genera and 147 species from the Myrtaceae tribes Chamelaucieae, Leptospermeae and Lindsayomyrteae was surveyed using scanning electron microscopy (SEM) and light microscopy (LM). Syncolpate pollen were observed in all genera of Leptospermeae and some genera of Chamelaucieae. Genera of tribe Chamelaucieae displayed five distinct colpal morphologies, which makes it the tribe with the most diverse pollen in Myrtaceae. Six genera of Chamelaucieae, including Actinodium, Chamelaucium, Darwinia, Homoranthus, Pileanthus and Verticordia, produce large acolpate pollen not observed in any other Myrtaceae. Two of these genera produce distinct pollen; Actinodium is the only genus to have prolate-spheroidal shaped pollen, and Pileanthus pollen is large and dicolporate. A number of anomalous aperture types occurred in species of Chamelaucieae, including monocolporate (Homoranthus thomasii), pentacolporate (Calytrix oldfieldii) and hexacolporate (Sannantha tozerensis). Pollen of Lindsayomyrteae appeared similar to those of Leptospermeae and Chamelaucieae, and on the basis of pollen features, could be related to these two tribes.

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Introduction

Representatives of the Myrtaceae tribes Chamelaucieae, Leptospermeae and Lindsayomyrteae are mainly distributed in Australia, with a small number of genera also occurring in New Caledonia, New Zealand and Malesia. Chamelaucieae and Leptospermeae form a well-supported sister clade in all phylogenetic studies (Wilson et al. 2005; Biffin et al. 2007, 2010; Thornhill et al. 2012c). The placement of Lindsayomyrteae is less certain, but it is sometimes placed as sister to Leptospermeae and Chamelaucieae (Wilson et al. 2005). Pollen morphology of the members of these tribes has been previously studied by Pike (1956), McIntyre (1963), Patel et al. (1984), Boyd (1992), Moar (1993) and Ladd et al. (2000). It has been noted that brevicolpate pollen (acolpate in our study) occur in the Chamelaucieae; however, this morphological pollen type also occurs in other tribes of Myrtaceae and is therefore not useful for classification (Pike 1956; Johnson and Briggs 1984). Ladd et al. (2000) reported that pollen of Verticordia had a colpal morphology that was brevicolpate, brevissimicolpate (synonymised with acolpate in the present study) or porate with exine patterns that ranged from psilate to strongly scabrate. It has been observed that, unlike most Myrtaceae, pollen of some genera of Chamelaucieae are shed in a fluid called ‘pollenkitt’ (Beardsell et al. 1989; Houston et al. 1993; Ladd et al. 2000).

Materials and methods

Methods and terminology used in the present study are detailed in part 1 (Thornhill et al. 2012a). In figures and tables, the current accepted species name is applied and the previous name appears in parentheses. The list of taxa used for the present study includes previous and current accepted names to enable cross-referencing to past palynological work (Tables S1 and S2, available as Supplementary Material).
Scanning electron microscopy (SEM)

Samples were viewed with a S360 (Cambridge Instruments, UK) or a 4300 SE/N (Hitachi HighTechnologies Corp., Japan) scanning electron microscope, both housed at the Electron Microscopy Unit, Research School of Biology, Australian National University. Some Chamelaucieae pollen images were captured using a S360 housed at the Sydney Herbarium.

Results

Pollen descriptions

Tribe Chamelaucieae

There are 23 genera assigned to Chamelaucieae. The majority of genera are found exclusively within Australia, although species of \textit{Sannantha} occur in New Caledonia and species of \textit{Baeckea} occur in Malesia. Chamelaucieae are widely distributed in heathlands in the more coastal regions of Australia, rarely extending into the arid zone. \textit{Verticordia} and \textit{Calytrix} contain a large number of species. Pollen measurements for Chamelaucieae are summarised in Tables 1 and 2.

Genus \textit{Actinodium}

\begin{itemize}
  \item \textbf{Number of species:} 2.
  \item \textbf{Distribution:} south-western Australia.
\end{itemize}

\textit{Actinodium} pollen are unique within Myrtaceae in that they are tricolporate but also prolate-spherical rather than oblate, as first described by Pike (1956). The exine was consistently psilate. Pollen sides were either deeply concave or greatly convex, and colpal morphology was acolpate. Pollen ambs were flat or round. Pollen length ranged from 10 to 15.6 µm.

\textit{LM}: the exine of \textit{Actinodium} was psilate. Pollen sides were concave, greatly convex or convex and the colpal morphology was acolpate. Pollen ambs were round. Pollen length ranged from 11.8 to 14.4 µm.

Genus \textit{Aluta}

\begin{itemize}
  \item \textbf{Number of species:} 5.
  \item \textbf{Distribution:} central Australia.
\end{itemize}

\textit{Aluta} pollen were tricolporate with a psilate or psilate/rugulate exine. Pollen sides were straight or convex and the colpal morphology was parasympocolpate with inverse arcuate colpi. Pollen ambs were round, colpal edges were smooth and the apocolpal field was psilate. Pollen length ranged from 15.7 to 16.6 µm. Colpus/length ratio ranged from 31.7 to 36%.

\textit{LM}: the exine of \textit{Aluta} was psilate. Pollen sides were convex and colpal morphology was parasympocolpate with inverse arcuate colpi. Pollen ambs were round, colpal edges were smooth and the apocolpal field was psilate. Pollen length ranged from 15.7 to 16.6 µm. Colpus/length ratio ranged from 31.7 to 36%.

Genus \textit{Astartea}

\begin{itemize}
  \item \textbf{Number of species:} ~20.
  \item \textbf{Distribution:} south-western Australia.
\end{itemize}

\textit{Astartea} pollen were tricolporate or occasionally tetracolporate with a granulate/scabrate or scabrate exine. Pollen sides were straight or less commonly convex and the colpal morphology was syncolpate. Pollen ambs were pointed, colpal edges were smooth and the apocolpal field was psilate or not visible. Pollen length ranged from 15 to 17.5 µm. Colpus/length ratio ranged from 50.9 to 55.7%.

Genus \textit{Baeckea}

\begin{itemize}
  \item \textbf{Number of species:} ~50.
  \item \textbf{Distribution:} Australia, Malesia and southern China.
\end{itemize}

\textit{Baeckea} pollen were tricolporate or sometimes tetracolporate with a verrucate, rugulate or psilate exine. Pollen sides were straight or concave and the colpal morphology was syncolpate, parasympocolpate with arcuate colpi or acolpate. Pollen ambs were pointed or less often round, colpal edges were smooth, broken or rough, and the apocolpal field was psilate or scabrate. Pollen length ranged from 8.5 to 13.6 µm. Colpus/length ratio ranged from no colpi to 61.5%.

\textit{LM}: the exine of \textit{Baeckea} was psilate. Pollen sides were straight or less often concave and the colpal morphology was parasympocolpate with arcuate or angular colpi. Pollen ambs were pointed or round, colpal edges were smooth and the apocolpal field was psilate. Pollen length ranged from 9.5 to 13.1 µm. Colpus/length ratio ranged from 38.4 to 58.7%.

Genus \textit{Balaustion}

\begin{itemize}
  \item \textbf{Number of species:} 1.
  \item \textbf{Distribution:} south-western Australia.
\end{itemize}

\textit{Balaustion} pollen were tricolporate with a verrucate/scabrate exine. Pollen sides were straight or concave and the colpal morphology was either syndemicolpate, parasympocolpate with arcuate colpi or syncolpate. Pollen ambs were pointed or
Pollen shape: Ob, oblate; Tri, triporate; Pro, prolate.

Pore no.: Di, dicotulate; Tri, tricoculate; Tet, tetracoculate; Pen, pentacoculate; Hex, hexacoculate; Mon, monococulate.

Colpal morphology: Syn, syncolpate; Arc, parasyncolpate arcuate; Ang, parasyncolpate angular; Inv, parasyncolpate inverse arcuate; Bre, brevicolpate; Aco, acolpate; Syn, syndemicolpate.

Shape of side: Str, straight; Conv, convex; GC, greatly convex; Conc, concave; DC, deeply concave.

Exine: Psi, psilate; Rug, rugulate; Ver, verrucate; Sca, scabrate; Gra, granulate; Verm, vermiculate.

Amb shape: R, round; P, pointed; Fl, flat; N, notched.

Colpal edge: S, smooth; R, rough; B, broken; N, none.

Apocolpial field: Gra, granulate; Psi, psilate; Rug, rugulate; Sca, scabrate; Ver, verrucate; N, none.

Island type: N, none; S, small/irregular; C, closely fitting; G, globular.

<table>
<thead>
<tr>
<th>Species Pollen</th>
<th>Pore no.</th>
<th>Shape of side</th>
<th>Exine</th>
<th>Amb shape</th>
<th>Colpal edge</th>
<th>Apocolpial field</th>
<th>Island type</th>
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<td>Tri, Tet</td>
<td>Syn, Str</td>
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<td>S</td>
<td>Gra</td>
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<td>Tri, Tet</td>
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<td>Ps, Sca</td>
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Table 1. (continued)
| Species                     | Ob | Tri | Aco | Conc, DC | Rug, Ver | R | P | N | N | N | N | N | N | N | N | N | N |
|-----------------------------|----|-----|-----|----------|----------|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| *Verticordia helichrysantha* |    |     |     |          |          |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
| *Verticordia helmsii*       |    |     |     |          |          |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
| *Verticordia huegelli*       |    |     |     |          |          |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
| *Verticordia humilis*        |    |     |     |          |          |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
| *Verticordia jamesonii*      |    |     |     |          |          |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
| *Verticordia longistyli*     |    |     |     |          |          |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
| *Verticordia minutiflora*    |    |     |     |          |          |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
| *Verticordia micheliana*     |    |     |     |          |          |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
| *Verticordia monadelpha*     |    |     |     |          |          |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
| *Verticordia Muelleriana*    |    |     |     |          |          |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
| *Verticordia nitens*         |    |     |     |          |          |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
| *Verticordia ovalifolia*     |    |     |     |          |          |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
| *Verticordia penngera*       |    |     |     |          |          |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
| *Verticordia picta*          |    |     |     |          |          |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
| *Verticordia pittyhopet*     |    |     |     |          |          |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
| *Verticordia plumosa*        |    |     |     |          |          |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
| *Verticordia pulchella*      |    |     |     |          |          |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |

Number of species: 78.

Genus *Calyptria*.


Previous pollen studies: PIKE (1956); Boyd (1992).

Images: SEM polar view – Figs 15 and 21; LM views – Fig. 5a and 14b; SEM exine pattern – Figs 5b and 4f; LM exine pattern – Figs 6a, 6b, 7a and 8d.

*Calyptria* pollen was tricolporate with an exine that was smooth, and the apocolpial field was smooth or notched. Pollen length ranged from 23.1 to 31 µm. Colpus/length ratio ranged from 4.8 to 48.8%.

from no colpi to 57.6%.

**Previous pollen studies**


Genus *Calytrix*.


Previous pollen studies: PIKE (1956); Patel (1984).

Images: SEM polar view – Figs 1 and 4; LM views – Figs 8a and 9d.

*Calytrix* pollen was tricolporate or sometimes dicolporate. Pollen sides were convex and the colpal morphology was acolpate or parasyncolpate with angular colpi. Pollen length ranged from 12.9 to 20.4 µm. Colpus/length ratio ranged from 14.9 to 20.4.

from no colpi to 48.9%.

**Previous pollen studies**


Genus *Chamelaucium*.

Distribution: Western Australia. Specimens examined: PIKE (1956); Patel et al. (1994).

Previous pollen studies: PIKE (1956); Patel et al. (1994).

Images: SEM polar view – Figs 16 and 22; LM views – Fig. 15a and 16b.

*Chamelaucium* pollen was tricolporate or sometimes dicolporate. Pollen sides were straight, greatly convex or concave and the colpal morphology was syncolpate, or parasyncolpate with angular colpi. Pollen length ranged from 9.5 to 16.4 µm. Colpus/length ratio ranged from 34.5 to 48.3%.

from no colpi to 48.9%.

**Previous pollen studies**

Material examined: PIKE (1956); Patel et al. (1994).

Genus *Lhotzkya*.


Previous pollen studies: PIKE (1956); Patel (1984).

Images: SEM polar view – Figs 14 and 15; LM views – Figs 15a, 15b, 15c and 15d.

*Lhotzkya* pollen was tetracolporate or pentacolporate. Pollen sides were convex and the colpal morphology was syncolpate, or parasyncolpate with angular colpi. Pollen length ranged from 12.9 to 20.4 µm. Colpus/length ratio ranged from 14.9 to 20.4.

from no colpi to 48.9%.
Table 2. Chamelaucieae light microscopy sample measurements

See Table 1 for explanation of abbreviations and length and width data

<table>
<thead>
<tr>
<th>Species</th>
<th>Pollen shape</th>
<th>Pore no.</th>
<th>Colpal morph.</th>
<th>Shape of side</th>
<th>Exine Amb shape</th>
<th>Colpal edge</th>
<th>Apocolpial field</th>
<th>Island type</th>
<th>Length (µm)</th>
<th>Width (µm)</th>
<th>Colpus length (µm)</th>
<th>Colpus/length (%)</th>
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<td>Pro</td>
<td>Tri</td>
<td>Aco</td>
<td>Conc, GC</td>
<td>Psi</td>
<td>R</td>
<td>N</td>
<td>N</td>
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<td>Aco</td>
<td>Conc, Conv</td>
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<td>Psi</td>
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<td>Str</td>
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<td>R</td>
<td>N</td>
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<td>Conc</td>
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<td>N</td>
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<td>Conc</td>
<td>Psi</td>
<td>R</td>
<td>N</td>
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<td>Conv</td>
<td>Sca, P, R</td>
<td>R, S</td>
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<td>N</td>
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<td>20.2</td>
<td>16.2 (17.8)</td>
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<td>Str</td>
<td>Psi</td>
<td>R</td>
<td>S</td>
<td>N</td>
<td>N</td>
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<td>Str</td>
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<td>R</td>
<td>S</td>
<td>N</td>
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<td>12.2 (21.2)</td>
<td>27.1</td>
<td>11.2 (19.7)</td>
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<td>Str</td>
<td>Gra/Sca</td>
<td>R</td>
<td>P, R, B</td>
<td>N, Sca</td>
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<td>20.1 (21.8)</td>
<td>25.1</td>
<td>18.5 (20.5)</td>
</tr>
</tbody>
</table>
### Myrtaceae pollen morphology. Part 3

**Homalocalyx (Wehlia) coarctatus**
- Ob Tri Syn Str, Conv Gra/Sca R S N N 20 (21) 22.1 18.4 (19.6) 20.6 9.4 (10.4) 11 47.2 (49.7) 51.2

**Homalocalyx (Wehlia) staminosus**
- Ob Tri Ang, Syn Str, Conv Gra/Sca R, S, Sca, N, C 26.6 (28.1) 29.2 25.2 (26.8) 27.4 11.2 (11.5) 12.3 38.7 (41.1) 43.6

**Homalocalyx (Wehlia) thryptomenoides**
- Ob Tri Syn Conv Gra/Sca R S Sca N 21.4 (22.9) 24.8 19.8 (21.2) 23 10.7 (11.6) 12.9 49.6 (51) 52.6

**Homoranthus darwiniioides**
- Ob Tri Aco Str Psi R, N N N N 18.7 (25.3) 29.5 18.2 (24.3) 28.5 0 (2.2) 3.8 0 (7.9) 136

**Homoranthus flavescens**
- Ob Tri Aco Str, Conv Psi R N N N 18.7 (23.8) 25.6 17.9 (22.5) 24.2 0 0

**Homoranthus tropicus**
- Ob Tri Aco Str, Conc Psi R, P N N N 18 (21.2) 24.3 18.9 (21.5) 24.7 0 0

**Homoranthus wilhelmit**
- Ob Tri Aco Str Psi R N N N 15.3 (17.3) 19 14.9 (16.8) 18.3 0 0

**Hypocalymma angustifolium**
- Ob Tri Syn Str Gra/Sca R S, B Psi N 19.5 (20.3) 21 18.7 (19.9) 20.6 10.5 (10.8) 11.1 52.2 (53.1) 53.8

**Hypocalymma robustum**
- Ob Tri Syn Conv Gra/Sca R B, S N N 16.2 (16.7) 17.2 15.1 (15.7) 16.1 8.1 (8.5) 8.7 49.4 (50.8) 53.3

**Micromyrtus ciliata**
- Ob Tri Arc Str, Conv Psi R, P S Psi N 9.1 (10.2) 11.4 8.7 (9.8) 10.9 4.3 (4.7) 5.2 42.5 (46.2) 49.6

**Micromyrtus obovata (drummondii)**
- Ob Tri Aco Str, Conv Psi R/F S Psi N 12.9 11.8 5.1 39.2

**Pileanthus filifolius**
- Pro Di Di Str Psi R/F S Psi N 20.2 (27.6) 36.8 15.3 (19.9) 26.5 0 100

**Pileanthus peduncularis**
- Pro Di Di Str Psi R/F S Psi N 35.4 (40.2) 47.5 26.2 (28.9) 32.4 0 100

**Scholtzia laxiflora**
- Ob Tri Inv Conc, DC Psi R, P S Psi N 11.7 (12.8) 13.8 12.45 (13.1) 13.7 5 (5.6) 6.2 42.6 (43.8) 45.1

**Scholtzia leptantha**
- Ob Tri Inv Conc, GC Psi R, P S Psi N 12.8 (13.8) 15.2 11.8 (12.9) 14.4 4.9 (5.3) 5.5 35.8 (38.4) 41

**Thryptomene calycina**
- Ob Tri Inv GC Psi R S Psi N 13.5 (14) 14.5 12 (12.5) 14.4 4.5 (5.5) 5.3 34.4 (35.4) 37.6

**Alata (Thryptomene) maisonneuvi**
- Ob Tri Inv GC Psi R S Psi N 15.7 (16) 16.6 14.4 (14.8) 15.4 5 (5.4) 6 31.7 (33.5) 36

**Thryptomene racemulosa**
- Ob Tri Inv GC Psi R S Psi N 15.5 13.3 5.4 35

**Thryptomene saxicola**
- Ob, Pro Tri, Di Inv GC Sca, Psi R S Psi N 13 (13.7) 14.5 11.2 (11.9) 12.7 3.7 (3.9) 4.3 28.1 (28.7) 29.4

**Verticordia densiflora**
- Ob Tri, Tet Aco, Arc Str, Conv Psi, Sca R, N, B, N, Sca N 18 (18) 18 16.5 (16.6) 16.7 0 0

**Verticordia grandis**
- Ob Tri Ang Str Psi R, R, S Psi N 26.8 (27.1) 27.7 26.7 (27.4) 28.2 6.9 (8.5) 9.9 25.4 (31.2) 36.5

**Verticordia pennigera**
- Ob Tri, Tet Aco Conc Psi R N N N 17.4 (19.4) 22 17.3 (19.2) 20.4 0 0

**Verticordia picta**
- Ob Tri Aco DC, Conc Psi F, R N N N 15.1 (16.5) 17.5 16.2 (17.7) 18.7 0 0

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\(^{a}\)Slide from Pike collection.
Fig. 1. Polar view of Chamelaucieae under scanning electron microscope. Scale bar = 10 µm. (a) Actinodium cunninghamii, (b) Alata maisonneuevi, (c) Sannantha (Babingtonia) cunninghamii, (d) Harmogia (Babingtonia) densifolia, (e) Kardomia (Babingtonia) jucunda, (f) Sannantha (Babingtonia) tozerensis, (g) S. (Babingtonia) tozerensis, (h) Baeckea crassifolia, (i) Enekblatis (Baeckea) cryptandroides, (j) Baeckea ericacea, (k) B. gunniana, (l) B. ovalifolia, (m) B. polystemonea, (n) Balaustion pulcherrimum, (o) Calytrix arborescens, (p) C. ecalycata, (q) C. tetragona, (r) Chamelaucium ciliatum, (s) C. micranthum and (t) C. megalopetalum.
Fig. 2. Polar view of Chamelaucieae under scanning electron microscope. Scale bar = 10 μm. (a) Chamelaucium uncinatum, (b) Darwinia capitellata, (c) D. collina, (d) D. diosmoides, (e) D. fascicularis, (f) D. hypericifolia, (g) D. inconspicua, (h) D. leiostyla, (i) D. leptantha, (j) D. pinelioides, (k) D. procera, (l) Enekbatus eremaeus and (m) Euryomyrtus denticulata.
Genus *Darwinia*

*Number of species:* ~74.

*Distribution:* south-western and eastern Australia.

*Specimens examined:* SEM – 10; LM – 8.

*Previous pollen studies:* Pike (1956); Boyd (1992).

*Images:* SEM polar view – Fig. 2b–k; SEM exine pattern – Fig. 9d–h; SEM equatorial view – Fig. 14d; LM polar view – Fig. 15x–ee.

*SEM:* *Darwinia* pollen were tricolporate with a psilate or rugulate exine. Pollen sides were straight or concave and the colpal morphology was acolpate. Pollen ambs were round or pointed. Pollen length ranged from 13.5 to 25.9 μm. Colpus/length ratio ranged from no colpi to 22.1%.

*LM:* the exine of *Darwinia* was psilate or sometimes scabrate. The majority of grains were tricolporate, except for some *D. capitellata* grains that were tetracolporate. Pollen sides were concave, straight or convex and the colpal morphology was acolpate. Pollen ambs were round or less commonly flat. Pollen length ranged from 14.5 to 33.8 μm. Colpus/length ratio ranged from no colpi to 8.7%.

Genus *Enekbatus*

*Number of species:* 9.

*Distribution:* western Australia.

*Specimens examined:* SEM – 2; LM – not observed.

*Previous pollen studies:* none.

*Images:* SEM polar view – Fig. 2l; SEM exine pattern – Fig. 10a.

*SEM:* *Enekbatus* pollen were tricolporate with a verrucate or rugulate exine. Pollen sides were concave or straight, and the colpal morphology was syndemicolpate. Pollen ambs were pointed or round, and colpal edges were rough or broken. Pollen length ranged from 12.4 to 16.7 μm. Colpus/length ratio ranged from 45.6 to 58.5%.

Genus *Euryomyrtus*

*Number of species:* 7.

*Distribution:* southern Australia.

*Specimens examined:* SEM – 3; LM – 2.

*Previous pollen studies:* Pike (1956).

*Images:* SEM polar view – Figs 2m and 3a, b; SEM exine pattern – Fig. 10b, c; LM polar view – Fig. 15ff, gg.

*SEM:* *Euryomyrtus* pollen were tricolporate with a verrucate/scabrate or granulate/scabrate exine. Pollen sides were straight and the colpal morphology was syncolpate or less often brevicolpate. Pollen ambs were pointed or round, colpal edges were broken or rough, and the apocolpial field was granulate, scabrate or psilate. Pollen length ranged from 9.3 to 18.3 μm. Colpus/length ratio ranged from 47 to 57.8%.

*LM:* exine patterns of *Euryomyrtus* were scabrate. Pollen sides were straight or convex and the colpal morphology was syncolpate. Pollen ambs were round or pointed, colpal edges were round or smooth and the apocolpial field was psilate. Pollen length ranged from 12.5 to 20.2 μm. Colpus/length ratio ranged from 37.1 to 53.3%.

Genus *Harmogia*

*Number of species:* 1.

*Distribution:* eastern Australia.

*Specimens examined:* SEM – 1; LM – not observed.

*Previous pollen studies:* none.

*Images:* SEM polar view – Fig. 1d.

*SEM:* *Harmogia* pollen were tricolporate with a psilate exine. Pollen sides were concave or straight and the colpal morphology was syndemicolpate or parasyncolpate with inverse arcuate colpi. Pollen ambs were pointed, colpal edges were rough or broken and the apocolpial field was scabrate. Pollen length ranged from 8.4 to 9.1 μm.

Genus *Homoranthus*

*Number of species:* 11.

*Distribution:* south-western, northern and eastern Australia.

*Specimens examined:* SEM – 3; LM – 5 (as Wehlia).

*Previous pollen studies:* Pike (1956).

*Images:* SEM polar view – Fig. 3c–e; SEM exine pattern – Fig. 10d, e; SEM equatorial view – Fig. 14e; LM polar view – Fig. 15h–l.

*SEM:* *Homoranthus* pollen grains were tricolporate with a verrucate or rugulate exine. Pollen sides were straight or convex and the colpal morphology was syncolpate or less often parasyncolpate with arcuate colpi. Pollen ambs were pointed or round, colpal edges were broken or round, and the apocolpial field was verrucate or psilate. Most pollen lacked an apocolpial island, except for some *H. polyandrus* grains that had small irregular islands. Pollen length ranged from 15.4 to 22.6 μm. Colpus/length ratio ranged from 41.5 to 56.8%.

*LM:* exine patterns of *Homoranthus* were granulate/scabrate or, less often, psilate. Pollen sides were straight or convex and colpal morphology was syncolpate or parasyncolpate with arcuate or angular colpi. Pollen ambs were round or less often pointed, colpal edges were smooth or rough, and the apocolpial field was scabrate or psilate. The majority of pollen lacked an apocolpial island, except for some *H. (Wehlia) staminosus* grains that had closely fitting islands. Pollen length ranged from 12.2 to 29.2 μm. Colpus/length ratio ranged from 38.7 to 52.6%.

Genus *Homalocalyx*

*Number of species:* 11.

*Distribution:* south-western, northern and eastern Australia.

*Specimens examined:* SEM – 3; LM – 5 (as Wehlia).

*Previous pollen studies:* Pike (1956).

*Images:* SEM polar view – Figs 3–5; LM – 1; LM – not observed.

*SEM:* *Homalocalyx* pollen grains were tricolporate with a verrucate or rugulate exine. Pollen sides were straight or convex and the colpal morphology was syndemicolpate or parasyncolpate with arcuate colpi. Pollen ambs were pointed or round, colpal edges were broken or round, and the apocolpial field was verrucate or psilate. Most pollen lacked an apocolpial island, except for some *H. polyandrus* grains that had small irregular islands. Pollen length ranged from 15.4 to 22.6 μm. Colpus/length ratio ranged from 41.5 to 56.8%.

*LM:* exine patterns of *Homalocalyx* were granulate/scabrate or, less often, psilate. Pollen sides were straight or convex and colpal morphology was syncolpate or parasyncolpate with arcuate or angular colpi. Pollen ambs were round or less often pointed, colpal edges were smooth or rough, and the apocolpial field was scabrate or psilate. The majority of pollen lacked an apocolpial island, except for some *H. (Wehlia) staminosus* grains that had closely fitting islands. Pollen length ranged from 12.2 to 29.2 μm. Colpus/length ratio ranged from 38.7 to 52.6%.
Fig. 3. Polar view of Chamelaucieae under scanning electron microscope. Scale bar = 10 μm. (a) Euryomyrtus leptospermoide, (b) E. ramosissima, (c) Homaloxyx ericaeus, (d) H. polyandrus, (e) H. thryptomenoides, (f) Homoranthus decumbens, (g) H. homoranthoides, (h) H. prolixus, (i) H. thomasii, (j) H. thomasii, (k) H. tropicus, (l) H. virgatus and (m) H. wilhelmii.
Fig. 4. Polar view of Chamaeleaceae under scanning electron microscope. Scale bar = 10 µm. (a) Homoranthus zeteticorum, (b) Hypocalymma angustifolium, (c) H. xanthopetalum, (d) Malleostemon roseus, (e) Micromyrtus ciliata, (f) Ochroperma citriodorum, (g) O. lineare, (h) O. oligomerum, (i) Pileanthus filifolius, (j) P. limacis, (k) Rinzia dimorphandra, (l) R. fumana, (m) Scholtzia obovata (involucrata), (n) S. teretifolia, (o) Stenostegia congesta, (p) Thryptomene saxicola, (q) Triplarina imbricata, (r) T. nowraensis and (s) T. volcanica.
monocolporate. The exine was psilate or less often rugulate. Pollen sides were concave, straight or deeply concave and the colpal morphology was acolpate. Pollen ambs were round or pointed. Pollen length ranged from 16.2 to 28.3 μm. Colpus/length ratio ranged from 0.7 to 7%.

LM: the exine of Homoranthus was psilate. Pollen sides were straight or less often concave or convex, and the colpal morphology was acolpate. Pollen ambs were round, or sometimes notched or pointed. Pollen length ranged from 15.3 to 29.5 μm. Colpus/length ratio ranged from no colpi to 7.9%.

Previous pollen studies: none.

Images: SEM polar view – Fig. 4d.

SEM: Malleostemon pollen were tricolporate or sometimes tetracolporate, with a psilate or psilate/rugulate exine. Pollen sides were straight or concave and the colpal morphology was acolpate. Pollen ambs were round. Pollen length ranged from 11.3 to 13.8 μm. Colpus/length ratio ranged from no colpi to 7.9%.

Genus Micromyrtus

Number of species: ~44.

Distribution: eastern and western Australia.

Specimens examined: SEM – 1; LM – 2.

Previous pollen studies: Pike (1956); Boyd (1992).

Images: SEM polar view – Fig. 4e; SEM exine pattern – Fig. 11c; LM polar view – Fig. 16k, l.

SEM: only one Micromyrtus pollen grain was observed with SEM and its morphology was tricolporate with a verrucose/scabrate exine. Pollen sides were straight and the colpal morphology was syncolpate or parasyncolpate with arcuate colpi. Pollen ambs were pointed, colpal edges were rough and the apocolpial field was scabrate/psilate.

LM: the exine of Micromyrtus was psilate. Pollen sides were convex or straight, and the colpal morphology was parasyncolpate with arcuate or angular colpi. Pollen ambs were round, pointed or flat, colpal edges were smooth and the apocolpial field was psilate. Pollen length ranged from 9.1 to 12.9 μm. Colpus/length ratio ranged from 39.2 to 49.6%.

Genus Ochrosperma

Number of species: 6.

Distribution: eastern Australia.

Specimens examined: SEM – 4 (3 taxa); LM – not observed.

Previous pollen studies: none.

Images: SEM polar view – Fig. 4f–h; SEM exine pattern – Fig. 11d, e.

SEM: Ochrosperma pollen were tricolporate with a scabrate or granulate exine. Pollen sides were deeply concave or less often straight and the colpal morphology was either syncolpate or brevicolpate. Pollen ambs were pointed or round and colpal edges were rough or smooth. Pollen length ranged from 7.4 to 14.6 μm. Colpus/length ratio ranged from 9.7 to 66.7%.

Genus Pileanthus

Number of species: 8.

Distribution: south-western Australia.

Specimens examined: SEM – 2; LM – 2.

Previous pollen studies: Pike (1956).

Images: SEM polar view – Fig. 4i, j; SEM exine pattern – Fig. 11f; LM polar view – Fig. 16m, n.

SEM: Pileanthus pollen were dicolporate with a psilate or rugulate exine. Pollen sides were straight and the colpal morphology was dicolpate. Pollen ambs were round/flat and
the colpal edges were smooth. Pollen length ranged from 26.2 to 37.6 μm.

_LM_: the exine of _Pileanthus_ was psilate. Pollen sides were straight and the colpal morphology was monocolporate. Pollen amb was round/flat, colpal edges were smooth and the apocolpial field was psilate. Pollen length ranged from 20.2 to 47.5 μm.

**Genus Rinzia**

Number of species: 7.

*Distribution*: south-western Australia.

*Specimens examined*: _SEM_ – 2; _LM_ – not observed.

*Previous pollen studies*: none.

*Images*: _SEM_ polar view – Fig. 4k, l; _SEM_ exine pattern – Fig. 11g.

_SEM_: _Rinzia_ pollen were tricolporate with a verrucate exine. Pollen sides were straight and the colpal morphology was synecolpate or less often brevicolpate. Pollen amb was pointed, colpal edges were broken, and the apocolpial field was psilate or granulate. Pollen length ranged from 9.1 to 13.9 μm. Colpus/length ratio ranged from 39.8 to 58.5%.

**Genus Sannantha**

Number of species: 15.

*Distribution*: eastern Australia and New Caledonia.

*Specimens examined*: _SEM_ – 3; _LM_ – 2.

*Previous pollen studies*: Pike (1956).

*Images*: _SEM_ polar view – Fig. 1c, f, g; _SEM_ exine pattern – Fig. 8c; _LM_ polar view – Fig. 15h.

_SEM_: _Sannantha_ pollen were in the majority tricolporate; however, a small number of anomalous dicolporate, tetracolporate and hexacolporate pollen was observed for the genus. The exine was consistently psilate. Pollen sides were straight or concave and the colpal morphology was syndemicolpate with inverse arcuate colpi. Pollen amb was round or less often pointed, colpal edges were smooth or rough and the apocolpial field was scabrate or psilate. Pollen length ranged from 9.5 to 12.8 μm. Colpus/length ratio ranged from no colpi to 45.6%.

_LM_: the exine of _Sannantha_ was psilate. Pollen sides were greatly convex or concave and the colpal morphology was parasyncolpate with inverse arcuate colpi or syndemicolpate. Pollen amb was round, colpal edges were smooth or rough, and the apocolpial field was psilate. Pollen length ranged from 8.3 to 13.7 μm. Colpus/length ratio ranged from 26.8 to 45.6%.

**Genus Scholtzia**

Number of species: 7.

*Distribution*: south-western Australia.

*Specimens examined*: _SEM_ – 2; _LM_ – 3.

*Previous pollen studies*: Pike (1956).

*Images*: _SEM_ polar view – Fig. 4m, n; _SEM_ exine pattern – Fig. 11h; _LM_ polar view – Fig. 16o–r.

_SEM_: _Scholtzia_ pollen were tricolporate with a psilate, rugulate, or verrucate exine. Pollen sides were deeply concave and the colpal morphology was syncolpate or brevicolpate. Pollen amb were pointed or round, colpal edges were rough, smooth or broken and the apocolpial field was granulate or not visible. Pollen length ranged from 10.8 to 11.9 μm. Colpus/length ratio ranged from 55.4 to 66.8%.

_LM_: the exine of _Scholtzia_ was psilate. Pollen sides were concave or greatly convex and the colpal morphology was parasyncolpate with inverse arcuate colpi. Pollen amb were round or pointed, colpal edges were smooth, and the apocolpial field was psilate. Pollen length ranged from 11.7 to 15.2 μm. Colpus/length ratio ranged from 33.3 to 45.1%.

**Genus Stenostegia**

Number of species: 1.

*Distribution*: northern Australia.

*Specimens examined*: _SEM_ – 1; _LM_ – not observed.

*Previous pollen studies*: none.

*Images*: _SEM_ polar view – Fig. 4o.

_SEM_: _Stenostegia_ pollen were tricolporate with a rugulate or granulate exine. Pollen sides were deeply concave or concave and the colpal morphology was synecolpate. Pollen amb were pointed or flat and colpal edges were smooth or rough. Pollen length ranged from 9.3 to 9.9 μm. Colpus/length ratio ranged from 49.2 to 62.3%.

**Genus Thryptomene**

Number of species: ~31.

*Distribution*: Australia.

*Specimens examined*: _SEM_ – 1; _LM_ – 4 (3 taxa).

*Previous pollen studies*: Pike (1956); Patel et al. (1984); Boyd (1992).

*Images*: _SEM_ polar view – Fig. 4p; _SEM_ exine pattern – Fig. 12a; _LM_ polar view – Fig. 16s–v.

_SEM_: _Thryptomene_ pollen were tricolporate with a rugulate exine. Pollen sides were greatly convex and the colpal morphology was parasyncolpate with inverse arcuate colpi or syndemicolpate. Pollen amb were round, colpal edges were rough or smooth, and the apocolpial field was psilate. Pollen length ranged from 11.9 to 16.5 μm. Colpus/length ratio ranged from 30 to 35.6%.

_LM_: the exine of _Thryptomene_ was psilate or scabrate. Pollen sides were greatly convex and the colpal morphology was parasyncolpate with inverse arcuate colpi. Pollen amb were round, colpal edges were smooth, and the apocolpial field was psilate. Pollen length ranged from 13 to 20 μm. Colpus/length ratio ranged from 28.1 to 37.6%.

**Genus Triplarina**

Number of species: 7.

*Distribution*: eastern Australia.

*Specimens examined*: _SEM_ – 3; _LM_ – 1.

*Previous pollen studies*: Pike (1956).
Images: SEM polar view – Fig. 4q–s; SEM exine pattern – Fig. 12b, c; LM polar view – Fig. 15j.

**SEM:** *Triplarina* pollen were tricolporate with a rugulate or verrucate/scabrate exine. Pollen sides were straight or less often concave, and colpal morphology was syncolpate or parasyncolpate with arcuate colpi. Pollen ambs were pointed or less commonly round, colpal edges were smooth or rough, and the apocolpial field was psilate or scabrate. Pollen length ranged from 8.2 to 10.3 µm. Colpus/length ratio ranged from 47.4 to 60.7%.

**LM:** the exine of *Triplarina* was psilate. Pollen sides were convex, and the colpal morphology was syncolpate. Pollen ambs

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**Fig. 5.** Polar view of Chamelaucieae under scanning electron microscope. Scale bar = 10 µm. (a) *Verticordia blepharophylla*, (b) *V. brownii*, (c) *V. carinata*, (d) *V. cunninghamii*, (e) *V. cunninghamii*, (f) *V. decussata*, (g) *V. gracilis*, (h) *V. habrantha*, (i) *V. helichrysantha*, (j) *V. helmsii* and (k) *V. huegelii*. 
were rough, colpal edges were smooth and the apocolpial field was psilate. Pollen length ranged from 10.5 to 11.7 μm. Colpus/length ratio from 47.6 to 48.1%.

Genus *Verticordia*

*Number of species*: ~106.

*Distribution*: western Australia.


Previous pollen studies: Pike (1956); Boyd (1992); Ladd *et al.* (2000).

Images: SEM polar view – Figs 5–7; SEM exine pattern – Figs 12d–h and 13; SEM equatorial view – Fig. 14i, j; LM polar view – Fig. 16w–bb.

SEM: *Verticordia* pollen were tricolporate, or less often tetracolporate, with a psilate, rugulate or verrucate exine.
Pollen sides were concave, straight or deeply concave, and the colpal morphology was mainly acolpate, except for three species that were syndemicolpate or parasyncolpate with arcuate colpi. Pollen ambs were round, pointed or flat and the majority of observed pollen lacked colpal edges and an apocolpial field. When present, colpal edges were smooth or broken, and the apocolpial field was psilate or less commonly granulate. Pollen length ranged from 13.2 to 36.6 μm. Colpus/length ratio ranged from no colpi to 56.3%.

LM: exine patterns of *Verticordia* were psilate or less commonly scabrate. Most grains were tricolporate, or less commonly tetracolporate. Pollen sides were straight, concave...
or convex and the colpal morphology was acolpate or parasyncolpate with angular colpi. Pollen amb were round or less often flat. If present, colpal edges were rough or broken, and the apocolpial field was psilate. Pollen length ranged from 15.1 to 27.7 mm. Colpus/length ratio ranged from no colpi to 36.5%.

Tribe Leptospermeae
There are 10 genera in Leptospermeae and these occur in dry-heathland, savanna and rainforest communities. All genera occur in Australia, with Asteromyrtus and Leptospermum extending to Malesia, and Kunzea and Leptospermum occurring in New Zealand. Leptospermum is the largest genus of the tribe and contains >80 species. Pollen measurements for Leptospermeae are summarised in Tables 3 and 4.

Genus Agonis

Number of species: 4.
Distribution: south-western Australia.
Specimens examined: SEM – 1; LM – 1.
Previous pollen studies: Pike (1956).
Table 3. Leptospermeae scanning electron microscopy sample measurements

<table>
<thead>
<tr>
<th>Species</th>
<th>Pollen shape</th>
<th>Pore no.</th>
<th>Colpal morph.</th>
<th>Shape of side</th>
<th>Exine</th>
<th>Amb shape</th>
<th>Colpal edge</th>
<th>Apocopal field</th>
<th>Island type</th>
<th>Length (μm)</th>
<th>Width (μm)</th>
<th>Colpus length (μm)</th>
<th>Colpus length (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Agonis flexuosa</td>
<td>Ob Tri</td>
<td>Syn</td>
<td>Str, Conc, DC</td>
<td>Ver/Sca</td>
<td>P, F</td>
<td>S</td>
<td>N</td>
<td>N</td>
<td>N</td>
<td>10.9 (11.4)</td>
<td>11.4 (12.1)</td>
<td>6.6 (6.9) 7.3</td>
<td>59.9 (60.6) 61.5</td>
</tr>
<tr>
<td>Asteromyrtus arnhemica</td>
<td>Ob Tri</td>
<td>Syn</td>
<td>Conv</td>
<td>Rug</td>
<td>R, S, R</td>
<td>P, S</td>
<td>N</td>
<td>N</td>
<td>N</td>
<td>12.4 (12.8)</td>
<td>13.3 (13.9)</td>
<td>6.1 (6.6) 6.7</td>
<td>48.6 (51.8) 55.1</td>
</tr>
<tr>
<td>Asteromyrtus symphyocarpa</td>
<td>Ob Tri</td>
<td>Syn</td>
<td>Str</td>
<td>Rug</td>
<td>R, P, R, S</td>
<td>P, S, Pca</td>
<td>N</td>
<td>N</td>
<td>N</td>
<td>13 (14.6)</td>
<td>15.7 (16.1)</td>
<td>7 (8.2) 8.9</td>
<td>54.4 (55.7) 56.5</td>
</tr>
<tr>
<td>Homalospermum firmum</td>
<td>Ob Tri</td>
<td>Syn</td>
<td>Conc</td>
<td>Ver/Sca</td>
<td>P, R, B, R</td>
<td>P, Sca</td>
<td>N</td>
<td>N</td>
<td>N</td>
<td>17.7 (18.7)</td>
<td>20 (19.9)</td>
<td>9 (9.4) 9.6</td>
<td>48.1 (50.2) 51</td>
</tr>
<tr>
<td>Kunzea capitata</td>
<td>Ob Tri</td>
<td>Syn, Arc</td>
<td>Str, Conv</td>
<td>Rug</td>
<td>P, R, S, Psi</td>
<td>N, N, C</td>
<td>N</td>
<td>N</td>
<td>N</td>
<td>7.2 (14.6)</td>
<td>16.2 (16.7)</td>
<td>6.9 (8.4) 7.3</td>
<td>49.8 (51.1) 58.5</td>
</tr>
<tr>
<td>Kunzea preissiana</td>
<td>Ob Tri, Tet</td>
<td>Syn, Inv</td>
<td>Str, Conc, Conv</td>
<td>Rug, Ver, R, P, R, S, Psi</td>
<td>N</td>
<td>20 (20.9)</td>
<td>21.5 (21.9)</td>
<td>19.4 (20.1)</td>
<td>21.2 (21.6)</td>
<td>7 (8.2) 8.9</td>
<td>48.6 (51.8) 56.5</td>
<td></td>
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<tr>
<td>Leptospermum scoparium</td>
<td>Ob Tri</td>
<td>Syn</td>
<td>Str</td>
<td>Rug</td>
<td>P, S, R</td>
<td>P, S, Pca</td>
<td>N</td>
<td>N</td>
<td>N</td>
<td>12.4 (13.1)</td>
<td>13.7 (14.3)</td>
<td>7.3 (8.7) 8.1</td>
<td>56.6 (59.1) 61.7</td>
</tr>
<tr>
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<td>Syn</td>
<td>Str</td>
<td>Gra/Sca</td>
<td>P, R, Sca</td>
<td>N</td>
<td>N</td>
<td>N</td>
<td>N</td>
<td>15.5 (15.8)</td>
<td>16.6 (17.2)</td>
<td>7.8 (8.3) 9</td>
<td>48.6 (49.1) 57.3</td>
</tr>
<tr>
<td>Leptospermum squarrosum</td>
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<td>Syn</td>
<td>Str</td>
<td>Ver, Sca</td>
<td>P, S, R, Psi</td>
<td>N</td>
<td>N</td>
<td>N</td>
<td>N</td>
<td>12.3 (12.9)</td>
<td>13.1 (14.3)</td>
<td>7.8 (8.7) 8.1</td>
<td>56.3 (61.6) 64.2</td>
</tr>
<tr>
<td>Leptospermum trinervium</td>
<td>Ob Tri, Tet</td>
<td>Syn</td>
<td>Str</td>
<td>Ver</td>
<td>P, S</td>
<td>P, S, Pca</td>
<td>N</td>
<td>N</td>
<td>N</td>
<td>12.8 (14.5)</td>
<td>16.1 (16.7)</td>
<td>7.7 (8.4) 9.2</td>
<td>57 (58.1) 59.7</td>
</tr>
<tr>
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<td>Ob Tri</td>
<td>Syn</td>
<td>Str</td>
<td>Gra</td>
<td>P, B</td>
<td>Gra</td>
<td>N</td>
<td>N</td>
<td>N</td>
<td>15 (16)</td>
<td>17.1 (17.4)</td>
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<td>47.6 (55.4) 58.5</td>
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<td>Ver</td>
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<td>P, S, Psi</td>
<td>N, N, S</td>
<td>N</td>
<td>N</td>
<td>17 (18.3)</td>
<td>19.8 (20)</td>
<td>10.2 (10.8)</td>
<td>56.4 (59.2) 62.9</td>
</tr>
<tr>
<td>Pericalymma spongocaulce</td>
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<td>Conc</td>
<td>Ver</td>
<td>P, S, R</td>
<td>Psi</td>
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<td>N</td>
<td>N</td>
<td>14.4 (15.2)</td>
<td>16 (16.2)</td>
<td>8.1 (8.9) 9.2</td>
<td>54.7 (55.6) 57.5</td>
</tr>
</tbody>
</table>

Images: SEM polar view – Fig. 18a, b; LM polar view – Fig. 20a, b. SEM exine pattern Fig. 17a, b. Distribution: Australia and New Zealand (New Guinea). Previous pollen studies. Pike (1956), McIntyre (1963). Boyd (1992); Mean (1993). Previous pollen studies: Levetin (1992); Moar (1993).
Table 4. Leptospermeae light microscopy sample measurements

See Table 1 for explanation of abbreviations and length and width data.

<table>
<thead>
<tr>
<th>Species</th>
<th>Pollen shape</th>
<th>Pore no.</th>
<th>Colpal morph.</th>
<th>Shape of side</th>
<th>Exine</th>
<th>Amb shape</th>
<th>Colpal edge</th>
<th>Apocolpial field</th>
<th>Island type</th>
<th>Length (µm)</th>
<th>Width (µm)</th>
<th>Colpus length (µm)</th>
<th>Colpus length (%)</th>
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<tbody>
<tr>
<td>Agonis flexuosa</td>
<td>Ob</td>
<td>Tri, Tet</td>
<td>Syn, Anc</td>
<td>Conc</td>
<td>Sea</td>
<td>R, N, P</td>
<td>S</td>
<td>Sea, Psi</td>
<td>N</td>
<td>13 (16.7) 19.6</td>
<td>13.9 (17) 19.2</td>
<td>7.5 (9.2) 10.6</td>
<td>52.1 (55.3) 57.8</td>
</tr>
<tr>
<td>Kunzea ambiguus</td>
<td>Ob</td>
<td>Tri</td>
<td>Syn</td>
<td>Conc</td>
<td>Psi</td>
<td>P</td>
<td>S</td>
<td>N</td>
<td>N</td>
<td>10.8 (11.8) 12.5</td>
<td>12.5 (12.8) 13.1</td>
<td>5.9 (6.5) 7.1</td>
<td>51.1 (54.7) 56.7</td>
</tr>
<tr>
<td>Kunzea capitata</td>
<td>Ob</td>
<td>Tri, Tet</td>
<td>Syn</td>
<td>Str, Conv</td>
<td>Psi</td>
<td>P</td>
<td>S, R</td>
<td>Psi</td>
<td>N</td>
<td>15.8 (17.6) 18.2</td>
<td>15.6 (17.1) 18</td>
<td>7.8 (8.9) 9.9</td>
<td>47.3 (50.8) 56.2</td>
</tr>
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<td>Tri</td>
<td>Syn</td>
<td>Conc</td>
<td>Psi</td>
<td>P</td>
<td>S</td>
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<td>R</td>
<td>S</td>
<td>N</td>
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<td>S</td>
<td>Psi</td>
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<td>Sea</td>
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<td>Str</td>
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<td>P, R</td>
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<td>Str</td>
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<td>R</td>
<td>S</td>
<td>Psi</td>
<td>N</td>
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<td>Syn</td>
<td>Conv</td>
<td>Gra, Sea</td>
<td>R, P</td>
<td>S</td>
<td>Psi</td>
<td>N</td>
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<td>S, R</td>
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<td>N</td>
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<td>N</td>
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<td>Syn</td>
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<td>R, P</td>
<td>S</td>
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<td>N</td>
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<td>5.7 (6) 6.4</td>
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</tr>
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<td>R</td>
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<tr>
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<td>Syn</td>
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<td>Gra, Sea</td>
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<td>7.5 (7.6) 7.7</td>
<td>50.4 (51.3) 52.2</td>
</tr>
</tbody>
</table>

*S*lide from Pike collection.
SEM: *Kunzea* pollen were tricolporate or occasionally tetracolporate with a rugulate or verrucate exine. Pollen sides were straight or convex and the colpal morphology was syncolpate or parasyncolpate with inverse arcuate or arcuate colpi. Pollen amb were pointed or round, colpal edges were smooth or rough, and the apocolpial field was psilate. Closely fitting apocolpial islands were observed on some *Kunzea preissiana* grains. Pollen length ranged from 7.2 to 21.5 μm. Colpus/length ratio ranged from 19.1 to 58.5%.

LM: the exine of *Kunzea* was psilate or scabrate. Most pollen were tricolporate except for some *Kunzea capitata* grains that were tetracolporate. Pollen sides were concave or straight and colpal morphology was syncolpate. Pollen amb were pointed or round, colpal edges were smooth and the apocolpial field was psilate. Pollen length ranged from 9.8 to 22.2 μm. Colpus/length ratio ranged from 42.6 to 56.7%.

**Genus Leptospermum**

*Number of species:* ~87.

*Distribution:* Australia, New Zealand and Malesia.

*Specimens examined:* SEM – 4; LM – 15 (14 taxa).
Previous pollen studies: Pike (1956); McIntyre (1963); Boyd (1992); Moar (1993); Chalson and Martin (1995).

Images: SEM polar view – Fig. 17g–j; SEM exine pattern – Fig. 18e–g; SEM equatorial view – Fig. 14l; LM polar view – Fig. 20l–aa.

SEM: Leptospermum pollen were tricolporate or occasionally tetracolporate with a verrucate, granulate/scabrate or rugulate exine. Pollen sides were straight or concave and the colpal morphology was syncolpate or parasyncolpate with angular colpi. Pollen ambs were pointed, colpal edges were smooth or rough, and the apocolpial field not visible. Pollen length ranged from 12.3 to 16.6 μm. Colpus/length ratio ranged from 48.6 to 64.2%.

LM: the exine of Leptospermum was psilate or granulate/scabrate. Most pollen were tricolporate or occasionally tetracolporate or dicolporate. Pollen sides were straight but were also sometimes concave or convex. Colpal morphology was syncolpate. Pollen ambs were pointed or round, colpal edges were smooth or less often broken or rough, and the apocolpial field was psilate. Pollen length ranged from 9.8 to 20.1 μm. Colpus/length ratio ranged from 44.3 to 60.6%.

Fig. 10. Exine patterns of Chamelaucieae under scanning electron microscope. Scale bar = 2 μm. (a) Enekbatus eremaeus, (b) Euryomyrtus denticulata, (c) E. leptospermoides, (d) Homalocalyx polyandrus, (e) H. thryptomenoides, (f) Homoranthus decumbens, (g) H. thomasi and (h) H. tropicus.
Genus *Neofabricia*

*Number of species:* 3.

*Distribution:* northern Australia.

*Specimens examined:* SEM – 1; LM – not observed.

*Previous pollen studies:* none.

*Images:* SEM polar view – Fig. 17k; SEM exine pattern – Fig. 18h.

*SEM:* *Neofabricia* pollen were tricolporate with a granulate exine. Pollen sides were straight and the colpal morphology was syncolpate. Pollen ambs were pointed, colpal edges were broken and the apocolpial field was granulate. Pollen length ranged from 15 to 17.1 μm. Colpus/length ratio ranged from 47.6 to 58.5%.

Genus *Pericalymma*

*Number of species:* 4.

*Distribution:* south–western Australia.

*Specimens examined:* SEM – 2; LM – 1.
Previous pollen studies: none.

Images: SEM polar view – Fig. 17l, m; SEM exine pattern – Fig. 19a, b; SEM equatorial view – Fig. 14m; LM polar view – Fig. 20bb.

**SEM:** *Pericalymma* pollen were tricolporate with a verrucate exine. Pollen sides were concave and the colpal morphology was syncolpate. Pollen ambs were pointed, colpal edges were smooth or rough, and the apocolpial field was psilate. Pollen length ranged from 14.4 to 19.8 μm. Colpus/length ratio ranged from 54.7 to 62.9%.

**LM:** Exine patterns of *Pericalymma* were granulate/scabrate. Pollen sides were straight or concave and colpal morphology was syncolpate. Pollen ambs were pointed and colpal edges were smooth. Pollen length ranged from 18.3 to 21.1 μm. Colpus/length ratio ranged from 52 to 56.5%.

**Genus Taxandria**

**Number of species:** 11.

**Distribution:** south-western Australia.
Specimens examined: SEM – not observed; LM – 3.

Previous pollen studies: Pike (1956).

Images: LM polar view – Fig. 20b–d.

LM: Taxandria exine was most commonly granulate/scabrate. Pollen sides were concave or less often straight and colpal morphology was syncolpate. Pollen amb were round or less often pointed, colpal edges were smooth and there was no apocolpial field pattern. Pollen length ranged from 10.8 to 15.3 μm. Colpus/length ratio from 50.2 to 56.3%.

Tribe Lindsayomyrteae

The tribe Lindsayomyrteae is monogeneric and is found in rainforest areas of Australia and Malesia. The fruit produced by the single species in this tribe is considered leathery, unlike the fleshy or dry fruit of most other Myrtaceae (Wilson 2011). Lindsayomyrteae pollen measurements are summarised in Table 5.

Genus Lindsayomyrtus

Number of species: 1.

Distribution: northern Australia and Malesia.

Specimens examined: SEM – 1; LM – not observed.

Previous pollen studies: none.

Images: SEM polar view – Fig. 17n; SEM exine pattern – Fig. 19c.

SEM: Lindsayomyrtus pollen were tricolporate with a verrucate exine. Pollen sides were convex and colpal morphology was syncolpate. Pollen amb were round, colpal edges were broken and the apocolpial field was granulate or psilate. Pollen length ranged from 11.2 to 13.5 μm. Colpus/length ratio ranged from 40.4 to 51.8%.

Summary of tribes Chamelaucieae, Leptospermeae and Lindsayomyrteae

Chamelaucieae

Chamelaucieae pollen displayed the greatest variation of colpal morphology within a Myrtaceae tribe. Most genera produced grains that were syncolpate. Five genera, namely Actinodium, Chamelaucium, Darwina, Homoranthus and Verticordia, were acolpate and displayed very small or no colpi at all. Interestingly, a small number of Chamelaucium and Verticordia species had parasyncolpate or syndemicolpate
colpal morphology. *Actinodium* pollen differed from all other Chamelaucieae and Myrtaceae pollen by having prolate-spheroidal-shaped pollen. The following two main exine pattern types were observed within Chamelaucieae: (1) a granulate or verrucate exine ornamentation, which was observed on many genera, and (2) a rugulate or psilate exine that was also commonly encountered.

Chamelaucieae pollen exhibited the greatest diversity of aperture number seen within a tribe. Most genera produced pollen that were tricolporate, and pollen grains of *Pileanthus*...
Fig. 15. Polar view of Chamelaucieae as viewed under light microscope. Scale bar=10 μm. (a) Actinodium cunninghamii, (b) A. cunninghamii, (c) A. cunninghamii*, (d) Astartea ambiguus, (e) A. ambiguus*, (f) A. fascicularis*, (g) A. scoparia*, (h) Sannantha (Babingtonia) tozerensis, (i) Baeckea behrii*, (j) Triplarina volcanica subsp. volcanica (Baeckea camphorata)*, (k) Baeckea gunniana, (l) B. gunniana, (m) B. gunniana*, (n) B. utilis, (o) Calytrix gracilis*, (p) C. oldfieldii*, (q) C. oldfieldii*, (r) C. tetragona*, (t) Chamelaucium axillare*, (u) C. axillare*, (v) C. uncinatum*, (w) C. uncinatum*, (x) Darwinia capitellata, (y) D. citriodora*, (z) D. diosmoides*, (aa) D. fascicularis, (bb) D. fascicularis*, (cc) D. micropetala*, (dd) D. pauciflora*, (ee) D. vestita*, (ff) Euryomyrtus leptospermoides, (gg) E. (Baeckea) ramosissima*, (hh) Homalocalyx ericaeus*, (ii) H. polyandrus, (jj) H. (Wehlia) coarctatus*, (kk) H. (Wehlia) staminosus* and (ll) H. (Wehlia) thryptomenoides*. Slides indicated with asterisk are from Pike collection.
Fig. 16. Polar view of Chamelaucieae as viewed under light microscope. Scale bar = 10 μm. (a) Homoranthus darwinoides*, (b) Homoranthus flavescens*, (c) Homoranthus tropicus, (d) Homoranthus virgatus*, (e) Homoranthus wilhelmii*, (f) Hypocalymma angustifolium*, (g) Hypocalymma robustum*, (h) Calyrix (Lhotzkya) alpestris*, (i) Calyrix alpestris (Lhotzkya genetylloides)*, (j) Calyrix alpestris (Lhotzkya genetylloides)*, (k) Micromyrtus ciliata*, (l) Micromyrtus obovata (drummondii)*, (m) Pileanthus filifolius*, (n) Pileanthus peduncularis*, (o) Scholtzia laxiflora*, (p) Scholtzia laxiflora*, (q) Scholtzia laxiflora*, (r) Scholtzia leptantha*, (s) Thryptomene calycina*, (t) Aluta (Thryptomene) maisonneuvi*, (u) Thryptomene racemulosa*, (v) Thryptomene saxicola, (w) Verticordia densiflora*, (x) Verticordia densiflora*, (y) Verticordia grandis*, (z) Verticordia grandis*, (aa) Verticordia pennigera and (bb) Verticordia picta*. Slides indicated with asterisk are from Pike collection.
Fig. 17. Polar view of Leptospermeae and Lindsayomyrtaceae under scanning electron microscope. Scale bar = 10 μm. (a) Agonis flexuosa, (b) Asteromyrtus arnhemica, (c) A. symphyocarpa, (d) Homalospermum firmum, (e) Kunzea capitata, (f) K. preissiana, (g) Leptospermum scoparium, (h) L. spectabile, (i) L. squarrosum, (j) L. trinervium, (k) Neofabricia myrtifolia, (l) Pericalymma ellipticum, (m) P. spongiocaule and (n) Lindsayomyrtus racemoides.
were dicolporate, which appears to be an evolutionarily stable transition to two apertures in this genus. There were also many occurrences of anomalous aperture numbers in Chamelaucieae pollen. Some genera produced tetracolporate pollen, and there were less common occurrences of monocolporate (*Homoranthus*), pentacolporate (*Calytrix*) and hexacolporate (*Sannantha*) pollen. Pollen size, like most other pollen characters in Chamelaucieae, was in two distinct groups, including (1) small pollen (<12 μm) that were observed for most genera; and (2) large pollen (>20 μm) that occurred in six genera (*Balaustion*, *Chamelaucium*, *Darwinia*, *Pileanthus*, *Homoranthus* and *Verticordia*).

**Leptospermeae**

Most Leptospermeae pollen were syncolpate or less often parasyncolpate with arcuate colpi. The following two types of exine pattern were predominantly seen in Leptospermeae: (1) an ornate verrucate or granulate exine pattern found in five of the seven genera observed with SEM (*Agonis*, *Asteromyrtus*, *Agonis flexuosa*, *Homalospermum firmum*, *Kunzea capitata*, *K. preissiana*, *Leptospermum scoparium*, *L. spectabile*, *L. trinervium* and *Neofabricia myrtifolia*).

![Fig. 18. Exine patterns of Leptospermeae under scanning electron microscope. Scale bar = 2 μm. (a) Agonis flexuosa, (b) Homalospermum firmum, (c) Kunzea capitata, (d) K. preissiana, (e) Leptospermum scoparium, (f) L. spectabile, (g) L. trinervium and (h) Neofabricia myrtifolia.](image-url)
Leptospernum, Homalospermum, Neofabricia and Pericalymma; and (2) a rugulate exine pattern that was observed on the pollen of two genera (Asteromyrtus and Kunzea). Most Leptospermeae pollen did not have an apocolpial island; however, two genera, Kunzea and Pericalymma, sometimes had a closely fitting or small irregular island, respectively. Pollen size in Leptospermeae was, in general, average for Myrtaceae (~13–15 μm), although Leptospermum (11–19 μm) and Kunzea (12–18 μm) species recorded widely variable pollen lengths.

Lindsayomyrtusae

Pollen of Lindsayomyrtus had syncolpate colpal morphology, similar to that in Leptospermeae and some Chamelaucieae. The exine pattern was verrucate, which was also similar to the pollen of genera in tribes Leptospermeae and Myrteae. The average pollen size was 12.5 μm, which is within the average size range recorded for Myrtaceae.

Discussion

Distinct pollen morphology in phylogenetic groups

Phylogenetic studies of Myrtaceae have indicated that Leptospermeae and Chamelaucieae are sister tribes (Wilson et al. 2005; Biffin et al. 2010). Syncolpate pollen were observed in all genera of Leptospermeae and some genera of Chamelaucieae, indicating a possible phylogenetic signal of this type of colpal morphology. Differences in exine pattern were observed in the genera of Leptospermeae, Kunzea (psilate) and Leptospermum (granulate), which could be used as a diagnostic feature to separate these two closely related genera (Thornhill 2010). A phylogenetic study of Leptospermeae showed genera Agonis (of which some species are now Taxandria) and Pericalymma to be sister (O’Brien et al. 2000) and pollen of these genera were all syncolpate, with the presence of a small apocolpial island and distinct margo. This combination of features appears to be homologous for these two genera, although Beaufortia of tribe Melaleuceae (see Thornhill et al. 2012b) also produces pollen with similar characteristics. The separation of Agonis with Taxandria (and Paragonis), as proposed by Wheeler and Marchant (2007), is supported by the observed difference in pollen size of the two genera (Fig. 20a–d).

Genera of tribe Chamelaucieae had five distinct colpal morphology types, making it the tribe with the highest pollen diversity in Myrtaceae. Pollen of genera Baeckea, Euryomyrtus, Rinzia, Stenostegia and Triplarina were syncolpate with a pronounced granulate exine. Phylogenetic assessment of Chamelaucieae suggests that these genera do not form a monophyletic group (Lam et al. 2002). Scholtzia and Ochrosperma were also syncolpate, but noticeably differed from the previously mentioned genera by having deeply concave sides and distinct margo. Despite the similarity of Scholtzia and Ochrosperma pollen, the phylogenetic analysis of the family suggests that these genera are not closely related (Lam et al. 2002). Aluta, Sannantha, Thryptomene and Micromyrtus were syndemicolpate with a psilate exine, but also do not form a monophyletic group within Chamelaucieae.

There were two clades in Chamelaucieae that displayed possible phylogenetic signal. A clade of Homalocalyx and Calytrix species had pollen that were all syncolpate with a granulate exine, and a clade of four genera, including Chamelaucium, Darwinia, Homoranthus and Verticordia (Wilson et al. 2004; Wilson et al. 2005; Biffin et al. 2010), produced large acolpate pollen not observed in any other taxa of Myrtaceae.
Fig. 20. Polar view of Leptospermeae as viewed under light microscope. Scale bar = 10 µm. (a) Agonis flexuosa, (b) Taxandria (Agonis) juniperina*, (c) T. (Agonis) linearifolia*, (d) T. (Agonis) marginata*, (e) Kunzea ambiguca, (f) K. capitata, (g) K. ericoides, (h) K. ericoides, (i) K. muelleri*, (j) K. parvifolia, (k) K. parvifolia, (l) Leptospermum (attenuatum) trinervium*, (m) L. (attenuatum) trinervium*, (n) L. (citratum) petersonii*, (o) L. coriaceum*, (p) L. grandifolium, (q) L. laevigatum*, (r) L. lanigerum, (s) L. myrsinoides*, (t) L. myrsinoides*, (u) L. rupestre*, (v) L. scoparium, (w) L. speciosum*, (x) L. spectabile, (y) L. sphaerocarpum*, (z) L. squarrosum*, (aa) L. trinervium and (bb) Pericalymma ellipticum. Slides indicated with asterisk are from Pike collection.
Myrtaceae. The colpal morphology of the two other genera within the monophyletic group, namely *Actinodium* and *Pileanthus*, was not acolpate, but nevertheless produced distinctive pollen. *Actinodium* pollen are a unique type in Myrtaceae, being prolate-spheroidal shaped. Two observed *Pileanthus* species produced dicolporate pollen, but this character was also seen in two other genera of Myrtaceae (see Thornhill et al. 2012b). Other aperture-number morphs in Chamelaucieae were hexacolporate pollen of *Sannantha* tozerensis (Fig. 1g), monocolporate pollen of *Homoranthus thomasii* (Fig. 3j), tetracolporate pollen of *Verticordia cunninghamii* (Fig. 5e) and pentacolporate pollen of *Calytrix oldfieldii* (Fig. 15r). These anomalous morphs are unlikely to be of significance in Myrtaceae systematics, but illustrate the plasticity of pollen morphology within Myrtaceae.

The monotypic *Lindsayomyrtus* had pollen features similar to Leptospermeae and Chamelaucieae and could be related to these two these tribes on the basis of pollen features. However, the placement of *Lindsayomyrtus* in phylogenetic studies varies and remains unresolved (Wilson et al. 2005; Biffin et al. 2010). The genus could also be related to tribe Myrteae, with which it shares a similar granulate exine.

**Pollen types within genera**

### Baeckea

The observed size range of *Baeckea* pollen was wide. However, *Baeckea* is a paraphyletic group (Lam et al. 2002; Wilson et al. 2004) and many of the taxa named *Baeckea* in the present study belong to, as yet, undescribed genera. For example, published phylogenies indicate that *B. ericaea* and *B. crassifolia* are sister taxa (Lam et al. 2002; Wilson et al. 2004) and these species have a similar scabrate exine, syncolpate colpal morphology, and size. These two species also appear to be related to *Rinzia* and, more distantly, to *B. polystemonea* that also produce scabrate, syncolpate pollen. *B. ovalifolia* is sister to *Babingtonia sens. str.* (B. camphorosmae) in the analyses of Wilson et al. (2004, 2007); however, the latter species was not sampled in the present study. Only one true *Baeckea* species was observed with SEM in the present study, namely *B. gunniana*, although the closely related species *B. utilis* was included among the species sampled for LM. *B. gunniana* pollen are small, syncolpate, psilate, with straight sides, and share similarities to the pollen of *Sannantha* species. In contrast, *B. utilis* pollen are larger, and have distinctly notched amb. Pollen morphology supports the future segregation of these species from *Baeckea sens. str.* as it does with segregates that have already been recognised, such as *Triplarina*, *Euryomyrtus* and *Enekbatus*. With more phylogenetic investigation of the genus, it should be possible to see whether the variety of pollen morphology is congruent with phylogeny.

### Chamelaucium

Three species of *Chamelaucium* in our study (C. axillare, C. ciliatum and C. megalopetalum) had pollen with distinct apocolpial regions. These three species do not form a clade (M. D. Barrett, P. G. Wilson and L. M. Copeland, unpubl. data), as opposed to the two *Chamelaucium* species of our study that produce acolpate pollen (Barrett et al. 2006).
Further palynological sampling is needed to determine the occurrence of acolpate pollen within the genus and whether it can be linked to phylogenetic groups of Chamelaucium.

**Verticordia**

Two exine types were seen within Verticordia, namely psilate and rugulate, but these two exine types appear to have no connection with taxonomic or phylogenetic groups. Ladd et al. (2000) suggested that a connection could be made between Verticordia subgenera and aperture type and illustrated examples in two subgenera. In our study, three species of Verticordia (V. decussata, V. muelleri, and V. ovalifolia) were parasyncolpate or syndemicolpate; however, according to phylogenetic analysis, they do not form a monophyletic clade (Barrett et al. 2006). One species (Verticordia longistylis) had acolpate pollen and distinct margo, which could be indicative of the transition from a parasyncolpate to acolpate colpal morphology. The remainder of Verticordia species observed in the present study had very small colpi or were acolpate. An interesting hypothesis raised by Ladd et al. (2000), and worth further investigation, is the possibility of pollen that lack colpi being shed in fluid. It was noticed when preparing Verticordia, Homoranthus, Chamelaucium and Darwinia SEM samples that anthers were difficult to remove from the flower with forceps, possibly because of the viscous gland secretions produced by the anther, as previously observed in Thryptomene (Beardsell et al. 1989) and Verticordia (Houston et al. 1993). To test this hypothesis, the volume of anther secretion produced by Chamelaucium and Verticordia species that produce acolpate, parasyncolpate and syndemicolpate pollen could be investigated and contrasted.

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**References**


Boyd WE (1992) ‘A pollen flora of the native plants of South Australia and southern Northern Territory, Australia.’ (The University of Adelaide: Adelaide)


Wheeler JR, Marchant NG (2007) A revision of the Western Australian genus Agonis (Myrtaceae) and two new segregate genera *Taxandria* and *Paragonis*. *Nyctias* 16, 393–433.

